Syllabi (Suggestive)
Secondary Stage

Integrated Teacher Education Programme (ITEP)

गुरूर्गुरूतमो धाम
NCTE

National Council for Teacher Education
(A Statutory Body of the Government of India)
G-7, Sector-10, Dwarka, New Delhi-110075

Syllabi (Suggestive)
Secondary Stage

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राष्ट्रीय अध्यापक शिक्षा परिषद
(भारत सरकार का एक सांविधिक निकाय)

National Council for Teacher Education
(A Statutory Body of the Government of India)

Table of Contents

Table 1: ITEP Structure												
S. No	Curricular components	Courses	Credits per semester								Total credits per course	Total credits
			S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8		
1.	1. Student Induction Programme	Two-Week Student Induction Programme		--	--	--	--	--	--	--	--	--
2.1	2. Foundations of Education	Evolution of Indian Education	4	--	--		--	--	--	--	4	30
2.2		Child Development & Educational Psychology	--	--	4	--	--	--	--	--	4	
2.3		Philosophical & Sociological Perspectives of Education -I	--	--	--	4	--	--	--	--	4	
2.4		Assessment & Evaluation	--	--	--	--		2	--	--	2	
2.5		Inclusive Education	--	--	--	--	--	2	--	--	2	
2.6		Perspectives on School Leadership and Management		--	--	--	--	--	2	--	2	
2.7		Curriculum Planning & Development (textbooks, material development, etc.) - (Stage Specific)	--	--	--	--	--	--	2	--	2	
2.8		Philosophical & Sociological Perspectives of Education -II	--	--	--	--	--	--	--	4	4	
2.9		Education Policy Analysis	--	--	--	--	--	--	--	2	2	
2.10		One Elective from the offered courses as per the choice of student-teachers (e.g., Adolescence Education, Education for Mental Health, Education for Sustainable Development, Emerging Technologies in Education, Gender Education, Guidance and Counselling, Human Rights Education, Peace Education, Sports and Fitness Education, Tribal Education, Economics of Education, or any other relevant course decided by the University/Institution)	--	--	--	--	--	--	--	4	4	
3.1	3. Disciplinary / Inter-disciplinary Courses	One/two discipline(s) from any of the school curricular areas. I) Languages ii) Physical Sciences (Physics, Chemistry, etc.) iii) Biological Sciences (Zoology, Botany, etc.) iv) Mathematics v) Social Sciences & Humanities (Economics, History, Geography, Psychology, Political Science etc.) vi) Business Studies, Accountancy, etc. vii) Arts (Visual and Performing) viii) Physical Education and Yoga ix) Vocational Education x) Computer Science xi) Agriculture xii) Home Science xiii) Any other school subject	8	12	12	12	12	8	--	--	64	64

Table 1: ITEP Structure													
S. No	Curricular components	Courses	Credits per semester								Total credits per course	Total credits
			S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8		
4.1	4. Stage-Specific Content-cum-Pedagogy	Stage-Specific Content-cum-Pedagogy Courses	--	--	4	4	4	4	--	--	16	16
5.1	5. Ability Enhancement & Value-Added Courses	Language-I (as per the 8th schedule of constitution of India)	4		--	--	--	--	--	--	4	28
5.2		Language-II (Other than Language-I)	--	4	--	--	--	--	--	--	4	
5.3		Art Education (Performing and Visual)	2	--	--	--	--	--	2	--	4	
5.4		Understanding India (Indian Ethos and Knowledge Systems)	2	2	--	--	--	--	--	--	4	
5.5		Teacher and Society	--	2	--	--	--	--	--	--	2	
5.6		ICT in Education	--	--	--	--	2	--	--	--	2	
5.7		Mathematical & Quantitative Reasoning	--	--	--	--	--	2	--	--	2	
5.8		Sports, Nutrition and Fitness	--	--		--	--	--	2	--	2	
5.9		Yoga and Understanding Self	--	--		--	--	--	--	2	2	
5.10		Citizenship Education, Sustainability and Environment Education	--	--	--	--	--	--	--	2	2	
6.1	6. School Experience	Pre-internship Practice (Demonstration lessons, Peer teaching)	--	--	--	--	2	--	--	--	2	20
6.2		School Observation (Field Practice)	--	--	--	--	--	2	--	--	2	
6.3		School-based Research Project	--	--	--	--	--	--	2	--	2	
6.4		Internship in Teaching	--	--	--	--	--	--	10	--	10	
6.5		Post Internship (Review and Analysis)	--	--	--	--	--	--	--	2	2	
6.6		Creating Teaching Learning Material/Work Experience (Educational Toy making, local/traditional vocations, etc)	--	--	--	--	--	--	--	2	2	
7.1	7. Community Engagement and Service	Community Engagement and Service (Participation in NSS-related activities, New India Literacy Programme etc.)	--	--	--	--	--	--	--	2	2	2
		Total	**20**	**20**	**20**	**20**	**20**	**20**	**20**	**20**	**160**	

1.0 STUDENT INDUCTION PROGRAMME

(Two -Weeks Student Induction Programme)

To be evolved by the Institution concerned

2.0 FOUNDATIONS OF EDUCATION

2.1 Evolution of Indian Education

Credits: 4
Semester: S-1

2.1.1 About the Course

The course seeks to develop an understanding among student teachers of the evolution of education in India that would allow student teachers to locate themselves within the larger system of education. The course aims at orienting student teachers to the historical perspective of Indian education including the development and features of education in ancient India such as the Gurukuls, post-Vedic period, during Mauryan and Gupta empires, during colonial era and post-independence period, and future perspectives about education development in India, and progression from Education 1.0 to Education 4.0 etc. This course also provides an overview of the contribution of Indian thinkers to evolve Indian Education system – Savitribai and Jyotiba Phule, Rabindranath Tagore, Swami Vivekananda, Mahatma Gandhi, Sri Aurobindo, Gijubhai Badheka, Pt. Madanmohan Malaviya, Jiddu Krishnamurti, Dr. Bhima Rao Ambedkar and others.

2.1.2 Learning Outcomes

After completion of this course, student teachers will be able to:

- discuss genesis, vision, and evolution of education in ancient India to the contemporary India,
- enable themselves to shape their educational perspective to act as an effective teacher.

UNIT - I

Ancient Indian Education: Vedic Period

A. Vision, objectives and salient features of Vedic Education System.
B. Teaching and Learning Process.
C. Development of educational institutions: Finances and Management.
D. Famous Educational institutions and Guru-Shishya.
E. Education at the time of Epics: Ramayana and Mahabharata.

UNIT - II

Ancient Indian Education: Buddhist and Jain Period

A. Vision, objectives and salient features of Buddhist and Jain Education System.
B. Teaching and Learning Process.
C. Finance and Management of Educational Institutions.
D. Educational Institutions: Nalanda, Taxila, Vikramshila, Vallabhi, Nadia.
E. Famous Guru-Shishya.

UNIT - III

Post-Gupta Period to Colonial Period

A. Vision, objectives, brief historical development perspective as well as salient features of Education in India.
B. Teaching and Learning Process.
C. Finance and Management of educational institutions.

UNIT - IV
Modern Indian Education

A. Colonial Education in India

- Woods Despatch, Macaulay Minutes and Westernization of Indian Education

B. Shiksha ka Bhartiyakaran (Indigenous Interventions in Education)

(Bird's eye view of their contribution)

- Swadeshi and Nationalist attempts of educational reforms with special reference to general contribution of Indian thinkers –
  Savitribai and Jyotiba Phule, Rabindranath Tagore, Swami Vivekananda, Mahatma Gandhi, Sri Aurobindo, Gijubhai Badheka, Pt. Madanmohan Malaviya, Jiddu Krishnamurti and Dr. Bhima Rao Ambedkar others – to the education systems of India.

C. Education in Independent India

- Overview of Constitutional values and educational provisions.
- Citizenship Education:
  - Qualities of a good citizen.
  - Education for fundamental rights and duties.
- Overview of 20th Century Committees, Commissions and Policies.
- UEE, RMSA, RTE Act 2009: Overview and impact.
- NEP 2020: vision and implementation for a vibrant India.

2.1.3 Suggestive Practicum

1. Prepare a report highlighting educational reforms with special reference to school education in the light of NEP 2020.
2. Critically analyze the concept of good citizen from the perspective of education for democratic citizenship.
3. Compare vision, objectives, and salient features of education during different periods.
4. Working out a plan to develop awareness, attitude and practices related to Fundamental Rights or fundamental duties or democratic citizenship qualities, execute it in the class and write the details in form of a report.
5. Sharing of student experiences (in groups) related to Indian constitutional values, help them to reshape their concept and enable them to develop vision, mission and objectives for a school and their plan to accomplish the objectives in form of a group report.
6. Analyses of current educational strengths and weaknesses of one's own locality and work out a critical report.
7. Visit to places of educational significance and value centers and develop a project report.
8. Observation of unity and diversity in a social locality and matching it with unity and diversity in the class and work out a plan for awareness for national-emotional integration for class to develop awareness, attitudes, skills, and participatory values, execute it in the class and report the details.

2.1.4 Suggestive Mode of Transaction

The course content transaction will include the following:

- Planned lectures infused with multimedia /power-point presentations.
- Small group discussion, panel interactions, small theme-based seminars, group discussions, cooperative teaching and team teaching, selections from theoretical readings, case studies, analyses of educational statistics and personal field engagement with

educationally marginalized communities and groups, through focus group discussion, surveys, short term project work etc.

- Hands on experience of engaging with diverse communities, children, and schools.

2.1.5 Suggestive Mode of Assessment

The assessment will be based on the tests and assignments.

2.1.6 Suggestive Reading Materials

Teachers may suggest books/readings as per the need of the learners and learning content.

2.2 Child Development & Educational Psychology

Credits: 4
Semester: S-3

2.2.1 About the Course

To enable student teachers to understand the interplay of three different processes namely biological processes, cognitive processes, and socio-emotional processes that influence development of a child. Biological, cognitive, and socio-emotional processes are intricately interwoven with each other. Each of these processes plays a role in the development of a child whose body and mind are interdependent.

The course seeks to provide an understanding of the developmental characteristics of a child:

- during infancy that ranges from birth to 24 months of age,
- during Early Childhood stage which begins around age 3 and usually extends up to 6-7 years of age,
- Middle to Late Childhood stage which begins around 6-7 years to 10-11 years of age, and
- Adolescence stage which begins at approximately the age of 12 years, and which is a period of transition from childhood to early adulthood.

The course will introduce development across domains – physical development, cognitive development, language development, socio-emotional development, aesthetic development, moral development – during each of the above-mentioned developmental stages of a child.

Educational Psychology component of the course:

Informs student teachers about the various theories of learning and motivational states for learning and their implications for pedagogy. It includes the study of how people learn, pedagogical approaches that are required to improve student learning, teaching-learning processes that enable learners to attain the defined learning outcomes, and individual differences in learning. It provides opportunities to student teachers to explore the behavioral, cognitive and constructivist approach to facilitating student learning, and the emotional and social factors that influence the learning process.

2.2.2 Learning Outcomes

After completion of this course, student teachers will be able to:

- describe the meaning, concept, characteristics, and factors affecting growth and development,
- use the knowledge of Indian concept of self,
- apply various problem solving and learning strategies in real classroom settings,
- identify the various approaches of the process of learning,
- explain group dynamics and apply strategies to facilitate group learning.

UNIT - I
Child Development

A. Meaning and significance of understanding the process of Child Development
   - Biological, cognitive, socio-emotional, and moral.

B. Developmental characteristics of a child during:
   - Infancy stage
   - Early Childhood stage
   - Middle to Late Childhood stage

- Adolescence stage

C. The Indian concept of self: Mind (मनस्), Intellect (बुद्धि), Memory (चित्त). Panch-koshIya Vikas (पञ्चकोशीय विकास).

D. Educational Implications.

UNIT - II
Developmental Process

A. Development across domains:
   - Physical Development
   - Cognitive Development
   - Language Development
   - Socio-Emotional Development
   - Aesthetic Development
   - Moral Development

   During each of the above-mentioned developmental stages of a child.

B. Factors affecting development.

C. Individual differences:
   - Children with special needs including developmental disorders.
   - Tools and Techniques for Identifying Learner with different abilities.

D. Teachers' role and strategies to address the needs of learners with different learning abilities.

UNIT - III
Process of Learning

A. Conceptual Clarity and significance.

B. Approaches:
   - Behaviorist
   - Cognitivist
   - Constructivist
   - Developmental
   - Information processing Model of learning
   - Shri Aurobindo's Integral approach

C. Problem Solving and Learning Strategies: Inquiry and problem-based learning, Steps and Strategies in problem solving, Factors hindering problem solving.

D. How to Learn: Significance and Strategies

UNIT - IV
Motivation and Classroom Management

A. Motivation
   - Conceptual clarity, nature, and significance
   - Intrinsic and Extrinsic Motivation
   - Strategies for Motivation

B. Classroom management
   - Creating a positive learning environment
   - Planning space for learning

- Managing behavioral problems

C. Group dynamics:
   - Classroom as a social group
   - Characteristics of group
   - Understanding group interaction-sociometry
   - Strategies to facilitate group learning.

2.2.3 Suggestive Practicum

1. Spending day with a child and preparing a report based on our observations of children for:
   - A day from different economic status (low and affluent)
   - Focus on various factors: Physical, emotional, social, language, cultural and religious influencing the child on daily basis.
2. Observing children to understand the styles of children learning process.
3. Identifying the Learning Difficulties of Students in Different learning areas and the Possible Reason for them- Case Study Report.
4. Preparing Personalized Intervention plan for Students with Learning Difficulties.
5. Plan to use advanced technology to encourage talented / gifted children.
6. Encouraging gifted / talented students beyond the general school curriculum.
7. Familiarization and Reporting of Individual Psychological Tests.

2.2.4 Suggestive Mode of Transaction

The course content transaction will include the following:

- Planned lectures infused with multimedia /power-point presentations.
- Small group discussion, panel interactions, small theme-based seminars, group discussions, cooperative teaching and team teaching, selections from theoretical readings, case studies, analyses of educational statistics and personal field engagement with educationally marginalized communities and groups, through focus group discussion, surveys, short term project work etc.
- Hands on experience of engaging with diverse communities, children, and schools.

2.2.5 Suggestive Mode of Assessment

The assessment will be based on the tests and assignments.

2.2.6 Suggestive Reading Materials

Teachers may suggest books/readings as per the need of the learners and learning content.

2.2 Philosophical & Sociological Perspectives of Education – I

Credits: 4
Semester: S-4

2.3.1 About the Course

The course aims at enabling student teachers to explore educational philosophy, including the concept, nature and scope; the aims of educational philosophy; relationship between philosophy and education; Indian philosophical traditions and their implications for education; some of the key philosophical schools of thought such as idealism, naturalism, pragmatism, progressivism and existentialism and their implication for educational practices. The course also would provide an analysis of the Western schools of philosophy and their approaches etc.

2.3.2 Learning Outcomes

- To encourage students to explore the nature of knowledge, the nature of human beings, the nature of society and its aims and the educational implications of these understandings.
- To engage the prospective teachers to read and acquaint themselves with the meaning of terms like Vidya, Avidya, Shiksha, Education etc. and to facilitate them to understand and differentiate them through reflections on these terms on the basis of ancient Indian texts.
- To facilitate prospective teachers to engage themselves in peer groups for sharing of their real-life reflective experiences regarding socio-cultural and philosophical living and facilitate them to conceptualize the meaning of terms like philosophical, social and cultural traditions in Indian educational context.
- To orient and engage prospective teachers to read, observe and understand the vision of some great Indian and global educators and categorically reflect on vision/aim, process of education and the contemporary relevance.

UNIT - I
Education and Philosophy

A. Conceptual clarity, nature and relationships.
B. Aims of studying philosophical perspective of education.
C. Branches of Philosophy and their educational implications: Metaphysics (तत्त्वमीमांसा), Epistemology (ज्ञानमीमांसा), Axiology (मूल्यमीमांसा)
D. Understanding Indian Perspective of Education
    - Meaning, nature and aims of education with special reference to Vedic, Buddhist, Jain, Sikh and Islamic traditions.
    - Understanding the terms Darshana, Para and Apara Vidya, Avidya, Shiksha, Samvaad, Panchkosha, Gurukulam, Acharya, Guru, Shishya, Upadhyaya, Jigyasa, Swadhyaya.
E. Understanding Western Perspective of Education
    - Meaning, Nature and aims of education with reference to Cognitive, Behaviorist and Developmental theories of Education.

UNIT - II
Philosophical Schools and Education

A. Conceptual Clarity of the following schools of thoughts with their implications for educational practices:
   - **Bharatiya:** Samakhya, Yoga, Nyaya, Vaisheshika, Mimansa, Vedanta
   - **Western:** Idealism, Naturalism, Pragmatism, Progressivism.

UNIT - III
Educational Thinkers

A. Deliberations on aims, process and educational institutions developed on thoughts of following thinkers and practitioners:
   - **Bharatiya:** Swami Vivekananda, Sri Aurobindo Ghosh, Gurudev Rabindra Nath Tagore, J. Krishnamurti, Mahamana Madan Mohan Malaviya, Mahatma Gandhi, Gijubhai Badheka.
   - **Western:** J. Rousse, Maria Montessori, Friedrich Froebel, John Dewey.

UNIT - IV
Value Education

A. Conceptual Clarity, Significance and Types of Values.
B. Indian Traditional Values.
C. Guru-Shishya-Parampara and Educational Values.
D. Convocation message in Taittiriya Upanishad.
E. Values enshrined in Indian Constitution.
F. NEP, 2020 and Values with special reference to 21st Century.
G. Pedagogical Issues.

2.3.3 Suggestive Practicum

1. Individual/group assignments/tasks in various forms like writing small paragraphs/brief notes, conceptualizations on specific terms etc.
2. Institutional visits in small groups in coordination to institutions related to different thinker/s and preparation of a report followed by individual/group presentation.
3. Sharing of student experiences (in groups) related to readings on great thinkers help them to reshape their concept and enable them to develop vision, mission and objectives for a school and their plan to accomplish the objectives in form of a group report.
4. Identification and reporting of Indian perspective related to educational aims, student-teacher characteristics, methods, evaluation procedure, convocation etc. based on critical study of life and thoughts of thinkers.

2.3.4 Suggestive Mode of Transaction

The course content transaction will include the following:

- Organized lectures using variety of media.
- Small group discussion, panel interactions, small theme based seminars, group discussions, cooperative teaching and team teaching, engagement of in reading of primary or secondary sources of literature (Original texts, reference books etc.) related to different aspects of life and education of Great Educators, case studies, short term project work etc.

- Critically examining their experiences to carve out their world and life view and further analyze them from philosophical point of view to reshape their perspective. They will engage prospective teachers in the development of comparative educational charts related to vision, aims, process, institution etc. They will also lead to reading-based interactions and critical reflections related to process and significance of entry/admission rituals, convocation system etc.

2.3.5 Suggestive Mode of Assessment

The assessment will be based on the tests and assignments.

2.3.6 Suggestive Reading Materials

Teachers may suggest books/readings as per the need of the learners and learning content.

2.4 Assessment and Evaluation

Credits: 2
Semester: S-6

2.4.1 About the Course

The main thrust of this course on assessment and evaluation is to equip student teachers with the knowledge and capacities required to develop and implement approaches to assessment that is more regular and formative, is more competency-based, is appropriate for assessing learning outcomes relating to all domains of learning, is appropriate for testing not only subject-related learning but also generic learning outcomes such as problem solving, critical thinking, creative thinking, communication skills, judgement and decision making, ethical and moral reasoning etc.

2.4.2 Learning Outcomes

After completion of this course, student teachers will be able to:

- use different approaches to assess and evaluate of student performance such as time-constrained examinations; closed/open-book tests; problem-based assignments; practical assignment reports; observation of practical skills; individual and group project reports; oral presentations; viva voce interviews; computerized adaptive testing; peer and self-assessment etc.,
- develop and use informal and formal diagnostic, formative, and summative assessment strategies to monitor student learning levels and help the teacher continuously revise teaching-learning processes to optimize learning and development for all students,
- develop an understanding among student teachers of the approaches to provide timely, effective, and appropriate feedback to students about their performance relative to the expected learning outcomes and organizing learning enhancement initiatives that are required to bridge the gap in student learning levels,
- present report on student achievement, making use of accurate and reliable records etc.
- develop assessment "as", "of", and "for" learning that are aligned to the expected learning outcomes,
- design the progress card of students based on school-based assessment to make it a holistic, 360-degree, multidimensional report that reflects the progress as well as the performance of learners assessed through self-assessment and peer assessment, project-based and inquiry-based learning, quizzes, role plays, group work, portfolios, etc., along with teacher assessment that would provide students with valuable information on their strengths, areas of interest, and needed areas of improvement.

UNIT - I
Assessment and Education

A. Assessment and Evaluation
   - Meaning and significance of assessment and evaluation in educational field.
   - Conceptual Clarity and purpose of Measurement, Assessment, Examination, Appraisal and Evaluation in Education.
   - Learning outcomes across the stages and assessment.
   - Taxonomy of Objectives (Revised in 2001) and Implications.

B. Forms of Assessment
   - Formative, Summative, diagnostic, prognostic.

- Internal and External assessment.
- Assessment For learning, of learning and as learning.
- Authentic Assessment; Online Assessment.

C. Improving Assessment and Evaluation in Schools: Brief Historical Review (1975, 1988, 2000, 2005, 2020)

UNIT - II
Process of Assessment and Evaluation

A. Formative and Summative Assessment: Concept and Characteristics.
B. Approaches to assess and evaluate student performance such as time-constrained examinations; closed/open-book tests; problem-based assignments; practical assignment reports; observation of practical skills; individual and group project reports; oral presentations; viva-voce interviews; computerized adaptive testing; peer and self-assessment etc.
C. Assessing Higher Order Thinking Abilities: Problem solving, critical thinking, creative thinking, communication skills, judgement and decision making, ethical and moral reasoning.
D. Tools and Techniques
   - Observation, rating scale, check list, anecdotes, interviews.
   - Assessment of attitudes and interests.
   - Socio-metric techniques.
   - Criteria for assessment of social and personal behaviour.
   - Self-assessment and Peer Assessment.

UNIT - III
Analysis and Interpretation

A. Analysis of students' performance and scores: credit and grading
B. Graphical representation (Histogram, Frequency Curves)
C. Interpretation of student's performance based on the analysis and their further uses in improving learner's performance: credit and grading, constructive feedback.
D. Reporting student's performance: 360-degree progress reports, cumulative records and their uses, portfolios, PTA meetings, qualitative reporting based on the observations, descriptive indicators in report-cards.

2.4.3 Suggestive Practicum

1. Review of various education commission, Policies and reports and NCF 2005 to get a brief view of the recommendations on Assessment and Evaluation.
2. Constructing a unit test using table of specifications.
3. Construction of any one of the tools (rating scale, check list, observation schedule, etc.) and administering it to group of students or using it to observe the school and classroom environment and interpreting it.
4. Analysis of question papers of various Boards.
5. Analysis of report cards - State and Central (CBSE)
6. Preparing format of 360-degree report Card.
7. Review of learning outcomes by NCERT in different subject areas.

8. Interviews with teachers and students to study the assessment practices, issues and problems related to it followed by presentation.
9. Reviewing Assessment Discussions in NPE (2020).

2.4.4 Suggestive Mode of Transaction

The course content transaction will include the following:

- Planned lectures infused with multimedia /power-point presentations.
- Small group discussion, panel interactions, small theme-based seminars, group discussions, cooperative teaching and team teaching, selections from theoretical readings, case studies, analyses of educational statistics and personal field engagement with educationally marginalized communities and groups, through focus group discussion, surveys, short term project work etc.
- Hands on experience of engaging with diverse communities, children, and schools.

2.4.5 Suggestive Mode of Assessment

The assessment will be based on the tests and assignments.

2.4.6 Suggestive Reading Materials

Teachers may suggest books/readings as per the need of the learners and learning content.

2.5 Inclusive Education

Credits: 2
Semester: S-6

2.5.1 About the Course

This course seeks to orient student teachers to the approaches to bridging gender and social category gaps in terms of participation rates and student learning levels at all levels of school education. The course will provide orientation to the strategies pursued and required to improve participation and learning levels of children from Socio-Economically Disadvantaged Groups (SEDGs) that can be broadly categorized based on gender identities, particularly female and transgender individuals, socio-cultural identities (such as Scheduled Castes, Scheduled Tribes, OBCs, and minorities), geographical identities (such as students from remote locations, villages, small towns, and aspirational districts), disabilities (including learning disabilities), linguistic identities, and socio- economic conditions (such as migrant communities, low income households, children in vulnerable situations, including orphans and the urban poor).

2.5.2 Learning Outcomes

After completion of this course, student teachers will be able to:

- ensure inclusion and equal participation in education of children with disabilities in the regular schooling process that allows students with and without disabilities learn together, ensuring their retention in the school system, and enabling them to achieve the defined learning outcomes,
- adapt teaching and learning process to meet the learning needs of different students with disabilities, including providing education and opportunities for participating in arts, sports, and vocation-related activities, making school buildings and compounds as well as other facilities barrier free and accessible for children with disabilities, supporting activities that help the provision of individualized learning environment and learning activities/resources, making available assistive devices and appropriate technology-based tools, as well as adequate and language-appropriate teaching-learning materials (e.g., textbooks in accessible formats such as large print and Braille) to help children with disabilities integrate more easily into classrooms and engage with teachers and their peers, using appropriate modes and means of communication, detecting specific learning disabilities in children at the earliest and taking appropriate measures to overcome them, monitoring completion of education and learning levels of students with disabilities etc.

UNIT - I
Inclusion and Education

A. Conceptual Clarity, relation, and significance with special reference to:
   - UNCRPD, 2006,
   - RPWD Act, 2016,

   With special reference to Indian Context.
B. Clarity of various terms and phrases associated with Inclusive Education:
   Integrated Education, Special Education, Impairment and Disability, Assessment and Evaluation, Curriculum, adaptation, modification and differentiation, universal design of learning
C. Shifting from Disability to the Inclusive view.

D. Shifting Paradigms from Bio centric to Human Rights.
E. Introductory reference of Policies/Acts with reference to educational implications for Children with Disabilities: Right to Education Act, 2009/ 2012, RPWD Act, 2016, UNCRPD, National Trust Act, 1999, National Educational Policy, 2020.

UNIT - II

Children with Disabilities and Marginalized Groups

A. Nature and needs of children with sensory impairments: cognitive impairments and intellectual disability, physical disabilities, cerebral palsy, multiple disabilities.
B. Specific needs of children with behavioral, emotional learning disabilities
C. Health Problems.
D. Educational needs of children belonging to Marginalized Groups.

UNIT - III

Pedagogical Issues

A. Conceptual clarity and significance.
B. Meeting the specific needs of Children with Disabilities with special reference to:
    - education and opportunities for participating in arts, sports, and vocation-related activities,
    - making school buildings and compounds as well as other facilities barrier free and accessible
    - supporting the learning activities and resources for individualized learning environment
    - making available assistive devices and appropriate technology-based tools,
    - language-appropriate teaching-learning materials (e.g., textbooks in accessible formats such as large print and Braille)
    - assessing strategies
C. Designing strategies assessment for inclusive classrooms.

2.5.3 Suggestive Practicum

1. Developing a checklist for identifying the various needs of children with disabilities.
2. Visiting schools of different categories and talking to parents, teachers, and Children with and without disabilities and listing the problems faced by these children and the families at the local level in gaining access to education.
3. Analyzing RPWD Act 2016 and list its implications for CWD in inclusive settings.
4. Outlining the problems faced by children with Visual Disabilities while learning mathematics and EVS.
5. Giving a few exemplary adaptations based on the Preparatory Level textbooks.
6. Outlining the problems faced by children with hearing impairments while learning language. Give a few exemplar adaptations based on the primary level textbooks.
7. Students work in small groups of 10 or so to prepare a street play highlighting the meaning and provisions of inclusive education.
8. Analyzing the Context of NPE 2020 in the light of Inclusive Education.

2.5.4 Suggestive Mode of Transaction

The course content transaction will include the following:

- Planned lectures infused with multimedia /power-point presentations.
- Small group discussion, panel interactions, small theme-based seminars, group discussions, cooperative teaching and team teaching, selections from theoretical readings, case studies, analyses of educational statistics and personal field engagement with educationally marginalized communities and groups, through focus group discussion, surveys, short term project work etc.
- Hands on experience of engaging with diverse communities, children, and schools.

2.5.5 Suggestive Mode of Assessment

The assessment will be based on the tests and assignments.

2.5.6 Suggestive Reading Materials

Teachers may suggest books/readings as per the need of the learners and learning content.

2.6 Perspectives on School Leadership and Management

Credit: 2
Semester: S-7

2.6.1 About the Course

Amidst the changing policy landscape, the new curriculum framework, the challenge of accommodating and adapting to the changing demands and the increasing expectations that come with the culture of performativity. The role of the school leader has never been more complex. School leaders are key change agents and as instructional leaders are responsible for improving practice while navigating an increasingly challenging school environment. Understanding the school system, its nuances, the social, cultural, and political contexts and leading schools requires a strong foundation of knowledge and skills to effectively manage improvement and lead successful schools. The course on 'Perspectives on School Leadership and Management' is designed to equip student teachers with the competencies they need to drive school transformation and help diverse stakeholders establish priorities and improve practice.

2.6.2 Learning Outcomes

After completion of the course, student teachers will be able to:

- describe the diversity of schools in India, its structure, its governance, issues, challenges and school leadership needs,
- critically examine the different leadership theories and practices and its relationship with the governance structures, the autonomy and accountability mechanisms and the larger educational policy context,
- critically think in relation to education leadership and its potential application to different contexts,
- reflect critically on school-based data for reflection and improvement,
- develop a culture of cooperation collaboration and teamwork,
- synthesise effectively to develop coherent and compelling arguments in the area of study,
- develop school vision, mission, goals, and School Development Plans.

UNIT - I
Understanding Indian School System

A. School as a normative organization vis-a-vis school as a socio-emotional-cultural space for learning.
B. Studying the diversity of schools in India; their structure, governance, socio-political and cultural context, funding, management, autonomy and accountability mechanisms, support systems.
C. Relationship between school leadership and school diversity issues, challenges, and needs.
D. Engagement with diversity discourses, educational policies, reforms and practices and role in developing inclusive schools.

UNIT - II
Understanding School Leadership

A. School Leadership: concept as defined, and concept as practiced.

B. Being a School Leader: exploring the multiple roles and responsibilities, issues and challenges of school leadership in the Indian context.
C. What works in schools: sharing National and International best practices on School leadership.

UNIT - III

Schools as Learning Organizations: Role of School Leadership

A. Schools as motivating learning spaces: Developing inspiring school ethos.
B. Schools as learning organization: promoting personal mastery, examining mental models, and developing a shared vision, team learning and a system's thinking perspective.
C. Development of a shared vision and shaping of the school culture.
D. Use of data for school improvement focused on students' learning, addressing equity challenges, and building an equitable school culture that promotes excellence for all.
E. Nurturing school belongingness: engaging students, teachers, staff, parents, SMC, and community in the formulation of a whole school development plan.
F. Designing professional and collaborative learning opportunities for self and others (teachers, parents, and SMC members) and improving teaching and learning.

2.6.3 Suggestive Mode of Transaction

Perspectives on school leadership and management is a practitioner-centric course and aims to enable future teachers to be efficient school leaders. The approach to curriculum transaction therefore would include a blend of lectures, tutorials, group-work, case-based approaches, and enquiry-based learning.

- Student teachers would engage in case-based learning on topics like improving student learning, classroom observation and feedback, planning and budgeting for school improvement, leadership in diversified school contexts and such others.
- Exposure of student teachers to virtual case studies featuring leaders from a representative cross-section of Schools in India and analyze their experiences, insights, and best practices.
- Learning activities that help student teachers to understand the entire structure and functioning of school organization through interactive lectures and panel discussion with education officers who hold leadership positions at different levels from schools to cluster, block, and district and state levels and understand their leadership issues, challenges and needs and thus get a perspective of the school ecosystem.
- Learners would reflect on their practice as pre-service interns, knowledge, skills, and understandings—and identify opportunities to apply course learnings to their school context.

2.6.4 Suggestive Mode of Assessment

Being a practitioner centric course, the assessment would largely include application-based tasks. This includes exploring the work and life of a school principal and writing a detailed report on the observations and the learning. The following are some exemplars. The institutes may choose either of these or think of other innovative assignment that would enhance the leadership learning experience:

- Preparing school vision, mission, goals, and school development plan.
- Shadowing school principals: a critical observation of the principal's daily work life.

- A critical examination of the diversity of schools; their governance structure, leadership, autonomy and accountability mechanisms, issues and challenges and work life of the school principal

2.6.5 Suggestive Reading Materials

Teachers may suggest books/readings as per the need of the learners and learning content.

2.7 Curriculum Planning and Development

Credits: 2
Semester: S-7

2.7.1 About the Course

The course on curriculum planning and development will introduce to student teachers to the process of designing and organizing the curriculum i.e., the totality of learning experience provided to learners through a deliberate and organized set of arrangements (the selection of subjects that are to be taught, the pedagogical approaches and practices to be pursued, books and other teaching-learning-material to be used, examinations and other forms of learning assessment, school culture and processes etc.) that contribute to the development of the knowledge, capacities, and values and dispositions that help fulfill the aims of school education derived from the purposes and goals articulated in NEP 2020.

2.7.2 Learning Outcomes

After completion of this course, student teachers will be able to:

- discuss aims of education,
- identify and formulate of desirable values and dispositions,
- explain capacities and knowledge,
- outline curricular areas,
- demonstrate teaching-learning assessment processes and
- practice the relevance in terms of achieving the aims of school education.

UNIT - I
Education and Curriculum

A. Meaning, need, relationship and significance.
B. Types of Curriculums: subject-centered, activity-centered, environmental centered, community-centered
C. Relationship and difference between curriculum, curriculum framework, syllabus and textbooks.

UNIT - II
Developing the Curriculum

A. Basic principles of Curriculum Development
B. Concerns for developing the Curriculum - aims to be achieved, structure and nature of discipline, different perspectives on learning and their implications to curriculum development, socio–cultural aspects and aspirations of society, value transitions, social efficiency and needs, environmental concerns, gender concerns, inclusiveness, technological advancement.
C. Impact of Globalization.

UNIT - III
Approaches, Planning, and Implementation

A. Approaches to Curriculum Development: Learner and activity centered, Constructivist, Knowledge Construction
B. Curriculum planning as a cyclic process.

C. Curriculum Implementation: Operationalizing curriculum into learning situations, Converting curriculum into syllabus, Curriculum engagement activities, Role of school at Regional, State and National level for implementation.

D. Role of teachers in operationalizing and evaluating the curriculum with special reference to: textbooks and teachers handbooks, source books, workbooks and manuals, other learning material such as kits, AV and software materials, library, laboratory, playground, neighborhood etc.

2.7.3 Suggestive Practicum

1. Arranging discussion on:
   - Basis of National curriculum frame works (1975, 1988, 2000, and 2005).
   - Document: Learning without burden" by Prof. Yashpal
2. Preparing of Report based on observation of:
   - Facilities and infrastructure to implement the present curriculum.
3. Interviewing teachers to understand their role in:
   - Implementing and assessment of the curriculum.
4. Analysis of the following in the context of principles of developing the Curriculum:
   - Guidelines of NEP, 2020.
   - Curriculum of 4 Years B.Ed. Integrated Programme
   - Learning without Burden, MHRD, and India.
   - Position paper (2006). National Focus Group on 'Curriculum, Syllabus, Textbooks', NCERT.
   - NCERT (1988) National Curriculum for Elementary and Secondary Education: A framework.
   - NCERT (2000) National Curriculum Framework for school Education.
   - NCERT (2005) National Curriculum Framework. NCERT publications.

2.7.4 Suggestive Mode of Transaction

The course content transaction will include the following:

- Planned lectures infused with multimedia /power-point presentations.
- Small group discussion, panel interactions, small theme-based seminars, group discussions, cooperative teaching and team teaching, selections from theoretical readings, case studies, analyses of educational statistics and personal field engagement with educationally marginalized communities and groups, through focus group discussion, surveys, short term project work etc.
- Hands on experience of engaging with diverse communities, children, and schools.

2.7.5 Suggestive Mode of Assessment

The assessment will be based on the tests and assignments.

2.7.6 Suggestive Reading Materials

Teachers may suggest books/readings as per the need of the learners and learning content.

2.8 Philosophical and Sociological Perspectives of Education – II

Credits: 4
Semester: S-8

2.8.1 About the Course

Sociological Perspectives of Education seek to encourage students to explore the relationship between social structures and educational provision. The course focuses on the study of the social behavior of individuals, groups, and societies. It provides opportunities for student teachers to examine relationships among individuals, as well as relationships between people and their societies.

2.8.2 Learning Outcomes

After completion of this course, student teachers will be able to:

- recognize the social context of education,
- outline the meaning, nature, and scope of educational sociology,
- establish the link between education and socialization,
- analyze the main agents of socialization, such as family, school, community and peer groups,
- analyze the impact of culture on education through a study of dimensions of culture and their importance to education practices,
- recognize the different aspects of social stratification,
- identify the close relationship between education and modernization, the role of education in Modernization, and factors and constraints to social change.

UNIT - I
Education and Society

A. Conceptual clarity, relationship, significance and aims of studying relationship between these two.
B. Educational sociology and social perspective of education: meaning and functions.
C. Education as a Social System.
D. Conceptual clarity of the following terms: society, social behavior, status, institution, ideology, system, sub-system, socialization, social system, social values and norms, conflict, modernization.
E. Understanding the relation between individual and group behavior with special reference to purpose of education.

UNIT - II
Education and Social Change

A. Meaning, relation, and dimensions of Social Change.
B. Factors affecting Education and Social Change: technology, social and educational movements, curricular innovations, value conflict, legal provisions.
C. Constitution of India and Education.
D. Education and Modernity.
E. Role of education with reference to social change.

UNIT - III
Education, Culture and Socialization

A. Relationship between Education and Culture.
B. Education as a process of Socialization.
C. Impact of following on Culture and Educational Process: Social Welfare, Social Reform Movements, Legal interventions on Child Marriage and child labor Act, Educational Policies and Acts, Adult Literacy, New Technology of communication, Equality.
D. Constitutional Provisions and Education with special reference to Social Equality and Equity.

UNIT - IV
Education and Values

A. Conceptual Clarity, Relationship and Significance.
B. Types of Values.
C. Constitutional Values and its impact on our Education.
D. Human Rights and Values.
E. Environment and Education.
F. Pedagogical issues.

2.8.3 Suggestive Practicum

1. Critical/Reflective study of contemporary aims of education and their social determinants.
2. Observation and critical study on how textbooks determine every activity of teacher and learner in the school.
3. A critique of textbook culture in school.
4. Observing the process of knowledge construction by children in structured and unstructured environments to appreciate their learning processes and nature.
5. A critical analysis of Constitution of India in the context of process of Education in India / Educational Policies / Educational Commissions)
6. Critically observing nearby society/ locality in groups of 4-5 students and sharing observations related to cultural/ social influences on educational practice.
7. Analyzing social purpose of NEP, 2020.

2.8.4 Suggestive Mode of Transaction

The course content transaction will include the following:

- Planned lectures infused with multimedia /power-point presentations.
- Small group discussion, panel interactions, small theme-based seminars, group discussions, cooperative teaching and team teaching, selections from theoretical readings, case studies, analyses of educational statistics and personal field engagement with educationally marginalized communities and groups, through focus group discussion, surveys, short term project work etc.
- Hands on experience of engaging with diverse communities, children, and schools.

2.8.5 Suggestive Mode of Assessment

The assessment will be based on the tests and assignments.

2.8.6 Suggestive Reading Materials

Teachers may suggest books/readings as per the need of the learners and learning content.

2.9 Education Policy Analysis

Credits: 2
Semester: S-8

2.9.1 About the Course

This course on Education Policy Analysis aims at orienting student teachers to the theoretical frameworks and methodology that will help assess and evaluate the effectiveness of policies at the national, state and programme levels.

2.9.2 Learning Outcomes

After completion of this course, student teachers will be able to:

- discuss knowledge and capacity to engage in education policy analysis and evaluate their effectiveness,
- explain processes involved in policy analysis including undertaking situation analysis and research.
    - To identify possible policy options,
    - Describing these possible options,
    - Comparing the potential policy options,
    - Ranking the possible policy options and
    - Choosing the most effective option that could address issues and problems confronting school education.

UNIT - I
Planning an Educational Policy

A. Meaning and significance of `Policy on Education'.
B. Purpose and Dimensions of an Educational Policy at local and Global level.
C. Philosophical and Sociological Perspective of planning an Educational Policy.
D. Historical development of Educational Policies in India.
E. Basic steps involved in planning.
F. Constitutional provision for Policy on Education.
G. Fundamental principles for analyzing an Educational Policy.

UNIT - II
Educational Policies in India

- Critical analysis of Policies on Education since Independence: 1968, 1986 (Modified in 1992), 2020 in the context of: need and significance, goals and frameworks of educational policies, content of policies, issues raised in policies, constitutional provisions, special stress, modification of policies, implementation strategies.
- Issue of modifying an Educational Policy.

UNIT - III
Implementation of an Educational Policy

A. Meaning, need and significance.
B. Mechanism of Policy Implementation.
C. Strategies to Implement an Educational Policy.

D. Programme of action and implementation: conceptual clarification and significance.
E. Role of different Organization / Groups: Legislature/ Judiciary/ Political Will and Parties/ Voluntary Organizations/ Non-governmental organizations (NGOs)/ Pressure Groups/ Public.
F. Challenges for Implementation.

2.9.3 Suggestive Practicum

1. Reviewing and presenting report on NEP, 2020 in reference to Policy Implementation.
2. To present a critical review of the Programme of Action (1987).
3. Preparing a list of challenges to implement the present new National Education Policy, 2020 in our States.
4. Preparing a list of Measures to be taken or taken to implement National Education Policy, 2020 in our State.

2.9.4 Suggestive Mode of Transaction

The course content transaction will include the following:

- Planned lectures infused with multimedia /power-point presentations.
- Small group discussion, panel interactions, small theme-based seminars, group discussions, cooperative teaching and team teaching, selections from theoretical readings, case studies, analyses of educational statistics and personal field engagement with educationally marginalized communities and groups, through focus group discussion, surveys, short term project work etc.
- Hands on experience of engaging with diverse communities, children and schools.

2.9.5 Suggestive Mode of Assessment

The assessment will be based on the tests and assignments.

2.9.6 Suggestive Reading Materials

Teachers may suggest books/readings as per the need of the learners and learning content.

2.10 Education for Mental Health

Credits: 4
Semester: S-8

2.10.1 About the Course

This course on Education for Mental Health will give a comprehensive understanding on the concept of meaning and determinants of Mental Health. The course will further enhance the student teacher's ability to know different stress management and adjustment techniques. The course aims to introduce historical and contemporary developments of Mental Health Education programs in Indian and Global perspectives.

2.10.2 Learning Outcome

After studying this course, student teachers will be able to:

- express the meaning and significance of mental health,
- describe social and psychological determinants of mental health,
- analyze the causes of stress and process of stress management,
- analyze the significance of adjustment in life,
- analyze the needs and importance of global mental health education programme,
- explain the special role of teachers and parents to maintain the good mental health of children,
- suggest prevention and promotional measures to maintain good mental health of society,
- express the need for health policies globally.

UNIT - I
Mental Health

A. Meaning and determinants of Mental Health.
B. Mental Health Vs Mental Hygiene.
C. Mental disorders: Characteristics and Types.
D. Causes of poor Mental Health.
E. Myths Vs Facts about Mental Health.
F. Legal perspectives of Mental Health in India.
G. Concept of Healthy Personality

Unit-II
Stress, Stress Management and Adjustment

A. Stress: meaning, nature and symptoms, types of stress, social and psychological perspectives, remedial measures.
B. Stress management and adjustment: meaning and significance of stress management and adjustment, prevention and promotion, role of parents, peer group and teachers.

UNIT - III
Mental Health Education Programme

A. Meaning and significance of Mental Health Education Programme.
B. Dimensions of Mental Health Education Programme in India.
C. Historical development of Mental Health Education Programmes in India.
D. Local and Global Perspective of Mental Health Education Programme.
E. Organizations at local and international level.

F. Characteristics of a good Mental Health Education Programme.
G. Role of Educational Institutions.

UNIT - IV
Challenges to Pedagogical Issues

A. Home Vs. school
   - Diverse school and home contexts
   - Lifestyles of teachers and parents
   - Stereo-type roles
   - Mental health concerns of teachers and parents
   - Material availability/ production
B. Guidance and Counselling Programme:
   - Concept, need and techniques.
   - Teacher as a counselor
C. Designing and evaluating Mental Health Programmes

2.10.3 Suggestive Practicum

1. Visiting of Mental hospital and preparing list of four cases admitted in Hospital.
2. Preparation of two case histories on causes of abnormal behavior.
3. Critical analysis of laws and Public Health Policies.
4. Critical analysis of National Educational Policy, 2020 in the context of Health of children at school.
5. Critical analysis of Legal perspectives Mental Health Education in India.
6. Preparing comprehensive report on Mental Health Education Programme in India.

2.10.4 Suggestive Mode of Transaction

The course content transaction will include the following:

- Planned lectures infused with multimedia /power-point presentations.
- Small group discussion, panel interactions, small theme-based seminars, group discussions, cooperative teaching and team teaching, selections from theoretical readings, case studies, analyses of educational statistics and personal field engagement with educationally marginalized communities and groups, through focus group discussion, surveys, short term project work etc.
- Hands on experience of engaging with diverse communities, children, and schools.

2.10.5 Suggestive Mode of Assessment

The assessment will be based on the tests and assignments.

2.10.6 Suggestive Reading Materials

Teachers may suggest books/readings as per the need of the learners and learning content.

2.10 Education for Sustainable Development

Credits: 4
Semester: S-8

2.10.1 About the Course

This course is designed to highlight the meaning, nature and significance of Education and Sustainable Development in the light of 17 sustainable development goals envisaged in United nations agenda. The course is designed to make student teachers aware and understand SDG 4 goal of Inclusive and Quality Education in the light of NEP 2020. The course also highlights the politics and policies involved in Sustainable Development.

2.10.2 Learning Outcome

After studying this course, student teachers will be able to:

- clarify the meaning and significance of sustainable development,
- explore the relationship among education, development and environment,
- appreciate the relation between education and sustainable development,
- describe the characteristics of ESD,
- explain the role of education in sustainable development,
- critically analyze the meaning and importance of education in the context of sustainable development.,
- explain the role of education to achieve sustainable development,
- analyze the pedagogical issues related to ESD.

UNIT - I
Education and Sustainable Development

A. Meaning, relationship, goals, and significance.
B. Characteristics of ESD
C. Education for Sustainable Development: Historical Perspective
D. Philosophical, Sociological and Psychological Perspective.
E. Role of Education for Sustainable Development.
F. Decolonizing Knowledge for Sustainable Development.
G. Challenges of Education for Sustainable Development.

UNIT - II
Sustainable Development Goals (SDGs)

A. Meaning, nature and significance of SDGs.
B. 17 Sustainable Development Goals (SDGs): UNESCO agenda.
C. SDGs and Social Transformation as Universal Commitment.
D. Education as a Human Right to achieve Sustainable Development.
E. Sustainable Development and Peace.
F. Role of Educational Institutions and Challenges to achieve SDGs.

UNIT - III

SD Goal-4: Quality Education for All

A. Meaning, Nature, and Significance.
   - NEP, 2020 on SDG-4: Sustainable lifestyle, Gender equality, Promotion of peace & non-violence, Global citizenship, Good mental health & wellbeing, Justice in society.

B. Pedagogical issues for SDG-4.

UNIT - IV

Sustainable Development: Politics and Policies

A. Understanding the Policy-Making Process.
B. Policy Analysis.
C. Democratizing Science and Technology.
D. Globalization and the Environment: Capitalism, Ecology and Power.
E. Perspectives, Methods, and Skills.
F. Innovation for Sustainability.
G. Key Issues from an International perspective.
H. Critical issues involved in sustainability.

2.10.3 Suggestive Practicum

1. To present critical review on NEP, 2020 in the context of SDGs.
2. Critical study of Delors Commission Report, 1996: **Learning: The Treasure within** with reference to SDGs.
3. To review and present a critical report on legal perspective on SDGs.
4. To prepare Toolkit for Educations for Sustainable Development.
5. To organize discussions/ seminars of Teachers of all streams to present their views on SDGs and to present Action Plan for this.
6. To prepare and present a short Video/film to promote SDGs.

2.10.4 Suggestive Mode of Transaction

The course content transaction will include the following:

- Planned lectures infused with multimedia /power-point presentations.
- Small group discussion, panel interactions, small theme-based seminars, group discussions, cooperative teaching and team teaching, selections from theoretical readings, case studies, analyses of educational statistics and personal field engagement with educationally marginalized communities and groups, through focus group discussion, surveys, short term project work etc.
- Hands on experience of engaging with diverse communities, children, and schools.

2.10.5 Suggestive Mode of Assessment

The assessment will be based on the tests and assignments.

2.10.6 Suggestive Reading Materials

Teachers may suggest books/readings as per the need of the learners and learning content.

2.10 Emerging Technologies in Education

Credits: 4
Semester: S-8

2.10.1 About the Course

The course is designed to use Information and Communication Technology in a classroom as an important 21st century skill and an important step for ICT enabled education of the country. The course explores various ICT approaches and its integration in Pedagogy, Assessment and Management. The course will help student teachers to know and apply online and offline software applications and it will enhance their understanding related to social, economic, and ethical issues associated with the use of ICT.

2.10.2 Learning Outcome

After studying this course, student teachers will be able to:

- describe the need and uses of technology in the field of education,
- use various digital technologies for creating the resources,
- provide learning experiences for all types of learners including differently abled.
- create learning environment in the class room,
- understand the role of ICT to enhance the creativity of students,
- view the use of massive open online courses (MOOCs),
- explain the role of ICT in authentic and alternative assessment,
- discuss the social, economic, and ethical issues associated with the use of ICT.

UNIT - I
Education and Technology

A. Relationship between Education and Technology.
B. Conceptual clarity of Technology of Education and Technology in Education.
C. Meaning, Nature, and significance of Technology in Education.
D. Historical Development of use of Technology in Education.
E. Principles of using Technology in Education.
F. Emerging trends in Technology in Education.

UNIT - II
Information and Communication Technology

A. Meaning, nature, and types.
B. Fundamentals of Information and Communication Technology.
C. ICT Tools and application.
D. Hardware and Software: meaning, difference and types.
E. System software and Application software.
F. ICT application and multiple intelligence.
G. Social, Economic, and Ethical issues associated with the use of ICT.

UNIT - III

Technology in Education and Pedagogy

A. Approaches of integration of Technology in teaching and learning.
B. Subject specific ICT tools for creating and facilitating learning.
C. Subject specific online resources and their uses in lesson Planning.
D. Technology integrated learning experiences and creating learning Environment.
E. Use of Technology for children with special needs: Tools and processes; Universal Design for Learning.
F. Massive Open Online Courses (MOOC)-Concept and use.
G. ICT for Assessment and Management.

UNIT - IV

Online and Offline Software Applications

A. Application software- meaning and types.
B. Word processing, spreadsheet, presentation: Features and educational applications.
C. Drawing tools – diagrams, concept maps, timelines, flow charts. Educational applications of these tools.
D. Web 2.0 technology and tools: meaning characteristics and types.
E. Social networking and social book marking: Educational Applications.
F. Blog and micro blog – reflective journaling and other educational applications.
G. Wiki, YouTube, TED, Skype – collaborative authoring and projects.
H. Instant messaging and its educational applications.
I. Online forums/discussion groups and chats: educational applications.
J. Social media sharing – video, presentations, audio (podcasts), graphics, and text.
K. Web 2.0 tools for creating, sharing, collaborating, and networking.

UNIT - V

Instructional Design and E-content

A. Instructional Design: concept, principles, models, and stages.
B. E-learning courseware (e-content) design.
C. Identifying and organizing course content: need analysis (learner, content, and task), learning objectives and course sequence.
D. Designing instructional media, evaluation, and delivery strategies.
E. Creating interactive content: story board, courseware outline, interactivity, and interface
F. Courseware delivery and evaluation.
G. Multimedia tools: Audio editing, video editing, screen casting, graphic editing, and basics of animation, and creating interactive media.
H. Reusable learning objects (RLO) – meaning, types and characteristics, RLO repositories, metadata and standards.
I. E-content authoring tools- open source and proprietary alternatives.
J. Open Educational Resources – Meaning and importance, various OER initiatives, creative common licensing.

2.10.3 Suggestive Practicum:

1. Creating an account in wikispace/wikipedia/mediawiki and adding/editing content.
2. Developing an educational blog in www.blogger.com, www.wordpress.com.

3. A critical study of some ***e-learning*** course.
4. Developing a multimedia e-content for a topic.
5. Field visits to the EDUSAT center and take part in teleconferencing.
6. Planning and creating digital rubrics for any topic
7. Organizing web conferencing using Skype/Yahoo/ Messenger/ Google+.
8. Interview of computer hardware engineer/ICT specialist regarding Hardware planning, evaluation, maintenance, and up gradation
9. Review of NEP, National ICT policy and curriculum in the context of Technology in Education.
10. Enrolling and completing some MOOC courses of interest.
11. Developing technology integrated unit/lesson plans and trying them out in schools.

2.10.4 Suggestive Mode of Transaction

The course content transaction will include the following:

- Planned lectures infused with multimedia /power-point presentations.
- Small group discussion, panel interactions, small theme-based seminars, group discussions, cooperative teaching and team teaching, selections from theoretical readings, case studies, analyses of educational statistics and personal field engagement with educationally marginalized communities and groups, through focus group discussion, surveys, short term project work etc.
- Hands on experience of engaging with diverse communities, children, and schools.

2.10.5 Suggestive Mode of Assessment

The assessment will be based on the tests and assignments.

2.10.6 Suggestive Reading Materials

Teachers may suggest books/readings as per the need of the learners and learning content.

2.10 Gender Education

Credits: 4
Semester: S-8

2.10.1 About the Course

The course Gender Education seeks to develop understanding and interlinkages between gender and education. The course is designed to develop a conceptual understanding of the overall gender discourse with special emphasis on issues such as gender bias, gender stereotypes in school, curriculum and in textual materials. The course also addresses gender sexuality, sexual violence, abuse, and legal perspectives.

2.10.2 Learning Outcomes

After completion of this course the students will be able to:

- clarify key concepts like gender, transgender, gender bias, gender stereotype, empowerment, gender parity, equity and equality and patriarchy,
- explain the shifting from women studies to gender studies,
- clarify gender issues in school, curriculum, and textual materials across disciplines, pedagogical processes and its intersection with class, caste, religion, and region,
- examine school environment, curriculum, and pedagogy with reference to gender related issues,
- address issues related to sexuality, sexual violence, and abuse,
- draw framework for gender sensitized classroom and school environment.

UNIT - I
Gender and Education

A. Meaning, relationship, and significance of studying.
B. Conceptual clarity of related terms: Gender, gender perspective, sexuality, patriarchy, masculinity, feminist, gender bias, transgender, gender stereotyping and empowerment.
C. Gender as the basis in school education.
D. Constitutional Provisions with special reference to equity and equality, rights of girls.
E. Education and women's empowerment.
F. Shifting from women's studies to Gender Studies.

UNIT - II
Learning Gender Roles

A. Social and Cultural Perspectives of Gender Identity: role of family and school, media, and other formal and informal organizations/ agencies
B. Socialization and learning gender roles.
C. Gender stereotyping/Role models.
D. Preventing Measures: role of school and home

UNIT - III
Gender, Sexuality, Sexual Violence and Abuse

A. Development of sexuality and its impact on children with reference to gender, body image, role-models.
B. Sexual violence in formal and informal institutions.

C. Child sexual abuse from pre-primary stage to secondary stage: providing accurate information on child sexual abuse, helping, and identifying signs of sexual abuse in children.
D. Providing dos and don'ts about sexual abuse.
E. Legal perspective: Laws for safety and Security of girls and women, Implementation of the POCSO Act.

UNIT - IV
Pedagogical Issues

A. Analyzing classroom practices.
B. Creating gender friendly classrooms and school environment.
C. Analyzing Curriculum from gender perspective: learning outcomes, textual material, teaching-learning processes, language used, teaching aids, assessment strategies.
D. ICT pedagogy for gender sensitive school curriculum.
E. Challenges for pedagogical issues.

2.10.3 Suggestive Practicum

1. Preparing a Report on National Educational Policies, (1986/1992 and2020) in the context of gender issues in Education.
2. Preparation of projects on:
    - Analysis of textual materials from the gender perspective for identifying gender bias and gender stereotype in textual materials.
    - Recommendations of commissions and policies on education to empower girls/women.
    - Mahila Samakhya Programme.
    - Women Role Models in various fields with emphasis on women in unconventional roles.
    - Video clipping on portrayal of women.
    - Folklores reflecting socialization process.
    - How students perceive sexuality and their own body images.
3. Field visits to schools to observe the schooling processes from a gender perspective.
4. Preparing Analytical Report on portrayal of men and women in print and electronic media.

2.10.4 Suggestive Mode of Transaction

The course content transaction will include the following:

- Planned lectures infused with multimedia /power-point presentations.
- Small group discussion, panel interactions, small theme-based seminars, group discussions, cooperative teaching and team teaching, selections from theoretical readings, case studies, analyses of educational statistics and personal field engagement with educationally marginalized communities and groups, through focus group discussion, surveys, short term project work etc.
- Hands on experience of engaging with diverse communities, children, and schools.

2.10.5 Suggestive Mode of Assessment

The assessment will be based on the tests and assignments.

2.10.6 Suggestive Reading Materials

Teachers may suggest books/readings as per the need of the learners and learning content.

2.10 Guidance and Counselling

Credits: 4
Semester: S-8

2.10.1 About the Course

This course comprises of four units aiming to develop the understanding about the concept, need and significance of guidance and counselling. It will give a comprehensive understanding of guidance and counselling principles, techniques, and real-world applications. This course also deals with psychological testing and diagnosis in counselling. It examines the factors affecting guidance and counselling along with ethical considerations. The importance of counselling for individuals with disabilities, visual impairment, and hearing impairment is also emphasized in this course along with challenges related to providing counselling services in schools.

2.10.2 Learning Outcomes

After completion of this course the students will be able to:

- explain the basic meaning, need and significance of Guidance and Counseling in the context of education,
- differentiate between Guidance and Counselling with special reference to the purpose and strategies,
- clarify the general social, psychological, and historical perspective of Guidance and Counselling,
- describe the basic features of Guidance and Counseling with reference to students needs at school level,
- explain the basic principles of Guidance and Counselling,
- organize guidance program,
- analyze the reports of educational commission and educational policies with reference to Guidance and Counselling.

UNIT - I
Guidance

A. Meaning, need, nature and scope of Guidance.
B. Brief historical background of Guidance movement in India.
C. Individual and Group Guidance.
D. Basic assumptions and principles of Guidance.
E. Need to understand the needs of the individual and group in the context of Guidance.
F. Essential information for Effective Guidance.
G. Vocational Guidance and Role of teachers.

UNIT - II
Counselling

A. Meaning, importance, areas, and types of Counselling.
B. Approaches to Counseling: directive, non-directive and eclectic, behaviorally, and cognitively oriented.
C. Process of Counseling: initiating counseling, preparation, and intake procedures, establishing rapport, termination of and response to initial interview.

D. Establishing Structure: attending behaviour, observation, non-verbal behaviour, listening, verbal patterning and communication responses, silence, use of questions. transference and countertransference. regarding and respect in counseling relationships. involuntary clients, client expectation.
E. Role of family and community.

UNIT - III

Tools and Techniques to Collect Data

A. Psychological Testing and Diagnosis: Need and Nature.
B. Test use and interpretation, appraisal techniques.
C. Counseling Interview: Essential aspects, basis procedures, problems, and their handling.
D. Personality Assessment: Historical perspective
E. Material administration, scoring, interpretation, and evaluation of frequently used personality inventories/ questionnaire and projective tests. Personal Orientation Tests and Rating Scales: Type a behaviour, Locus of Control, Attitude scale, ST AI etc., and other clinical rating scales.
F. Case Study: Need and Importance.

UNIT - IV

Issues Related to Guidance and Counselling

A. Factors affecting Guidance and Counselling.
B. Ethical issues in Guidance and Counseling.
C. Limitation of diagnosis with special reference to Counselling.
D. Challenges to organize Guidance and Counselling programmes in schools.
E. Counselling and Guidance of persons with learning disabilities, visual and hearing impairment.
F. Challenges related to counselling services in schools.

2.10.2 Suggestive Practicum

1. Prepare a case study on students with learning difficulties.
2. Prepare a report on challenges of organizing guidance and counselling programmes in school.

2.10.4 Suggestive Mode of Transaction

The course content transaction will include the following:

- Planned lectures infused with multimedia /power-point presentations.
- Small group discussion, panel interactions, small theme-based seminars, group discussions, cooperative teaching and team teaching, selections from theoretical readings, case studies, analyses of educational statistics and personal field engagement with educationally marginalized communities and groups, through focus group discussion, surveys, short term project work etc.
- Hands on experience of engaging with diverse communities, children, and schools.

2.10.5 Suggestive Mode of Assessment

The assessment will be based on the tests and assignments.

2.10.6 Suggestive Reading Materials

Teachers may suggest books/readings as per the need of the learners and learning content.

2.10 Adolescence Education

Credits: 4
Semester: S-8

2.10.1 About the Course

The course is designed to develop a comprehensive understanding and knowledge about Adolescence and Adolescence education with special references of Adolescence Education programmes in India at School level. There is an attempt to develop understanding about intellectual, emotional, physiological, socio-cultural, and interpersonal issues related to the processes of growing up and to inculcate healthy attitude towards sex and sexuality, respect for the opposite gender and understanding of responsible social behaviour. The course highlights core life skills and their significance in adolescence life period and try to know about the various Adolescence Education programmes undergoing for Adolescence in India.

2.10.2 Learning Outcomes

After the completion of this course students will be able to:

- develop sensitivity, understanding and knowledge about Adolescence and Adolescence Education,
- know the historical development of Adolescent Educational Programme in India,
- know the role of local as well as international agencies towards Adolescent Educational Programme,
- develop a positive attitude towards the importance of Adolescence Education Programmes at the school level,
- develop knowledge and sensitivity on matters related to reproductive health, sex and sexuality and communicate effectively on these issues,
- develop understanding about intellectual, emotional, physiological, socio-cultural, and interpersonal issues related to the processes of growing-up,
- inculcate a healthy attitude towards sex and sexuality, respect for the opposite gender and an understanding of responsible sexual behavior,
- develop an understanding about the desired life skills,
- acquire pedagogical related skills for Adolescence Education Programmes.

UNIT - I

Adolescence and Adolescence Education

A. Understanding Adolescence: intellectual, emotional, social, and physiological aspects of Adolescence, issues and challenges during Adolescence, myths and realities.
B. Adolescence Education: concept, nature, and significance of Adolescence Education in Indian context, aims and objectives of Adolescence Education.
C. Role of school, family, media, and community as social agencies in Adolescence Education.
D. Challenges of Adolescence Education.

UNIT - II
Life Skills and Adolescence Education

A. Concept, nature, and significance of Life Skills for Adolescence Education.
B. Relationship between Life Skills and Adolescence Education.
C. Core Life Skills and their significance.
D. Understanding sexual and reproductive health.
E. STIs and HIV/AIDS: causes, prevention, cure, and skills of coping.

UNIT - III
Adolescence Education Programme in India (AEP)

A. Historical Development of Adolescence Education Programme in India.
B. Goals and Significance of Adolescence Education Programme in India.
C. Role of Teachers in Adolescence Education in India (AEP).
D. Challenges to Educational Programmes in India.
E. Myths / Misconceptions

UNIT - IV
Pedagogical Issues

A. Meaning, goals and significance.
B. Challenges of teaching adolescence education: understanding student's behavior, dealing with personal self-constraints, socio- cultural issues, class-room issues and challenges, material production, methodology
C. Preparation of teachers
D. Approaches to adolescence education: case studies and critical incidents, brainstorming, role-playing, gaming, value clarifications, question box, discussions and debates, puppet shows, role reversal, video shows.

2.10.3 Suggestive Practicum

1. Study of Case studies and Critical Incidents. a) Field visit/s
2. Review and analysis of the work done by Government and Non-Government.
3. Study of Organizations (NGO) at national and international level.
4. A research study or detailed case study: Adolescents' behavior in different socio-economic settings, a study on child abuse victims, adolescents in drug rehabilitation centers, adolescents residing in the precincts of industrial areas and factory establishments, adolescents in the educational regions showing either higher or lower drop-out rate, adolescents belonging to communities in which social evils affecting them are manifested like child marriages, conducting Adolescence Education sessions in School.

2.10.4 Suggestive Mode of Transaction

The course content transaction will include the following:

- Planned lectures infused with multimedia /power-point presentations.
- Small group discussion, panel interactions, small theme-based seminars, group discussions, cooperative teaching and team teaching, selections from theoretical readings, case studies, analyses of educational statistics and personal field engagement with

educationally marginalized communities and groups, through focus group discussion, surveys, short term project work etc.

- Hands on experience of engaging with diverse communities, children, and schools.

2.10.5 Suggestive Mode of Assessment

The assessment will be based on the tests and assignments.

2.10.6 Suggestive Reading Materials

Teachers may suggest books/readings as per the need of the learners and learning content.

2.10 Art in Education

Credits 4
Semester S-8

2.10.1 About the Course

The course seeks to develop an understanding of Art with special reference to its relevance in human life in general and Education in particular. It will further develop imagination and sense of appreciation and aesthetic of art. The theoretical considerations of Art Education are highlighted from Indian and western perspectives of art in Life. The course talks about the fundamental principles of Art Education at school level. The pedagogical issues of art education and approaches to teaching-learning process are also discussed.

2.10.2 Learning Outcomes

After completion of this course, student teachers will be able to:

- develop art appreciation with special reference to relevance and place of Art in human life,
- acquaint with conceptual understanding of the key ideas of Art Education,
- discuss critically the value development in Art Education.,
- understand the implications of Art in Education,
- sensitize towards the problems and issues in Art Education,
- sensitize towards pedagogical issues of Art Education,

UNIT - I
Art and Education

A. Conceptual clarity, relationship, and significance of studying art education with special reference to place of art in Human life.
B. Historical development of art education in school education.
C. Goals of studying art education in school curriculum at different stages.
D. Studying art education across the curriculum.
E. Perspective of NEP, 2020 on Art Education.

UNIT - II
Theoretical Consideration of Art Education

A. Philosophical, psychological and sociological perspective of Art Education.
B. Formal and informal theories of art.
C. Indian perspective of art in life.
D. Western perspective of art in life.
E. Critical analysis of theories of Art Education.

UNIT - III
Fundamentals of Art Education

A. Literature of Art Education
B. Conceptual clarity of the following basic concepts of art at school level: aesthetics, criticism and judgement at school level, beauty, reality, idea, truth, taste, sense.

C. Basic requirements of teaching-learning art at school across stages.
D. Question of social ethics.

UNIT - IV

Pedagogical Issues of Art Education

A. Approaches to teaching-learning process of Art Education.
B. Curriculum of art education with special to challenges of developing curriculum.
C. Material production and its challenges.
D. Assessment and Evaluation strategies with special reference to challenges.
E. Criterion of analyzing: curriculum of Art Education, teaching-learning material, assessment and evaluation strategies, teaching strategies of art at school level.
F. Values in Art teaching.

2.10.3 Suggestive Practicum

1. Preparing multimedia material for Art Education in senior secondary schools.
2. Preparation of instructional material for education in the arts for secondary school.
3. Organizing the Art Club.
4. Case studies of the children's work of art and their understanding of the concept of Art.

2.10.4 Suggestive Mode of Transaction

The course content transaction will include the following:

- Planned lectures infused with multimedia /power-point presentations.
- Small group discussion, panel interactions, small theme-based seminars, group discussions, cooperative teaching and team teaching, selections from theoretical readings, case studies, analyses of educational statistics and personal field engagement with educationally marginalized communities and groups, through focus group discussion, surveys, short term project work etc.
- Hands on experience of engaging with diverse communities, children, and schools.

2.10.5 Suggestive Mode of Assessment

The assessment will be based on the tests and assignments.

2.10.6 Suggestive Reading Materials

Teachers may suggest books/readings as per the need of the learners and learning content.

3.0 DISCIPLINARY/ INTER-DISCIPLINARY COURSES

(To be developed by the University/ Institution concerned in line with regular-Year Undergraduate Programme – FYUP within prescribed credits as outlined in Curriculum Framework)

STAGE SPECIFIC CONTENT CUM PEDAGOGY COURSES

4.4 Content Cum Pedagogy Courses at Secondary Stage

NEP 2020 envisages that teachers must be grounded in Indian values, languages, knowledge, ethos, and traditions including tribal traditions, while also being well-versed in the latest advances in education and pedagogy. Aligning with this, the four-year Integrated Teacher Education Programme (ITEP) envisions the creation of passionate, motivated, qualified, professionally trained, and well-equipped teachers capable of designing and implementing developmentally appropriate learning experiences for students at different stages of school education and seeks to ensure that the prospective teachers are given the highest quality education in content, pedagogy, values, and practice.

Pedagogy of a school subject can be referred to as a teacher's understanding of how the students learn. Pedagogy demands a variety of quality classroom interactions between the teacher and students which motivates students to learn. The use of appropriate pedagogy manifests in visible student enthusiasm and a desire to engage constructively in the learning process. The involvement of students is the key aspect of teaching learning process and the pedagogical decisions and responses made by the teachers have a significant effect on the student's participation. Consequently, the selection of teachers' learning experiences and implementation will have a significant influence both on student academic performance and motivation. At the Secondary level, the challenge for the teacher intensifies due to the nature of adolescence to understand and employ pedagogies that effectively support all three important dimensions of student's behaviour i.e., emotional, cognitive and conative as NEP 2020 lays emphasis on the holistic development of students.

The secondary stage of school education occupies a crucial position in the entire system of education because it is the terminal stage of school education. The secondary stage of teacher preparation involves four years of multidisciplinary study but with greater depth, greater critical thinking, and greater attention to life aspirations (Curriculum Framework, ITEP, 2023). It covers Grades 9–12 covering ages from 14–18. It emphasizes a pedagogy that is based on a combination of peer-facilitated, expert-led and self-learning processes with an emphasis on promoting conceptual understanding, collaboration, and creativity both in teacher education classrooms and school classrooms. Teachers' pedagogical expertise and subject matter expertise both are critical to successful teaching and student understanding.

Students develop greater disciplinary knowledge and approaches in the secondary stage. By locating the theoretical concepts within the overall conceptual framework of the disciplines, explaining them using the most recent, accepted theories of the discipline, and connecting these concepts to theoretical concepts in other disciplines, would help them understand the deeper meanings.

The Pedagogy courses at the secondary stage extend from semester III to VI covering 16 credits. There are four contents cum pedagogical courses across all subject-specific pedagogies. The first course, offered in the III semester is an introductory course entitled, Basics of Pedagogy, which is 4 credits course common to all subject disciplines such as Languages, Commerce, Sciences, Social Sciences, Home Science, Computer Science, Physical Education, Arts Education, Vocational Education and Agriculture. In Semesters IV, V and VI, subject-specific pedagogy courses are being offered, each with 2 credits. The student teachers of this stage have to choose

two contents cum pedagogical courses in semesters IV, V and VI. The subject-specific pedagogical courses are designed to effectively integrate theory and practice for attaining higher goals of preparing quality teachers as enshrined in NEP 2020.

In addition to being well-versed in the most recent developments in pedagogy and education, a student who completes these courses will have a solid foundation in Indian values, languages, knowledge, ethos, and culture. The requirement for 21st century skills has been addressed by these courses. These courses will be a pre-requisite of the internship of a student teacher and direct linkage to subject-specific school practices.

The following pedagogy courses are designed to realize the curricular objectives of the Secondary Stage:

S.No.	Discipline of the school curricular area	Courses	Semester	Credits
1.	General Pedagogy - For all curricular areas	Basics of Pedagogy at Secondary Stage - ***This course shall be offered as common compulsory course across all the pedagogy courses.***	3	4
2.	Languages L1: Any one Language from Schedule 8 L2: Any one Language other than L1	Content cum Pedagogy of Language 1 at Secondary Stage – Course (I) Content cum Pedagogy of Language 2 at Secondary Stage- Course (I)	4	2 2
		Content cum Pedagogy of Language 1 at Secondary Stage- Course (II) Content cum Pedagogy of Language 2 at Secondary Stage- Course (II)	5	2 2
		Content cum Pedagogy of Language 1 at Secondary Stage- Course (III) Content cum Pedagogy of Language 2 at Secondary Stage- Course (III)	6	2 2
3.	Mathematics	Content cum Pedagogy of Mathematics at Secondary Stage – Course (I)	4	2
		Content cum Pedagogy of Mathematics at Secondary Stage – Course (II)	5	2
		Content cum Pedagogy of Mathematics at Secondary Stage - Course (III)	6	2
4.	Sciences (Physical Sciences)	Content cum Pedagogy of Physical Sciences at Secondary Stage - Course (I)	4	2
		Content cum Pedagogy of Physical Sciences at Secondary Stage - Course (II)	5	2
		Content cum Pedagogy of Physical Sciences at Secondary Stage - Course (III)	6	2
5.	Sciences (Biological Sciences)	Content cum Pedagogy of Biological Sciences at Secondary Stage - Course (I)	4	2
		Content cum Pedagogy of Biological Sciences at Secondary Stage - Course (II)	5	2

		Content cum Pedagogy of Biological Sciences at Secondary Stage - Course (III)	6	2
6.	Social Sciences (Economics, Geography, History and Political Science)	Content cum Pedagogy of Social Sciences at Secondary Stage - Course (I)	4	2
		Content cum Pedagogy of Social Sciences at Secondary Stage - Course (II)	5	2
		Content cum Pedagogy of Social Sciences at Secondary Stage - Course (III)	6	2
7.	Commerce, Accountancy & Business Studies	Content cum Pedagogy of Commerce, Accountancy and Business Studies at Secondary Stage- Course (I)	4	2
		Content cum Pedagogy of Commerce, Accountancy and Business Studies at Secondary Stage - Course (II)	5	2
		Content cum Pedagogy of Commerce, Accountancy and Business Studies at Secondary Stage - Course (III)	6	2
8.	Computer Science	Content cum Pedagogy of Computer Science at Secondary Stage - Course (I)	4	2
		Content cum Pedagogy of Computer Science at Secondary Stage - Course (II)	5	2
		Content cum Pedagogy of Computer Science at Secondary Stage - Course (III)	6	2
9.	Arts (Visual &Performance)	Content cum Pedagogy of Arts at Secondary Stage: - Course (I)	4	2
		Content cum Pedagogy of Arts at Secondary Stage - Course (II)	5	2
		Content cum Pedagogy of Arts at Secondary Stage - Course (III)	6	2
10.	Vocational Education	Content cum Pedagogy of Vocational Education at Secondary Stage - Course (I)	4	2
		Content cum Pedagogy of Vocational Education at Secondary Stage - Course (II)	5	2
		Content cum Pedagogy of Vocational Education at Secondary Stage - Course (III)	6	2
11.	Physical Education & Yoga	Content cum Pedagogy of Health, Physical Education and Yoga at Secondary Stage - Course (I)	4	2

		Content cum Pedagogy of Health, Physical Education and Yoga at Secondary Stage - Course (II)	5	2
		Content cum Pedagogy of Health, Physical Education and Yoga at Secondary Stage - Course (III)	6	2
12.	Agriculture	Content cum Pedagogy of Agriculture at Secondary Stage - Course (I)	4	2
		Content cum Pedagogy of Agriculture at Secondary Stage - Course (II)	5	2
		Content cum Pedagogy of Agriculture at Secondary Stage - Course (III)	6	2
13.	Home Science	Content cum Pedagogy of Home Science at Secondary Stage - Course (I)	4	2
		Content cum Pedagogy of Home Science at Secondary Stage - Course (II)	5	2
		Content cum Pedagogy of Home Science at Secondary Stage - Course (III)	6	2

*Note: Pedagogy courses are developed as per curricular areas. HEIs may further develop as per their subject specific needs based on the syllabi.

4.4.1 Basics of Pedagogy at Secondary Stage

Credit: 4
Semester: S-3

4.4.1.1 About the Course

This course deals with diverse range of topics of basics of pedagogy at secondary sage that will equip student teachers with valuable knowledge, capacities and competencies. This course comprises four units and a practicum. This course prepares student teachers to understand secondary-stage learners and design teaching accordingly. This course also aims to equip teachers with the necessary tools, knowledge, and competencies to continuously evolve as professionals and create a positive and transformative impact on their students and society as a whole. In this course a strong foundation will be established by exploring the fundamental principles and concepts that support basics of pedagogy in the light aims and objectives of the curriculum. This course emphasizes understanding learners and their backgrounds comprehensively so that an engaging and supportive learning environment, that fosters a need for learning, can be created for facilitating learner's holistic development. This course is designed to equip student teachers with a wide array of teaching learning strategies. It also focuses on innovative and transformative approaches to education, aiming to create lifelong learners equipped to thrive in an ever-changing world. Through professional development opportunities, student teachers will be better prepared to meet the ever-changing demands of the educational landscape and inspire the next generation of learners.

4.4.1.2 Learning Outcomes

After completion of this course, student teachers will be able to:

- build comprehensive understanding of secondary stage learners,
- assess the physical, mental, social, and emotional growth of secondary stage learners,
- develop skills to observe and recognize the unique capabilities and strengths of secondary stage learner,
- discuss the necessary knowledge and skills to implement effective teaching and learning strategies,
- create enriching and inclusive learning environments to foster values-based education,
- develop a deeper understanding of various pedagogical approaches and their impact on learners,
- determine the knowledge to make informed decisions about instructional practices,
- explain the crucial role of pedagogy in facilitating effective learning experiences for students,
- outline knowledge and skills necessary for continuous professional development.

UNIT - I
Understanding Secondary Stage Learners

A. Understanding the learners and learner background
   i. The physical, mental, social, and emotional growth of learners
   ii. Thought processes and cognitive skills of learners.
   iii. Psychological and social orientations of learners
   iv. Social and academic lives of learners
   v. Conflicts and challenges of secondary learners

vi. Characteristics of secondary stage learners

B. Observing the unique capabilities of a child

UNIT - II

Strategies of Teaching and Learning

A. Understanding teaching and learning strategies:
   i. Concept, characteristics and functions of teaching
   ii. Making abstract concepts enjoyable by relating them to real-life situations,
   iii. Promoting multidisciplinary learning through integration of different disciplines
   iv. Promoting learner participation and engagement in learning
   v. Building values through art integrated activities, community engagement etc.
   vi. Promoting multidisciplinary learning through integration of different disciplines
   vii. Promoting health and social sensitivities
   viii. Developing respect toward cultural heritage
   ix. Making classrooms inclusive and joyful learning spaces

B. Relationship between Aims and Values of Education, Curriculum and Pedagogy

UNIT - III

Pedagogical Approaches

A. Pedagogical approaches: constructivist approach; collaborative approach; reflective approach; integrative approach, inquiry- based approach; other contemporary approaches, art-integrated learning, sports- integrated learning.

B. Types of pedagogy: social pedagogy; critical pedagogy; culturally responsive pedagogy; Socratic pedagogy in inclusive setup.

C. Role of pedagogy in effective learning: how does pedagogy impact the learner?

UNIT - IV

Continuous Professional Development of Teacher

A. Meaning and need, professional and ethical competencies and need for updating content and pedagogical competencies to develop their professional competencies.

B. Professional development activities: seminars, conferences, orientation programmes, workshops, online and offline courses, competitions, publications, development of teaching portfolio, capacity building programmes, and teacher exchange programmes.

C. Development of professional competencies to deal with gender issues, equity and inclusion, ethical issues, environmental issues, human health and well-being, population, human rights, and various issues (emotional, mental, physical issues related to pandemic (for example covid-19).

4.4.1.3 Suggestive Practicum (Any Three)

1. Analyze NEP 2020 with reference to pedagogical aspects of the concerned subject.
2. Analyze and reflect on the qualities of an 'Innovative Teacher' in Context of National Professional Standards for Teachers (NPST) and National Mentoring Mission (NMM).
3. Explore different platforms such as National Teacher's Portal, NISHTHA, DIKSHA, and SWAYAM for an online course and prepare a report.

4. Participate in a workshop or seminar to explore the concept of Continuous Professional Development (CPD), its significance in lifelong learning and prepare a write up on the findings.
5. Develop teaching learning strategies to address the needs of diverse learners in context of gender, equity and inclusion and prepare a PowerPoint presentation.
6. Raise awareness on the ethical and social challenges in education through field trip and create an e-portfolio.
7. Any other project assigned by HEI.

4.4.1.4 Suggestive Mode of Transaction

Lecture cum discussion, project-based method, problem solving method, experiential learning, art integrated learning, sports integrated learning, ICT integrated learning, interactive methods such as group discussions, peer tutoring, workshops, observations, and presentations.

4.4.1.5 Suggestive Mode of Assessment

Portfolio creation, written tests, classroom presentations, seminars, assignments, practicum, sessional, terminal semester examinations (As per UGC norms).

4.4.1.6 Suggestive Reading Materials

- National Council of Educational Research and Training. (April 2022). Mandate documents Guidelines for the development of National Curriculum Frameworks.
- National Education Policy 2020, MoE, Government of India (English and Hindi)
- National Steering Committee for National Curriculum Frameworks, (2023). Draft National Curriculum Framework for School Education.
- National Policy on Education 1968, 1986 and 2020.

*Teachers may also suggest books/readings as per the need of the learners and learning content.

4.4.2 Content cum Pedagogy of Language 1/ Language 2 at Secondary Stage - Course (I)

Credit: 2
Semester: S-4

4.4.2.1 About the Course

Interventions from quality teachers are vital in view of the objectives of NEP 2020. Sound pedagogical content knowledge and teaching methods are the determinants of a teacher's quality and professionalism. Teacher education programme strongly emphasizes pedagogy, its principles, and the practices of teaching and learning. Research clearly shows that children pick up language very quickly. It is also a well-known fact that students learn and grasp abstract concepts more quickly through their mother tongue or local language. Therefore, for teaching-learning any language, maximum exposure of the language needs to be given. This course comprises of three units emphasizing the knowledge of developing the teaching skills of language for the student-teacher. The course also focuses on the understanding of nature, scope, importance, and functions of a language. It also deals with the historical/policy perspectives along with the approaches, methods of teaching the language for development of language skills among the children.

4.4.2.2 Learning Outcomes

After completion of this course, student teachers will be able to:

- outline the aims and objectives of teaching Language at the secondary level,
- identify and relate values of the Language with other disciplines,
- summarize the historical perspective of the Language,
- discuss methods, approaches, and materials for teaching Language at the secondary stage in the Indian context,
- appraise the Language diversity of the surroundings.

UNIT - I

Nature, Scope, and Historical Perspective of Language

A. Nature, scope, and importance of the Language; Linguistic features of the Language.
B. Functions of Language, Language learning, and Language acquisition.
C. Historical perspective of the Language with a special focus on inclusivity in classrooms to learn the Language, evolution of Language with the power dynamics.
D. Language as discourse: Language - Identity and Gender.
E. Recommendations/suggestions of various committees, commissions, and policies on teaching-learning the Language in school education.
F. Universality of Languages.

UNIT - II

A. Aims and objectives of teaching the Language (L1 and L2).
B. Linkages of the Language with other school subjects.
C. Linkages between literature and society.
D. Place of the Language in school curriculum at the national and international scenario.
E. Values of Language: functionality, fluency, coherence.

UNIT - III

Pedagogical Aspects of Language

A. Approaches of teaching Language – inductive deductive, constructivist, experiential learning, art-integrated learning, blended learning, interdisciplinary and multidisciplinary approaches.
B. Critical and analytical pedagogical concerns related to teaching Language with special focus on Higher-Order Thinking skills (HOTs).
C. Methods of teaching Language: learner-centric and group-centric, lecture-cum-demonstration, grammar-cum-translation method, direct method, audio-lingual method, task-based learning, lexical approach, activity-based discussion, problem-solving, hands-on activity, concept-mapping, collaborative and cooperative learning.
D. Capabilities of students in Language skills and reflection.

4.4.2.3 Suggestive Practicum (Any Three)

1. Prepare a report on any one Language of your neighborhood focusing on how it has evolved.
2. Enumerate values of the Language and prepare a write up.
3. Write an article on the recommendations of NEP 2020 in context to Language development.
4. Prepare relevant resource materials of the Language at the secondary level.
5. Prepare a report on various pedagogical activities to teach the Language.
6. Any other project assigned by the HEI.

4.4.2.4 Suggestive Mode of Transaction

Lecture-cum-discussion, project-based method, problem-solving method, experiential learning, inquiry approach, ICT integrated learning, interactive methods such as group discussions, peer tutoring, workshops, observations, and presentations.

4.4.2.5 Suggestive Mode of Assessment

Written tests, classroom presentations, seminars, assignments, practicum, sessional, and terminal semester examinations (As per UGC norms).

4.4.2.6 Suggestive Reading Materials

- National Curriculum Framework for School Education, Government of India
- National Education Policy 2020 (NEP 2020). Government of India. (English/ Hindi).
- National Policy on Education (With Modifications Undertaken In 1992). Ministry of Human Resource Development: New Delhi.
- The Right of Children to Free and Compulsory Education Act-2009, The Gazette of India, 2009.

*Teachers may also suggest books/readings as per the need of the learners and learning content.

4.4.2 Content cum Pedagogy of Language 1/ Language 2 at Secondary Stage - Course (II)

Credit: 2
Semester: S-5

4.4.2.1 About the Course

Building on the previous level's knowledge of the philosophy of the Language, the course will introduce students to the core knowledge of pedagogy and planning in Language education at the secondary level. It is designed to make student-teacher aware of the teaching-learning aids and other resources available as well as created for making Language learning meaningful and joyful. It will also help them to know the effectiveness of such resources and the impact on the children's Language skills. It also focuses on textbook analysis and planning for teaching Language and Literature and its pedagogical issues in the light of NEP 2020. Student teachers are expected to identify various concepts and processes. Accordingly, they are expected to develop lesson plans based on learning outcomes and experiential learning for classroom and online teaching.

4.4.2.2 Learning Outcomes

After completion of this course, student teachers will be able to:

- explain teaching-learning materials related to Language education with reference to NEP 2020,
- apply different types of teaching-learning aids during classroom teaching,
- make use of multimedia in Language teaching. Acquire knowledge about Language through online resources,
- develop lesson plan for effective teaching of Language,
- summarize the meaning and need of how to learn concepts of Language,
- identify the role of a teacher in facilitating learning of the Language.

UNIT - I

Teaching Learning Resources

A. Teaching learning aids/materials: concept, role, and importance in classroom teaching learning of Language.
B. Types of teaching learning aids/ materials: print media such as textbook, scrambled books, teachers' manual/ handbook and other print materials., non-print and digital media such as radio, TV, websites, animations, audios, videos, images, simulations, digital repository, Augmented Reality (AR), Virtual Reality (VR) and Artificial Intelligence (AI) based digital resources and Open Educational Resources (OERs) for offline/ online classroom teaching learning (reflective journals, charts, 2-D and 3-D models, games, toys, flash cards, worksheets, multimedia etc.)
C. Identification and use of teaching aids/teaching learning materials from the environment.
D. Language laboratory – types, design, management, and practices; Virtual laboratories, teaching learning kits, subject clubs, fairs, exhibitions, educational parks, excursions, community resources and pooling of resources.

UNIT - II

Content Analysis and Planning for Teaching Language

A. Concept, types and importance of unit and lesson planning.
B. Pedagogical analysis of content taking examples from topics of Language textbooks of secondary stage, identification of concepts, listing learning outcomes and competencies, planning, and evaluating learning experiences in an inclusive setup.
C. Developing unit plans and lesson plans based on learning outcomes and experiential learning (art integrated) of Languages.

UNIT - III

ICT Integration and Application

A. Scope and importance of using ICT in learning process of Languages.
B. Use of ICT in the classroom: artificial intelligence, machine learning, smart boards, for enhancing learning.
C. Tools, software and platform for teaching learning of Language at secondary stage.
D. Developing ICT integrated lesson plans using Technological Pedagogical Content Knowledge (TPCK) for classroom and online teaching using digital resources and multimedia.

4.4.2.3 Suggestive Practicum (Any Three)

1. Prepare a teaching learning resource for developing Language skills.
2. Develop an e-content on any one topic from Language textbooks at secondary stage.
3. Develop a list of Literature which can play instrumental role in curriculum enrichment.
4. Prepare a write-up on pedagogical aspects of Language teaching in reference to NEP 2020.
5. Prepare outcome-based lesson plans on Prose, Poetry, and Grammar of Language.
6. Any other project assigned by the HEI.

4.4.2.4 Suggestive Mode of Transaction

Lecture-cum-discussion, project-based method, problem-solving method, experiential learning, inquiry approach, ICT integrated learning, interactive methods such as group discussions, peer tutoring, team teaching, workshops, observations and presentations.

4.4.2.5 Suggestive Mode of Assessment

Written tests, classroom presentations, seminars, assignments, practicum, sessional, terminal semester examinations will be used to assess the course outcomes (As per UGC norms).

4.4.2.6 Suggestive Reading Materials

- National Curriculum Framework for School Education, Government of India
- National Education Policy 2020 (NEP 2020). Government of India. (English/ Hindi).
- National Policy on Education (With Modifications Undertaken In 1992). Ministry of Human Resource Development: New Delhi.
- The Right of Children to Free and Compulsory Education Act-2009, The Gazette of India, 2009.

*Teachers may also suggest books/readings as per the need of the learners and learning content.

4.4.2 Content cum Pedagogy of Language 1/ Language 2 at Secondary Stage – Course (III)

Credit: 2
Semester: S-6

4.4.2.1 About the Course

This course comprises three units and a practicum. It focuses on assessment and evaluation. It also focuses on assessment based on learning outcomes, strategies for continuous assessment, school-based assessment, formative and summative assessment including 360◦ assessment. The students will be exposed to research and innovative practices in teacher education. In this course student teachers will learn how to plan different types of activities in online and offline mode. It emphasizes how to integrate and use ICT in the classroom of Language and Literature. Assessment serves the dual purpose of tracking the performance of the learners as well as feedback mechanism for effectiveness of teaching. Today's scenario emphasizes competency-based assessment practices and tests higher order thinking skills and conceptual clarity. Major reforms in assessment are need of the hour to stay vibrant and effective in the process of teaching learning of Language and Literature. Finally, the instructor will enable the students to understand the concepts of assessment and evaluation as well as differentiate between assessment and evaluation for Language learning.

4.4.2.2 Learning Outcomes

After completion of this course, student teachers will be able to:

- list the different concepts related to assessment and evaluation in Language Teaching,
- enumerate the characteristics of innovative practices in the teaching-learning process of the Language,
- discuss tools and techniques of assessment and evaluation in Language Teaching,
- examine issues in Language assessment and their impact on classroom teaching,
- apply ICT in the teaching-learning process of Language,
- develop e-content of Language using Language lab and virtual lab.

UNIT - I

21st Century Skills for Learning

A. Need for and importance of how to learn 21st century skills for learners and teachers of Language.
B. Psychological, sociological, and philosophical perspective of teaching and learning Language.
C. Qualities of a Language teacher as professional for enhancing teaching learning skills.
D. Role of a teacher in facilitating learning and creating dynamic learning environment of Language.

UNIT - II

Assessment and Evaluation

A. Assessment and evaluation: need for and importance of Languages.
B. Development of learning indicators, performance-based assessment, learners' records of observations.
C. Strategies for continuous assessment, school-based assessment, formative and summative assessment, formal, informal and 360o assessment.
D. Performance assessment: assessment of group activities, field observations, recording and reporting, creating platform and portfolio management, assessment of lab skills, assignments, projects, and presentations.
E. Tools and techniques of assessment and evaluation; unit test based on Table of Specification (TOS) and its importance; basic steps of question paper setting, types of test items and preparing answer key and criteria for school, assessment, and feedback mechanism in teaching learning of Languages.

UNIT - III

Research and Innovative Practices in Teaching Languages

A. Divergent thinking and innovation in psychological, sociological, and philosophical perspectives for quality learning experiences.
B. Recent trends in research related to teaching learning of Language.
C. Action research: meaning, significance, steps and planning.
D. Evidence-based practices and reflection, school-based research in Language.
E. Effective communication with special reference to multilingualism using Language lab and virtual lab.

4.4.2.3 Suggestive Practicum (Any Three)

1. Design devices for assessment of Listening, Speaking, Reading, and Writing skills of Language through activities such as debate, extempore, group discussion, Speech, etc.
2. Assess the peers in the Language and prepare an analytical report.
3. Write a reflective note on two editorial pieces on the same topic from different newspapers from multilingualism perspective.
4. Complete an online certificate course on Language from SWAYAM portal.
5. Develop a write-up on the power of Language in regard to NEP 2020 recommendations.
6. Any other project assigned by HEI.

4.4.2.4 Suggestive Mode of Transaction

Lecture-cum-discussion, project-based method, problem-solving method, experiential learning, inquiry approach, ICT integrated learning, interactive methods such as group discussions, peer tutoring, team teaching, workshops, observations and presentations.

4.4.2.5 Suggestive Mode of Assessment

Written tests, classroom presentations, seminars, assignments, practicum, sessional, terminal semester examinations will be used to assess the course outcomes (As per UGC norms).

4.4.2.6 Suggestive Reading Material

- National Curriculum Framework for School Education, Government of India
- National Education Policy 2020 (NEP 2020). Government of India. (English/

Hindi).

- National Policy on Education (With Modifications Undertaken In 1992). Ministry of Human Resource Development: New Delhi.
- The Right of Children to Free and Compulsory Education Act-2009, The Gazette of India, 2009.

*Teachers may also suggest books/readings as per the need of the learners and learning content.

4.4.3 Content cum Pedagogy of Mathematics at Secondary Stage - Course (I)

Credit: 2
Semester: S-4

4.4.3.1 About the Course

Mathematics is an important school subject and students are expected to master computational and problem-solving skills with the help of mathematical concepts and reasoning during study. Teaching of Mathematics is not only concerned with the computational know-how of the subject but is also concerned with pedagogical content knowledge and communication leading to its meaningful learning amongst students. This course enables the student-teachers to understand the nature of mathematical knowledge and the mathematics curriculum at secondary stage. The objectives of teaching Mathematics should not be limited to the development of computational skills but to enable mathematical reasoning to solve problems of life. Student teachers will develop skills to formulate classroom objectives as well as plan for development of the values through Mathematics. Student teachers will have a thorough understanding of Mathematics content and their relevant specific pedagogy for the effective learning of Mathematics. They would be exposed to various pedagogical approaches, methods, and techniques so that they will be able to create a learner friendly classroom environment.

4.4.3.2 Learning Outcomes

After completion of this course, student teachers will be able to:

- appraise the contribution of Indian Knowledge Systems in development of Mathematics,
- explain the nature of Mathematics as an important subject for human development,
- interpret the recommendation of the various policy documents in reference to Mathematics education,
- classify the aims and objectives of teaching Mathematics,
- formulate objectives based on learning outcomes for Mathematics teaching,
- select and demonstrate various approaches and methods of teaching Mathematics,
- plan strategies to inculcate values through teaching Mathematics.

UNIT - I

Nature, Scope and Historical Perspective of Mathematics

A. Development of Mathematics from a historical perspective.
B. Nature of Mathematical Knowledge – Axioms and Postulates, Conjectures, Proofs in Mathematics: inductive - deductive reasoning, theorems, mathematical modeling.
C. Importance of Mathematics knowledge in everyday life.
D. Recommendations of various committees, commissions and policies related to Mathematics education at Secondary stage (especially in National Education Policies and National Curriculum Frameworks).

UNIT - II

Aims and Objectives of Teaching Mathematics

A. Aims and objectives of teaching Mathematics at secondary stage.
B. Learning outcomes and competencies of teaching Mathematics at secondary stage.
C. Linkages of Mathematics with other school subjects and place in school curriculum.

D. Inculcation of values through teaching of Mathematics.

UNIT - III

Pedagogical Aspects of Mathematics

A. Implication of various approaches of teaching Mathematics – inductive deductive, analytical synthetical, constructivist, blended learning, experiential learning, transdisciplinary, interdisciplinary, and multidisciplinary.
B. Learner-centric and participative methods of teaching of Mathematics: lecture cum demonstration, problem-solving, laboratory, project based.
C. Analytical pedagogical concerns in teaching of Mathematics for higher order thinking skills such as critical, creative, decision making, reflective, collaborative, and cooperative.
D. Techniques of teaching learning Mathematics: oral, written, drill work, homework, self-study, group study, supervised study, concept-mapping, learning, art and sports integrated learning.

4.4.3.3 Suggestive Practicum (Any Three)

1. Prepare a collage/ biographic sketch on the contribution of Indian mathematician.
2. Present a paper on comparison of nature of mathematical knowledge with other school subjects.
3. Formulate objectives based on learning outcomes and experiential learning for any one unit of secondary Mathematics.
4. Develop strategy to connect any three topics for value inculcation in teaching of Mathematics.
5. Analyze the content of one chapter of Mathematics textbook and develop concept maps at secondary stage.
6. Select and list approaches and methods for teaching various topics of secondary stage Mathematics.
7. Any other project assigned by HEI.

4.4.3.4 Suggestive Mode of Transaction

Demonstration, field-based experience, library visits, classroom discussions, self-study, field observations, assignment preparation, classroom presentations, discussion forums, observation, research report, engaging in dialogue, flipped classroom.

4.4.3.5 Suggestive Mode of Assessment

Written test, classroom presentation, workshop, assignments, practicum, sessional and terminal semester examination (As per UGC norms).

4.4.3.6 Suggestive Reading Material

- MESE 001(2003) Teaching and Learning Mathematics. IGNOU series
- NCERT Publications: Pedagogy of Mathematics (Code-13074)

*Teachers may also suggest books/readings as per the need of the learners and learning content.

4.4.3 Content cum Pedagogy of Mathematics at Secondary Stage – Course (II)

Credit: 2
Semester: S-5

4.4.3.1 About the Course

The teaching learning of Mathematics is a complex activity, and many factors determine the success of this activity. The nature and quality of instructional material, the presentation of content, the pedagogic skills of the teacher, the learning environment. Students at this stage are keen in exploring and constructing their own knowledge, so facilitating with resources is important for the schoolteacher. This course will provide illustrative exposure to the resource materials for Mathematics teaching learning. Teaching Mathematics requires a thorough understanding of the pedagogical content knowledge. It is the integration or the synthesis of teachers' pedagogical knowledge and their subject matter knowledge that comprises pedagogical content knowledge. Planning of the learning experiences is a must for the quality learning outcome and the better use of resources. This course provides skills to develop the planning of Mathematics teaching learning for classroom. This course also extends the support of technology integration for enhancement of pedagogical planning. The course will be helpful for Student teachers in knowing how the mathematical content knowledge is organized and used in the teaching learning process with support of technological tools.

4.4.3.2 Learning Outcomes

After completion of the course, student teachers will be able to:

- discuss the nature and functions of various instructional resources,
- explore and utilize the teaching learning resources to support pedagogical experiences of Mathematics,
- organize and manage supportive activities for development of mathematical aptitude of secondary school students,
- plan appropriate experiences for teaching Mathematics,
- explore diverse backgrounds and interests' children bring to set up the inclusive classroom for Mathematics learning,
- elaborate technological tools for teaching and learning of Mathematics,
- integrate technology to judiciously facilitate learning for enhancing inclusive environment.

UNIT - I

Teaching Learning Resources

A. Teaching learning materials: meaning and importance for secondary school Mathematics.
B. Types of teaching learning resources: print media (Mathematics textbook, teachers' manual/ handbook, laboratory manual), non-print and digital media (charts, 2-D and 3-D models, games, web resources, interactive boards, animations, videos, images, simulations) for offline/ online classroom teaching and learning
C. Identification and use of learning resources in Mathematics from the local environment, community resources and pooling of resources.
D. Mathematics resource room/ laboratory – equipment and management, concept of virtual laboratories.

E. Organization of Mathematics club, fairs, exhibitions, learner community.

UNIT - II

Content Analysis and Planning for Teaching Mathematics

A. Analysis for identification of axioms, concepts, rules, formulas, theorems, corollaries; pedagogical content knowledge of arithmetic, algebra, geometry, mensuration, and trigonometry of secondary stage.
B. Planning and evaluating learning experiences in an inclusive setup based on learning outcomes and competencies, building a community of mathematicians in classrooms.
C. Developing annual plan, unit plan, lesson plan – need, main consideration, and format.
D. Strategies for method-based lesson plan for secondary classes - inductive-deductive, analytical- synthetical, lecture cum demonstration, problem-solving, laboratory, and project based.

UNIT - III

ICT Integration and Applications in Teaching of Mathematics

A. Scope and importance of ICT for teaching and learning Mathematics.
B. Use of ICT (digital repository, Augmented Reality (AR), Virtual Reality (VR) and Artificial Intelligence (AI) based digital resources, open education resources, blogs, forums, interactive boards, and devices) in the teaching learning, assessment and resource management of secondary Mathematics.
C. Use of tools, software, and platforms such as GeoGebra, Khan Academy along with national teacher's portal, DIKSHA, SWAYAM.
D. Developing ICT integrated lesson plans using Technological Pedagogical Content Knowledge (TPCK) for Mathematics classroom and online teaching.

4.4.3.3 Suggestive Practicum (Any Three)

1. Develop learning resources for Mathematics teaching learning.
2. Prepare annual plan for any secondary class.
3. Prepare a unit plan from the Mathematics textbook at secondary stage.
4. Prepare learning outcomes-based lesson plan using experiential learning for any one topic of Mathematics at secondary stage.
5. Develop a lesson plan on a topic of Mathematics at secondary stage by integrating ICT tools.
6. Write script for developing e-content on any one topic of Mathematics for online teaching.
7. Any other Project assigned by HEI.

4.4.3.4 Suggestive Mode of Transaction

Lecture cum discussion, group work, ICT enabled methods, Activity based and Art Integrated Demonstration, Field-based experiences, Library Visits, Self-study, Field observations, Assignment preparation. Classroom presentations, Discussion forums, Observation, Flip classroom, Use of digital platform.

4.4.3.5 Suggestive Mode of Assessment

Written test, classroom presentation, workshop, assignments, practicum, sessional, and terminal semester examination (As per UGC norms).

4.4.3.6 Suggestive Reading Materials

- NCERT: A Handbook for Designing Mathematics Laboratory in Schools (Code- 1555)
- NCERT: Manual for Higher Secondary Mathematics Kit (Code- 3165)

*Teachers may also suggest books/readings as per the need of the learners and learning content.

4.4.3 Content cum Pedagogy of Mathematics at Secondary Stage - Course (III)

Credit: 2
Semester: S-6

4.4.3.1 About the Course:
Development of 21st century skills are important for Mathematics teaching learning. Learning the imagination, spatial visualization, mathematical reasoning is important for novice learners. The course comprises three units describing 21st century skills for learning, assessment and evaluation and research and innovative practices in teaching learning Mathematics. This course also aims to improve skills and competencies required for Mathematics teachers to conduct effective learner assessments. The course describes various evaluation strategies and devices which can be efficiently used in the teaching learning of Mathematics and in the development of skills among the student teachers for improving student outcomes, conduct action research and school-based research in the teaching of Mathematics.

4.4.3.2 Learning Outcomes
After completion of the course, student teachers will be able to:

- analyze the sources of the development of 21st century skills through Mathematics teaching and learning,
- determine role of teacher in facilitating learning and creating dynamic learning environment of Mathematics,
- describe need for and importance of assessment in the learning process of Mathematics,
- develop various types of tests for assessing students learning in Mathematics,
- design and develop innovative strategies and techniques for successful inteaching and learning Mathematics,
- conduct school- based research in Mathematics teaching,
- explain the various methods of exploring knowledge,
- explore innovative ideas for teaching and learning of Mathematics,
- assess the steps of action research.

UNIT - I

21st Century Skills for Learning Mathematics

A. Need for and importance of how to learn 21st century skills such as practicing imagination, spatial visualization, mathematical reasoning, problem solving for learners and teachers of Mathematics.
B. Psychological, sociological, and philosophical perspective of teaching learning and development of Mathematics.
C. Qualities of a Mathematics teacher as professional.
D. Role of a teacher in facilitating learning and creating dynamic learning environment of Mathematics.

UNIT - II

Assessment for Learning in Mathematics

A. Meaning, need and organization of oral, written, and practical assessment in Mathematics.
B. Construction of types of questions in Mathematics: objective, short answer, long answer, considerations for the marking different types of questions in Mathematics.

C. Planning and developing teachers made tests in Mathematics - Table of Specification (TOS), question paper setting and preparing answer key.
D. Tools to identify learning difficulties and provide corrective measures in Mathematics, concept of 360° assessment, holistic progress card and assessment of mathematical aspects of students.

UNIT - III

Research and Innovative Practices in Teaching of Mathematics

A. Divergent thinking for innovation in psychological, sociological, and philosophical perspectives of Mathematics for quality learning experiences.
B. Innovative practices in Mathematics.
C. Research on issues of gender, class and culture in Mathematics learning and achievement - expectations, attitudes and stereotypes; access to higher Mathematics; interrogating the notion of 'Achievement Gap'; construction of learners' identity in a Mathematics classroom.
D. Recent trends and research related to teaching learning of Mathematics – digital gaming, digital storytelling, using Artificial Intelligence for Mathematics teaching and learning.
E. Action research for solving problems of teaching and learning of Mathematics: meaning, significance, steps, and planning.

4.4.3.3 Suggestive Practicum (Any Three)

1. List 21st century skills with reference to various topics of school Mathematics.
2. Writing a paper on recent trends and research related to teaching learning of Mathematics.
3. Prepare a scrap book for 'Mathematics in Print Media'.
4. Prepare a small video for recent trends of Mathematics in social media.
5. Plan a teacher made test for a unit of secondary Mathematics.
6. Prepare a report after using an innovative idea to teach a difficult topic of secondary Mathematics.
7. Plan for action research on any one problem of teaching learning Mathematics.
8. Any other project assigned by HEI.

4.4.3.4 Suggestive Mode of Transaction

Lecture cum discussion, group work, ICT enabled methods, activity based and art integrated demonstration, field-based experiences, library visits, self-study, field observations, assignment preparation, classroom presentations, discussion forums, observation, flip classroom, use of digital platform.

4.4.3.5 Suggestive Mode of Assessment

Written test, classroom presentation, workshop, assignments, practicum, sessional and terminal semester examination (As per UGC norms).

4.4.3.6 Suggestive Reading Material

- NCERT (2012). Pedagogy of Mathematics
- NCERT: Manual for Higher Secondary Mathematics Kit (Code- 3165)

*Teachers may also suggest books/readings as per the need of the learners and learning content.

4.4.4 Content cum Pedagogy of Physical Sciences at Secondary Stage – Course (I)

Credit: 2
Semester: S-4

4.4.4.1 About the Course

The focus of the National Education Policy (NEP) 2020 is on the holistic development of students. To achieve the objectives, interventions from quality teachers are vital. Sound pedagogical content knowledge and teaching methods are the determinants of a teacher's quality and professionalism. Teacher education programme strongly emphasizes pedagogy, its principles, and the practices of teaching and learning. Pedagogical knowledge and approaches refer to the specialized knowledge of the teacher for creating an active, child-centered, and inclusive teaching-learning environment for the students and need to be developed among the student teachers. This pedagogical course in Physical Sciences is intended to enhance the pedagogical content knowledge of student teachers through different learning approaches and methods. This course comprises three units and a practicum. The course is devoted to developing an understanding of the nature and scope of Physical Sciences and the aims and objectives of teaching Physical Sciences and its linkages with other disciplines. Historical/policy perspectives of Physical Sciences are discussed in unit second. Physical Sciences is conceptualized in very broad terms by relating it to technology, society, humans, and sustainable development. It also focuses on the place of Physical Sciences in school curriculum including an emphasis on how to build inclusive classrooms. It focuses on pedagogical concerns of Physical Sciences. Critical, creative, and analytical pedagogical concerns in teaching Physical Sciences with special reference to higher-order thinking are also placed in unit third.

4.4.4.2 Learning Outcomes

After completion of this course, student teachers will be able to:

- explain nature, scope and importance of Physical Sciences,
- illustrate aims and objectives of teaching Physical Sciences for sustainable development of society,
- outline linkages between Physical Sciences and other subjects,
- identify the values and importance of Physical Sciences and alternative knowledge systems,
- summarize the historical/policies perspective of Physical Sciences,
- examine pedagogical concerns of Physical Sciences,
- categorize approaches and methods of teaching learning Physical Sciences,
- apply appropriate pedagogy in teaching learning the concepts of Physical Sciences.

UNIT - I

Nature, Scope and Historical Perspective of Physical Sciences

A. Nature, scope, and importance of Physical Sciences.
B. Historical perspective of Physical Sciences.
C. Contributions of Indian (ancient and modern) and other scientists.
D. Physical Sciences, society and human and sustainable development.
E. Recommendations/suggestions of various committees, commissions, and policies in reference to Physical Sciences.

UNIT - II

Aims and Objectives of Physical Sciences

A. Aims and objectives of teaching Physical Sciences.
B. Learning outcomes and competencies of teaching Physical Sciences at secondary stage.
C. Linkages of Physical Sciences with other school subjects and place of the Physical Sciences in school curriculum.
D. Values of Physical Sciences: scientific attitude and appreciating other systems of knowledge / alternative knowledge systems.

UNIT - III

Pedagogical Aspects of Physical Sciences

A. Implication of various approaches - inductive deductive, constructivist, experiential learning, art integrated learning, sports integrated learning, blended learning, interdisciplinary and multidisciplinary approaches in Physical Sciences.
B. Analytical pedagogical concerns in teaching of Physical Sciences for higher order thinking skills such as critical, creative, communication, decision making, reflective.
C. Methods of teaching learning Physical Sciences: learner-centric and group-centric, lecture cum demonstration, activity based, discussion, problem-solving, laboratory, stem and steam, project based, scientific inquiry, hands on activity, discovery, experimentation, concept-mapping, collaborative and cooperative learning.

4.4.4.3 Suggestive Practicum (Any Three)

1. Explore contributions of Indian scientists in the development of Physical Sciences and make presentations on historical development of Physical Sciences.
2. Analyze recommendations of policies/commissions in context of Physical Sciences.
3. Develop concept maps on different concepts of Physical Sciences.
4. Identify and integrate values in Physical Sciences concepts.
5. Demonstrate different pedagogical approaches and strategies for transacting concepts of Physical Sciences.
6. Prepare write-ups on the teaching of science using interdisciplinary and multidisciplinary approaches as recommended in NEP 2020.
7. Any other project assigned by HEI.

4.4.4.4 Suggestive Mode of Transaction

Lecture cum discussion/demonstration, hands-on activities, experiential learning, art and environment integrated learning, sports integrated learning.

4.4.4.5 Suggestive Mode of Assessment

Written tests, classroom presentations, workshops, seminars, assignments, practicums, sessional and terminal semester examinations (as per UGC norms).

4.4.4.6 Suggestive Reading Material

- National Council of Educational Research and Training. (April 2022). Mandate documents Guidelines for the development of National Curriculum Frameworks.
- National Education Policy 2020, MoE, Government of India.

- National Steering Committee for National Curriculum Frameworks, (2023). Draft National Curriculum Framework for School Education.
- NCERT, Textbooks of Physical Sciences at Secondary Stage.

*Teachers may also suggest books/readings as per the need of the learners and learning content.

4.4.4 Content cum Pedagogy of Physical Sciences at Secondary Stage - Course (II)

Credit: 2
Semester: S-5

4.4.4.1 About the Course

This course comprises three units and the practicum. The course is devoted to introducing various teaching aids material types and uses for teaching the concepts of physical sciences at secondary stage. Enough space is provided to discuss different types of teaching aids/materials for teaching learning concepts of physical sciences. It focuses on learning resources in physical sciences to enable student teachers to make use of available learning resources and how to generate new resources for teaching learning the concepts of physical sciences. It also focuses on textbook analysis and planning for teaching physical sciences. and its pedagogical issues in the light of NEP 2020. Student teachers are expected to identify various concepts and processes, list learning and outcomes, find out about various activities and experiments. Accordingly, they are expected to develop lesson plan based on learning outcomes and experiential learning for classroom and online teaching.

4.4.4.2 Learning Outcomes

After completion of this course, student teachers will be able to:

- identify teaching learning aids / materials and illustrate their importance in teaching learning the concepts of Physical Sciences,
- categorize teaching aids/materials/learning resources,
- develop teaching learning aids/material/kits/learning resources for teaching learning the concepts of Physical Sciences,
- utilize teaching aids/materials/learning resources for teaching learning the concepts of Physical Sciences,
- analyze the content of physical sciences textbooks at secondary stage,
- develop lesson plan based on learning outcomes and experiential learning using appropriate strategies.

UNIT - I

Teaching Learning Resources

A. Teaching learning aids/materials: concept, definition, role and importance in classroom teaching learning the physical sciences.
B. Types of teaching learning aids/ materials: print media such as textbook, teachers' manual/ handbook, laboratory manual and other print materials, non-print and digital media such as radio, TV, websites, animations, audios, videos, images, simulations, digital repository, Augmented Reality (AR), Virtual Reality (VR) and Artificial Intelligence (AI) based digital resources and Open Educational Resources (OERs) for offline/ online classroom teaching learning reflective journals, charts, 2-D and 3-D models, games, cards, worksheets, multimedia.
C. Identification and use of learning resources in physical sciences from the local environment.

D. Resource room/ laboratory/ library, virtual laboratories, teaching learning kits, physical sciences clubs, fairs, exhibitions, educational parks, excursions, community resources and pooling of resources.

UNIT - II

Content Analysis and Planning for Teaching Physical Sciences

A. Pedagogical analysis of content taking examples from topics of physical sciences textbooks at secondary stage, identification of concepts, listing learning outcomes and competencies, planning, and evaluating learning experiences in an inclusive setup.
B. Concept, types and importance of unit and lesson planning.
C. Developing unit plans and lesson plans based on learning outcomes and experiential learning by selecting topics from textbooks of physical sciences at secondary stage.

UNIT - III

ICT Integration and Applications

A. Scope and importance of ICT in physical sciences.
B. Use of ICT such as Artificial Intelligence, machine learning, smart boards in the teaching learning, assessment, and resource management.
C. Tools, software, and platforms for teaching learning of physical sciences at secondary stage.
D. Developing ICT integrated lesson plans by taking topics of physical sciences at secondary stage using Technological Pedagogical Content Knowledge (TPCK) for classroom and online teaching.

4.4.4.3 Suggestive Practicum (Any Three)

1. Develop e-content for the concepts of Physical Sciences at Secondary Stage.
2. Analyze the content of textbooks of Physical Sciences (Classes 9-12).
3. Identify the learning resources for transiting the concepts of Physical Sciences.
4. Develop teaching aids/teaching materials for teaching concepts of Physical Sciences at secondary stage.
5. Develop learning outcomes for the concepts of Physical sciences at the secondary stage.
6. Prepare learning outcomes and experiential learning-based lesson plan for the concepts of Physical Sciences.
7. Develop a project on the concepts of Physical Sciences using interdisciplinary and multidisciplinary approaches as recommended in NEP 2020.
8. Any other project assigned by HEI.

4.4.4.4 Suggestive Mode of Transaction

Lecture cum discussion/demonstration, hands-on activities, demonstration, discovery approach, project approach, inquiry approach, experimentation, problem-solving, concept mapping, experiential learning and ICT integrated approach.

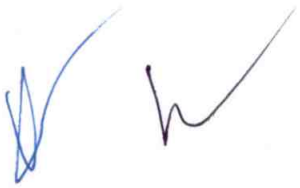
4.4.4.5 Suggestive Mode of Assessment

Written test, classroom presentations, workshops, seminars, assignments, practicums, sessional and terminal semester examinations (as per UGC norms).

4.4.4.6 Suggestive Reading Materials

- Draft National Curriculum Framework for School Education,
- Laboratory Manual of Science (Grade 9 & 10), NCERT.
- National Education Policy 2020, MoE, Government of India.
- National Steering Committee for National Curriculum Frameworks, (2023).
- NCERT Laboratory Manuals.
- NCERT Textbooks, Chemistry for Class XI and XII.
- NCERT Textbooks, Physics for Class XI and XII.
- NCERT Textbooks, Science for Class IX and XI.

*Teachers may also suggest books/readings as per the need of the learners and learning content.



4.4.4 Content cum Pedagogy of Physical Sciences at Secondary Stage - Course (III)

Credit: 2
Semester: S-6

4.4.4.1 About the Course

This course comprises three units and a practicum. It focuses on assessment and evaluation. It also focuses on assessment based on learning outcomes, strategies for continuous assessment, school-based assessment, formative and summative assessment including 360◦ assessment. Student teachers are expected to identify various concepts and processes, list learning and behavioral outcomes, find out about various activities and experiments, and identify relevant evaluation techniques and strategies. It focuses on Psychological, Sociological and Philosophical Perspective of Activity Oriented Classrooms in Physical Sciences. The importance of planning science learning and teaching in secondary schools. In this course student teachers will learn how to plan different types of activities in online and offline mode. It emphasizes how to integrate and use ICT in the classroom of Physical Sciences. Assessment serves the dual purpose of tracking the performance of the learners as well as feedback mechanism for effectiveness of teaching. Today's scenario emphasizes competency-based assessment practices and tests higher order thinking skills and conceptual clarity. Major reforms in assessment are need of the hour to stay vibrant and effective in the process of teaching learning of Physical Sciences.

4.4.4.2 Learning Outcomes

After completion of this course, student teachers will be able to:

- explain the significance of acquiring 21st-century skills for Physical Sciences teaching,
- outline the need for and importance of assessment and evaluation in the teaching of Physical Sciences,
- appraise with various assessment strategies for continuous assessment in reference to teaching of Physical Sciences,
- utilize appropriate tools and techniques for assessment and evaluation in teaching learning of Physical Sciences,
- identify recent trends in research related to the teaching and learning and its implications in teaching learning of Physical Sciences,
- prepare unit test item based on TOSS and develop different types of test items,
- construct and administer different type of tests,
- plan offline and online activities for testing higher order thinking skills in teaching learning of Physical Sciences,
- relate ICT integration and elaborate its use in classroom situations,
- identify a problem in the context of Physical Sciences teaching learning and plan action research.

UNIT - I

21st Century Skills for Learning

A. Need for and importance of how to learn 21st century skills for learners and teachers of Physical Sciences.

B. Psychological, sociological, and philosophical perspective of teaching and learning Physical Sciences.
C. Qualities of a Physical Sciences teacher as professional for enhancing teaching learning skills.
D. Role of a teacher in facilitating learning and creating dynamic learning environment of Physical Sciences.

UNIT - II

Assessment and Evaluation

A. Assessment and evaluation: need for and importance of Physical Sciences.
B. Assessment based on learning outcomes, strategies for continuous assessment, school-based assessment, qualitative assessment; formative and summative assessment, formal, informal and 360◦ assessment.
C. Performance assessment: assessment of group activities, field observations, recording and reporting, creating platform and portfolio management, assessment of laboratory skills, assignments, projects, and presentations.
D. Tools and techniques of assessment and evaluation - unit test based on Table of Specification (TOS) and its importance, basic steps of question paper setting, types of test items and preparing answer key and criteria for school, assessment, and feedback mechanism in teaching learning the content of Physical Sciences.

UNIT - III

Research and Innovative Practices in Physical Sciences

A. Divergent thinking and innovation in psychological, sociological, and philosophical perspectives for quality learning experiences.
B. Recent trends in research related to teaching learning of Physical Sciences.
C. Action research: meaning, significance, steps and planning.
D. Evidence-based practices and reflection, school-based research in Physical Sciences.

4.4.4.3 Suggestive Practicum (Any Three)

1. Prepare, administer, and analyze scores of an achievement test.
2. Explore AI based assessment tools and prepare an E-Portfolio for a student of Secondary Stage.
3. Conduct Simulated Teaching session for the concepts of Physical Sciences and observation by self, peer, and teacher.
4. Explore development of multidisciplinary projects and present using PowerPoint.
5. Interpret the concept of Physical Sciences with Psychological, Sociological and Philosophical Perspective.
6. Apply innovative practices in classroom teaching learning of Physical Sciences.
7. Make a presentation on the role of Physical Sciences in sustainable development of society.
8. Plan action research for Continuous Professional Development (CPD) of Physical Sciences teacher.
9. Any other project assigned by HEI.

4.4.4.4 Suggestive Mode of Transaction

Lecture cum discussion/demonstration, demonstration, discovery approach, project approach, inquiry approach, problem-solving, experiential learning.

4.4.4.5 Suggestive Mode of Assessment

Written test, classroom presentations, workshops, seminars, assignments, practicums, sessional and terminal semester examinations (as per UGC norms).

4.4.4.6 Suggestive Reading Material

- National Council of Educational Research and Training. (April 2022). Mandate documents Guidelines for the development of National Curriculum Frameworks.
- National Education Policy 2020, MoE, Government of India
- National Steering Committee for National Curriculum Frameworks, (2023). Draft National Curriculum Framework for School Education.

*Teachers may also suggest books/readings as per the need of the learners and learning content.

4.4.5 Content cum Pedagogy of Biological Sciences at Secondary Stage – Course (I)

Credit: 2
Semester: S-4

4.4.5.1 About the Course

Biology is an inseparable part of human life and is hence learning biological concepts and principles is given ample importance in school curricula. Knowledge of Biological Sciences enables students to recognize and value the diverse living forms, their structure and method of functioning, co-existence and how they harmoniously blend with other natural/physical factors that constitutes the complex environment. To enable school students adequately learn these aspects, teachers must design and adopt appropriate teaching-learning methods for teaching Biological Sciences. Biological Sciences offer us the unique facility of seeing, touching and observing materials. This course aims to educate the student teachers to learn the various methods and strategies in teaching Biological Sciences. The course comprises of three units describing the aims and scope of Biological Sciences in Secondary level. A glimpse of the history of Biological Sciences is dealt with ancient and modern Indian and international contributions in the study of biological methods and practices in building the modern-day Biological Sciences. Salient features of selected earlier curricular exercises with special reference to biology at secondary level are also emphasized.

4.4.5.2 Learning Outcomes

After completion of this course, Student teachers will be able to:

- explain nature, scope, and importance of Biological Sciences,
- illustrate aims and objectives of teaching Biological Sciences for sustainable development of society,
- outline linkages between Biological Sciences and other subjects,
- identify the values and importance of Biological Sciences and alternative knowledge systems,
- summarize the historical/policies perspective of Biological Sciences,
- examine pedagogical concerns of Biological Sciences,
- categorize approaches and methods of teaching learning Biological Sciences,
- apply proper pedagogy in teaching learning the concepts of Biological Sciences,
- realize the importance of studying Biological Sciences as part of the school curriculum,
- identify the values and significance of Biological Sciences in School curricula,
- apply appropriate method/s in teaching concepts of Biological Sciences.

UNIT - I

Nature, Scope and Historical Perspective of Biological Sciences

A. Nature, scope, and importance of Biological Sciences.
B. Historical perspective of Biological Sciences.
C. Contributions of Indian (ancient and modern) and other scientists.
D. Biological science for sustaining self, society, environment, and world.
E. Recommendations/suggestions of various committees, commissions, and policies in reference to Biological Sciences.

UNIT - II

Aims and Objectives of Biological Sciences

A. Aims and objectives of teaching biological science as a component of multidisciplinary science.
B. Learning outcomes and competencies of teaching Biological Sciences at secondary stage.
C. Linkages of Biological Sciences with other school subjects and place of the Biological Sciences in school curriculum.
D. Values of Biological Sciences; ethical, environmental and sustainability concerns.

UNIT - III

Pedagogical Aspects of Biological Sciences

A. Implication of various approaches – inductive deductive, constructivist, experiential, art-integrated, blended learning, interdisciplinary and multidisciplinary approaches, stimulating the spirit of investigation and enquiry.
B. Analytical pedagogical concerns in teaching of physical sciences for higher order thinking skills such as critical, creative, communication, decision making, reflective.
C. Methods of teaching learning Biological Sciences: learner-centric and group-centric, lecture cum demonstration, activity based, discussion, problem-solving, laboratory and hands on activity based, sports- integrated, project based, inquiry, discovery, experimentation, concept-mapping, collaborative and cooperative learning; stem and steam concept.

4.4.5.3 Suggestive Practicum (Any Three)

1. Plot a timeline of development of Biological Sciences from ancient to modern times mentioning the important developments.
2. Analyze and prepare a report on pedagogy of Biological Sciences with reference to NEP 2020.
3. Prepare a write up on ancient Indian contributions and practices in Ayurveda/Herbal medicines.
4. Develop concept maps on different concepts of Biological Sciences.
5. Demonstrate different pedagogical approaches and strategies for transacting concepts of Biological Sciences.
6. Any other project assigned by HEI.

4.4.5.4 Suggestive Mode of Transaction

Lecture cum discussion, demonstration, hands-on activities, experiential learning, inquiry, Group work, Presentations, multimedia.

4.4.5.5 Suggestive Mode of Assessment

Written tests, classroom presentations, workshops, seminars, assignments, practicums, sessional and terminal semester examinations (as per UGC norms).

4.4.5.6 Suggestive Reading Material

- National Council of Educational Research and Training. (April 2022). Mandate documents Guidelines for the development of National Curriculum Frameworks.
- National Education Policy 2020, MoE, Government of India.

- National Steering Committee for National Curriculum Frameworks, (2023). Draft National Curriculum Framework for School Education.
- NCERT, Textbooks of Biological Sciences at Secondary Stage.

*Teachers may also suggest books/readings as per the need of the learners and learning content.

4.4.5 Content cum Pedagogy of Biological Sciences at Secondary Stage – Course (II)

Credit: 2
Semester: S-5

4.4.5.1 About the Course

A wide array of teaching-learning resources is available to modern day teachers. This course comprises of three units which aims to introduce various resources and discuss their appropriate utilization in teaching. In this course, student teachers are introduced to different units and lesson plan based on learning outcomes and experiential learning. Requisite skills such as the use of print media, non-print media and digital resources are discussed in the course. This course also focuses on familiarizing student teachers in ICT integration in teaching and preparing ICT based lesson plans for online teaching using suitable tools. This course aims to prepare student teachers for teaching Biological Sciences using different dimensions pedagogical and technological aspects.

4.4.5.2 Learning Outcomes

After completion of this course, Student teachers will be able to:

- categorize different teaching learning resources and plan their appropriate usage in teaching learning of concepts of Biological Science,
- develop simple teaching learning materials using easily available/local materials,
- analyze the content of Biological Science textbooks at secondary stage,
- review various methods and strategies for teaching Biological Sciences,
- develop learning outcome-based lesson plan to promote experiential learning and higher order thinking skills,
- develop unit plans and lesson plans on different chapters in biology (Grades IX to XII).

UNIT - I

Teaching Learning Resources

A. Teaching learning aids/materials: concept, definition, role, and importance in classroom teaching learning the Biological Sciences.

B. Types of teaching learning aids/ materials: print media such as textbook, teachers' manual/ handbook, laboratory manual and other print materials, non-print and digital media such as museum, aquarium, terrarium, games, toys, radio, TV, websites, animations, audios, videos, images, simulations; Biological Sciences mobile apps, digital repository, Augmented Reality (AR), Virtual Reality (VR) and Artificial Intelligence (AI) based digital resources and Open Educational Resources (OERs) for offline/ online classroom teaching learning (reflective journals, charts, 2-d and 3-d models, games, cards, worksheets, multimedia etc.

C. Identification and use of learning resources in Biological Sciences from the local environment - using nature as a laboratory; biology laboratory - designing, management and safe practices; virtual laboratories and museums.

D. Resource room/ laboratory/ library, virtual laboratories, teaching learning kits, Biological Sciences clubs, fairs, exhibitions, science parks, zoo, botanical gardens, excursions community resources and pooling of resources.

UNIT - II

Content Analysis and Planning for Teaching Biological Sciences

A. Pedagogical analysis of content taking examples from topics of Biological Sciences textbooks at secondary stage, identification of concepts, listing learning outcomes and competencies, planning, and evaluating learning experiences in an inclusive setup.
B. Concept, types and importance of unit and lesson planning.
C. Developing unit plans and lesson plans based on learning outcomes and experiential learning by selecting topics from textbooks of Biological Sciences at secondary stage.

UNIT - III

ICT Integration and Application

A. Scope and benefits of using IT in teaching learning process; Artificial Intelligence, machine learning, smart boards.
B. Specific features and limitations of using ICT.
C. Open Educational Resources in Biological Sciences – BIOIDAC, MOOC, National Teachers Portal, DIKSHA, SWAYAM.
D. Developing ICT integrated lesson plans by taking topics of physical sciences at secondary stage using Technological Pedagogical Content Knowledge (TPCK) for classroom and online teaching.

4.4.5.3 Suggestive Practicum (Any Three)

1. Analyze the content of textbooks of Biological Sciences (Classes 9-12).
2. Develop e-content for the concepts of Biological Sciences at Secondary Stage.
3. Develop unit plans of selected chapters of Textbooks of Biological Sciences.
4. Prepare learning outcomes and experiential learning-based lesson plan for the concepts of Biological Sciences.
5. Developing ICT integrated lesson plans for offline and online classes.
6. Explore a course of Biological Sciences of MOOC and prepare a write up.
7. Any other project assigned by HEI.

4.4.5.4 Suggestive Mode of Transaction

Lecture cum discussion, demonstration, Hands-on activities, experiential learning, inquiry, Group work, Presentations, multimedia.

4.4.5.5 Suggestive Mode of Assessment

Written tests, classroom presentations, workshops, seminars, assignments, practicums, sessional and terminal semester examinations (as per UGC norms).

4.4.5.6 Suggestive Reading Material

- National Council of Educational Research and Training. (April 2022). Mandate documents Guidelines for the development of National Curriculum Frameworks.
- National Education Policy 2020, MoE, Government of India.
- National Steering Committee for National Curriculum Frameworks, (2023). Draft National Curriculum Framework for School Education.
- NCERT, Textbooks of Biological Sciences at Secondary Stage.

*Teachers may also suggest books/readings as per the need of the learners and learning content.

4.4.5 Content cum Pedagogy of Biological Sciences at Secondary Stage – Course (III)

Credit: 2
Semester: S-6

4.4.5.1 About the Course

Assessment and Evaluation are an inseparable component of teaching learning of Biological Sciences. In this course, student teachers will be exposed to various assessment practices that can be followed in assessment of Biological Sciences. The course also deals with planning action research in classroom situations. It focuses on Psychological, Sociological and Philosophical Perspective of Learning of Biological Sciences. The importance of planning science learning and teaching in secondary schools. In this course student teachers will learn how to plan different types of activities in online and offline mode. It emphasizes how to integrate and use ICT in the classroom of Biological Sciences.

4.4.5.2 Learning Outcomes

After completion of this course, Student teachers will be able to:

- appraise different types of assessment and strategies for continuous assessment,
- distinguish between assessment and evaluation,
- compare merits and demerits of different types of assessment,
- develop unit test item based on TOS and develop different type of test items,
- construct and administer the achievement test,
- familiarize with basic statistical methods for analyzing performance in tests,
- plan offline and online activity for testing higher order thinking skills,
- recognize challenges in modern day classrooms and plan appropriate strategies,
- relate ICT integration and elaborate its use in classroom situations.

UNIT - I
21st Century Skills for Learning

A. Need for and importance of how to learn 21st century skills for learners and teachers of Biological Sciences.
B. Psychological, sociological, and philosophical perspective of teaching and learning Biological Sciences.
C. Qualities of a Biological Sciences teacher as professional for enhancing teaching learning skills.
D. Role of a teacher in facilitating learning and creating dynamic learning environment of Biological Sciences.

UNIT - II
Assessment and Evaluation

A. Assessment and evaluation: concept, need for and importance of teaching learning the Biological Sciences.
B. Assessment based on learning outcomes, strategies for continuous assessment, school-based assessment, qualitative assessment; formative and summative assessment, formal, informal, and 360-degree assessment.

C. Performance assessment: assessment of group activities, field observations, recording and reporting, creating platform and portfolio management, assessment of lab skills, assignments, projects, and presentations based on the concepts of Biological Sciences.
D. Unit test based on Table of Specification (TOS) and its importance; basic steps of question paper setting of Biological Sciences, types of test items and preparing answer key and criteria for school, assessment, and feedback mechanism in teaching learning the concepts of physical science at secondary stage.

UNIT - III

Research and Innovative Practices in Biological Sciences

A. Divergent thinking and innovation in psychological, sociological, and philosophical perspectives for quality learning experiences, creating a sensitive and conducive classroom environment for learning and practicing life skills.
B. Recent trends in research related to teaching learning of Biological Sciences.
C. Action research: meaning, significance, steps, and planning.
D. Evidence-based practices and reflection, school-based research in Biological Sciences.

4.4.5.3 Suggestive Practicum (Any Three)

1. Prepare, administer, and analyze scores of an achievement test.
2. Explore AI based assessment tools and prepare an E-Portfolio for a student of Secondary Stage.
3. Identify a topic and Plan action research at secondary stage.
4. Conduct Simulated Teaching session for the concepts of Biological Sciences and observation by self, peer, and teacher.
5. Apply innovative practices in classroom teaching learning of Biological Sciences.
6. Any other project assigned by HEI.

4.4.5.4 Suggestive Mode of Transaction

Lecture cum discussion, demonstration, Hands-on activities, experiential learning, inquiry, Group work, Presentations, multimedia.

4.4.5.5 Suggestive Mode of Assessment

Written tests, classroom presentations, workshops, seminars, assignments, practicums, sessional and terminal semester examinations (as per UGC norms).

4.4.5.6 Suggestive Reading Material

- National Council of Educational Research and Training. (April 2022). Mandate documents Guidelines for the development of National Curriculum Frameworks.
- National Education Policy 2020, MoE, Government of India.
- National Steering Committee for National Curriculum Frameworks, (2023). Draft National Curriculum Framework for School Education.
- NCERT, Textbooks of Biological Sciences at Secondary Stage.

*Teachers may also suggest books/readings as per the need of the learners and learning content.

4.4.6 Content cum Pedagogy of Social Sciences at Secondary Stage - Course (I)

Credit: 2
Semester: S-4

4.4.6.1 About the Course:

The focus of the National Education Policy (NEP) 2020 is on the holistic development of students. To achieve the objectives, interventions from quality teachers are vital. Teacher education programme strongly emphasizes pedagogy, its principles, and the practices of teaching and learning. Sound pedagogical content knowledge and teaching methods are the determinants of a teacher's quality and professionalism. Pedagogical knowledge and approaches refer to the specialized knowledge of the teacher for creating an active, child-centered, and inclusive teaching-learning environment for the students and need to be developed among the student teachers. This pedagogical course in Social Sciences is intended to enhance the pedagogical content knowledge of student teachers through different learning approaches and methods. This course comprises three units and a practicum. The course is devoted to developing an understanding of the nature and scope of Social Sciences and the aims and objectives of teaching Social Sciences and its linkages with other disciplines. Historical/policy perspectives of Social Sciences are discussed in unit second. Critical, creative, and analytical pedagogical concerns in teaching Social Sciences with special reference to higher-order thinking are also placed in unit third.

4.4.6.2 Learning Outcomes

After completion of this course, student teacher will be able to:

- explain the nature and scope of Social Sciences,
- examine the pedagogical aspects of the Social Sciences,
- elaborate the aims and objectives of the Social Sciences,
- analyze the historical perspective and inherent values in Social Sciences,
- identify the importance/significance of Social Sciences in daily life,
- develop learning objectives and outcomes,
- differentiate between Social Sciences and social studies,
- determine the suitability of the methods for teaching learning Social Sciences,
- apply approaches and strategies of teaching learning Social Sciences at the secondary stage.

UNIT - I

Nature, Scope, and Historical Perspective of Social Sciences

A. Nature of Social Sciences.
B. Historical development of Social Sciences, scope, and role of Social Sciences in daily life.
C. Disciplines of Social Sciences and their interrelationship.
D. Concept of Social Sciences and Social Studies.
E. Recommendations and suggestions of various committees, commissions, and policies in reference to Social Sciences.

UNIT - II

Aims and Objectives of Teaching Social Sciences

A. Aims and objectives of teaching Social Sciences at secondary stage.
B. Learning outcomes and competencies of teaching Social Science at secondary stage.
C. Linkages of Social Sciences with other subjects and its place in school curriculum.
D. Values of Social Sciences such as intellectual, utilitarian, moral and aesthetic and environmental.

UNIT - III

Pedagogical Aspects of Social Sciences

A. Implication of various approaches- inductive deductive, constructivist, experiential learning, art-integrated learning, sports integrated learning, field visit, discovery, project methods for learning of the selected chapters/concepts in Social Sciences textbooks.
B. Moving towards more holistic, interdisciplinary, and multidisciplinary approaches of learning Social Sciences, learning exclusive of pre-conceptions and misconceptions, blended learning.
C. Methods of teaching Social Sciences: learner-centric and group-centric, activity based, discussion, problem-solving, role play, inquiry approach, problem-solving, concept mapping, collaborative & cooperative learning approach, field based experiential learning and applications of suitable methods for learning the selected chapters/concepts in Social Sciences textbooks.
D. Critical, creative and analytical pedagogical concerns in teaching the Social Sciences with special reference to higher-order thinking.

4.4.6.2.3 Suggestive Practicum (Any Three)

1. Develop write-ups on the teaching of Social Sciences using interdisciplinary and multidisciplinary approaches as suggested in NEP 2020.
2. Develop learning objectives and learning outcomes for the concepts of Social Sciences at the secondary stage.
3. Design an excursion activity to transact concepts of Social Sciences.
4. Prepare a detailed project on the curricular integration of skills, capacities, and values in Social Sciences.
5. Demonstrate different pedagogical approaches and strategies for transacting concepts of Social Sciences
6. Analyze the different recommendations of policies/commissions in context to Social Sciences.
7. Any other project assigned by HEI.

4.4.6.4 Mode of Transactions

Lectures with discussion, Hands-on activities, project approach, problem-solving, concept mapping, collaborative & cooperative approach, experiential learning, and toy/art/sports integrated learning.

4.4.6.5 Suggestive Mode of Assessment

Written tests, classroom presentations, workshops, seminars, assignments, practicums, sessional and terminal semester examinations (as per UGC norms).

4.4.6.6 Suggestive Reading Material:

- NCERT Textbooks of Social Sciences for Classes IX - XII
- Epistemology of Social Sciences, the scientific status, values and Institutionalisation, Vol. XXXVI, UNESCO publications, (1984)
- National Policy on Education 1968, 1986 and 2020.

*Teachers may also suggest books/readings as per the need of the learners and learning content.

4.4.6 Content cum Pedagogy of Social Sciences at Secondary Stage - Course (II)

Credit: 2
Semester: S-5

4.4.6.1 About the Course:

This course comprises three units and the practicum. The course is devoted to introducing various teaching aids material types and uses for teaching the concepts of Social Sciences at secondary stage. Enough space is provided to discuss different types of teaching aids/materials for teaching learning concepts of Social Sciences. It focuses on learning resources in Social Sciences to enable student teachers to make use of available learning resources and also process to generate new resources for teaching learning the concepts of Social Sciences. It also focuses on textbook analysis and planning for teaching Social Sciences and its pedagogical issues in the light of NEP 2020. Student teachers are expected to identify various concepts and processes, list learning outcomes, find out about various activities. Accordingly, they are expected to develop lesson plan based on learning outcomes and experiential learning for classroom and online teaching. Pedagogy must evolve to make education more experiential, holistic, integrated, inquiry-driven, discovery-oriented, learner-centered, discussion-based, flexible, and enjoyable. This pedagogical course of Social Sciences enhances the pedagogical knowledge and skills of prospective teachers through different learning approaches. Student teachers are expected to identify various concepts and processes, list learning and behavioral outcomes, find out about various activities and experiments, and identify relevant evaluation techniques and strategies. It focuses on psychological, sociological and philosophical perspective of Social Sciences. In this course student teachers will learn how to plan different types of activities in online and offline mode. It emphasizes on how to integrate and use ICT in Social Sciences' classroom.

4.4.6.2 Learning Outcomes

After completion of this course, student teacher will be able to:

- utilize online and other resources in the teaching-learning process of Social Sciences,
- prepare lesson plans based on learning outcomes,
- identify learning resources from the local environment and apply the concepts of Social Sciences in daily life,
- utilize teaching learning resources effectively in teaching Social Sciences content at the secondary stage,
- prepare ICT integrated lesson plans for online classroom teaching using digital resources and multimedia.

UNIT - I

Teaching Learning Resources

A. Teaching learning aids/materials: concept, definition, role, and importance in classroom teaching learning Social Sciences.
B. Types of teaching learning aids/ materials: print media such as textbook, teachers' manual/ handbook and other print materials, non-print and digital media such as radio, TV, websites, animations, audios, videos, images, simulations, digital repository, Augmented Reality (AR), Virtual Reality (VR) and Artificial Intelligence (AI) based digital resources and Open Educational Resources (OERs) for offline/ online classroom

teaching learning (reflective journals, charts, 2-D and 3-D models, games, toys, flash cards, worksheets, multimedia etc.)

C. Identification and use of learning resources in Social Sciences from the local environment
D. Social Sciences projects, clubs, fairs, exhibitions and visits places of historical and geographical importance, Social Sciences laboratory and museum as a learning resource including virtual laboratories, community resources and pooling of learning resources.

UNIT - II

Content Analysis and Planning for Teaching Social Sciences

A. Concept, types and importance of unit and lesson planning.
B. Pedagogical analysis of content taking examples from topics of subject textbooks of secondary stage, identification of concepts, listing learning outcomes and competencies, planning and evaluating learning experiences in an inclusive setup.
C. Developing unit plans and lesson plans based on learning outcomes and experiential learning (art and sports integration) of Social Sciences.
D. Need for enrichment of content knowledge in Social Sciences.

UNIT - III

ICT Integration and Application

A. Scope and importance of using ICT in learning process of Social Sciences.
B. Use of ICT in the classroom: Artificial Intelligence, machine learning, smart boards for student development.
C. Tools, software, and platform for teaching learning of Social Science at secondary stage.
D. Developing ICT integrated lesson plans using Technological Pedagogical Content Knowledge (TPCK) for classroom and online teaching using digital resources and multimedia.

4.4.6.3 Suggestive Practicum (Any Three)

1. Prepare one working model/toy/game on the concepts of Social Sciences.
2. Create an e-content on any two concepts of Social Sciences at secondary stage.
3. Prepare a lesson plan keeping in view blended learning approach for the concepts. of Social Sciences followed by presentation in the class.
4. Select a topic for teaching learning of Social Science and develop a write up (name of unit, name of theme/topic, learning outcomes, material used and procedure).
5. Identify and use learning resources from the surroundings in Social Sciences and write a detailed report.
6. Prepare lesson plans based on learning outcomes and experiential learning by selecting two topics from the Social Sciences textbooks at secondary stage.
7. Any other project assigned by HEI.

4.4.6.4 Suggestive Mode of Transaction

Lectures, hands-on activities, discovery approach, project approach, inquiry approach, experimentation, problem-solving, concept mapping, collaborative & co-operative approach, experiential learning, art integrated learning, sport integrated learning.

4.4.6.5 Suggestive Mode of Assessment

Written tests, classroom presentations, workshops, seminars, assignments, practicums, sessional

and terminal semester examinations (as per UGC norms).

4.4.6.6 Suggestive Reading Material

- *National Policy on Education, 1968, 1986 and 2020*
- NCERT (2023) *National Curriculum Framework of School Education (Draft)*
- NCTE (2009) National *Curriculum Framework for Teacher Education: Towards Preparing Professional and Humane Teacher*. NCTE, New Delhi.
- UNESCO, (1984) Epistemology of Social Science, the Scientific Status, Values and Institutionalization, Vol. XXXVI, UNESCO Publications.

*Teachers may also suggest books/readings as per the need of the learners and learning content.

4.4.6 Content cum Pedagogy of Social Sciences at Secondary Stage - Course (III)

Credit: 2
Semester: S-6

4.4.6.1 About the Course:

This course focuses on the need and scope to know how to learn the concepts of Social Science. They will also understand the role of a teacher as facilitator. They will reconcile themselves as per National Professional Standards for Teachers (NPST) and National Mentoring Mission (NMM). The teacher will enable the students to understand the importance of continuous professional development to meet the current challenges. The students will get motivated to participate in professional development activities to develop 21st century skills to deal with various issues. They will also understand action research and will be able to conduct it for the improvement of Social Science practices. They will develop leadership attributes to lead for a good cause keeping in view Indian values and ethos. This course focuses on how to learn Social Science along with psychological, sociological, and philosophical perspective. It also emphasizes innovative practices to enhance effective communication to be a dynamic and innovative Social Science teacher. Therefore, the course highlights the need and significance of continuous professional development of a teacher to meet the current and forthcoming challenges. Assessment serves the dual purpose of tracking the performance of the learners as well as feedback mechanism for effectiveness of teaching. National Education Policy (NEP) 2020 emphasizes on the formative assessment, which is more competency based, promotes learning and holistic development of the students, and tests higher order skills such as analysis, critical thinking and conceptual clarity. It also focuses on assessment based on learning outcomes, strategies for continuous assessment, school-based assessment, formative and summative assessment including 360◦ assessment. This pedagogical course of Social Sciences aims to provide details about the concepts of assessment and evaluation, tools and techniques of assessment in Social Sciences.

4.4.6.2 Learning Outcomes

After completion of this course, student teacher will be able to:

- discuss the meaning and need of how to learn the concepts of Social Science,
- identify the role of teacher in facilitating learning for Social Science,
- enumerate the characteristics of innovative practices in teaching-learning process of Social Science,
- plan action research to improve practices of Social Science,
- compare and apply the different types/modes of assessment,
- develop the learning indicators and construct test items to measure learning achievement,
- construct and administer achievement test,
- apply tools and techniques of assessment in teaching learning process.

UNIT - I
21st Century Skills for Learning

A. Need for and importance of how to learn 21st century skills for learners and teachers of Social Sciences.

B. Psychological, sociological, and philosophical perspective of teaching and learning Social Sciences.
C. Qualities of a Social Sciences teacher as professional for enhancing teaching learning skills.
D. Role of a teacher in facilitating learning and creating dynamic learning environment of Social Science.

UNIT - II

Assessment and Evaluation

A. Assessment and evaluation: need for and importance of Social Sciences.
B. Development of learning indicators, performance-based assessment, learners' records of observations.
C. Strategies for continuous assessment, school-based assessment, formative and summative assessment, formal, informal and 360o assessment.
D. Performance assessment: assessment of group activities, field observations, recording and reporting, creating platform and portfolio management, assessment of lab skills, assignments, projects, and presentations.
E. Tools and techniques of assessment and evaluation; unit test based on Table of Specification (TOS) and its importance; basic steps of question paper setting, types of test items and preparing answer key and criteria for school, assessment, and feedback mechanism in teaching learning of Social Sciences.

UNIT - III

Research and Innovative Practices in Teaching Social Sciences

A. Divergent thinking and innovation in psychological, sociological, and philosophical perspectives for quality learning experiences.
B. Recent trends in research related to teaching learning of Social Sciences.
C. Action research: meaning, significance, steps and planning.
D. Evidence-based practices and reflection, school-based research in Social Sciences.

4.4.6.3 Suggestive Practicum (Any Three)

1. Prepare, administer, and analyze scores of an achievement test.
2. Explore AI based assessment tools and prepare an E-Portfolio of a student of Secondary Stage.
3. Explore development of multidisciplinary projects and present using PowerPoint in Social Sciences.
4. Apply innovative practices in classroom teaching learning of Social Sciences.
5. Plan action research for Continuous Professional Development (CPD) of Social Sciences teacher.
6. Pilot new ways of assessment using educational technologies focusing on 21st century skills.
7. Organize a field trip and write a detailed report evaluating the learning processes.
8. Any other project assigned by HEI.

4.4.6.4 Suggestive Mode of Transaction

Lectures cum discussion, observation, project approach, field based, inquiry approach,

experimentation, problem-solving, concept mapping, collaborative & co-operative approach, experiential learning.

4.4.6.5 Suggestive Mode of Assessment

Written tests, classroom presentations, workshops, seminars, assignments, practicums, sessional and terminal semester examinations (as per UGC norms).

4.4.6.6 Suggested Reading Material

- National Policy on Education, 1968, 1986 and 2020
- NCERT (2023) National Curriculum Framework of School Education (Draft)
- NCTE (2009) National Curriculum Framework for Teacher Education: Towards Preparing Professional and Humane Teacher. NCTE, New Delhi.
- UNESCO, (1984) Epistemology of Social Science, the Scientific Status, Values and Institutionalization, Vol. XXXVI, UNESCO Publications.

*Teachers may also suggest books/readings as per the need of the learners and learning content.

4.4.7 Content cum Pedagogy of Commerce at Secondary Stage - Course (I)

Credit: 2
Semester: S-4

4.4.7.1 About the Course:

Commerce is an important school subject and students are expected to master knowledge and skills related to business, accounts, Finance, and allied areas during study. Commerce subject deals with economic issues and concerns of a society thus this course focuses on the real-life situations and primary sources of information so that the student-teachers can grasp concepts and develop thinking skills. 'Teaching of Commerce' at school level has a great relevance to acquaint prospective schoolteachers with various pedagogical aspects and interventions in commerce. This course encompasses three units focusses on the scope of Commerce (Business studies and accountancy) and allied subjects and the purpose of teaching Commerce in schools, nature, scope and importance of Commerce teaching, its historical perspective. The course emphasizes the aims, objectives and learning outcomes of teaching Commerce at the secondary level.

4.4.7.2 Learning Outcomes

After completion of this course, student teachers will be able to:

- discuss contribution of Indian (ancient and modern) and other expert in development of commerce,
- explain the nature and scope of Commerce as an important subject for civil society,
- interpret the recommendation of the various policy documents about Commerce education,
- outline linkages between Commerce and other subjects,
- classify the aims and objectives of teaching commerce,
- examine pedagogical concerns of Commerce,
- demonstrate various approaches and methods of teaching commerce,
- apply proper pedagogy in teaching learning the concepts of Commerce,
- plan strategies to inculcate values through teaching of Commerce.

UNIT - I
Nature, Scope, and Historical Perspective of Commerce

A. Nature, scope, and importance of Commerce as a school subject.
B. Historical perspective of development of Commerce as a subject.
C. Contributions of Indian (ancient and modern) and other experts.
D. Commerce, society and human and sustainable development.
E. Recommendations and suggestions of various committees, commissions, and policies in reference to Commerce education.

UNIT - II
Aims and Objectives of Teaching Commerce

A. Aims and objectives of teaching Commerce at secondary stage.
B. Learning outcomes and competencies of teaching Commerce at secondary stage.

C. interrelationships within Commerce and allied subject knowledge (accountancy, business studies, management, finance, economics)
D. Linkages of Commerce with other disciplines and place of Commerce in school curriculum.
E. Inculcation of values through teaching of commerce.

UNIT - III

Pedagogical Aspects of Commerce

A. Implication of various approaches- inductive deductive, constructivist, art integrated learning, sports integrated learning, blended learning, interdisciplinary and multidisciplinary approaches in commerce.
B. Analytical pedagogical concerns in teaching of Commerce for higher order thinking skills such as critical, creative, communication, decision making, reflective.
C. Methods of teaching learning commerce: learner-centric and participative, demonstration, case study, discussion, problem-solving, laboratory, project based, scientific inquiry, discovery, experimentation, concept-mapping, seminar, collaborative and cooperative learning.
D. Experiential learning in Commerce – industry trips, real field experiences, dalton method, simulations, role play.

4.4.7.3 Suggestive Practicum (Any Three)

1. Participate in the discussion (class level) on any recent development in the field of Commerce and prepare a report.
2. Make a report on activities performed by any one company regarding its social responsibility.
3. Prepare learning outcomes for any two units of Commerce at secondary stage.
4. Explore contributions of Indian experts in the development of Commerce and make presentations on historical development of commerce.
5. Analyze recommendations of policies/commissions in context to commerce.
6. Develop Concept maps on different topics of commerce.
7. Demonstrate different pedagogical approaches and strategies for transacting concepts of commerce.
8. Prepare write-ups on the teaching of Commerce using interdisciplinary and multidisciplinary approaches as recommended in NEP 2020.
9. Any other project assigned by HEI.

4.4.7.4 Suggestive Mode of Transaction

Lecture cum discussion/demonstration, hands-on activities, experiential learning, art and environment integrated learning, sports integrated learning.

4.4.7.5 Suggestive Mode of Assessment

Written tests, classroom presentations, workshops, seminars, assignments, practicums, sessional and terminal semester examinations (as per UGC norms).

4.4.7.6 Suggestive Reading Material

- National Education Policy 2020, MoE, Government of India
- National Steering Committee for National Curriculum Frameworks, (2023).
- Draft National Curriculum Framework for School Education,
- NCERT Textbooks, Business Studies for Class XI and XII
- NCERT Textbooks, Accountancy for Class XI and XII

*Teachers may also suggest books/readings as per the need of the learners and learning content.

4.4.7 Content cum Pedagogy of Commerce at Secondary Stage - Course (II)

Credit: 2
Semester: S-5

4.4.7.1 About the Course:

This course comprises three units and the practicum. The course is devoted to introducing various teaching aids material types and uses for teaching the concepts of Commerce at secondary stage. This course discusses different types of teaching aids/materials for teaching learning concepts of Commerce. It emphasizes learning resources in Commerce to enable student teachers to make use of available learning resources and how to generate new resources for teaching learning the concepts of Commerce. It also focuses on textbook analysis and planning for teaching Commerce. and its pedagogical issues in the light of NEP 2020. Student teachers are expected to identify various concepts and processes, list learning and outcomes, find out about various activities and experiments. Accordingly, they are expected to develop lesson plans based on learning outcomes and experiential learning for classroom and online teaching.

4.4.7.2 Learning Outcomes

After completion of this course, student teachers will be able to:

- identify teaching learning aids / materials and illustrate their importance in teaching learning the concepts of Commerce,
- categorize teaching aids/materials/learning resources,
- develop teaching learning aids/material/kits/learning resources for teaching learning the concepts of Commerce,
- utilize teaching aids/materials/learning resources for teaching learning the concepts of commerce,
- analyze the content of Commerce textbooks at secondary stage,
- develop lesson plan based on learning outcomes and experiential learning using appropriate strategies.

UNIT - I
Teaching Learning Resources

A. Teaching learning aids/materials: concept, definition, role, and importance in classroom teaching learning the commerce.
B. Types of teaching learning aids/ materials: print media (such as textbook, teachers' manual/ handbook, laboratory manual and other print materials.), non-print and digital media (such as radio, TV, websites, animations, audios, videos, images, simulations, digital repository, Augmented Reality (AR), Virtual Reality (VR) and Artificial Intelligence (AI) based digital resources and Open Educational Resources OERs) for offline/ online classroom teaching learning (reflective journals, charts, 2-D and 3-D models, games, cards, worksheets, multimedia etc.)
C. Identification and use of learning resources in Commerce from the local environment.
D. Resource room/ laboratory/ library, virtual laboratories, teaching learning kits, Commerce clubs, fairs, exhibitions, excursions, community resources and pooling of resources.

UNIT - II

Content Analysis and Planning for Teaching Commerce

A. Pedagogical analysis of content taking examples from topics of Commerce textbooks of secondary stage, identification of concepts, listing learning outcomes and competencies, planning, and evaluating learning experiences in an inclusive setup.
B. Concept, types and importance of unit and lesson planning.
C. Developing unit plans and lesson plans based on learning outcomes and experiential learning by selecting topics from textbooks of Commerce at secondary stage.

UNIT - III

ICT Integration and Application

A. Scope and importance of ICT in commerce.
B. Use of ICT (such as Artificial Intelligence, machine learning, smart boards) in teaching learning, assessment and resource management.
C. Tools, software, and platforms for Commerce specific online learning, e-commerce, m-commerce.
D. Developing ICT integrated lesson plans by taking topics of Commerce at secondary stage using Technological Pedagogical Content Knowledge (TPCK) for classroom and online teaching.

4.4.7.3 Suggestive Practicum (Any Three)

1. Develop e-content for the concepts of Commerce at Secondary Stage.
2. Analyze the content of textbooks of Commerce.
3. Identify the learning resources for transiting the concepts of Commerce.
4. Develop teaching aids/teaching materials for teaching concepts of Commerce at secondary stage.
5. Prepare learning outcomes and experiential learning-based lesson plan for the concepts of Commerce.
6. Develop a project on the concepts of Commerce using interdisciplinary and multidisciplinary approaches as recommended in NEP 2020.
7. Any other project assigned by HEI.

4.4.7.4 Suggestive Mode of Transaction

Lecture cum discussion/demonstration, hands-on activities, demonstration, discovery approach, project approach, inquiry approach, experimentation, problem-solving, concept mapping, experiential learning and ICT integrated approach, Flip classroom, Use of digital platform.

4.4.7.5 Suggestive Mode of Assessment

Written test, classroom presentations, workshops, seminars, assignments, practicums, sessional and terminal semester examinations (as per UGC norms).

4.4.7.6 Suggestive Reading Material

- Draft National Curriculum Framework for School Education,
- National Education Policy 2020, MoE, Government of India
- National Steering Committee for National Curriculum Frameworks, (2023).
- NCERT Textbooks, Accountancy for Class XI and XII
- NCERT Textbooks, Business Studies for Class XI and XII

*Teachers may also suggest books/readings as per the need of the learners and learning content.

4.4.7 Content cum Pedagogy of Commerce at Secondary Stage - Course (III)

Credit: 2
Semester: S-6

4.4.7.1 About the Course:

The 21st century skills are the major concerns for a progressive society. Development of 21st century skills are important for a Commerce teacher and learner. This course comprises three units and a practicum. The first unit emphasizes professional and skill development of the teachers of the Commerce. The second unit focuses on assessment and evaluation. It also focuses on assessment based on learning outcomes, strategies for continuous assessment, school-based 360◦ assessment. Student teachers are expected to identify various concepts and processes, list learning and behavioral outcomes, find out about various activities and experiments, and identify relevant evaluation techniques and strategies. It focuses on Psychological, Sociological and Philosophical Perspective of Activity Oriented Classrooms in Commerce. In this course student teachers will learn how to plan different types of activities in online and offline mode. It emphasizes how to integrate and use ICT in the classroom of Commerce. Assessment serves the dual purpose of tracking the performance of the learners as well as feedback mechanism for effectiveness of teaching. The course describes various evaluation strategies and devices which can be efficiently used in the teaching of Commerce and in the development of skills among the student teachers for improving student outcomes, conduct action research and school-based research in the teaching of Commerce.

4.4.7.2 Learning Outcomes

After completion of this course, student teachers will be able to:

- appraise different types of assessment and strategies for continuous assessment,
- compare merits and demerits of different types of assessment in Commerce,
- prepare unit test item based on TOS and develop different type of test items,
- construct and administer the diagnostic and achievement test,
- plan offline and online activity for testing higher order thinking skills,
- analyze NEP 2020 with special reference to activity-oriented classrooms,
- relate ICT integration and elaborate its use in classroom situations.

UNIT - I

21st Century Skills for Learning

A. Need for and importance of how to learn 21st century skills for learners and teachers of Commerce.
B. Psychological, sociological, and philosophical perspective of teaching and learning Commerce.
C. Qualities of a Commerce teacher as professional in enhancing learning.
D. Role of a teacher in facilitating learning and creating dynamic learning environment of Commerce.

UNIT - II
Assessment and Evaluation

A. Assessment and evaluation: need for and importance of Commerce.
B. Assessment based on learning outcomes, strategies for continuous assessment, school-based assessment, qualitative assessment; formative and summative assessment, formal, informal and 360◦ assessment.
C. Performance assessment: assessment of group activities, field observations, recording and reporting, creating platform and portfolio management, assessment of laboratory skills, assignments, projects, and presentations.
D. Tools and techniques of assessment and evaluation - unit test based on Table of Specification (TOS) and its importance, basic steps of question paper setting, types of test items and preparing answer key and criteria for school, assessment, and feedback mechanism in teaching learning the content of Commerce.

UNIT - III
Research and Innovative Practices

A. Divergent thinking and innovation in psychological, sociological, and philosophical perspectives for quality learning experiences.
B. Recent trends in research related to teaching learning of Commerce.
C. Action research for improvement in the learning of Commerce: meaning, significance, steps and planning.
D. Evidence-based practices and reflection, school-based research in Commerce.

4.4.7.3 Suggestive Practicum (Any Three)

- Prepare, administer, and analyze scores of an achievement test.
- Explore AI based assessment tools and prepare an E-Portfolio for a student of Secondary Stage.
- Conduct Simulated Teaching session for the concepts of Commerce and observation by self, peer, and teacher.
- Explore development of multidisciplinary projects and present using PowerPoint.
- Interpret the concept of Commerce with Psychological, Sociological and Philosophical Perspective.
- Apply innovative practices in classroom teaching learning of Commerce.
- Make a presentation on the role of Commerce in sustainable development of society.
- Conduct action research for Continuous Professional Development (CPD) of Commerce teacher.

4.4.7.4 Suggestive Mode of Transaction

Lecture cum discussion/demonstration, demonstration, discovery approach, project approach, inquiry approach, problem-solving, experiential learning.

4.4.7.5 Suggestive Mode of Assessment

Written test, classroom presentations, workshops, seminars, assignments, practicums, sessional and terminal semester examinations (as per UGC norms).

4.4.7.6 Suggestive Reading Material

- National Council of Educational Research and Training. (April 2022). Mandate documents Guidelines for the development of National Curriculum Frameworks.
- National Education Policy 2020, MoE, Government of India
- National Steering Committee for National Curriculum Frameworks, (2023). Draft National Curriculum Framework for School Education.

*Teachers may also suggest books/readings as per the need of the learners and learning content.

4.4.8 Content cum Pedagogy of Computer Science at Secondary Stage - Course (I)

Credit: 2
Semester: S-4

4.4.8.1 About the Course

Computer Science is a rapidly evolving discipline that lies at the core of the modern technological era. It is the study of algorithms, data structures, and the principles of computation, encompassing a wide range of topics related to computing and information technology. As a discipline, it blends theory and practice, fostering innovation and problem-solving in diverse fields. This course on the pedagogy of Computer Science comprises of three units and a practicum. It aims to provide student teachers with a comprehensive understanding of the Computer Science discipline's nature, historical context, evolving trends, and its correlation with other school subjects. It focuses on defining the aims and objectives of teaching Computer Science, along with the development of learning outcomes and competencies for student teachers. The course also explores different pedagogical approaches and teaching methods to foster higher-order thinking skills and prepare student teachers for the practical, social, disciplinary, and cultural aspects of Computer Science. By the end of the course, student teachers will be equipped with effective strategies to engage learners and facilitate their learning in the field of Computer Science.

4.4.8.2 Learning Outcomes

After completion of this course, student teachers will be able to:

- identify the nature, scope, and Importance of Computer Science,
- explain aims and objectives of teaching Computer Science,
- recognize the multidisciplinary nature of Computer Science and its linkages with other school subject,
- summarize the historical and policy perspective of Computer Science,
- demonstrate the practical, social, disciplinary, and cultural values of teaching learning Computer Science,
- discuss the policy recommendations and suggestions in regard to Computer Science,
- examine the implications of different pedagogical approaches of teaching Computer Science,
- analyze different methods of teaching Computer Science.

UNIT - I

Nature, Scope and Historical Perspective of Computer Science

A. Nature, scope and importance of Computer Science.
B. Historical perspective of Computer Science.
C. Computer Science as an evolving discipline.
D. Recommendations/suggestions of various committees, commissions, and policies in reference to Computer Science.

UNIT - II

Aims and Objectives of Teaching Computer Science

A. Aims and objectives of teaching Computer Science.
B. Learning outcomes and competencies of teaching Computer Science at secondary stage.
C. Linkages of Computer Science with other school subjects and its place in school curriculum.
D. Values of teaching Computer Science: practical, social, disciplinary, and cultural values.

UNIT - III

Pedagogical Aspects of Computer Science

A. Implication of various approaches - inductive deductive, constructivist, experiential learning, computer/ web supported pedagogical approaches such as personalized adaptive learning and Computer Managed Learning (CML), multimedia approach, interdisciplinary and multidisciplinary approaches in Computer Science.
B. Analytical pedagogical aspects in teaching of Computer Science for higher order thinking skills such as critical, creative, communication, decision making and reflective.
C. Methods of teaching the Computer Science: learner-centric and group-centric, lecture cum demonstration, problem-solving, laboratory, and project based, analytic and synthetic, flipped classrooms, Computer Assisted Instructions (CAI), mobile learning and online learning.

4.4.8.3 Suggestive Practicum (Any Three)

1. Analyze recommendations of policies/commissions in context to Computer Sciences.
2. Prepare a write-up on any two topics of Computer Science regarding their learning outcomes and competencies at Secondary Stage.
3. Create an interactive multimedia presentation, including videos, animations, and simulations, to explain complex Computer Science concepts.
4. Prepare a report on interdisciplinary and multidisciplinary approaches used in the practices of Computer Sciences.
5. Identify the challenges and benefits of implementing CAI in educational settings and prepare a report.
6. Identify and integrate values in Computer Science concepts and prepare a PowerPoint presentation.
7. Any other project assigned by HEI.

4.4.8.4 Suggestive Mode of Transaction

Lecture cum demonstration method, discussion method, laboratory method, project method, inquiry approach, problem solving, experiential learning approach, flipped classrooms, mobile apps and interactive methods such as group discussions, peer tutoring, workshops, observations and presentations.

4.4.8.5 Suggestive Mode of Assessment

Seminars, demo lessons, case studies, practical tasks, hands-on activities in laboratories, written tests, classroom presentations, workshops, assignments, practicums, sessional and terminal semester examinations (as per UGC norms).

4.4.8.6 Suggestive Reading Materials:

- National Council of Educational Research and Training. (April 2022). Mandate documents Guidelines for the development of National Curriculum Frameworks.
- National Education Policy 2020, MoE, Government of India
- National Steering Committee for National Curriculum Frameworks, (2023). Draft National Curriculum Framework for School Education.
- NCERT (2019). Computer Science: Textbook for class XI – XII.
- NCERT (2019). Information and Communication Technology: A Textbook for Class IX - X.

*Teachers may also suggest books/readings as per the need of the learners and learning content.

4.4.8 Content cum Pedagogy of Computer Science at Secondary Stage - Course (II)

Credit: 2
Semester: S-5

4.4.8.1 About the Course

This course aims to equip student teachers with the necessary knowledge and skills to effectively teach Computer Science at the secondary stage. The course comprises of three units and a practicum. The course focuses on various teaching-learning resources, content analysis and planning, as well as the integration of Information and Communication Technology (ICT) to enhance the teaching-learning experience. The primary objective is to create a dynamic and inclusive learning environment that enables learners to grasp fundamental concepts in Computer Science while keeping up with the rapid advancements in technology. Furthermore, the course will explore the significance and organization of Computer Science laboratories and libraries, as well as the integration of social media platforms as valuable teaching-learning resources. Student teachers will learn how to identify core concepts, list learning outcomes and competencies, and effectively plan and evaluate inclusive learning experiences. Student teachers will also gain insights into educational software, mobile apps, and websites specifically designed for Computer Science education at the secondary stage. The course also emphasizes the development of ICT-integrated lesson plans using Technological Pedagogical Content Knowledge (TPCK) for both traditional classroom settings and online teaching.

4.4.8.2 Learning Outcomes

After completion of this course, student teachers will be able to:

- identify various types of teaching learning aids/materials and illustrate their importance in teaching of Computer Science,
- analysis the content of Computer Science textbooks at secondary stage,
- develop lesson plans based on specified learning outcomes,
- assess the potential of social media platforms as teaching learning resources in the context of teaching of Computer Science,
- utilize virtual laboratories, Computer Science clubs, fairs, exhibitions, excursions, community resources, and pooling of resources effectively to enhance Computer Science learning experience,
- explore and categorize educational software, mobile apps and websites catering to Computer Science topics for secondary stage learners,
- apply the concept of Technological Pedagogical Content Knowledge (TPCK) to create ICT-integrated lesson plans for effective implementation in online teaching learning environments.

UNIT - I

Teaching Learning Resources

A. Teaching learning aids/materials: concept, definition, role, and importance in teaching learning of Computer Science.
B. Types of teaching learning aids/ materials: print media such as textbook, teachers' manual/ handbook, laboratory manual, worksheets and other print materials, non-print and digital media such as charts, 2-D and 3-D models, radio, TV, websites, multimedia (animations, audios, videos, images, digital text), simulations, digital repository,

Augmented Reality (AR), Virtual Reality (VR) and Artificial Intelligence (AI) based digital resources and Open Educational Resources (OERs) for offline/ online teaching learning of Computer Science.

C. Identification and use of learning resources in Computer Science from the local environment.

D. Resource rooms, Computer Science laboratory – layout, management, and practices; Computer Science library – importance and its organization; social media as teaching learning resources, virtual laboratories and e-library, Computer Science clubs, fairs, exhibitions, excursions, community resources and pooling of resources.

UNIT - II

Content Analysis and Planning for Teaching Computer Science

A. Pedagogical analysis of content taking examples from topics of Computer Science textbooks at secondary stage, identification of concepts, listing learning outcomes and competencies, planning and evaluating learning experiences in an inclusive setup.

B. Concept, types and importance of unit planning and lesson planning.

C. Developing unit plans and lesson plans based on learning outcomes and experiential learning by selecting topics from textbooks of Computer Science at secondary stage.

UNIT - III

ICT Integration and Applications

A. Scope and importance of ICT in Computer Science.

B. Use of ICT such as Artificial Intelligence, machine learning, smart boards in the teaching learning, assessment process and resource management of Computer Science.

C. Tools, software, and platform for teaching learning of Computer Science at secondary stage,

D. Developing ICT integrated lesson plans using Technological Pedagogical Content Knowledge (TPCK) for classroom and online teaching.

4.4.8.3 Suggestive Practicum (Any Three)

1. Explore different learning resources inside and outside the school and document the findings.
2. Collaborate with local Computer Science clubs, fairs, exhibitions, and consolidate outcomes in the form of a report.
3. Critically analyze two chapters of Computer Science textbooks at secondary stage.
4. Develop an e-Content on any one topic from Computer Science textbook at secondary stage.
5. Develop an outcome-based lesson plan on a topic of Computer Science at secondary stage by integrating ICT tools.
6. Plan judicious use of technology in inclusive classrooms and prepare a PowerPoint presentation.
7. Any other project assigned by HEI.

4.4.8.4 Suggestive Mode of Transaction

Lecture cum demonstration method, discussion method, laboratory method, project method, inquiry approach, problem solving, experiential learning approach, flipped classrooms, mobile

apps, and interactive methods such as group discussions, peer tutoring, workshops, observations and presentations.

4.4.8.5 Suggestive Mode of Assessment

Seminars, demo lessons, case studies, practical tasks, hands-on activities in laboratories, written tests, classroom presentations, workshops, assignments, practicums, sessional and terminal semester examinations (as per UGC norms).

4.4.8.6 Suggestive Reading Materials

- National Council of Educational Research and Training. (April 2022). Mandate documents Guidelines for the development of National Curriculum Frameworks.
- National Education Policy 2020, MoE, Government of India
- National Steering Committee for National Curriculum Frameworks, (2023). Draft National Curriculum Framework for School Education.
- NCERT (2019). Computer Science: Textbook for class XI – XII.
- NCERT (2019). Information and Communication Technology: A Textbook for Class IX - X.

*Teachers may also suggest books/readings as per the need of the learners and learning content.

4.4.8 Content cum Pedagogy of Computer Science at Secondary Stage - Course (III)

Credit: 2
Semester: S-6

4.4.8.1 About the Course

This course comprises of three units and a practicum. It lays the foundation of research by focusing on the significance of 21st-century skills in the context of teaching learning of Computer Science. It explores the essential skills that student teachers need to acquire and apply in the ever-evolving technological landscape. The course examines the psychological, sociological, and philosophical perspectives that influence teaching and learning Computer Science. Moreover, it identifies the qualities of a competitive Computer Science teacher, emphasizing their role in enhancing the learning experience. In this course, student teachers will recognize how assessment plays a crucial role in ascertaining learners' understanding and progress. The course will emphasis on fostering innovation and research in the teaching of Computer Science. Student Teachers will explore the concept of divergent thinking and its application in constructing quality learning experiences in teaching and learning of Computer Science. They will also review recent trends and research findings related to teaching and learning in the field of Computer Science. The course will introduce the concept of action research and school-based research to student teachers, and they will explore evidence-based practices and the importance of reflective practices in improving teaching methodologies.

4.4.8.2 Learning Outcomes

After completion of this course, student teachers will be able to:

- explain the significance of acquiring 21st-century skills for Computer Science teaching,
- outline the need for and importance of assessment and evaluation in the teaching of Computer Science,
- appraise with various assessment strategies for continuous assessment in reference to teaching of Computer Science,
- utilize appropriate tools and techniques for assessment and evaluation in teaching learning of Computer Science,
- identify recent trends in research related to the teaching and learning and its implications in teaching learning of Computer Science,
- prepare unit test item based on TOSS and develop different types of test items,
- construct and administer different type of tests,
- plan offline and online activities for testing higher order thinking skills in teaching learning of Computer Science,
- relate ICT integration and elaborate its use in classroom situations,
- identify a problem in the context of Computer Science teaching learning and plan action research.

UNIT - I
21st Century Skills for Learning

A. Need for and importance of how to learn 21st century skills for learners and teachers of Computer Science.
B. Psychological, sociological, and philosophical perspective of teaching and learning Computer Science.
C. Qualities of a Computer Science teacher as professional for enhancing teaching learning skills.
D. Role of a teacher in facilitating learning and creating dynamic learning environment of Computer Science.

UNIT - II
Assessment and Evaluation

A. Assessment and evaluation: need for and importance of Computer Science
B. Assessment based on learning outcomes, strategies for continuous assessment, school-based assessment, formative and summative assessment, formal, informal and 360° assessment.
C. Performance assessment: assessment of group activities, field observations, recording and reporting, creating platform and portfolio management, assessment of lab skills, assignments, projects, and presentations.
D. Tools and techniques of assessment and evaluation; unit test based on Table of Specification (TOS) and its importance; basic steps of question paper setting, types of test items and preparing answer key and criteria for school, assessment, and feedback mechanism in teaching learning of Computer Science.

UNIT - III
Research and Innovative Practices in Teaching of Computer Science

A. Divergent thinking and innovation in psychological, sociological, and philosophical perspectives for quality learning experiences in teaching of Computer Science.
B. Recent trends in research related to teaching learning of Computer Science.
C. Action research: meaning, significance, steps, and planning.
D. Evidence-based practices and reflection, school-based research in Computer Science.

4.4.8.3 Suggestive Practicum (Any Three)

1. Prepare, administer, and analyze the scores of an achievement test.
2. Prepare an assessment tool on any one topic at Secondary Stage using E-Resources.
3. Take a real-life case study where Computer Science played a vital role in solving problems and analyze its impact in such scenario and present your findings as a report.
4. Analyze the ethical dilemmas related to Computer Science, such as data privacy, AI ethics and cyber security concerns. Reflect on the broader societal impact of these issues and prepare a PowerPoint presentation.
5. Apply innovative practices in classroom teaching learning of Computer Science and prepare an e-portfolio.
6. Plan action research for continuous professional development of Computer Science teacher.
7. Any other project assigned by HEI.

4.4.8.4 Suggestive Mode of Transaction

Lecture cum demonstration method, discussion method, laboratory method, project method, inquiry approach, problem solving, experiential learning approach, flipped classrooms, mobile apps, and interactive methods such as group discussions, peer tutoring, workshops, observations and presentations.

4.4.8.5 Suggestive Mode of Assessment

Seminars, demo lessons, case studies, practical tasks, hands-on activities in laboratories, written tests, classroom presentations, workshops, assignments, practicums, sessional and terminal semester examinations (as per UGC norms).

4.4.8.6 Suggestive Reading Materials:

- National Council of Educational Research and Training. (April 2022). Mandate documents Guidelines for the development of National Curriculum Frameworks.
- National Education Policy 2020, MoE, Government of India
- National Steering Committee for National Curriculum Frameworks, (2023). Draft National Curriculum Framework for School Education.
- NCERT (2019). Computer Science: Textbook for class XI – XII.
- NCERT (2019). Information and Communication Technology: A Textbook for Class IX - X.

*Teachers may also suggest books/readings as per the need of the learners and learning content.

4.4.9 Content cum Pedagogy of Arts Education at Secondary Stage - Course (I)

Credit: 2
Semester: S-4

4.4.9.1 About the Course

The term 'Art' refers to a wide range of human endeavors and the resulting works that reflect technical mastery, aesthetic beauty, emotional heft, or mental concepts. Through the involvement of the hearts, mind, and hand, the education of Arts, craft, and design plays a special role in the holistic development of human beings, empowering them to construct their own world with wisdom and to comprehend and value the work of others. This course comprises three units related to the nature, scope and historical perspective of Arts Education, aims and objectives of Arts Education teaching and pedagogical aspects of Arts Education. The course deals with knowledge of Indian Arts which will enable the students to appreciate the diversity and richness of artistic traditions, as well as to become liberal, original thinkers, and responsible citizens of the country, provisions in NEP 2020 in reference to Arts Education, learning outcomes and competencies of teaching arts at the secondary stage and the inculcation of associated values. It emphasizes the implication of various approaches to teaching arts, the development of high order thinking skills, to adapt different methods and techniques for effective teaching and develop skills for providing varied student-centric, participatory quality learning experiences to the students.

4.4.9.2 Learning Outcomes

After completion of this course, student teachers will be able to:

- discuss the modern meaning of arts and design,
- reflect on Indian arts and its relevance in secondary school,
- interpret the need of arts education in nation development,
- explain arts education as a curricular discipline and its evolution as a subject,
- discuss significance of arts education in school and its relationship with other school subjects,
- outline aims, objectives and learning outcomes of teaching arts at school level,
- select objectives and competencies for teaching of Arts,
- adapt various methods for teaching of Arts,
- maximize the reflection on values inculcation.

UNIT - I

Nature, Scope, and Historical Perspective of Arts Education

A. Appreciation of arts, the modern concept of Arts, interdependence of arts, craft, and design, forms of Arts.
B. The scope of arts and its importance in the development of nation and as a profession.
C. Knowledge of Indian arts – from earliest to the contemporary as a subject, historical perspective, and major landmarks in the evolution of arts (visual and performing arts) as a subject.
D. Recommendations/suggestions of various committees, commissions and policies, provisions in NEP 2020 in reference to Arts Education.

UNIT - II

Aims and Objectives of Arts Teaching

A. Aims and objectives of teaching Arts at secondary stage.
B. Learning outcomes and competencies of teaching Arts at secondary stage.
C. Understanding arts/craft (visual and performing) traditions of India and its relevance in secondary school, traditional crafts as a pedagogy assimilating with other school subjects.
D. Inculcation of different values through teaching of Arts.

UNIT - III

Pedagogical Aspects of Arts Education

A. Implication of various approaches such as inductive-deductive, constructivist, experiential learning, blended learning, interdisciplinary and multidisciplinary approaches in teaching of Arts.
B. Analytical pedagogical aspects in teaching of arts for the development of high order thinking skills such as critical, creative, communication, decision making, collaborative and reflective.
C. Methods of teaching arts: learner-centric and participatory methods. lecture cum demonstration, activity based, discussion, problem-solving, project based, hands on activity, field-based observations, assignments, brainstorming as a thinking strategy, design thinking skills, divergent thinking, meta-cognition, artistic expression, exploration and creation, experimentation, collaborative and cooperative learning, peer learning.

4.4.9.3 Suggestive Practicum (Any Three)

1. Organize a workshop on how Art forms can be integrated in teaching and learning of other school subjects and prepare a report.
2. Report on how the Artist design their products, manage their resources, including raw materials, its marketing and other challenges they face.
3. Explore traditional Art forms in the community or neighborhood and prepare a report.
4. Make puppets and their costumes and prepare a write up of the entire process.
5. Applied Arts activities: Design the school magazine and bulletin boards, make posters, and greeting/invitation cards, stage scenes for music, dance, and drama performances.
6. Analyze NEP 2020 with reference to emphasis on Arts Education.
7. Write learning outcomes and competencies for two topics of Arts Education at Secondary Stage.
8. Visit any monumental place and observe its aesthetics. Prepare a report based on your observations relating it to different forms of Art.
9. Any other project assigned by HEI.

4.4.9.4 Suggestive Mode of Transaction

Lecture cum demonstration, Experimental method, Field-based experiences, Project method, Laboratory method, Hands on Activity, Problem solving method, Inquiry method, Success stories, Discussions, Self-study, Brainstorming and Experiential method.

4.4.9.5 Suggestive Mode of Assessment

Written test, classroom presentations, discussion forums, observation, research/study report, assignments, practicum, performance based, sessional and terminal examination (As per UGC Norms).

4.4.9.6 Suggestive Reading Materials

- Draft National Curriculum Framework for School Education,
- National Education Policy 2020, MoE, Government of India
- National Steering Committee for National Curriculum Frameworks, (2023).
- NCERT Textbooks for Art Education
- UNESCO, (2006), Appeals for the Promotion of Arts Education and Creativity at School to help Construct a Culture of Pace, Paris, November 3 {No.99-241}UNESCO PRESSE. http://www.://www.unesco.org/education/ecp/Arts_edu.htm,19.09.2019, 20:20.9.
- UNESCO, (2006), Road Map for Arts Education. The World Conference on Arts Education: Building Creative Capacities for the 21st Century, Lisbon, 6-9 March 2006, http://www.unesco.org/new/fileadmin/MULTIMEDIA/HQ/CLT/CLT/pdf/Arts_Edu_Road Map_en.pdf,13.08.2019,09(PDF) 3.

*Teachers may also suggest books/readings as per the need of the learners and learning content.

4.4.9 Content cum Pedagogy of Arts Education at Secondary Stage – Course (II)

Credit: 2
Semester: S-5

4.4.9.1 About the Course

Art focuses on the presentation of ideas, sentiments, and visual aspects. A person who produces or develops Arts by applying deliberate skill and imaginative creativity is called an Artist. It's crucial to comprehend content analysis if one wants to teach Arts. It gives teachers the ability to gather and compare variations in the subjects being taught, as well as student perceptions and relevant trends. This course encompasses three key areas of Arts Education, Teaching Learning Resources for Arts Teaching, Content Analysis and Planning for Teaching Arts and ICT Integration and Applications in Arts Education. The course deals to develop the skills of student teachers related to effective teaching such as listing behavioural outcomes, planning activities and experiments, evaluation procedures, identification and selection of teaching learning resources, and how integrating various pedagogical techniques in the teaching of content related to Arts Education. It emphasizes the skill of developing lesson plans for the teaching of Arts (Visual and Performing).

4.4.9.2 Learning Outcomes

After completion of this course, student teachers will be able to:

- distinguish learning resources and e-resources for Arts teaching,
- classify, identify, and use learning resources from the local environment,
- analyze different contents from textbooks for pedagogical aspects,
- apply Artificial Intelligence in various fields of Arts education,
- develop skills of meaningful observation and judgements,
- design and maintain portfolios,
- value Arts and TPCK and provide ICT based opportunity to learn,
- develop unit and lesson plans for the content of Arts education,

UNIT - I

Teaching Learning Resources for Arts Teaching

A. Teaching learning resources: concept, characteristics, and importance in teaching of Arts.
B. Types of teaching learning aids/ materials: print media (such as textbook, teachers' manual/ handbook, laboratory manual and other print materials), non-print and digital media such as radio, TV, websites, animations, audios, videos, images, simulations, digital repository, Augmented Reality (AR), Virtual Reality (VR) and Artificial Intelligence (AI) based digital resources and Open Educational Resources (OERs) for offline/ online classrooms, reflective journals, posters, charts, 2-D and 3-D models, worksheets, multimedia etc.
C. Identification and use of learning resources from the local environment in teaching of arts.
D. Resource room/ laboratory/ library - management and practices; virtual laboratories, teaching learning kits, subject clubs, fairs, exhibitions, excursions, community resources and pooling of resources; management of resource center for arts crafts and design, maintaining report, records and registers.

UNIT - II

Content Analysis and Planning for Teaching Arts

A. Pedagogical Analysis of Content Taking Examples from Topics of Arts Textbooks of Secondary Stage, Identification of Concepts, Listing Learning Outcomes and Competencies, Planning and Evaluating Learning Experiences in an Inclusive Setup.
B. Concept, Types and Importance of Unit Planning and Lesson Planning. Essential components of lesson plan for the teaching of Arts.
C. Developing Unit Plans and Lesson Plans based on Learning Outcomes (topics to be taken from textbooks). Experiential Learning in Arts Teaching.

UNIT - III

ICT Integration and Applications in Arts Education

A. Scope and importance of ICT in arts education.
B. Use of ICT such as Artificial Intelligence, machine learning, smart boards in the teaching of arts, assessment process and resource management.
C. Use of tools, software, and platforms for teaching learning of arts at secondary stage.
D. Developing ICT integrated lesson plans using Technological Pedagogical Content Knowledge (TPCK) for face to face and online teaching.

4.4.9.3 Suggestive Practicum (Any Three)

1. Analyze Arts Education textbooks and prepare a suggestive report.
2. Prepare a report on the pedagogical analysis of any two topics from Arts textbook.
3. Organize activities such as Drama, Theatre, Poster designing, sketching and land escapes and prepare a report.
4. Maintain a diary on Arts interactions.
5. Develop an e-content for teaching learning of Arts.
6. Critically evaluate the available MOOCs on Arts Education and prepare a report.
7. Any other project assigned by HEI.

4.4.9.4 Suggestive Mode of Transaction

Lecture cum demonstration, experimental method, field-based experiences, project method, laboratory method, hands on activity, problem solving method, inquiry method, success stories, discussions, self-study, brainstorming and experiential method.

4.4.9.5 Suggestive Mode of Assessment

Written test, classroom presentations, discussion forums, observation, research/study report, assignments, practicum, performance based, sessional and terminal examination (As per UGC Norms).

4.4.9.6 Suggestive Reading Materials

- Draft National Curriculum Framework for School Education,
- National Education Policy 2020, MoE, Government of India
- National Steering Committee for National Curriculum Frameworks, (2023).
- NCERT Textbooks for Art Education

- UNESCO, (2006), Appeals for the Promotion of Arts Education and Creativity at School to help Construct a Culture of Pace, Paris, November 3 {No.99-241}UNESCO PRESSE. http://www.://www.unesco.org/education/ecp/Arts_edu.htm,19.09.2019, 20:20.9.
- UNESCO, (2006), Road Map for Arts Education. The World Conference on Arts Education: Building Creative Capacities for the 21st Century, Lisbon, 6-9 March 2006, http://www.unesco.org/new/fileadmin/MULTIMEDIA/HQ/CLT/CLT/pdf/Arts_Edu_Road Map_en.pdf,13.08.2019,09(PDF) 3.

*Teachers may also suggest books/readings as per the need of the learners and learning content.

4.4.9 Content cum Pedagogy of Arts Education at Secondary Stage – Course (III)

Credit: 2
Semester: S-6

4.4.9.1 About the Course

Art is a window to the imagination. Art can help students develop the kind of creativity, ingenuity, communication, and performance skills that will assist them throughout their education and career. Any teacher of Art must be skilled in the various approaches, strategies, and techniques for the assessment and evaluation. The Teacher must be competent to provide quality feedback and know the process of reporting. They should know how to enhance learning and plan future activities. The course includes three units based on 21st Century Skills for Learning, Assessment and Evaluation in Teaching of Arts, Research, and Innovative Practices in Teaching of Arts. The course focuses on the development of skills associated with the measurement of learning outcomes, providing feedback, reporting, constructing achievement tests, planning action research projects and school-based research in the teaching of Arts. The course emphasizes the versatility of Arts for a wide range of prospective career options in different fields, including writing, photography, fine Arts, animation, digital media, spatial design, fashion, jewellery and graphic design and promoting entrepreneurship.

4.4.9.2 Learning Outcomes

After completion of this course, student teachers will be able to:

- explain the need for and importance of how to learn,
- summarize 21st century skills for learners and teachers of Arts Education,
- discuss the qualities required for teachers of Arts Education,
- observe and evaluate learning in an inclusive setup,
- discuss the importance of evaluation and assessment in Arts teaching,
- construct table of specialization and write items,
- assess and reflect on evaluation devices for arts teaching,
- adapt performance-based evaluation,
- plan action research project in the teaching of Arts Education.

UNIT - I

21st Century Skills for Learning

A. Need for and importance of how to learn, 21st century skills for learners and teachers of Arts Education, creative and imaginative expression of the learners.
B. Psychological, sociological, and philosophical perspective of teaching and learning of arts education, application of arts and aesthetics in day-to-day life in the institute and in the community.
C. Qualities of arts teachers as professionals, role of a teacher in facilitating learning and creating dynamic learning environment for Arts Education.

UNIT - II

Assessment and Evaluation in Teaching of Arts

A. Assessment and evaluation: need for and importance of Arts Education.

B. Assessment based on learning outcomes, strategies for continuous assessment, finding gaps in learning and planning further activities for improvement, qualitative assessment, 360◦ assessment in Arts Education.
C. Performance based assessment, assessment of group activities, field observations, recording and reporting, creating platform and portfolio management, assessment of lab skills, assignments, projects, and presentations.
D. Tools and techniques of assessment and evaluation in arts education; unit test based on Table of Specification (TOS) and its importance; basic steps of question paper setting, types of test items and preparing answer key and criteria for school, assessment, and feedback mechanism in teaching of Arts.

UNIT - III

Research and Innovative Practices in Teaching of Arts

A. Divergent thinking and innovation in psychological, sociological, and philosophical perspectives for quality learning experiences in teaching of Arts, promoting creativity and innovation.
B. Recent trends in research related to teaching learning of Arts.
C. Action research in arts education, meaning, significance, steps, and planning.
D. School based research in arts education, evidence-based practices and reflection, arts & design and skill development and entrepreneurship.

4.4.9.3 Suggestive Practicum (Any Three)

1. Prepare a report on Indian local Arts after meaningful observation and judgement.
2. Prepare a write-up on the quality of experiences for teaching of Arts.
3. Construct a Table of Specification/Achievement test.
4. Prepare a Portfolio/e-portfolio.
5. Prepare a plan for action research.
6. Conduct School Based Research and prepare an evidence-based report.
7. Conduct Case Studies/ Market Surveys/ Field visit and prepare a report.
8. Any other project assigned by HEI.

4.4.9.4 Suggestive Mode of Transaction

Lecture cum demonstration, experimental method, field-based experiences, project method, laboratory method, hands on activity, problem solving method, inquiry method, success stories, discussions, self-study, brainstorming and experiential method.

4.4.9.5 Suggestive Mode of Assessment

Written test, classroom presentations, discussion forums, observation, research/study report, assignments, practicum, performance based, sessional and terminal examination (As per UGC Norms).

4.4.9.6 Suggestive Reading Materials:

- Draft National Curriculum Framework for School Education,
- National Education Policy 2020, MoE, Government of India (Hindi and English).
- National Steering Committee for National Curriculum Frameworks, (2023).
- NCERT Textbooks for Art Education

- UNESCO, (2006), Appeals for the Promotion of Arts Education and Creativity at School to help Construct a Culture of Pace, Paris, November 3 {No.99-241}UNESCO PRESSE. http://www.://www.unesco.org/education/ecp/Arts_edu.htm,19.09.2019, 20:20.9.
- UNESCO, (2006), Road Map for Arts Education. The World Conference on Arts Education: Building Creative Capacities for the 21st Century, Lisbon, 6-9 March 2006, http://www.unesco.org/new/fileadmin/MULTIMEDIA/HQ/CLT/CLT/pdf/Arts_Edu_Road Map_en.pdf,13.08.2019,09(PDF) 3.

*Teachers may also suggest books/readings as per the need of the learners and learning content.

4.4.10 Content cum Pedagogy of Vocational Education at Secondary Stage - Course (I)

Credit: 2
Semester: S-4

4.4.10.1 About the Course

Vocational Education is a critical aspect of education and training that prepares individuals for the workforce. It provides practical skills and knowledge necessary for specific trades and professions, and it plays a significant role in the economy's growth. The objective is to provide students with the tools they need to become self-sufficient and productive members of society. This course encompasses three units related to the nature, scope, and relevance of Vocational Education, nature, scope and historical perspective of Vocational Education, Aims and Objectives of Vocational Education Teaching and Pedagogical Aspects of Vocational Education. The course emphasizes the formulation of objectives in behavioural terms, learning outcomes and competencies of teaching Vocational Education, place, and significance of Vocational Education at the secondary stage. It focuses on the implication of various approaches for the development of higher order thinking skills and different methods of teaching learning Vocational Education.

4.4.10.2 Learning Outcomes

After completion of this course, student teachers will be able to:

- explain the nature and scope of Vocational Education,
- interpret the need of Vocational Education and skill development,
- list the aims and objectives of Vocational Education at the secondary stage,
- discuss significance of Vocational Education in school and its relationship with other subjects,
- select learning outcomes and competencies for teaching of Vocational Education,
- analyze pedagogical aspects in Teaching of Vocational Education for development of Higher Order Thinking Skills,
- make use of methods and approaches of teaching Vocational Education
- maximize the reflection on values inculcation,

UNIT - I

Nature, Scope, and Historical Perspective of Vocational Education

A. Meaning and types of Vocational Education such as agriculture, beauty and wellness industry, apparel, furnishing, jewellery designing, plumbing, electronics and automative.
B. Nature, scope and relevance of Vocational Education.
C. Historical perspective and major landmarks in the evolution of Vocational Education as a subject.
D. Recommendations/suggestions of various committees, commissions and policies, provisions in NEP 2020 in reference to Vocational Education.

UNIT - II

Aims and Objectives of Vocational Education Teaching

A. Aims and objectives of teaching Vocational Education at the secondary stage, formulation of objectives in behavioural terms.
B. Learning outcomes and competencies of teaching Vocational Education at secondary stage.
C. Place and significance of Vocational Education in secondary school; its linkages with other school subjects.
D. Identify and integrate values in Vocational Education concepts.

UNIT - III

Pedagogical Aspects of Vocational Education

A. Implication of various approaches such as inductive-deductive, constructivist, experiential learning, blended learning, interdisciplinary and multidisciplinary approaches in teaching of Vocational Education.
B. Analytical pedagogical aspects in teaching of Vocational Education for the development of higher order thinking skills such as critical, creative, communication, decision making, collaborative and reflective.
C. Methods of teaching Vocational Education: learner-centric and participatory methods. lecture cum demonstration, activity based, discussion, problem-solving, project based, scientific inquiry, hands on activity, real experiences, making field-based observations, apprenticeships, and internships, case study, assignments, discovery, experimentation, collaborative and cooperative learning, peer learning.

4.4.10.3 Suggestive Practicum (Any Three)

1. Analyze recommendations of NEP 2020 with reference to emphasis on Vocational Education.
2. Prepare a report on skill development in relation to achievement of Make in India.
3. Prepare a report on interdisciplinary and multidisciplinary approaches used in the practices of Vocational Education.
4. Write learning outcomes and competencies for two topics of Vocational Education at Secondary Stage.
5. Conduct a short survey to know the expectations of students, parents, industries, and society about Vocational Education and compile a report.
6. Any other project assigned by HEI.

4.4.10.4 Suggestive Mode of Transaction

Lecture cum demonstration, field observations, experimental method, industry visit, real-world experiences, project method, laboratory method, discovery, problem solving method, inquiry method, success stories, discussions, self-study, and experiential method.

4.4.10.5 Suggestive Mode of Assessment

Written test, classroom presentations, discussion forums, observation, research/study report, assignments, practicum, sessional and terminal examination (As per UGC Norms).

4.4.10.6 Suggestive Reading Materials

- Draft National Curriculum Framework for School Education,
- FICCI. (n.d.). *Reimagining vocational education in India: The missing piece.* https://www.globalskillsummit.com/2.pdf
- National Education Policy 2020, MoE, Government of India (Hindi and English).
- National Steering Committee for National Curriculum Frameworks, (2023).

*Teachers may also suggest books/readings as per the need of the learners and learning content.

4.4.10 Content cum Pedagogy of Vocational Education at Secondary Stage - Course (II)

Credit: 2
Semester: S-5

4.4.10.1 About the Course

Teaching Vocational Education is a challenging but rewarding endeavour that requires careful planning and preparation. The aim of Vocational Education is to prepare students for successful careers in their chosen fields. Instructors must develop effective lesson plans tailored to their student's needs and interests while ensuring that they have the most up-to-date and relevant resources available. The course covers three units focusing on teaching learning resources for Vocational Education teaching, content analysis and planning for teaching Vocational Education and ICT integration and applications in Vocational Education teaching learning. The course deals with types of teaching learning resources, identification and utilizing of learning resources, pedagogical analysis of content, and developing art integrated unit plans and lesson plans. The course emphasizes on importance and use of ICT in Vocational Education and plans using Technological Pedagogical Content Knowledge (TPCK) for face-to-face and online teaching.

4.4.10.2 Learning Outcomes

After completion of this course, student teachers will be able to:

- identify and use learning resources from the local environment,
- discuss the importance of teaching learning resources in the teaching of Vocational Education,
- classify teaching resources and use e-resources for Vocational Education teaching,
- analyze the content of Vocational Education for integration in pedagogical activities,
- identify concepts, list learning outcomes and plan teaching learning process in an inclusive setup,
- utilize tools, software, and platforms for online teaching learning,
- integrate art and TPCK to develop lesson plans for face to face and online teaching learning.

UNIT - I

Teaching Learning Resources for Vocational Education Teaching

A. Teaching learning resources: concept, characteristics, and importance in teaching of Vocational Education.

B. Types of teaching learning aids/ materials: print media (such as textbook, teachers' manual/ handbook, industry catalogue, laboratory manual and other print materials), non-print and digital media such as radio, TV, websites, animations, audios, videos, images, simulations, digital repository, Augmented Reality (AR), Virtual Reality (VR) and Artificial Intelligence (AI) based digital resources and Open Educational Resources (OERs) for offline/ online classrooms, reflective journals, charts, 2-D and 3-D models, games, worksheets, multimedia etc.

C. Identification and use of learning resources from the local environment in teaching of Vocational Education, industry-oriented learning resources.

D. Resource room/ laboratory/ library - management and practices; virtual laboratories, teaching learning kits, fairs, exhibitions, industry excursions, community resources and pooling of resources.

UNIT - II

Content Analysis and Planning for Teaching Vocational Education

A. Pedagogical analysis of content taking examples from topics of Vocational Education from textbooks of secondary stage, identification of concepts, listing learning outcomes and competencies, planning, and evaluating learning experiences in an inclusive setup.
B. Concept, types and importance of unit planning and lesson planning, essential components in the lesson plan of Vocational Education.
C. Developing art integrated unit plans and lesson plans based on learning outcomes (topics to be taken from Vocational Education textbooks), experiential learning in Vocational Education teaching.

UNIT - III

ICT Integration and Applications in Vocational Education Teaching

A. Scope and importance of ICT in Vocational Education.
B. Use of ICT such as Artificial Intelligence, machine learning, smart boards in the teaching of Vocational Education, assessment process and resource management.
C. Use of tools, software, and platforms of Vocational Education at secondary stage.
D. Developing ICT integrated lesson plans using Technological Pedagogical Content Knowledge (TPCK) for face to face and online teaching.

4.4.10.3 Suggestive Practicum (Any Three)

1. Organize a workshop on 'Methods and Materials for Vocational Education Teaching' in which every student teacher will be assigned a topic to make presentation using a specific method and material.
2. Visit to Vocational Education institutions/industry/workplaces to explore and prepare a report.
3. Develop e-Content for teaching Vocational Education.
4. Search MOOCs available in the field of Vocational Education and prepare a report mentioning link and their appropriateness.
5. Critically evaluate a textbook of Vocational Education and prepare a report.
6. Any other Project assigned by HEI.

4.4.10.4 Suggestive Mode of Transaction

The course will be transacted through Lecture cum demonstration, Field observations, Experimental method, Industry Visit, Real-World Experiences, Project method, Laboratory method, Discovery, Problem solving method, Inquiry method, Success stories, Discussions, Self-study, and Experiential method.

4.4.10.5 Suggestive Mode of Assessment

Written test, classroom presentations, discussion forums, observation, research/study report, assignments, practicum, sessional and terminal examination (As per UGC Norms).

4.4.10.6 Suggestive Reading Materials

- Draft National Curriculum Framework for School Education,
- FICCI. (n.d.). *Reimagining vocational education in India: The missing piece.* https://www.globalskillsummit.com/2.pdf
- National Education Policy 2020, MoE, Government of India (Hindi and English).
- National Steering Committee for National Curriculum Frameworks, (2023).

*Teachers may also suggest books/readings as per the need of the learners and learning content.

4.4.10 Content cum Pedagogy of Vocational Education at Secondary Stage - Course (III)

Credit: 2
Semester: S-6

4.4.10.1 About the Course

Vocational Education focuses on hands on training which allows the students to develop necessary skills required for their chosen profession. The objective is to provide students with the tools they need to become self-sufficient and productive members of society, ultimately helping individuals to achieve career success, financial stability and developing entrepreneurship skills. As an educator, there are many factors to be considered while planning for teaching learning Vocational Education. This course is designed to incorporate three key areas of Vocational Education teaching associated with 21st Century Skills for Learning, Assessment and Evaluation in Teaching of Vocational Education and Research and Innovative Practices in Teaching Vocational Education. This course focuses on the assessment and evaluation of essential Vocational Education components using different assessment tools. The course deals with the Need for and Importance of 21st Century Skills and Creating a Dynamic Learning Environment, Qualitative Assessment, 360◦ Assessment, Action Research and School Based/Industry Based Research.

4.4.10.2 Learning Outcomes

After completion of this course, student teachers will be able to:

- discuss the need for and importance of how to learn,
- appraise 21st century skills for learners and teachers of Vocational Education,
- list the characteristics of Vocational Education teachers as professionals,
- create dynamic learning environment for Vocational Education teaching,
- summarize the need and importance evaluation and assessment Vocational Education teaching,
- construct Table of Specification and write items,
- identify and plan action research in the teaching of Vocational Education,
- adapt performance-based assessment for improving outcomes.

UNIT - I
21st Century Skills for Learning

A. Need for and Importance of How to Learn, 21st Century Skills for Learners and Teachers of Vocational Education.
B. Psychological, Sociological and Philosophical Perspective of Teaching and Learning of Vocational Education.
C. Qualities of Vocational Education Teachers as Professionals. Role of a Teacher in Facilitating Learning and Creating Dynamic Learning Environment of Vocational Education.

UNIT - II

Assessment and Evaluation in Teaching of Vocational Education

A. Assessment and Evaluation: Need for and Importance of Vocational Education.
B. Assessment Based on Learning Outcomes, Strategies for Continuous Assessment, finding gaps in learning and planning further activities for improvement, Qualitative Assessment, 360◦ Assessment.
C. Performance based Assessment, Assessment of Group Activities, Field Observations, Recording and Reporting, Creating Platform and Portfolio Management, Assessment of Lab Skills and industry visit, Assignments, Projects, and Presentations.
D. Tools and Techniques of Assessment and Evaluation; Unit Test Based on Table of Specification (TOS) and its Importance; Basic Steps of Question Paper Setting, Types of Test Items and Preparing Answer Key and Criteria for School, Assessment and Feedback Mechanism in Teaching of Vocational Education.

UNIT - III

Research and Innovative Practices in Teaching of Vocational Education

A. Divergent Thinking and Innovation in Psychological, Sociological and Philosophical Perspectives for Quality Learning Experiences in teaching of Vocational Education.
B. Recent Trends in Research Related to Teaching Learning of Vocational Education.
C. Action Research in Vocational Education, Meaning, Significance, Steps and Planning.
D. School Based/Industry Based Research in Vocational Education, Evidence-Based Practices and Reflection.
E. Vocational Education, skill development, Make in India, and Entrepreneurship.

4.4.10.3 Suggestive Practicum (Any Three)

1. Construct an Achievement test/ Table of Specialization.
2. Prepare a portfolio/kit of any Vocation.
3. Find success stories related to skill development and entrepreneurship in Vocational Education and appreciate their uniqueness in the form of a report.
4. Identify a problem and plan action research project for Vocational Education.
5. Conduct School Based Research/ case study/ industry and market related surveys and prepare an evidence-based report.
6. Prepare a write up on quality of learning experiences for teaching Vocational Education.
7. Any other project assigned by HEI.

4.4.10.4 Suggestive Mode of Transaction

The course will be transacted through Lecture cum demonstration, Field observations, Experimental method, Industry Visit, Real-World Experiences, Project method, Laboratory method, Discovery, Problem solving method, Inquiry method, Success stories, Discussions, Self-study, and Experiential method.

4.4.10.5 Suggestive Mode of Assessment

Written test, classroom presentations, discussion forums, observation, research/study report, assignments, practicum, sessional and terminal examination (As per UGC Norms).

4.4.10.6 Suggestive Reading Materials

- Draft National Curriculum Framework for School Education,
- FICCI. (n.d.). *Reimagining vocational education in India: The missing piece.* https://www.globalskillsummit.com/2.pdf
- National Education Policy 2020, MoE, Government of India (Hindi and English).
- National Steering Committee for National Curriculum Frameworks, (2023).

*Teachers may also suggest books/readings as per the need of the learners and learning content.

4.4.11 Content cum Pedagogy of Physical Education and Yoga at Secondary Stage – Course (I)

Credit: 2
Semester: S-4

4.4.11.1 About the Course

The focus of the National Education Policy (NEP) 2020 is on the holistic development of students. To achieve the objectives, interventions from quality teachers are vital. Sound pedagogical content knowledge and teaching methods are the determinants of a teacher's quality and professionalism. Teacher education programme strongly emphasizes pedagogy, its principles, and the practices of teaching and learning. Pedagogical knowledge and approaches refer to the specialized knowledge of the teacher for creating an active, child-centered, and inclusive teaching-learning environment for the students and need to be developed among the student teachers. This pedagogical course in Physical Education and Yoga is intended to enhance the pedagogical content knowledge of student teachers through different learning approaches and methods. This course comprises three units and a practicum. The course is devoted to developing an understanding of the nature and scope of Physical Education and Yoga, aims, and objectives of teaching Physical Education and Yoga and its linkages with other disciplines. Historical/policy perspectives of Physical Education and Yoga are discussed in unit second. Physical Education and Yoga is conceptualized in very broad terms by relating it to technology, society, humans, and sustainable development. It also focuses on the place of Physical Education and Yoga in school curriculum including an emphasis on how to build inclusive classrooms. It focuses on pedagogical concerns of Physical Education and Yoga. Critical, creative, and analytical pedagogical concerns in teaching Physical Education and Yoga with special reference to higher-order thinking are also placed in unit third.

4.4.11.2 Learning Outcomes

After completion of this course, student teachers will be able to:

- explain nature, scope and importance of Physical Education and Yoga,
- discuss aims and objectives of teaching Physical Education and Yoga at secondary stage,
- outline linkages between Physical Education and Yoga with other school subjects,
- appraise the values inculcation for Physical Education and Yoga,
- summarize the historical perspective of Physical Education and Yoga in policies/commissions,
- make use of pedagogical aspects of Physical Education and Yoga,
- categorize approaches and methods of teaching learning Physical Education and Yoga,
- apply appropriate pedagogy in teaching learning the concepts of Physical Education and Yoga.

UNIT - I

Nature, Scope and Historical Perspective of Physical Education and Yoga

A. Nature, scope, and importance of Physical Education and Yoga.
B. Historical perspective of Physical Education and Yoga.
C. Contributions of Indian (ancient and modern) and other personalities.

D. Role of Physical Education & Yoga in society and sustainable development.
E. Recommendations/suggestions of various committees, commissions, and policies.

UNIT - II

Aims and Objectives of Teaching Physical Education and Yoga

A. Aims and objectives of teaching Physical Education and Yoga.
B. Learning outcomes and competencies of teaching Physical Education and Yoga at secondary stage.
C. Linkages of Physical Education and Yoga with other school subjects and place of the Physical Education and Yoga in school curriculum.
D. Inculcation of values through teaching of Physical Education and Yoga.

UNIT - III

Pedagogical Aspects of Physical Education and Yoga

A. Implication of various approaches- inductive-deductive, constructivist, experiential learning, art integrated learning, interdisciplinary and multidisciplinary approaches in Physical Education and Yoga.
B. Analytical pedagogical concerns in teaching of Physical Education and Yoga for high order thinking skills such as critical, creative, communication, decision making.
C. Methods of teaching learning Physical Education and Yoga: learner-centric and group-centric, lecture cum demonstration, activity based, imitation, drill and practice, discussion, problem-solving, project based, hands on activity, discovery, experimentation, field activities, collaborative, cooperative and peer learning.

4.4.11.3 Suggestive Practicum (Any Three)

1. Explore and prepare a write up on the contributions of Indian personalities in the development of Physical Education and Yoga.
2. Make a presentation on the historical development of Physical Education and Yoga.
3. Analyze recommendations of policies/commissions in context of Physical Education and Yoga.
4. Identify and analyze the types of values inculcated through teaching of Physical Education and Yoga concepts and prepare a report.
5. Prepare write-ups on the teaching of Physical Education and Yoga using interdisciplinary and multidisciplinary approaches as recommended in NEP 2020.
6. Any other project assigned by HEI.

4.4.11.4 Suggestive Mode of Transaction

Lecture cum discussion, demonstration, hands-on activities, experiential learning, art integrated learning, field activities.

4.4.11.5 Suggestive Mode of Assessment

Written tests, classroom presentations, workshops, seminars, assignments, practicums, sessional and terminal semester examinations (as per UGC norms).

4.4.11.6 Suggestive Reading Material:

- National Council of Educational Research and Training. (April 2022). Mandate documents Guidelines for the development of National Curriculum Frameworks.
- National Education Policy 2020, MoE, Government of India.
- National Steering Committee for National Curriculum Frameworks, (2023). Draft National Curriculum Framework for School Education.
- NCERT, Health and Physical Education. Textbook for IX-XII class New Delhi.

*Teachers may also suggest books/readings as per the need of the learners and learning content.

4.4.11 Content cum Pedagogy of Physical Education and Yoga at Secondary Stage – Course (II)

Credit: 2
Semester: S-5

4.4.11.1 About the Course

This course comprises three units and the practicum. The course is devoted to introducing various teaching aids material types and uses for teaching the concepts of Physical Education and Yoga at secondary stage. Enough space is provided to discuss different types of teaching aids/materials for teaching learning concepts of Physical Education and Yoga. It focuses on learning resources in Physical Education and Yoga to enable student teachers to make use of available learning resources and how to generate new resources for teaching learning the concepts of Physical Education and Yoga. It also focuses on textbook analysis and planning for teaching Physical Education and Yoga and its pedagogical issues in the light of NEP 2020. Student teachers are expected to identify various concepts and processes, list learning and outcomes, find out about various activities and experiments. Accordingly, they are expected to develop lesson plans based on learning outcomes and experiential learning for classroom and online teaching.

4.4.11.2 Learning Outcomes

After completion of this course, student teachers will be able to:

- identify teaching learning aids / materials and illustrate their importance in teaching learning the concepts of Physical Education and Yoga,
- categorize teaching aids/materials/learning resources,
- develop teaching learning aids/material/kits/learning resources for teaching learning the concepts of Physical Education and Yoga,
- utilize teaching aids/materials/learning resources for teaching learning the concepts of Physical Education and Yoga,
- analyze the content of Physical Education and Yoga textbooks at secondary stage,
- develop lesson plan based on learning outcomes and experiential learning using appropriate strategies.

UNIT - I

Teaching Learning Resources

A. Teaching learning aids/materials: concept, definition, role and importance in classroom teaching learning the Physical Education and Yoga.
B. Types of teaching learning aids/ materials: print media (such as textbook, teachers' manual/ handbook, laboratory manual and other print materials.), non-print and digital media (such as radio, tv, websites, animations, audios, videos, images, simulations, digital repository, Augmented Reality (AR), Virtual Reality (VR) and Artificial Intelligence (AI) based digital resources and Open Educational Resources (OERs) for offline/ online classroom teaching learning (reflective journals, charts, 2-D and 3-D models, games, cards, worksheets, multimedia etc.)
C. Identification and use of learning resources in Physical Education and Yoga from the local environment.

D. Resource room/ laboratory/ library, virtual laboratories, teaching learning kits, Physical Education and Yoga clubs, fairs, exhibitions, educational parks, excursions, community resources and pooling of resources.

UNIT - II

Content Analysis and Planning for Teaching Physical Education and Yoga

A. Pedagogical analysis of content taking examples from topics of Physical Education and Yoga textbooks of secondary stage, identification of concepts, listing learning outcomes and competencies, planning and evaluating learning experiences in an inclusive setup.
B. Concept, types and importance of unit and lesson planning.
C. Developing unit plans and lesson plans based on learning outcomes and experiential learning by selecting topics from textbooks of Physical Education at secondary stage.

UNIT - III

ICT Integration and Applications

A. Scope and importance of ICT in Physical Education and Yoga.
B. Use of ICT such as Artificial Intelligence, machine learning, smart boards in the teaching learning, assessment and resource management.
C. Tools, software, and platforms for Physical Education and Yoga specific online learning.
D. Developing ICT integrated lesson plans by taking topics of Physical Education and Yoga at secondary stage using Technological Pedagogical Content Knowledge (TPCK) for classroom and online teaching.

4.4.11.3 Suggestive Practicum (Any Three)

- Develop e-content for the concepts of Physical Education and Yoga at Secondary Stage.
- Analyze the content of textbooks of Physical Education and Yoga (Classes 9-12)/ Materials/Resources/Syllabi.
- Identify the learning resources for transiting the concepts of Physical Education and Yoga.
- Develop teaching aids/teaching materials for teaching concepts of Physical Education and Yoga at secondary stage.
- Develop learning outcomes for the concepts of Physical Education and Yoga at the secondary stage.
- Prepare learning outcomes and experiential learning-based lesson plan for the concepts of Physical Education and Yoga.
- Develop a project on the concepts of Physical Education and Yoga using interdisciplinary and multidisciplinary approaches as recommended in NEP 2020.
- Any other project assigned by HEI.

4.4.11.4 Suggestive Mode of Transaction

Lecture cum discussion, demonstration, hands-on activities, experiential learning, art integrated learning, field activities.

4.4.11.5 Suggestive Mode of Assessment

Written tests, classroom presentations, workshops, seminars, assignments, practicums, sessional and terminal semester examinations (as per UGC norms).

4.4.11.6 Suggestive Reading Material:

- National Council of Educational Research and Training. (April 2022). Mandate documents Guidelines for the development of National Curriculum Frameworks.
- National Education Policy 2020, MoE, Government of India.
- National Steering Committee for National Curriculum Frameworks, (2023). Draft National Curriculum Framework for School Education.
- NCERT, Health and Physical Education. Textbook for IX-XII class New Delhi.

*Teachers may also suggest books/readings as per the need of the learners and learning content.

4.4.11 Content cum Pedagogy of Physical Education and Yoga at Secondary Stage - Course (III)

Credit: 2
Semester: S-6

4.4.11.1 About the Course

This course comprises three units and a practicum. It focuses on assessment and evaluation. It also focuses on assessment based on learning outcomes, strategies for continuous assessment, school-based assessment, formative and summative assessment including 360◦ assessment. Student teachers are expected to identify various concepts and processes, list learning and behavioral outcomes, find out about various activities and experiments, and identify relevant evaluation techniques and strategies. It focuses on Psychological, Sociological and Philosophical Perspective of Activity Oriented Classrooms in Physical Education and Yoga. the importance of planning science learning and teaching in secondary schools. In this course student teachers will learn how to plan different types of activities in online and offline mode. It emphasizes how to integrate and use ICT in classroom of Physical Education and Yoga. Assessment serves the dual purpose of tracking the performance of the learners as well as feedback mechanism for effectiveness of teaching. Today's scenario emphasizes competency-based assessment practices and also tests higher order thinking skills and conceptual clarity. Major reforms in assessment are need of the hour to stay vibrant and effective in the process of teaching learning of Physical Education and Yoga.

4.4.11.2 Learning Outcomes

After completion of this course, student teachers will be able to:

- appraise different types of assessment and strategies for continuous assessment,
- distinguish between assessment and evaluation,
- compare merits and demerits of different types of assessment,
- prepare unit test item based on TOS and develop different type of test items,
- construct and administer the diagnostic and achievement test,
- plan offline and online activity for testing higher order thinking skills,
- analyze NEP 2020 with special reference to activity-oriented classrooms,
- relate ICT integration and elaborate its use in classroom situations.

UNIT - I
21st Century Skills for Learning

A. Need for and importance of how to learn 21st century skills for learners and teachers of Physical Education and Yoga.
B. Psychological, sociological and philosophical perspective of teaching and learning Physical Education and Yoga.
C. Qualities of a Physical Education and Yoga teacher as professional in enhancing learning.
D. Role of a teacher in facilitating learning and creating dynamic learning environment of Physical Education and Yoga.

UNIT - II

Assessment and Evaluation

A. Assessment and evaluation: need for and importance of Physical Education and Yoga.
B. Assessment based on learning outcomes, strategies for continuous assessment, school-based assessment, qualitative assessment; formative and summative assessment, formal, informal and 360°assessment.
C. Performance assessment: assessment of group activities, field observations, recording and reporting, creating platform and portfolio management, assessment of laboratory skills, assignments, projects, and presentations.
D. Tools and techniques of assessment and evaluation - unit test based on Table of Specification (TOS) and its importance, basic steps of question paper setting, types of test items and preparing answer key and criteria for school, assessment, and feedback mechanism in teaching learning the content of Physical Education and Yoga.

UNIT - III

Research and Innovative Practices

A. Divergent thinking and innovation in psychological, sociological, and philosophical perspectives for quality learning experiences.
B. Recent trends in research related to teaching learning of Physical Education and Yoga.
C. Action research: meaning, significance, steps, and planning.
D. Evidence-based practices and reflection, school-based research in Physical Education and Yoga.

4.4.11.3 Suggestive Practicum (Any Three)

1. Prepare, administer, and analyze scores of an achievement test.
2. Conduct Simulated Teaching session for the concepts of Physical Education and Yoga and observation by self, peer, and teacher.
3. Explore development of multidisciplinary projects and present using PowerPoint.
4. Interpret the concept of Physical Education and Yoga with Psychological, Sociological and Philosophical Perspective.
5. Apply innovative practices in classroom teaching learning of Physical Education and Yoga.
6. Make a presentation on the role of Physical Education and Yoga in sustainable development of society.
7. Conduct action research for Continuous Professional Development (CPD) of Physical Education and Yoga teacher.
8. Any other project assigned by HEI.

4.4.11.4 Suggestive Mode of Transaction

Lecture cum discussion, demonstration, hands-on activities, experiential learning, art integrated learning, field activities.

4.4.11.5 Suggestive Mode of Assessment

Written tests, classroom presentations, workshops, seminars, assignments, practicums, sessional and terminal semester examinations (as per UGC norms).

4.4.11.6 Suggestive Reading Material:

- National Council of Educational Research and Training. (April 2022). Mandate documents Guidelines for the development of National Curriculum Frameworks.
- National Education Policy 2020, MoE, Government of India.
- National Steering Committee for National Curriculum Frameworks, (2023). Draft National Curriculum Framework for School Education.
- NCERT, Health and Physical Education. Textbook for IX-XII class New Delhi.

*Teachers may also suggest books/readings as per the need of the learners and learning content.

4.4.12 Content cum Pedagogy of Agriculture at Secondary Stage – Course (I)

Credit: 2
Semester: S-4

4.4.12.1 About the Course

Agriculture is based on the life cycle of all living things. Aside from the fact that Agriculture is generally relevant to our daily lives, there are other advantages to making it a required subject in schools. Agriculture is a field based practical-orientated subject; hence, the learners are expected to actively participate in the learning process. The purpose of teaching Agriculture is to integrate education, research, and extension to provide the human resources, skills, and technology needed for the sustainable development of agriculture. It is helpful in achieving food security and SDGs 1 & 2. Quality teaching can change beliefs and approaches to Agriculture and empower dedicated teachers to teach Agriculture in more scientific ways. Keeping this in mind, the course comprises three units focused on the concept of Modern and Sustainable Agriculture, the history of Agriculture in India, the purpose of teaching Agriculture in schools, its correlation with other subjects and the Pedagogical aspects of teaching Agriculture. The course deals with approaches, different methods and techniques for providing varied student-centric, participatory learning experiences to the students.

4.4.12.2 Learning Outcomes

After completion of this course, student teachers will be able to:

- describe the meaning of agriculture, modern and sustainable Agriculture and its importance in a country like India,
- interpret the need of Agriculture in nation development,
- explain Agriculture as a curricular discipline and its evolution as a subject,
- discuss significance of Agriculture in school and its relationship with other subjects,
- outline aims, objectives and learning outcomes of teaching Agriculture at school level,
- select objectives and competencies for teaching of agriculture,
- reflect upon and adopt various methods for teaching of agriculture,
- reflect on values inculcation.

UNIT - I

Nature, Scope, and Historical Perspective of Agriculture

A. Agriculture: nature, scope and its importance in national economy, modern and sustainable agriculture, Agriculture as a discipline and profession.
B. Historical perspective and major landmarks in the evolution of Agriculture in India as a subject.
C. Recommendations/suggestions of various committees, commissions and policies, provisions in NEP 2020 in reference to Agriculture.

UNIT - II

Aims and Objectives of Agriculture Teaching

A. Aims of teaching Agriculture at school level.
B. Objectives of teaching Agriculture at secondary level.
C. Learning outcomes and competencies of teaching Agriculture at secondary stage.
D. Place and significance of Agriculture in secondary school; its linkages with other school subjects.
E. Inculcation of values through teaching of Agriculture.

UNIT - III

Pedagogical Aspects of Agriculture Teaching

D. Implication of various approaches such as inductive-deductive, constructivist, experiential learning, blended learning, interdisciplinary and multidisciplinary approaches in teaching of Agriculture.
E. Analytical pedagogical aspects in teaching of Agriculture for the development of higher order thinking skills such as critical, creative, communication, decision making, collaborative and reflective.
F. Methods of teaching agriculture: learner-centric and participatory methods. lecture cum demonstration, activity based, discussion, problem-solving, project based, scientific inquiry, hands on activity, making field-based observations, direct observation of agricultural practices, collecting field specimens, case study, assignments, discovery, experimentation, collaborative and cooperative learning, peer learning.

4.4.12.3 Suggestive Practicum (Any Three)

1. Prepare a report on Sustainable Agriculture in relation to achievement of sustainable development goals.
2. Analyze NEP 2020 with reference to emphasis on Agriculture Education.
3. Prepare a report on interdisciplinary and multidisciplinary approaches used in the practices of Agriculture.
4. Write learning outcomes and competencies for two topics of Agriculture at Secondary Stage.
5. Collect Field Specimens and prepare herbarium.
6. Any other project assigned by HEI.

4.4.12.4 Suggestive Mode of Transaction

Lecture cum demonstration, field observations, experimental method, field-based experiences, project method, laboratory method, discovery, problem solving method, inquiry method, success stories, discussions, self-study, and experiential method.

4.4.12.5 Suggestive Mode of Assessment

Written test, classroom presentations, discussion forums, observation, research/study report, assignments, practicum, sessional and terminal examination (As per UGC Norms).

4.4.12.6 Suggestive Reading Materials

- Draft National Curriculum Framework for School Education,
- National Education Policy 2020, MoE, Government of India
- National Steering Committee for National Curriculum Frameworks, (2023).
- NCERT Textbooks for Agriculture.

*Teachers may also suggest books/readings as per the need of the learners and learning content.

4.4.12 Content cum Pedagogy of Agriculture at Secondary Stage – Course (II)

Credit: 2
Semester: S-5

4.4.12.1 About the Course

For becoming an effective teacher in Agriculture, it is important to understand pedagogical content analysis. It enables teachers to compile and analyze differences in the subject matter, student perceptions, and pertinent trends. The course comprises three units highlighting the types of teaching-learning resources and their importance for the teaching of Agriculture, the process of Pedagogical Analysis of Content and application of ICT in teaching of Agriculture The course focuses on types of learning resources used in the teaching of Agriculture, laboratory organization and its maintenance, developing the abilities related to listing behavioural outcomes, planning activities, experiments, observing, and evaluating by developing pedagogical content analysis skills. Also, it develops the skills related to selecting content in textbooks, teaching-learning resources, and applying TPCK in the teaching of Agriculture. The course deals with agricultural teaching and lesson planning. It explains how to integrate various pedagogical techniques in the content related to Agriculture.

4.4.12.2 Learning Outcomes

After completion of this course, student teachers will be able to:

- distinguish learning resources and e-resources for Agriculture teaching,
- identify and use learning resources from the local environment,
- analyse different contents from textbooks for pedagogical aspects,
- plan instructional process and adopt the child centered approaches of teaching,
- explain Technological Pedagogical Content Knowledge (TPCK),
- apply Artificial Intelligence in various fields of Agriculture,
- integrate arts and TPCK and provide ICT based opportunity to learn,
- develop unit and lesson plans for varied contents of Agriculture,
- observe Agriculture fields as learning place and write field notes.

4.4.12.3 Learning Outcomes

After completion of [illegible]

UNIT - I

Teaching Learning Resources for Teaching Agriculture

A. Teaching learning resources: concept, characteristics, and importance in teaching of Agriculture

B. Types of teaching learning aids/ materials: print media (such as textbook, teachers' manual/ handbook, laboratory manual and other print materials), non-print and digital media such as radio, TV, websites, animations, audios, videos, images, simulations, digital repository, Augmented Reality (AR), Virtual Reality (VR) and Artificial Intelligence (AI) based digital resources and Open Educational Resources (OERs) for offline/ online classrooms, reflective journals, charts, 2-D and 3-D models, games, worksheets, improvised etc.

C. Identification and use of learning resources from the local environment in teaching of Agriculture, agricultural field notes, reports and records.

D. Resource room/ laboratory/ library - management and practices; virtual laboratories, teaching learning kits, subject clubs, fairs, exhibitions, educational parks, excursions,

community resources and pooling of resources, Agriculture field as a learning center, tools of Agriculture and their importance.

UNIT - II

Content Analysis and Planning for Teaching Agriculture

A. Pedagogical analysis of content taking examples from topics of agricultural from textbooks of secondary stage, identification of concepts, listing learning outcomes and competencies, planning and evaluating learning experiences in an inclusive setup.
B. Concept, types and importance of unit planning and lesson planning.
C. Developing unit plans and lesson plans based on learning outcomes (topics to be taken from textbooks), art and sports integrated lesson plan, experiential learning in Agriculture teaching.

UNIT - III

ICT Integration and Applications

A. Scope and importance of ICT in Agriculture
B. Use of ICT such as Artificial Intelligence, machine learning, smart boards in the teaching of Agriculture, assessment, and resource management.
C. Use of tools, software, and platforms for Agriculture specific online learning.
D. Developing ICT integrated lesson plans using Technological Pedagogical Content Knowledge (TPCK) for face to face and online teaching.

4.4.12.3 Suggestive Practicum (Any Three)

1. Develop e-Content for teaching Agriculture.
2. Critically evaluate the available MOOCs on Agriculture and prepare a report.
3. Use Platforms along with National Teacher's Portal, DIKSHA SWAYAM and prepare a report.
4. Critically evaluate a textbook for Agricultural components and prepare a report.
5. Any other project assigned by HEI.

4.4.12.4 Suggestive Mode of Transaction

Lecture cum demonstration, field observations, experimental method, field-based experiences, project method, laboratory method, discovery, problem solving method, inquiry method, success stories, discussions, self-study, and experiential method.

4.4.12.5 Suggestive Mode of Assessment

Written test, classroom presentations, discussion forums, observation, research/study report, assignments, practicum, sessional and terminal examination (As per UGC Norms).

4.4.12.6 Suggestive Reading Materials

- Draft National Curriculum Framework for School Education,
- National Education Policy 2020, MoE, Government of India.
- National Steering Committee for National Curriculum Frameworks, (2023).
- NCERT Textbooks for Agriculture.

*Teachers may also suggest books/readings as per the need of the learners and learning content.

4.4.12 Content cum Pedagogy of Agriculture at Secondary Stage – Course (III)

Credit: 2
Semester: S-6

4.4.12.1 About the Course

An Agriculture teacher must know about the various approaches, strategies, and techniques for the assessment and evaluation of learning among students. Teachers must measure what, how, and how much students are learning in the classroom to determine their progress. The Teacher must be competent enough to weigh the achievements, provide quality feedback, know the process of reporting, and reiterate the progress of the students. They should know how to enhance learning and plan future activities. The course includes three units focusing on the 21st Century Skills for Learning, the Need for and Importance of How to Learn, the qualities of Agricultural Teachers as Professionals, and Research and Innovative Practices in the field of teaching Agriculture. It describes the role of teachers in facilitating learning and a dynamic learning environment and will make the pupil-teachers skilled in the measurement of learning outcomes, providing feedback, and reporting. Further, the course will help in the development of assessment and evaluation skills among the student teachers. They will develop the skills to construct achievement tests and conduct action research and school-based research in Agriculture teaching.

4.4.12.2 Learning Outcome

After completion of this course, student teachers will be able to:

- explain the need for and importance of how to learn,
- describe 21st century skills for learners and teachers of agriculture,
- discuss the qualities required for teachers of agriculture,
- observe and evaluate learning in an inclusive setup,
- discuss the importance of evaluation and assessment in agriculture teaching,
- provide feedback based on learning outcomes,
- write items and construct table of specialization,
- reflect on evaluation devices for agriculture teaching,
- adopt performance-based evaluation and improving student outcomes,
- conduct action research in the teaching of Agriculture.

UNIT - I
21st Century Skills for Learning

A. Need for and importance of how to learn 21st century skills for learners and teachers of Agriculture.
B. Psychological, sociological, and philosophical perspective of teaching and learning of Agriculture.
C. Qualities of agricultural teachers as professionals, role of a teacher in facilitating learning and creating dynamic learning environment of Agriculture.

UNIT - II
Assessment and Evaluation in Agriculture Teaching

A. Assessment and evaluation: need for and importance of Agriculture.

B. Assessment based on learning outcomes, strategies for continuous assessment, finding gaps in learning and planning further activities for improvement, qualitative assessment, 360◦ assessment.

C. Performance based assessment, assessment of group activities, field observations, recording and reporting, creating platform and portfolio management, assessment of lab skills, assignments, projects, and presentations.

D. Tools and techniques of assessment and evaluation; unit test based on Table of Specification (TOS) and its importance; basic steps of question paper setting, types of test items and preparing answer key and criteria for school, assessment, and feedback mechanism in teaching of Agriculture.

UNIT - III

Research and Innovative Practices in Teaching of Agriculture

A. Divergent thinking and innovation in psychological, sociological, and philosophical perspectives for quality learning experiences in teaching of Agriculture.

B. Recent trends in research related to teaching learning of Agriculture.

C. Action research in agriculture, meaning, significance, steps, and planning.

D. School based research in agriculture, evidence-based practices, and reflection.

4.4.12.3 Suggestive Practicum (Any Three)

1. Conduct School Based Research and prepare an evidence-based report.
2. Prepare a plan for action research.
3. Conduct Case Studies, Market Surveys or Field visit and prepare a report.
4. Enlist quality of experiences for teaching of Agriculture.
5. Construct an Achievement test/ Table of Specialization.
6. Any other project assigned by HEI.

4.4.12.4 Suggestive Mode of Transaction

Lecture cum demonstration, field observations, experimental method, field-based experiences, project method, laboratory method, discovery, problem solving method, inquiry method, success stories, discussions, self-study, and experiential method.

4.4.12.5 Suggestive Mode of Assessment

Written test, classroom presentations, discussion forums, observation, research/study report, assignments, practicum, sessional and terminal examination (As per UGC Norms).

4.4.12.6 Suggestive Reading Materials

- Draft National Curriculum Framework for School Education,
- National Education Policy 2020, MoE, Government of India
- National Steering Committee for National Curriculum Frameworks, (2023).
- NCERT Textbooks for Agriculture.

*Teachers may also suggest books/readings as per the need of the learners and learning content.

4.4.13 Content cum Pedagogy of Home Science at Secondary Stage - Course (I)

Credit: 2
Semester: S-4

4.4.13.1 About the Course

Home Science is a multidisciplinary branch of study that makes the most use of the resources at hand to produce methodical and scientific information about various facets of family life. It involves every family member's health and happiness. This course encompasses three units describing the modern meaning of homemaking and the purpose of teaching Home Science in schools, nature, scope and importance of Home Science teaching, its historical perspective. The course emphasizes the aims, objectives and learning outcomes of teaching Home Science at the secondary level. The course deals with the implication of various approaches, development of high order thinking skills and various methods of teaching Home Science.

4.4.13.2 Learning Outcomes

After completion of this course, student teachers will be able to:

- explain the modern meaning of Home Science and its nature,
- discuss evolution of Home Science as a school subject and its correlation with other subjects,
- examine the scope and importance of Home Science in daily life,
- outline the aims, objectives and learning outcomes of the teaching of Home Science,
- adapt appropriate teaching methods based on learning outcomes,
- select participatory method for teaching Home Science,
- improve high order thinking skills,
- demonstrate values related to Home Science.

UNIT - I

Nature, Scope, and Historical Perspective of Home Science

A. Modern meaning of Home Science, nature of Home Science as a discipline.
B. Historical perspective and major landmarks in the evolution of Home Science as a subject.
C. Scope of Home Science and its importance in daily life and as a profession.
D. Recommendations/suggestions of various committees, commissions and policies related to education of Home Science.

UNIT - II

Aims and Objectives of Home Science Teaching

A. Aims and objectives of teaching Home Science.
B. Learning outcomes and competencies of teaching Home Science at secondary stage.
C. Place of Home Science in school curriculum, its correlation with other school subjects, economics in Home Science.
D. Inculcation of associated values for teaching Home Science.

UNIT - III

Pedagogical Aspects of Home Science

A. Implication of various approaches such as inductive-deductive, constructivist, experiential learning, interdisciplinary and multidisciplinary and blended learning approaches in Home Science teaching.
B. Analytical pedagogical aspects in teaching of agriculture for the development of high order thinking skills such as critical, creative, communication, decision making, collaborative and reflective.
C. Methods of teaching Home Science: one to one teaching and group teaching in Home Science, lecture cum demonstration, observation, activity based, discussion, problem-solving, laboratory, project based, hands on activity, discovery, inquiry, experimentation, exhibition and displays, collaborative and cooperative learning, peer learning and flipped classroom.

4.4.13.3 Suggestive Practicum (Any Three)

1. Prepare a report on the significance of Home Science in daily life.
2. Formulate objectives based on learning outcomes for two chapters of Home Science at secondary stage.
3. Analyze recommendations of NEP 2020 with reference to Home Science education.
4. Prepare a report on interdisciplinary and multidisciplinary approaches used in the practices of Home Science.
5. Identify and integrate values in Home Science concepts and prepare a write up.
6. Any other project assigned by HEI.

4.4.13.4 Suggestive Mode of Transaction

Lecture cum demonstration, experimental method, observation method, project method, laboratory method, discovery, problem solving method, inquiry method, success stories, discussions, self-study, and experiential method.

4.4.13.5 Suggestive Mode of Assessment

Written test, classroom presentations, discussion forums, observation, research/study report, assignments, practicum, sessional and terminal examination (As per UGC Norms).

4.4.13.6 Suggestive Reading Materials:

- Food Safety and Standards Authority of India. Ministry of Health and Family Welfare, Government of India.
- National Council of Educational Research and Training. (April 2022). Mandate documents Guidelines for the development of National Curriculum Frameworks.
- National Education Policy 2020, MoE, Government of India
- National Steering Committee for National Curriculum Frameworks, (2023). Draft National Curriculum Framework for School Education.

*Teachers may also suggest books/readings as per the need of the learners and learning content.

4.4.13 Content cum Pedagogy of Home Science at Secondary Stage - Course (II)

Credit: 2
Semester: S-5

4.4.13.1 About the Course

Home Science is a subject that demands activities and practical learning. For becoming an effective teacher in Home Science, it is important to develop the skill of identifying and using teaching learning resources and understanding content analysis. There are certain components to the process of content analysis for teaching. It enables teachers to compile and analyze differences in the subject matter, student perceptions, and pertinent trends. The course consists of three units related to the importance and types of teaching-learning resources, development of the skill for pedagogical analysis of content for listing behavioural outcomes, planning activities, development of unit and lesson plan, and ICT integration and applications in the teaching of Home Science. The course provides a platform for student teachers to learn about varied kinds of resources which can be used in the teaching of Home Science, those available in the local environment and develops the skill of how to develop learning resources as well as the pool resources. It deals with the development of art and ICT-integrated lesson plans using Technological Pedagogical Content Knowledge (TPCK) for face-to-face and online teaching of Home Science.

4.4.13.2 Learning Outcomes

After completion of this course, student teachers will be able to

- identify and use learning resources from the local environment,
- discuss the importance of teaching learning resources in the teaching of Home Science,
- classify teaching resources and use e-resources for Home Science teaching,
- analyze the content of Home Science for integration in pedagogical activities,
- identify concepts, list learning outcomes and plan teaching learning process in an inclusive setup,
- use of tools, software, and platforms for online learning,
- integrate art and TPCK to develop unit and lesson plans.

UNIT - I

Teaching Learning Resources for Home Science Teaching

A. Teaching learning resources: concept, characteristics, and importance in teaching of Home Science.

B. Types of teaching learning aids/ materials: print media (such as textbook, teachers' manual/ handbook, laboratory manual and other print materials), non-print and digital media such as radio, TV, websites, animations, audios, videos, images, simulations, digital repository, Augmented Reality (AR), Virtual Reality (VR) and Artificial Intelligence (AI) based digital resources and Open Educational Resources (OERs) for offline/ online classrooms, reflective journals, charts, 2-D and 3-D models, games, worksheets, multimedia etc.

C. Identification and use of learning resources from the local environment in teaching of Home Science.

D. Resource room/ laboratory/ library - management and practices; virtual laboratories, teaching learning kits, subject clubs, fairs, exhibitions, educational parks, excursions, community resources and pooling of resources, equipment in Home Science, their importance and maintenance.

UNIT - II

Content Analysis and Planning for Teaching Home Science

A. Pedagogical analysis of content taking examples from topics of Home Science textbooks of secondary stage, identification of concepts, listing learning outcomes and competencies, planning, and evaluating learning experiences in an inclusive setup.
B. Concept, types (theory and practical) and importance of unit and lesson planning in Home Science teaching, essential components in the lesson plan of Home Science.
C. Developing unit plans and lesson plans based on learning outcomes (topics to be taken from Home Science textbooks of secondary level), art integrated lesson plan, experiential learning in Home Science teaching.

UNIT - III

ICT Integration and Applications in Home Science Teaching

A. Scope and importance of ICT in Home Science.
B. Use of ICT such as Artificial Intelligence, machine learning, smart boards in teaching learning, assessment, and resource management.
C. Tools, software, and platform for teaching learning of Home Science at secondary stage.
D. Developing ICT integrated lesson plans using Technological Pedagogical Content Knowledge (TPCK) for classroom and online teaching.

4.4.13.3 Suggestive Practicum (Any Three)

1. Develop e-Content for teaching Home Science.
2. Search MOOCs available in the field of Home Science and prepare a report mentioning link and their appropriateness.
3. Critically evaluate a textbook of Home Science and prepare a report.
4. Prepare a Home Science kit.
5. Organize an exhibition/ seminar and prepare a report.
6. Prepare an art integrated lesson plan based on experiential learning on any topic of Home Science.
7. Any other project assigned by HEI.

4.4.13.4 Suggestive Mode of Transaction

Lecture cum demonstration, experimental method, observation method, project method, laboratory method, discovery, problem solving method, inquiry method, success stories, discussions, self-study, and experiential method.

4.4.13.5 Suggestive Mode of Assessment

Written test, classroom presentations, discussion forums, observation, research/study report, assignments, practicum, sessional and terminal examination (As per UGC Norms).

4.4.13.6 Suggested Reading Materials:

- Food Safety and Standards Authority of India. Ministry of Health and Family Welfare, Government of India.
- National Council of Educational Research and Training. (April 2022). Mandate documents Guidelines for the development of National Curriculum Frameworks.
- National Education Policy 2020, MoE, Government of India
- National Steering Committee for National Curriculum Frameworks, (2023). Draft National Curriculum Framework for School Education.

*Teachers may also suggest books/readings as per the need of the learners and learning content.

4.4.13 Content cum Pedagogy of Home Science at Secondary Stage - Course (III)

Credit: 2
Semester: S-6

4.4.13.1 About the Course

A Home Science teacher must know about the various approaches, strategies, and techniques for the assessment and evaluation of learning among students. The Teacher must be competent to provide quality feedback and know the process of reporting. They should know how to enhance learning and plan future activities. The course comprises three units describing 21st Century Skills for Learning, Assessment and Evaluation in Teaching Home Science and Research and Innovative Practices in Teaching Home Science. The course deals with the role of teachers in facilitating learning and a dynamic learning environment, measurement of learning outcomes, providing feedback, reporting and construction of achievement tests. The course describes various evaluation strategies and devices which can be efficiently used in the teaching of Home Science and in the development of skills among the student teachers for improving student outcomes, conduct action research and school-based research in the teaching of Home Science. It focuses on the development of skills associated with Home Science and entrepreneurship.

4.4.13.2 Learning Outcomes

After completion of this course, student teachers will be able to

- discuss the need for and importance of how to learn,
- appraise 21st century skills for learners and teachers of Home Science,
- list the characteristics of Home Science teachers as professionals,
- create dynamic learning environment for Home Science teaching,
- summarize the need and importance evaluation and assessment in Home Science teaching,
- construct Table of Specification and write items,
- plan action research in the teaching of Home Science,
- adapt performance-based assessment for improving outcomes,
- design and maintain rubrics and portfolios.

UNIT - I

21st Century Skills for Learning

A. Need for and importance of how to learn, 21st century skills for learners and teachers of Home Science.
B. Psychological, sociological, and philosophical perspective of teaching and learning of Home Science.
C. Home Science teachers as professionals, characteristics, networking, and ethics.
D. Role of a teacher in facilitating learning and creating dynamic learning environment of Home Science.

UNIT - II

Assessment and Evaluation in Teaching of Home Science

A. Assessment and evaluation: need for and importance of Home Science.
B. Assessment based on learning outcomes, strategies for continuous assessment, finding gaps in learning and planning further activities for improvement, qualitative assessment, 360◦ assessment.
C. Performance based assessment, assessment of group activities, field observations, recording and reporting, creating platform and portfolio management, assessment of lab skills, assignments, projects, and presentations.
D. Tools and techniques of assessment and evaluation; unit test based on Table of Specification (TOS) and its importance; basic steps of question paper setting, types of test items and preparing answer key and criteria for school, assessment, and feedback mechanism in teaching of Home Science.

UNIT - III

Research and Innovative Practices in Teaching of Home Science

A. Divergent thinking and innovation in psychological, sociological, and philosophical perspectives for quality learning experiences in teaching of Home Science.
B. Recent trends in research related to teaching learning of Home Science, kinds of data in Home Science and its management.
C. Action research in Home Science, meaning, significance, steps and planning.
D. School based research in Home Science, evidence-based practices, and reflection.
E. Home Science, skill development and entrepreneurship such as tailoring, knitting, cooking, baking, embroidery, jewellery designing, budgeting.

4.4.13.3 Suggestive Practicum (Any Three)

1. Construct an Achievement test/ Table of Specialization.
2. Prepare a portfolio.
3. Find success stories related to skill development and entrepreneurship in Home Science and present/appreciate its uniqueness in the form of report.
4. Identify a problem and plan action research.
5. Conduct School Based Research, case studies, market surveys and prepare an evidence-based report.
6. Prepare a write-up on quality of learning experiences for teaching Home Science.
7. Any other project assigned by HEI.

4.4.13.4 Suggestive Mode of Transaction

Lecture cum demonstration, experimental method, observation method, project method, laboratory method, discovery, problem solving method, inquiry method, success stories, discussions, self-study, and experiential method.

4.4.13.5 Suggestive Mode of Assessment

Written test, classroom presentations, discussion forums, observation, research/study report, assignments, practicum, sessional and terminal examination (As per UGC Norms).

4.4.13.6 Suggestive Reading Materials:

- Food Safety and Standards Authority of India. Ministry of Health and Family Welfare, Government of India.
- National Council of Educational Research and Training. (April 2022). Mandate documents Guidelines for the development of National Curriculum Frameworks.
- National Education Policy 2020, MoE, Government of India
- National Steering Committee for National Curriculum Frameworks, (2023). Draft National Curriculum Framework for School Education.

*Teachers may also suggest books/readings as per the need of the learners and learning content.

Suggestive Web Links

- http://14.139.60.153/bitstream/123456789/6857/1/AGRICULTURAL%20EDUCATION%20IN%20INDIA-CSL-IOD_IO112637.pdf
- http://Arts.brighton.ac.uk/__data/assets/pdf_file/0004/65308/Susan-Orr-Artsicle-Issue-10-pp-9-13.pdf
- http://egyankosh.ac.in/bitstream/123456789/46799/1/BES-143B2-E.pdf
- http://egyankosh.ac.in/bitstream/123456789/6691/1/Unit-4.pdf
- http://pedagogybyvasu.blogspot.com/2015/08/unit-test.html
- http://www.bdu.ac.in/cde/docs/ebooks/B-d/I/TEACHING%20OF%20MATHEMATICS.pdf
- http://www.englishclub.com/
- http://www.language-education.com/eng/index.asp
- http://www.mocp.org/
- http://www.ncert.nic.in/departments/nie/dse/activities/advisory_board/PDF/teaching_maths.pdf
- http://www.ncert.nic.in/oth_anoun/npe86.pdf
- http://www.ncert.nic.in/rightside/links/pdf/framework/english/nf2005.pdf
- http://www.tnteu.in/pdf/3-maths.pdf
- https://actascientific.com/ASAG/pdf/ASAG-03-0669.pdf
- https://doi.org/10.1111/j.1476-8070.1990.tb00482.x
- https://doi.org/10.1201/9781003245759
- https://doi.org/10.5032/jae.2018.03001
- https://doi:10.5032/jae.2019.02085
- https://dpi.wi.gov/sites/default/files/imce/cal/pdf/planning-curriculum-in-Arts-and-design.pdf
- https://dsel.education.gov.in/sites/default/files/NCF2023.pdf
- https://egyankosh.ac.in/handle/123456789/46528
- https://en.unesco.org/silkroad/sites/default/files/knowledge-bank-Artsicle/vol_IVb%20silk%20road_Arts%20and%20crafts%20BIS.pdf
- https://files.eric.ed.gov/fulltext/ED484721.pdf
- https://indl.iitkpg.ac.in
- https://link.springer.com/chapter/10.1007/978-94-011-2968-8_5
- https://link.springer.com/chapter/10.1007/978-94-011-2968-8_7
- https://lup.lub.lu.se/luur/download?func=downloadFile&recordOId=9028066&fileOId=9028067
- https://mospace.umsystem.edu/xmlui/bitstream/handle/10355/14417/research.pdf?sequence=2&isAllowed=y
- https://ncert.nic.in/deaa/pdf/tpaev201.pdf
- https://ncert.nic.in/desm/pdf/phy_sci_partI.pdf
- https://ncert.nic.in/ncerts/l/hess404.pdf
- https://ncert.nic.in/pdf/Mandate-NCF.pdf
- https://ncert.nic.in/pdf/ncfse2023.pdf
- https://ncert.nic.in/science-laboratory-manual.php

- https://ncert.nic.in/textbook.php
- https://ncert.nic.in/textbook.php?jesc1=9-16
- https://ncert.nic.in/textbook.php?kecs1=0-11
- https://ncert.nic.in/textbook.php?khgv1=1-10
- https://ncert.nic.in/textbook.php?lefa1=1-8
- https://ncert.nic.in/textbook.php?lefa1=2-8
- https://ncert.nic.in/textbook.php?lefa1=3-8
- https://ncert.nic.in/textbook.php?lefa1=4-8
- https://ncert.nic.in/textbook.php?lefa1=5-8
- https://ncert.nic.in/textbook.php?lefa1=6-8
- https://ncert.nic.in/textbook.php?lefa1=7-8
- https://ncert.nic.in/textbook.php?lefa1=8-8
- https://ncert.nic.in/textbook/pdf/kecs1ps.pdf
- https://ncert.nic.in/textbook/pdf/lecs1ps.pdf
- https://ncert.nic.in/textbook/pdf/lehe103.pdf
- https://ncert.nic.in/textbook/pdf/lehe105.pdf
- https://ncert.nic.in/textbook/pdf/lehe106.pdf
- https://ncert.nic.in/vocational.php?ieft1=0-6
- https://ncert.nic.in/vocational.php?iepf1=0-8
- https://ncert.nic.in/vocational.php?iepg1=1-5
- https://ncert.nic.in/vocational.php?ievt1=1-3
- https://ncert.nic.in/vocational.php?ivas1=1-7
- https://ncert.nic.in/vocational.php?ivsm1=ps-5
- https://old.amu.ac.in/emp/studym/100008102.pdf
- https://sos.cg.nic.in/E-Books/12th/English/eng-book%20321%20Home%20Science/321_Home%20Science%20-%201%20(Final%20Book).pdf
- https://swayam.gov.in
- https://ualresearchonline.Arts.ac.uk/id/eprint/629/1/cltad_learningoutcomes.pdf
- https://www.academia.edu/3188050/Formative_assessment_in_Arts_and_Design
- https://www.biologyonline
- https://www.education.gov.in/sites/upload_files/mhrd/files/NCF-School-Education-Pre-Draft.pdf
- https://www.education.gov.in/sites/upload_files/mhrd/files/NEP_Final_English_0.pdf
- https://www.education.gov.in/sites/upload_files/mhrd/files/NEP_final_HINDI_0.pdf
- https://www.education.gov.pg/TISER/documents/pastep/pd-tm-7-2-general-teaching-methods-student.pdf
- https://www.fao.org/3/i2516e/i2516e.pdf
- https://www.granthaalayahpublication.org/journals/granthaalayah/article/view/IJRG22_A05_6154
- https://www.mooc.org
- https://www.nsead.org/files/6f85ab8587bc53ce653702da1cc15690.pdf
- https://www.oecd.org/education/skills-beyond-school/LearningForJobsPointersfor%20PolicyDevelopment.pdf

- https://www.researchgate.net/publication/253504153_A_Document_Analysis_Of_The_Pedagogical_Knowledge_Espoused_In_Agriculture_Teaching_Methods_Courses
- https://www.researchgate.net/publication/341659182_3_The_Role_of_Arts_in_School_Education
- www.ibe.unesco.org.
- www.teachtci.com

1.0 ABILITY ENHANCEMENT AND VALUE-ADDED COURSES

The Ability Enhancement and Value-Added Courses are designed to help student teachers acquire and demonstrate:

- knowledge and capacities in areas that are essential to a holistic education.
- capacities and values that are both useful to life as well as to a career in education.
- sensitivity, critical thinking and analytical capacities, reflection, sensibilities for dialogue and cooperative learning, aesthetic appreciation, and values for a sustainable world - all this in the context of India's rich and diverse cultural context.
- capacity to explore possibilities in different areas of learning, directly and indirectly connected to education.

Principles of Designing the Course

- The courses have a practical orientation in that they emphasize real-world application of ideas with special focus on application in the practice of education.
- Pedagogy across courses emphasize 'practice' and 'doing.'
- The courses facilitate breadth of knowledge rather than depth.
- The courses have emphasized on the capacities and values that are important for teachers.

5.1 Language 1 (As per the 8th Schedule of the Constitution of India)

Credits: 4
Semester: S-1

5.1.1 About the Course

Language has undeniable links with all kinds of learning. Language enables an individual to understand new concepts, exchange ideas and communicate thoughts with fellow beings. To appreciate fully the role of language in education, one must begin to develop a holistic perspective on language. Language needs to be examined in a multi-dimensional space, giving due importance to its structural, literary, sociological, cultural, psychological, and aesthetic aspects. The National Education Policy 2020 envisages imparting language skills as part of holistic education. It lays thrust on the need to enhance linguistic skills for better cognitive development and the development of a rounded personality of the learners. This course aims at enabling student teachers to enhance their ability to listen, speak, read, write and demonstrate linguistic skills in an effective manner. Linguistic skills - listening, speaking, reading, writing, speaking effectively - are fundamental to constructing knowledge in all academic disciplines, and. participating effectively in the world of work and creating sense in the everyday life. Through this course, the students will be able to enhance proficiency in reading with comprehension, understanding, thinking, and conceptualizing. The course seeks to enhance critical thinking abilities and effective communication skills of student teachers. The course involves hands-on activities and practical sessions that help student teachers develop and use linguistic skills in a variety of situations.

5.1.2 Learning Outcomes

After completing the course, the student teachers will be able to:

- Demonstrate knowledge and capacity for effective listening, speaking, reading, writing and critical thinking.
- recognize the link between language and cognition and using linguistic knowledge and skills for effective communication of ideas and thoughts.
- build inter-personal relationships and enhance social skills.

UNIT - I

Understanding Language, Communication and Cognition

A. Language, communication, and cognition; Definitions and functions of language. Types of communication, Language, culture and society, Bi-/Multilingualism in India, Language learning, translation, formal and informal communication, verbal and non-verbal communication, gestures language skills (listening, speaking, reading, & writing) and the new-age technologies. Language as a means of communication and language as a medium of cognition.

B. Nature and process of communication: principles, Definition, and types; Language: Definition, characteristics, functions; Language and society: language variation, language and dialect, language policy and language planning, language standardization; Multilingualism in Indian context, Language as a means of communication and language as a medium of cognition.

C. The process of communication, barriers to communication, written and oral

communication, the story of human communication from early times to new age; Language variation, Multilingualism.

D. Context of communication, the role of decoder, face to face interaction, turn taking, conversation, politeness principles, opening and closing, regional variation, social variation, the standard language.

UNIT - II
Understanding Grammar

A. Classification of speech sounds and letters, stress, pitch, tone, intonation and juncture, parts of speech, identification of morphemes, word formation processes, sentences-simple, complex, and compound, semantics and pragmatics, lexical semantics, speech acts.

B. Production of speech sounds in languages; Suprasegmentals: stress, pitch, tone, intonation; Word formation processes; Sentence formation, semantics, and pragmatics.

C. Identification of morphemes, word formation processes; Sentence formation, vocabulary formation; Pragmatics and speech acts.

D. Sound production in the language; Coining new words, Speech acts.

UNIT - III
Reading Skills

A. Reading comprehension, types of reading, text, meaning and context, reading as an interactive process; strategies for making students active readers and developing critical reading skills; Understanding denotative and connotative aspects of a text, Vocabulary development through reading.

B. Features that make texts complex, reading as an interactive process; Strategies for making students active readers and developing critical reading skills; Understanding denotative and connotative aspects of a text, Vocabulary development through reading.

C. Reading discipline-based texts; vocabulary development

UNIT - IV
Writing Skills

A. Speech versus writing; Types of writing; writing for specific purposes (essays, letters, and reports).

B. Language and style of Writing; Dealing with New Words (Academic Vocabulary Building)

C. Summarizing and Paraphrasing techniques.

UNIT - V
Speaking skills

A. Speaking to learn and learning to speak; situational conversations and role plays; tasks/activities for developing speaking (speech, elocution, discussion, debate, storytelling, illustrations).

B. Activities for developing speaking, role play; The impact of culture on speaking.

C. Presentation and speaking skills; Practicing narrative skills; Body language, voice, and pronunciation; Creating interest and establishing a relationship with the audience.

UNIT - VI
Listening Skills

A. Why listening is important; kinds of listening; Listening strategies.
B. Need for modelling good listening behaviour; Listening across the curriculum, note taking.
C. Listening Comprehensions and Recorded speeches/texts; Understanding of various accents.

UNIT - VII
Academic writing

A. Academic writing components; development of academic language; Activities to develop academic writing skills.
B. Developing Critical, analytical, and interpretive thinking skills.
C. Learning to analyze.

UNIT - VIII
Critical thinking

A. Enhancing Critical thinking abilities; Critical Interpretation, Questioning and Challenging your Beliefs and Values; developing ideas and evaluating an argument.
B. Observing a problem, describing the problem, framing the problem, comparing, and evaluating a problem.

5.1.3 Suggestive Practicum

1. How do you interpret every day and reflect what you read? Prepare a report.
2. Analyze a recorded video from the perspective of voice and pronunciation and write a report.
3. Observing, describing and frame a problem and evaluating it.

5.1.4 Suggestive Mode of Transaction

Teaching this course will involve a mix of interactive lectures, tutorials, and practical involves such as discussion, role plays, projects, simulations, workshops, and language-awareness activities. The teaching intends deeper approaches to learning involving in- class room discussion, developing the critical thinking/ problem solving abilities among the students and will also focus on situations where in our daily lives the one would be performing tasks that involve a natural integration of language skills. The students are expected to read assigned chapters/ articles before the session and the course requires active participation from the students.

5.1.5 Suggestive Mode of Assessment

The assessment of the learner will be primarily based on the assessment of both linguistic and communicative skills using a battery of tests and test types, group work and projects.

5.1.6 Suggestive Reading Materials

Teachers may suggest books/readings as per the need of the learners and learning content.

5.2 Language 2 (Other than L1)

Credit 4
Semester S-2

5.2.1 About the Course

The course aims to prepare the students to teach language at the school level. It focuses on training the students to the sounds systems of languages, word formation processes, sentence formation, semantic and pragmatic aspects of languages. The course intends to enable the learners to integrate all the four language skills using different genres. The major aim of this course is to empower the learners to contribute to the discourses on various issues and themes. The course also orients the students to the use of different technology and digital media for developing their own communicative skills as well as the school students they would teach in the future. The course helps improve basic communication skills such as listening, speaking, reading, and writing skills among L2 language learners. The course is designed to enhance knowledge of grammar of L2 and enable the students to formulate grammatically correct and contextually appropriate sentences and words and empower the students with summarizing skills, oral presentations skills effectively. The course also seeks to enhance students' critical thinking capacities and demonstrate effective communication skills and provide hands-on activities to student teachers to develop their linguistic skills through practical sessions.

5.2.2 Learning Outcomes

After completing the course, student teachers will be able to:

- demonstrate reading, writing, listening, speaking, and thinking abilities in L2,
- recognize the link between language and mental skills and demonstrate their knowledge and skills effectively for all purposes,
- build inter-personal relationships and enhance social skills.

UNIT - I
Language, Society, and learning

A. Bi-/Multilingualism and scholastic achievements; need to promote multilingualism; Language variation and social variation; languages, dialects and varieties, cultural transmission of language, language, and gender; language and identity; language and power; constitutional provisions and National Education Policy 2020.
B. Language acquisition and Language learning; language learning from mother tongues to other tongues; advantages of learning other languages; language and education; notion of first language, second language and others.

UNIT - II
Speech and Writing

A. Writing Systems: Speech and writing; arbitrariness in language; types of writing systems.
B. Classification sessions of speech sounds: vowels, consonants, and others; suprasegmental: stress, pitch, tone, intonation, and juncture; Acoustic phonetics.

UNIT - III

Understanding Grammar

A. Word and meaning; parts of speech, grammatical categories; word formation: affixation, compounding, reduplication, vocabulary building.

B. Sentence and its constituents: simple, complex, and compound sentences; Semantics and pragmatics: lexical meaning- synonymy, antonymy, meronymy, grammatical meaning, speech acts.

UNIT - IV

Basic Communication Skills in L2

A. Pronunciation and listening comprehension skills.

B. Reading and reading comprehension skills.

C. Effective writing skills; effective presentation and speaking skills; summarizing and paraphrasing skills.

UNIT - V

Critical Reading and Thinking Skills

A. Components of critical thinking and reading; high order cognitive development; critical thinking and problem solving; rational inquiry.

5.2.3 Suggestive Practicum

1. Listen to a recorded speech and classify it based on sounds: vowels, consonants, and others; suprasegmental: stress, pitch, tone, intonation, and juncture; Acoustic phonetics.
2. Analyze sentences and their constituents as simple, complex, and compound sentences from written work.

5.2.4 Suggestive Mode of Transaction

Teaching this course will involve a mix of interactive lectures, tutorials, and practical involves such as discussion, role plays, projects, simulations, workshops and language-awareness activities. The teaching intends deeper approaches to learning involving in- class room discussion, developing the critical thinking/ problem solving abilities among the students and will also focus on situations where in our daily lives the one would be performing tasks that involve a natural integration of language skills. The students are expected to read assigned chapters/ articles before the session and the course requires active participation from the students.

5.2.5 Suggestive Mode of Assessment

The assessment of the learner will be primarily based on the assessment of both linguistic and communicative skills using a battery of tests and test types, group work and projects.

5.2.6 Suggestive Reading Materials

Teachers may suggest books/readings as per the need of the learners and learning content.

5.3 Art Education (Performing and Visual) and Creative Expressions

Arts - Approach

1. Every student has to complete two courses in the Arts of 2 credits each across the Visual and Performing Arts.
2. There are many art forms within both the Visual and Performing Arts.
3. All these forms require teacher expertise as well as time and resources for the student to learn.
4. We have described **three exemplar arts courses** based on different forms of Visual and Performing Arts.
5. Institutions could choose to offer any specific art form based on the availability of faculty and resources. Institutions could then design their courses based on these three exemplars.

5.3 Art Education (Performing and Visual) and Creative Expressions
Exemplar 1 - Puppetry

Credits 2
Semester S-1 and S-7

5.3.1 About the Course

Engagement with various forms of art as self-expression and need to develop sensibility to appreciate them has been an important concern in educational theory and practice. This concern is premised on the claim that forms of self-expression contribute immensely to the development of cognitive, affective, and psycho-motor dimensions among children, as well as that through one or another art form, children come to explore ways of expressing themselves. Further, it is also the case that critical appreciation of art enables children to form judgments of a very special kind, namely, aesthetic judgment. This enables students as they grow into adults to have focused attention on making sense of and appreciating cultural productions.

Children enjoy artwork a lot. They explore and find meaning in artwork. Their psycho-motor skills get developed through art. The huge element of socialization is acquired through different forms of art. They get to know each other and understand each other and make friends through art. They develop their peer group through getting involved in art forms. Learning to work with others is also achieved through art. It gives them space to think independently, create and reflect. It is one space where all the three are involved- hand, head, and heart.

Therefore, educational practitioners that the students of MA Education aim to be, will need to bring an element of art in practices that they engage in. To be able to do this, they need an appreciation of art in general, familiarity with one art form, and basic skills and capabilities to be creative and artful. Additionally, they should be familiar with some critical debates in art education, even if their work is in other subject areas.

To this end in the first semester students will do one course that aims to help them recognize and appreciate the importance of aesthetic judgment, develop familiarity with an art form and basic skills to be creative and artful in their expressions. Skills develop from practice, therefore hands-on training in doing art will be emphasized in this course. This course aims to help students develop a habit of performing skillful activities that are essentially aesthetic and artful which is expected to contribute to other educational practices that they develop in other courses in the programme. Therefore, this course will explicitly relate this skill to activities that practitioners of education engage in, like teaching, development of teaching-learning material, and content of other subject areas wherever possible.

Puppetry

Puppetry is an integrated art form, which takes into its fold everything from fine arts to performance. Puppetry is one of the oldest forms of performing art. Puppetry has evolved over the years into a sophisticated form of art. The journey was very interesting with a lot of ups and downs. There are thousands of forms of puppetry from simple finger puppets to highly complex puppets played by more than 3 people. Each country has a puppet form, why country, each area in a country has a puppet form. Hence, in India you will find many, many forms of puppetry.

In puppetry there are two main aspects. One the designing and creating of puppets and the other playing or performing puppetry. These two skills are different. Designing will need a lot of thinking, visualization, and technical skills while performance will need high level

communication skills. Hence, together they make a consolidated a high range of skills. In this course, students are exposed to different forms of puppets and puppetry. There will be a discussion around the forms and the aesthetic sense of puppetry. Later the students are encouraged to prepare, design and create puppets. They then prepare script and play the puppets. This creation of the puppets together in small groups with a lot of discussions and give and take helps the students develop working together skills and conceptual understanding.

Learning Outcomes

After completion of this course, student teachers will be able to:

- articulate the importance of aesthetics and art in elementary education,
- demonstrate their familiarity with and appreciation of puppetry,
- design puppets,
- practice and create a short puppetry show.

UNIT - I

Importance of Aesthetics and Art education (2 Sessions)

In this unit the basic idea of aesthetics and art, and ways in which the aesthetic dimension manifests itself in human life will be discussed. Using various examples of art, students will engage in identifying aesthetic aspects of daily life, develop aesthetic judgment, and gain familiarity with the role of art in education. Students will also be introduced to three aspects of art in education: The value of art itself and its use as an instrument in education; moral dimensions of works of art and the controversial distinction between the value of Popular art and High art.

UNIT - II

Designing Puppets (6 Sessions)

In this unit, students will learn about puppetry, its history and specifically about how puppets work. This unit will also discuss the imagination required to design puppets, visualize how puppets will be used and the technicalities of designing puppets. These will be learnt by designing puppets. Students will start with constructing finger puppets and move towards small shapes through papers, like Fish, birds, rat - then they will design masks, flat masks, and masks with dimensions. At the end they will design puppets with old newspaper. The puppets are designed with old newspapers and colour papers. They decorate it and design it in such a way that it can be played, performed. They prepare costumes and all other accessories.

UNIT - III

Performing the puppets (4 Sessions)

This unit will engage in performance of puppetry and the level of communication skills required to create a good engaging story and perform it with the help of puppets they have created. The performance will be expected to relate to some activity in the educational context. Students will perform the puppets they have designed. Initially each member will play their own puppets. Later they will play in pairs, later they will be formed into a small group and asked to prepare their own skits with the puppets. They conclude by performing in small groups. Their learning is consolidated and reflected.

Discussion is held on how different aspects of puppet making can be incorporated in class room processes of young children. Adapting the individual and group exercises done during the puppetry course will be discussed to be used in the classroom situation.

5.3.3 Pedagogy

The Pedagogy is basically hand-on training. More emphasis is given to experiential learning. They do things and through doing learn about art and its connection to education. The process takes you through different forms of art- fine arts, playing with colours, costume designing, facial make -up, script writing, music, and performance.

5.3.4 Suggestive Mode of Assessment

Details to be determined by the faculty member as per applicable UGC norms.

Week wise break up of sessions			
Sl. no	**Topics**	**Session flow**	**Remarks**
1	Aesthetics and art, art in everyday life.	Based on their experience	
2	Importance of art. Appreciation of art.	Discussion	
3	Art for art sake. Art with social responsibility. art for social change	Debate	
4	The world of puppetry. Different forms of puppetry.	Presentations	
5	History of puppetry	Lecture	
6	Preparation- finger puppets	Hands on	
7	Preparation of masks	Hands on	
8	Preparing puppets	Hands on	
9	Performing individually	Practice	
10	Performing in pairs	Practice	
11	Performing in groups – 3, 4, 5.	Practice	
12	Assignments	Written.	

5.3.5 Suggestive Reading Materials

Teachers may suggest books/readings as per the need of the learners and learning content.

5.3 Arts (Performing and Visual) and Creative Expressions
Exemplar 2 - Theatre

Credits 2
Semester S-1 and S-7

5.3.1 About the Course

The engagement with various forms of art as self-expression and the need to develop a sensibility to appreciate them has been an important concern in educational theory and practice. This concern is premised on the claim that forms of self-expression contribute immensely to the development of cognitive, affective, and psycho-motor dimensions among children, as well as that through one or another art form that children come to explore ways of expressing themselves. Further, it is also the case that critical appreciation of art enables children to form judgments of a very special kind, namely, an aesthetic judgment. This enables students as they grow into adults to have focused attention on making meaning of what surrounds them and in appreciating cultural productions.

Children are naturally tuned to appreciate art, as it activates their senses. Further, their psycho-motor skills get developed through art. It gives them space to think independently, create and reflect, while working with others. It is a unique space where all the three are involved- hand, head and heart.

Therefore, students who aim to be educational practitioners, will need to bring an element of art in educational practices that they engage in. To be able to do this, they need an appreciation of art in general, familiarity with one art form, and basic skills and capabilities to be creative and artful.

To this end in the first semester students will attend one course that aims to help them recognize and appreciate the importance of aesthetic judgment, develop familiarity with an art form and basic skills to be creative in their expressions. Skills develop from practice, therefore hands on training in doing art will be emphasised in this course. This course aims to help students develop a habit of improvising on theatrical performances that include following aesthetic judgement at all stages, which will contribute to other educational practices that they develop in the larger programme. Therefore, this course will explicitly relate this skill to activities that practitioners of education engage in, like teaching, development of teaching-learning material, and also producing content of other subject areas wherever possible.

Theatre

Theatre is a collaborative art form, and it is inherently interdisciplinary in its nature. It comprises many facets and skills like acting, directing, writing, designing the sets and costumes, make-up, production, lights, sounds and music. All these elements and skill sets come together and are stitched in the form of a 'play' which is performed live, in front of an audience. In the Indian context, theatre has a deep-rooted history with its classical, folk, and other cultural forms until other contemporary forms of theatre evolved in recent times.

Theatre education for children can play a vital role in their individual, social, and emotional development. It teaches them the values of trust and interdependence, makes them confident to express themselves and helps them learn to work in a collaborative environment. It develops their ability to contextualise, critique and discuss certain questions and thoughts they encounter in everyday life. It further helps them imagine, explore, and create their own narratives.

In this course, we will briefly talk about the aesthetics of theatre and how theatre exists in different forms. The students will learn some basic theatre tools that will help them create and perform a narrative they collaboratively arrive at.

In simple terms one can say theatre has two major aspects i.e., creating the script and then performing it. Body is the primary instrument in any theatrical performance accompanied by text, material, visual and sound. This course will introduce students to these aspects of any theatre performance, in the form of direct experience by doing this themselves.

5.3.2 Learning Outcomes

After completion of this course, students will be able to:

- articulate the importance of aesthetics and art in elementary education,
- demonstrate their familiarity with and appreciation of theatre,
- learn basic theatre tools of improvisation, ideation, and creation of a script,
- create a short performance with educational possibilities.

UNIT - I

Importance of Aesthetics and Art education (2 Sessions)

In this unit the basic idea of aesthetics and art, and ways in which the aesthetic dimension manifests itself in human life will be discussed. Using various examples of art, students will engage in identifying aesthetic aspects of daily life, develop aesthetic judgment, and gain familiarity with the role of art in education. Students will also be introduced to three aspects of art in education: The value of art itself and its use as an instrument in education; moral dimensions of works of art and the controversial distinction between the value of Popular art and High art.

UNIT - II

Introduction to Theatre, and Beginning with the body (3 Sessions)

We will discuss some core essentials in the aesthetics of theatre like the performance, the makers, the audience, and the context and how we relate this to the world around us, in everyday lives. In this unit, we will discuss examples of how theatre was used in social movements that have contributed to educating the larger population about important social issues. Additionally, we will also learn from practices and approaches of theatre groups like Budhan Theatre who work with denotified tribes, and Manalmagudi who work closely with physical nonverbal theatre. Exposing students to these approaches will lead to rich discussions on the role of theatre in pedagogy and practice.

In this unit, students will learn certain principles and awareness on how to use their body and voice in a given space and time, with respect to other bodies. There will be several games, exercises that will familiarise them with certain basics of movement, voice, acting and thereby create improvisations and images in a given context. The activities and tasks will be both in individuals and groups.

UNIT - III
Arriving at a script
(3 Sessions)

We will engage in some theatre making processes to arrive at a script by the end of this unit. How to adapt or devise a script with actors? How can we borrow from everyday experiences of memory, sound and visuals, without a written text or spoken word? Plays, stories, poems, newspapers articles, will be shared to read, reflect, analyse, and re-create like "Why, why Girl" by Mahashweta Devi, "Ratna Pakshi" by K Ramaiah, "Beyond the land of Hattamala and Scandal in Fairyland" by Baadal Sircar, and songs of Kabir etc. The texts chosen will have a direct relation with topics from social studies, moral and political education.

Students will use their skills of improvisation they learned in Unit 2 to explore, ideate, create, and finally arrive at a script. What kind of stories, narratives, and characters they choose to perform will lead back to the discussion of aesthetics. Students will mostly work in groups to choose or create a text, concept, or an idea which they want to perform. Students will be encouraged to use their perspectives on the education system, in converting the text into a script.

UNIT - IV
Performing the script

This unit will engage in the actual making of the final piece they choose to make. Students will have to visualise the final text on stage and start rehearsing in their groups. Apart from using their bodies to play characters, the students will also have to think about design and other aesthetic elements like sets, props, costumes, lights, music and sounds they want to use in the performance.

Students will have to practice beyond the six classes as the class time will be utilised to discuss and provide feedback as the work progresses. The last two classes in this unit will be utilised for the final rehearsals and assessments. The final performance will take place in front of a small audience followed by a brief post-performance discussion. Students will engage in discussing and reflecting on the views, questions and comments shared by the audience.

5.3.3 Pedagogy

The pedagogy is basically hands-on training. More emphasis is given to experiential learning. They do things and through doing, they learn about art and its connection to education. The process takes you through different forms of art- fine arts, playing with colours, costume designing, facial make -up, script writing, music, and performance.

5.3.4 Suggestive Mode of Assessment

Details to be determined by the faculty member as per applicable UGC norms.

Week wise break up of sessions		
Week	**Topics**	**Session flow**
1	**UNIT - I:** Aesthetics and art, art in everyday life. Importance of art. Appreciation of art	Based on their experience
2	Art for art's sake. Art with social responsibility. Art for social change	Discussion
3	**UNIT 2:** Aesthetics of Theatre	Discussion
4	Body work - Individual and group	Hands on
5	Body work – Improvisation	Hands on
6	**UNIT - III:** Adaptation of texts. Aesthetic choices.	Hands on, discussion
7	Story making and devising	Hands on
8	Arriving at a text	Hands on
9.	**UNIT - IV:** Visualising the final piece. Thinking about design and aesthetic elements.	Hands on, Discussion
10.	Rehearsals and feedback	Hands on
11.	Rehearsals and feedback	Hands on
12.	Final rehearsals and assessment	
13.	Finals rehearsals and assessment	
14.	Performance and audience discussion	

5.3.5 Suggestive Reading Materials

Teachers may suggest books/readings as per the need of the learners and learning content.

5.3 Arts (Performing and Visual) and Creative Expressions
Exemplar 3 - Collage-Making

Credits 2
Semester S-1 and S-7

5.3.1 About the Course

Engagement with various forms of art as self-expression and the need to develop sensibility to appreciate them has been an important concern in educational theory and practice. This concern is premised on the claim that forms of self-expression contribute immensely to the development of cognitive, affective and psycho-motor dimensions among children, as well as that through one or another art form, children come to explore ways of expressing themselves. Further, it is also the case that critical appreciation of art enables children to form judgments of a very special kind, namely, aesthetic judgment. This enables students as they grow into adults to have focused attention on making sense of and appreciating cultural productions.

Children enjoy artwork a lot. They explore and find meaning in artwork. Their psycho-motor skills get developed through art. The huge element of socialization is acquired through different forms of art. They get to know each other and understand each other and make friends through art. They develop their peer group through getting involved in art forms. Learning to work with others is also achieved through art. It gives them space to think independently, create and reflect. It is one space where all the three are involved- hand, head, and heart.

Therefore, educational practitioners that the students aim to be, will need to bring an element of art in practices that they engage in. To be able to do this, they need an appreciation of art in general, familiarity with one art form, and basic skills and capabilities to be creative and artful. Additionally, they should be familiar with some critical debates in art education, even if their work is in other subject areas.

To this end, students will do one course that aims to help them recognize and appreciate the *importance of aesthetic judgment*, *develop familiarity with an art form* and basic skills to be *creative and artful in their expressions*. Skills develop from practice, therefore hands-on training in doing art will be emphasized in this course. This course aims to help students develop a habit of performing skillful activities that are essentially aesthetic and artful which is expected to contribute to other educational practices that they develop in other courses in the programme.

Therefore, this course will explicitly relate this skill to activities that practitioners of education engage in, like teaching, development of teaching-learning material, and content of other subject areas wherever possible.

Collage as visual art medium

A major aspect of college, and one that is sometimes overlooked, is the incredibly diverse array of materials and objects that can be used. Collecting interesting materials is an ongoing activity for artists and for those who teach college. But it is just as important for young people to hunt for and make decisions about materials they would like to incorporate into their work. All materials, and the alterations that artists make to them, are suggestive of ideas and concepts based on their surfaces, forms, textures, degree of transparency and opacity, color, and other visual characteristics. Materials also connect us, through association and reference, to social and cultural worlds and places. What ideas might a scrap of newspaper, as a collage material,

express? How might these meanings differ from those of, say, feathers? Or twigs? Or a thin piece of plastic cut out from a plastic bag?

Working with and creating artwork in Collage involves various aspects: selecting materials, manipulating materials, investigating materiality, closely observing materials, discovering possibilities, composing, designing the artwork, planning, finding solutions, applying solutions, thinking flexibility, decision-making, research, using imagination, expressing, taking creative risks, develop perseverance, and much more. Students will also be introduced to various aspects of art in education: The value of art and artmaking by itself, art's use as an instrument in education, social and moral dimensions of art, and the controversial perceptions around good art and bad art.

This course aims for students to understand the importance of aesthetics and art in education, the role art can play in education, and mainly to appreciate, understand and gain skills with the medium of collage and its techniques.

5.3.2 Learning Outcomes

After completion of this course, students will be able to:

- articulate the importance and the role of aesthetics and art in education.
- understand the medium of collage and its versatility.
- design, plan, and create an expressive self-portrait collage by applying a variety of collage techniques.
- design and set up an interactive visual art exhibition to display their artworks.
- understand and appreciate art-based learning experiences.
- develop the ability to reflect and challenge their assumptions and beliefs around art and develop new understandings.

UNIT - I

Understand the importance of Aesthetics and Art in Education (2 Sessions)

Students will be introduced to Aesthetics and Arts by engaging in experiences, discussions, and dialogues. Students will experience a session of 'Visual thinking strategy' (VTS) activity in which students will collectively view and engage in a series of artworks closely, share their observations, critically analyze their observations, listen to multiple perspectives from peers, suspend judgements, and draw their own understanding of the artwork. Students will recognize aesthetic and un-aesthetic experiences through compare and contrast. Through this activity and unpacking of the experience, students will start making connections and develop understandings around what aesthetics mean, aesthetic aspects of daily life, develop aesthetic judgment, and how arts evoke emotion and awaken.

UNIT - II

Exploring paper collage and its techniques (4 Sessions)

Students will be introduced to the medium of collage and open their minds to the possibilities within this medium. Students will view and discuss examples of collage artworks, artist process and artist interview videos. Students will get a chance to compare and contrast various ways collage as a medium is used. Students will reflect upon their own past art educational experiences and observations and engage in dialogue and discussions. Students will analyze effective and ineffective ways of using the medium of collage in educational and other settings.

Through inquiry-based participatory demonstrations, students will investigate and discover a variety of ways to manipulate paper and create individual and unique two-dimensional compositions in the medium of paper Collage. They will understand and learn the techniques, artistic terminologies of the collage medium. Students will reflect on their experience and engage in facilitated discussions to deepen their understanding on the role of art medium exploration and how it can foster various learning skills.

Students then use their knowledge and experience from the previous sessions and explore collage as a medium further. Students will investigate, discover, and learn to create visual textures, physical textures, and create their own unique patterns. They will understand the difference between textures and patterns. Students will use a variety of techniques to create unique textures and patterns, analyze their findings, give each other feedback, work in groups to problem solve, etc. They will understand how art medium explorations can be used as a pedagogical tool in learning environments.

Students will bring in various materials found around them like different kinds of paper, paper-based materials, natural materials, fabric, and explore these materials and use them as materials to create collage compositions. Students will explore a wide range of techniques and discover their own ways to manipulate these found materials to create interesting textures and patterns. Students will work in groups, problem solve, investigate, develop solutions on their own, and share their findings with each other. Through discussions, students will reflect upon this exploration experience and understand how art making processes can develop skills and abilities in a learner.

Resource Videos

1. *Works of Deborah Roberts, William Kentridge, Wangechi Mutu, etc*
2. *Marc, Cut paper collage artist - https://www.youtube.com/watch?v=WgRZlWl-Oh0*
3. *G. Subramanian: Collage art - https://www.youtube.com/watch?v=ioRRi9R46a0*
4. *Amber Fletschock, Collage artist - https://www.youtube.com/watch?v=aa7p1vYqUc4*
5. *Arturo Herrera, artist - https://www.youtube.com/watch?v=Oagx3_NZ5HU*

UNIT - III

Ideating for an Expressive Self-Portrait (2 Sessions)

In this session students will further explore and discover possibilities in Collage as a medium. Students will learn a variety of ways to make paper stands and create interesting paper sculpture compositions using 3D techniques. Students will draw from their previous experiences of using paper for 2D explorations and add more interest to their unique 3D explorations. Students will share their findings with peers and widen their understanding about the possibilities. Students will reflect on all the material exploration sessions thus far and participate in a facilitated dialogue around art making and education.

Students will engage in a close observation sketching and drawing activity. Through a guided process, students will create a well observed self-portrait drawing. Students will engage in discussions and dialogue to unpack the self-portrait drawing experience, the learnings, discoveries, challenges and more. Through this activity students will also be able to challenge assumptions around talent and art-making.

Resources: Handouts out on Collage techniques and artist examples
Resources: JR's Face to face project (videos and readings) https://www.youtube.com/watch?v=4u_G0G6Jog4

UNIT - IV

Creation of an Expressive Self-Portrait Collage (3 Sessions)

Students will engage in a step-by-step process involving sketching, ideating, planning, applying their discoveries of using paper as a collage material, and finally create a large expressive self-portrait using the medium of paper collage. Throughout the process students will problem-solve, critically think, push their imagination, find multiple solutions, make independent decisions, receive and give peer feedback, use resources effectively, draw from their own experiences, apply their learnings into creating this unique and expressive self-portrait piece.

UNIT - V

Designing and setting up an Exhibition (2 Sessions and Exhibition Day)

Students will collectively start designing and planning for the exhibition to put up their artworks for a general audience to view and engage with. Students will be planning the various aspects of a visual art exhibition: ways to display artworks, designing the layout of the exhibition space and how the audience will move within the space, design invitations, ways that the audience can engage with the artworks, various ways the artists can talk about their art-making, and more. Students will divide the tasks among themselves, take on the various roles required, and set up the exhibition space.

Resources: Planning templates

5.3.3 Pedagogy

- Students will engage in hands-on art making activities.
- Students will engage in discussions and dialogues with peers.
- Students will engage in giving and receiving peer feedback.
- Students will continually reflect on their learning through journaling.
- Students will work independently and collaboratively throughout the course.
- Students will receive reference materials and resources to broaden and deepen their understanding.

5.3.4 Suggestive Assessment

Details to be determined by the faculty member as per applicable UGC norms.

5.3.5 Suggestive Reading Materials

Teachers may suggest books/readings as per the need of the learners and learning content.

5.4 Understanding India (Indian Ethos and Knowledge Systems)

Credits 2
Semester: S-1

5.4.1 About the Course

At a time when the world finds itself deep in dynamism, led by technological innovations and environmental changes, there is a need for an inward-looking approach to building the young minds of a country. By looking inwards, one not only finds a sociological belongingness but also a spiritual and intellectual rooting in these changing times. The course provides an overview of India's heritage and knowledge traditions across key themes of economy, society, polity, law, environment, culture, ethics, science & technology, and philosophy. It places special emphasis on the application of these knowledge traditions, helping students to noy only know and appreciate India's heritage and knowledge traditions but also to independently evaluate them through a multidisciplinary lens. This evaluation would produce valuable lessons for obtaining transferable and 21st-century skills. The course requires no pre-requisite knowledge or understanding. Spread over two years, the course will establish foundational knowledge and build upon it. It will allow students to have a basic understanding of the traditions of India and how it has evolved over the years. The course is designed to enable student teachers to outline and interpret the processes and events of the formation & evolution of knowledge of India through a multidisciplinary lens; to evaluate the diverse traditions of India to distinguish its achievements and limitations, and to develop and articulate an ethics-based education rooted in Indian thought to their students in the classroom context.

5.4.1 Learning Outcomes

After the completion of the course, students will be able to:

- recognize the vast corpus of knowledge traditions of India, while developing an appreciation for it,
- apply their acquired research and critical thinking skills in multidisciplinary themes,
- summarize and pass on their learnings to their students of different Indian traditions in an easily digestible manner.

UNIT - I

Introduction to the Knowledge of India

A. Definition & scope; Relevance of this knowledge.
B. Need to revisit our ancient knowledge, traditions, and culture.

UNIT - II

Culture - Art and Literature

A. Fine arts (traditional art forms, contemporary arts, arts & spirituality, arts and Identity, and art and globalization);
B. Performing Arts (Indian dance systems, traditional Indian pieces of music, visual arts, folk arts, etc.,).
C. Literature (Sanskrit literature, religious literature, Indian poetry, folk literature, Indian fiction, Sangam literature, Kannada, Malayalam literature, Bengali literature, etc.

UNIT - III
Polity and Law

A. Kingship & types of government (oligarchies, republics); Local administration (village administration);
B. Basis of Law: Dharma & its sources; Criminal Justice: police, jails, and punishments; Lessons from Chanakyaniti; Lessons for modern-day India: Towards a tradition-driven equitable and just polity and law system.

UNIT - IV
Economy

A. Overview of the Indian Economy from the Stone Age to the Guptas: The new culture of Urbanization (including castes, guilds, and other economic institutions; Harappan civilization economy; growth of agriculture and proliferation of new occupations; growth of writing);
B. Internal & external trade and commerce, including trade routes, Indo-roman contacts, and maritime trade of South India; Temple economy.
C. Land ownership - land grants & property rights, land revenue systems.
D. Understanding Arthashastra: Ideas & Criticism; Locating relevance of ancient Indian economic thought in modern-day Indian Economy.

UNIT - V
Environment & Health

A. Understanding Equilibrium between Society & Environment: Society's perceptions of natural resources like forests, land, water, and animals.
B. Sustainable architecture & urban planning; Solving today's environmental challenges (best practices from indigenous knowledge, community-led efforts, etc.).
C. India's Health Tradition: Ayurveda, Siddha, Ashtavaidya, Unani, and other schools of thought; Lessons from Sushruta Samhita and Charaka Samhita;
D. Mental health in ancient India: towards time-tested concepts of mental wellness (concept of mind, dhyana, mind-body relationship, Ayurveda, yoga darshan, atman, etc.)

5.4.3 Suggestive Practicum

The modes of curriculum transaction will include lectures, Tutorials, and Practicum.

- Practicum will include organization of day trips that help student teachers watch events relating to visual and performing art; activities that enable student teachers to identify and record through photos, videos, etc. the elements of ancient architecture still existing in the city around them; organization of Individual and group presentations based on themes such as Polity, Law and Economy etc., organization of a 'Knowledge of India' day in the institution to celebrate the culture (food, clothes, etc.) that they would have been explored in lectures and tutorials; interactions with family members, elders, neighbors, and other members of society about the evolution of local systems and economy etc.

5.4.4 Suggestive Mode of Transaction

- Lectures will include learner-driven participatory sessions, and Guest lectures through experts and practitioners, such as fine arts and performing arts practitioners along with contemporary poets & writers of Indian literature.

- Tutorials will include Screening of documentaries and films followed by a discussion; Learner-driven discussions in the form of focus group discussions (FGDs), Socratic Discussions, etc.; Debate/discussion can be organized to explain India's Vaad tradition; discuss on how some of the ancient methods of teaching are relevant in today's time; discussions that help Identify ethical dilemmas in daily lives and understanding the importance of ancient ethics and values to resolve them.

5.4.5 Suggestive Mode of Assessment

The approaches to learning assessment will include, for example:

- Supporting the curiosity and interest of student teachers in the selected themes through a multi-modal approach, including regular assessments and actionable feedback that enable learners to outline and interpret the processes and events of the formation & evolution of knowledge of India through a multidisciplinary lens.
- Enabling the student teachers to demonstrate critical analysis and independent thinking of the processes and events in the formulation & evolution of different traditions that help student teachers evaluate the diverse traditions of India to distinguish its achievements and limitations.
- Use of first-hand or second-hand experiences that enable student-teachers to develop and articulate an ethics-based education rooted in Indian thought to their students in the classroom context.

5.4.6 Suggestive Reading Materials

Teachers may suggest books/readings as per the need of the learners and learning content.

5.4 Understanding India (Indian Ethos and Knowledge Systems)

Credits 2
Semester: S-2

5.4.1 About the Course

At a time when the world finds itself deep in dynamism, led by technological innovations and environmental changes, there is a need for an inward-looking approach to building the young minds of a country. By looking inwards, one not only finds a sociological belongingness but also a spiritual and intellectual rooting in these changing times. The course provides an overview of India's heritage and knowledge traditions across key themes of economy, society, polity, law, environment, culture, ethics, science & technology, and philosophy. It places special emphasis on the application of these knowledge traditions, helping students to not only know and appreciate India's heritage and knowledge traditions but also to independently evaluate them through a multidisciplinary lens. This evaluation would produce valuable lessons for obtaining transferable and 21st-century skills. The course requires no pre-requisite knowledge or understanding. Spread over two years, the course will establish foundational knowledge and build upon it. It will allow students to have a basic understanding of the traditions of India and how it has evolved over the years. The course is designed to enable student teachers to outline and interpret the processes and events of the formation & evolution of knowledge of India through a multidisciplinary lens; to evaluate the diverse traditions of India to distinguish its achievements and limitations, and to develop and articulate an ethics-based education rooted in Indian thought to their students in the classroom context.

5.4.2 Learning Outcomes

After the completion of the course, students will be able to:

- recognize the vast corpus of knowledge traditions of India, while developing an appreciation for it,
- apply their acquired research and critical thinking skills in multidisciplinary themes,
- summarize and pass on their learnings to their students of different Indian traditions in an easily digestible manner.

UNIT - I
Introduction of Knowledge of India

A. Recap of the previous semester's definition and introduction.
B. Recap of previous knowledge.

UNIT - II
Philosophy, Ethics & Values: Schools of Philosophy

A. Vaishesika, Nyaya, Samkhya, Yoga, Purva Mimansa and Vedanta or Uttara Mimansa (theory and the major thinkers) – and Jain, Buddhist, and Charvak traditions.
B. Vedanta: philosophical systems (Advaita, Vishishtadvaita, Dvaita).
C. Ethics, morality, and social dilemma (including self-leadership) and their relevance in today's time.
D. How do Indians value spirituality? Spirituality and Social Responsibility; Importance of Spirituality in current times.

E. Using ethics in a technologically volatile world: leading an ethical and modern life.
F. Practical Vedanta for well-being (mindfulness, inter-connectedness, society-self relationship, etc.).

UNIT - III
Culture- Lifestyle

A. Food (regional cuisines, ayurvedic diet, food and festival, vegetarianism, Jainism in food, food and hospitality, and globalization).
B. Clothes (traditional Indian clothing, textile arts, religious costumes, clothing status, clothing, gender, globalization in clothing).
C. Sports (traditional Indian sports, martial arts, sports, and gender, sports & globalization).
D. The lifestyle of Yoga; adapting ancient lifestyle – A path towards longevity.

UNIT - IV
Science & Technology

A. Arithmetic and logic.
B. Natural sciences: math, physics, metallurgy, and chemistry.
C. Astronomy: India's contributions to the world.
D. Indian notions of time and space.
E. Technology in the economy: agriculture, transportation, etc.

UNIT - V
Linguistic Traditions

A. History of linguistics in India (conceptualizing ancient Indian linguistics, oral traditions, etc.).
B. Language as Culture: Evolution of Languages over the years & language as building blocks to different cultures and society
C. Language: Identity, culture, and History.

5.4.3 Suggestive Practicum

The modes of curriculum transaction will include lectures, Tutorials, and Practicum.

- Practicum will include organization of day trips that help student teachers watch events relating to visual and performing art; activities that enable student teachers to identify and record through photos, videos, etc. the elements of ancient architecture still existing in the city around them; organization of Individual and group presentations based on themes such as Polity, Law and Economy etc., organization of a 'Knowledge of India' day in the institution to celebrate the culture (food, clothes, etc.) that they would have been explored in lectures and tutorials; interactions with family members, elders, neighbors, and other members of society about the evolution of local systems and economy etc.

5.4.4 Suggestive Mode of Transaction

- Lectures will include learner-driven participatory sessions, and Guest lectures through experts and practitioners, such as fine arts and performing arts practitioners along with contemporary poets & writers of Indian literature.
- Tutorials will include Screening of documentaries and films followed by a discussion; Learner-driven discussions in the form of focus group discussions (FGDs), Socratic

Discussions, etc.; Debate/discussion can be organized to explain India's Vaad tradition; discuss on how some of the ancient methods of teaching are relevant in today's time; discussions that help Identify ethical dilemmas in daily lives and understanding the importance of ancient ethics and values to resolve them.

5.4.5 Suggestive Mode of Assessment

The approaches to learning assessment will include, for example:

- Supporting the curiosity and interest of student teachers in the selected themes through a multi-modal approach, including regular assessments and actionable feedback that enable learners to outline and interpret the processes and events of the formation & evolution of knowledge of India through a multidisciplinary lens.
- Enabling the student teachers to demonstrate critical analysis and independent thinking of the processes and events in the formulation & evolution of different traditions that help student teachers evaluate the diverse traditions of India to distinguish its achievements and limitations.
- Use of first-hand or second-hand experiences that enable student teachers to develop and articulate an ethics-based education rooted in Indian thought to their students in the classroom context.

5.4.6 Suggestive Reading Materials

Teachers may suggest books/readings as per the need of the learners and learning content.

5.5 Teacher and Society

Credit: 2
Semester S-2

5.5.1 About the Course

Teachers unarguably have the key role in nurturing young lives and shaping positive and inspired future generations. Emphasizing on the crucial role of teachers NEP 2020 states "teachers truly shape the future of our children - and, therefore, the future of our nation.". "The high respect for teachers and the high status of the teaching profession must be restored to inspire the best to enter the teaching profession. The motivation and empowerment of teachers is required to ensure the best possible future for our children and our nation." (NEP Para 5.1). The NEP in its introductory section states, "the teacher must be at the centre of the fundamental reforms in the education system" and highlights the need to "help re-establish teachers, at all levels, as the most respected and essential members of our society, because they truly shape our next generation of citizens". (NEP 2020, Introduction). The policy also stresses the need to "do everything to empower teachers and help them to do their job as effectively as possible." It is recognized that teachers are second to mothers in having the opportunity to work with children during the most impressionable years in their life and shape opinions, form ideas about personal and social goals and about society and life, contributing so much to the development of both individuals and society.

The focus of the course on 'Teacher & Society' is on developing an understanding among student teachers of the roles of teachers in the emerging Indian society, including the changing roles of teachers in the context of the global flows of people, culture and resources that are shaping society, and the application of technologies that are constantly redefining not only the educational landscape but also the human relationships and social norms which are continuously undergoing change which entails a recalibration of the teacher roles aligned to the current and future realities and preparing teachers for the volatile, uncertain, complex and ambiguous world. The course enables the students to understand the roles and obligations of teachers as an architect of the society based upon the cultural ethos, traditions, and diversity. The student teachers shall be equipped with the knowledge, capacities and value system that enables them to act as an agent for fostering national integration, a feeling of pride in the cultural heritage and achievements of India. This course also aims to ensure that student teachers understand their responsibility for producing a future generation that undertakes its responsibility as an awakened citizen who avoids wastage of national resources and takes up a proactive role for the emergence of India as a strong and disciplined nation.

In addition to these, the course also seeks to enable each of the student teachers to respond to the needs of students from diverse cultural, linguistic, social and economic backgrounds; to be sensitive to gender issues, promote tolerance and social cohesion, provide special attention to students with learning disabilities, learn and apply new pedagogies and technologies, keep pace with current educational developments and initiatives; and keep oneself professionally engaged to update/upgrade knowledge and practice. Student teachers will be encouraged to comprehend how societal structures, context and historical patterns shape teacher identities on one hand and how teacher identities, beliefs, values, convictions and commitment shape the ethics, culture, norms and values on the other; thus, impacting the larger societal thoughts and actions. The

course also explores the relationship of the teacher with education development, community and society through different course units that talk of the teacher as a person and as a professional, the socio-cultural and technological contexts of the teacher and how they impact the teaching-learning process, the multiple roles, identities and expectations of a teacher. It invites the student teachers to be reflexive of one's thoughts, beliefs and actions and continuously take a gaze inside out so as to unbiasedly engage children in a reflective dialogue.

The course explores the agentic role of a teacher, how it gets influenced and how it influences the education system. It concludes with the re-calibrating of roles of teacher and teaching beyond the curricular boundaries as an architect of an inclusive, harmonious, and developing India.

5.5.2 Learning Outcomes

After completion of the course, student teachers will be able to:

- examine the relationship between teacher beliefs, values, character, life history, social and cultural context and teaching critically,
- explain the teacher roles and characteristics; the personal and professional self; the teacher as a communicator, the charismatic influencer, the reflective practitioner, competent, learner and much more and their significant role in nurturing the posterity.
- differentiate between the narrow curricular aims of education and the broader educational aims and their role in shaping self, school, and society,
- demonstrate an ability to develop positive classrooms through engaging in the ethic of care,
- demonstrate an ability to critically reflect on personal and collective practice so as to improve learning and teaching,
- conceptualize teacher agency, its individual, contextual, and structural dimensions and how it gets impacted and in turn shapes education.

UNIT - I

Understanding the Teacher: Exploring the Personal and Professional Teacher

A. Exploring the wider Personal and General Social Context of Teacher: Life History, Teacher Beliefs, Values and Aspirations, Diverse Identities, Social Contexts and Commitment to Learning and Education.
B. Exploring the Professional Teacher: Qualifications, Education in teaching, Attitude, Aptitude, Experience and Exposure.
C. The Charismatic Teacher, the Communicator Teacher, The Missionary Teacher, The Competent Practitioner, The Reflective Practitioner, The Learning Teacher.
D. Reflexive Practice: Nurturing the Professional Capital through collaborative and/or collective engagement with self, others, the social context.

UNIT - II

Nurturing the Teacher: A Dialogue beyond the curricular goals, for Life and Posterity

A. Teaching: One profession, many roles
B. Teaching Character: Nurturing Teachers for Human Flourishing.
C. Holistic Teacher Development: Nurturing the Panchakoshas.
D. Teacher Values, Beliefs, and current Philosophy of Teaching: A Reflective Dialogue.
E. Developing an Ethic of Care in Teacher Education: Nurturing Teachers towards a pedagogy of care.

UNIT - III

Understanding and Fostering Teacher Agency: Role in shaping Education Systems of Tomorrow

A. Teacher Agency: What is it and why does it matter?
B. Individual, Cultural and Structural Dimensions of Teacher Agency.
C. Teacher discourses, Philosophy, Relationships, Networks and Professional Development: Shaping teacher agency and Creative insubordination.
D. Challenges and Issues inf fostering Teacher Agency: Performativity, Non-academic engagements, Systemic apathy, Policy and Practice gaps and others.
E. Role of Teacher in shaping the educational policy, practice, and reforms

UNIT - IV

Teacher as an Architect of the New India: Shaping the Society of Tomorrow

A. Engaging in Critical Education: Dialogues on power relations associated with Gender, Ethnicity, Culture, Disability, Class, Poverty, the reproduction of disadvantage and realizing the true human potential.
B. Being a Critical Teacher: Raising debates around rapid technological advancement and impact on individual, family and social life; the growing isolation and impact on mental and social health and well-being, changing relationships between the 'state' and the 'market' and their impact on formal education; the conceptualization of teacher, teaching and teacher roles, 'globalization' and the reconstructed nationalism shaping the socio-political milieu and impact on social psyche, growing materialistic urge, sensory drives and the gradual deterioration of the individual and societal character.

5.5.3 Suggestive Practicum

1. Take up a case study of any one teacher education Institution.
2. Write a biography of any one of your favourite teachers/ Educationists.

5.5.3 Suggestive Mode of Transaction

Teacher and Society is a reformatory course that invites teachers to re-think teachers and teaching. It awakens and inspires teachers to realize broader educational aims through an action and reflection cycle. The approach therefore would include a blend of lectures, in-class seminars, thinking exercises, critical reflections, group-work, case-based approaches, and enquiry-based learning.

▪ Learners would also be exposed to case studies featuring teachers from a representative cross-section of Schools in India and critically analyse their exercise of agentic force in school improvement and the improvement of teaching practice.

- Situating themselves in the geo-political context, the learners will get to critically engage in some of the policy dialogues.
- Learners would reflect on their practice as pre-service interns, knowledge, skills, and understandings—and identify opportunities to apply course learnings to their school context.

5.5.5 Suggestive Mode of Assessment

Being a very thought-provoking course, the assessment would largely include critical thinking kind of assignments. The following are some exemplars.

1. Write your current teaching philosophy based on your beliefs and values.
2. Choose any one area of immediate societal concern like environmental degradation, increasing crime against women, cybercrimes, bullying or any other and draw an action plan that you as a teacher would undertake to mobilize self, school and society towards betterment.
3. Critical Reflections on popular debates around power relations associated with Gender, Ethnicity, Culture, Disability, Class, Poverty, and such others

These are just prototypes and institutes may choose either of these or think of other innovative assignments that would inculcate in the future teachers a sense of belonging for society.

5.5.6 Suggestive Reading Materials

Teachers may suggest books/readings as per the need of the learners and learning content.

5.6 Information & Communication Technology (ICT) in Education

Credit 2
Semester S-5

5.6.1 About the Course

The present course focuses on moving beyond computer literacy and ICT-aided learning, to help student teachers interpret and adapt ICTs in line with educational aims and principles. The paper will orient the learners about the need for and importance of ICT in education. It will describe the importance of opensource software in education. Students will be given exposure to the various approaches and stages towards the use of ICT in education. Students are expected to develop reasonably good ICT skills in terms of the use of various computer software and ICT tools.

5.6.2 Learning Outcomes

On completion of this course, student teachers will be able to:

- explain the concept, nature, and scope of ICT in education,
- describe the importance of open-source software in education,
- list and explain various approaches to the adoption and use of ICT in education,
- describe the importance of various emerging technologies in education,
- See relationship between the social, economic, and ethical issues associated with the use of ICT,
- list out the challenges of educational technology in India,
- use various technological tools for improving teaching-learning- assessment processes.

UNIT - I
Introduction to (ICT) in Education

A. Meaning, Nature, importance of Information Technology, Communication Technology & Information and Communication Technology (ICT) and Instructional Technology,
B. Educational Technology and ICT in Education (Difference, Scope of ICT- Teaching, learning, Research & Publication Educational Administration and Assessment),
C. Technology & Engagement: Internet, Collaborative learning through Online Discussion Forums, group assignments & Peer reviews,
D. Meaning and Uses of Systems Approach in instructional design,
E. Models of Development of Instructional Design (ADDIE, ASSURE, Dick and Carey Model Mason's),
F. Flanders' Interaction Analysis Category System (FIACS),
G. Challenges relating to Educational Technology.

UNIT - II
Emerging Technologies in Education

A. E-learning Concept, methods, and media (LMS, Virtual Universities, Massive Open Online Course (MOOCs), Indian MOOCs, Types of MOOCs: cMOOCs, xMOOCs & LMOOCs).
B. Open Education Resources (Creative Commons, Concept, and application).

C. Augmented reality, Virtual reality, Artificial intelligence, Mixed Reality & Gamification in education (Meaning, history, importance, tools and uses).
D. Cloud Computing & Internet of Things - Meaning, importance and uses.
E. Ethical issues & safety in ICT- (Teaching, Learning and Research, Cyber bullying, Cyber security literacy & data protection, Online identity and privacy).

UNIT - III

ICT in Teaching-Learning & Assessment

A. Concept, Approaches to integrating ICT in teaching and learning: Technological Pedagogical Content Knowledge (TPCK), Technology Integration Matrix (TIM).
B. Implication of Learning Theories in ICT in Education: Behaviourism, Cognitivism & Constructivism.
C. Developing functional skills to use discipline specific ICT tools (Geogebra, PhET, Stellarium, Open Street Map, Marble, Turtle Art, Technological tools for Mind mapping etc.).
D. ICT and Assessment- Electronic assessment portfolio – Concept and types; e-portfolio tools.
E. Online and offline assessment tools – Rubrics, survey tools, puzzle makers, test generators, reflective journal, question bank.
F. ICT applications for Continuous and Comprehensive Evaluation (CCE).

5.6.3 Suggestive Practicum

1. Prepare an assessment tool on any one chapter of the textbook.
2. Explore any one online platform for MOOCs and prepare a report highlighting its structure and courses.

5.6.4 Suggestive Mode of Transaction

The pedagogy for the course ICT in Education should be designed to ensure that students have a good understanding of how to use technology for improving teaching-learning-assessment processes. It should provide a balance between theoretical knowledge and practical skills. The approaches to curriculum transaction may include the following:

- Active learning encourages student teachers to participate in discussions, brainstorming sessions, and problem-solving activities that help them develop critical thinking and problem-solving skills.
- Collaborative learning involves group projects and tasks that encourage student teachers to work collaboratively and learn from each other.
- Experiential learning involving Hands-on activities, field trips, and real-life scenarios that will give student teachers the opportunity to apply their knowledge and skills in a practical setting.
- Use of multimedia tools such as videos, interactive simulations, and animations that help enhance learning and make it more engaging.
- Self-directed and self-managed learning activities that encourage students to take charge of their learning process through independent research, self-reflection, and self-assessment which can promote lifelong learning.

5.6.4 Suggestive Mode of Assessment

The assessment for the course ICT in Education should evaluate students' knowledge, capacities, and attitudes towards the use of technology in education. The assessment methods will include the following:

- Project-based assessments involving projects that require student teachers to create an instructional/learning resource that incorporates ICT tools and then assess the quality of the resource.
- Peer assessment helps students develop their critical thinking and evaluative capacities through group tasks requiring assessment by a group of the work of another group.
- Reflective journals requiring student teachers to maintain a reflective journal and to reflect on their learning experience involving the use of ICT tools in education.
- Online quizzes and tests involving online quizzes and tests that can assess students' knowledge of the theoretical aspects of ICT in education.
- Observation and feedback involving observation of performance of student teachers during classroom activities and providing feedback that help assess their practical skills in using ICT tools for improving teaching-learning-assessment processes.

5.6.6 Suggested Reading Materials

Teachers may suggest books/readings as per the need of the learners and learning content.

5.7 Mathematical and Quantitative Reasoning

Credits 2
Semester S-6

5.7.1 About the Course

This course introduces the student teachers to study the basic mathematical & quantitative reasoning for their practical usage. This course is designed to provide student teachers with the knowledge and capacities required to analyze, interpret, and communicate quantitative data. Student teachers will learn to think critically about data and use quantitative reasoning to solve real-life problems.

5.7.2 Learning Outcomes

After completion of this course, student teachers will be able to:

- adapt mathematical reasoning to solve problems in the real world and explain some fundamental ideas and tenets in this field,
- analyze and interpret quantitative data,
- interpret & deduce the right conclusions from numerical representations like formulas, graphs, or tables,
- demonstrate critical thinking and problem-solving skills using mathematical and quantitative reasoning methods,
- evaluate operational matrix,
- analyze educational data and create educational model & use them in decision making,
- analyze and evaluate mathematical and quantitative reasoning problems and solutions.

UNIT - I

Introduction to mathematical and quantitative reasoning

A. Meaning, nature and scope of mathematical and quantitative reasoning.
B. Importance of mathematical and quantitative reasoning in various fields.
C. Types of quantitative reasoning.
D. Usage of mathematical and quantitative reasoning.
E. Concept of mathematization.

UNIT - II

Introduction to data in Education

A. Data requirement, different sources of data
B. School enrolment: gross enrolment ratios, net enrolment ratios, educational progression: dropout rate, literacy: measures of literacy
C. Indian censuses, details of different items on which Indian censuses collect data.
D. Nationwide sample surveys, National family health survey, District level household survey, UDISE

UNIT - III
Data Analysis & Interpretation

A. Concept of data interpretation (equation, diagram, graph, tables)
B. Statistical analysis of data in educational context and its applications (measures of central tendency, measures of variability, percentile)
C. Visual and numerical representation of data and its application (bar diagram, histogram, pie charts)
D. Learning analytics: concept, significance, types, levels, and its applications in educational context.

5.7.3 Suggestive Practicum

1. Take last 5 years of UDISE data and analyze various indicators related to schools, teachers, and students.

5.7.4 Suggestive Mode of Transaction

The approaches to curriculum transaction will focus on developing the analytical and critical thinking skills of students, as well as their ability to apply mathematical and quantitative reasoning in real-life situations. Some of the approaches to curriculum transaction will include the following:

- Active Learning which involves active participation of student teachers in problem-solving situations, group discussions, and hands-on activities that help student teachers engage with the material and apply mathematical thinking and reasoning to solve problems.
- Real-World Applications involving the use of real-world examples to demonstrate the practical applications of mathematical concepts that help student teachers see the relevance of what they are learning and how it can be applied in various fields.
- Collaborative learning encourages student teachers to work together in small groups, where they can share ideas and help each other learn. This fosters a sense of community in the classroom and helps students develop teamwork and communication skills.
- Technology Integration involves the incorporation of technology tools such as calculators, spreadsheets, and interactive software to help student teachers visualize and solve mathematical problems more easily.
- Overall, a pedagogy that combines active learning, real-world applications, collaborative learning, technology integration, and effective assessment strategies that help student teachers develop a strong foundation in mathematical and quantitative reasoning.

5.7.4 Suggestive Mode of Assessment

Use of a variety of assessment methods such as quizzes, exams, group projects, and presentations to evaluate student learning. Providing timely feedback and offering opportunities for students to revise their work and improve their understanding.

5.7.6 Suggested Reading Materials

Teachers may suggest books/readings as per the need of the learners and learning content.

5.8 Sports, Nutrition and Fitness

Credits 2
Semester S-7

5.8.1 About the Course

This course aims at enabling student teachers to recognize the importance of good health, fitness, and the right nutrition to live a healthy life. It also provides students with the experience of organizing and participating in sports and games.

5.8.2 Learning Outcomes

After completion of the course, student teachers will be able to:

- explain the importance of sports, and the need and impact of sport for maintaining,
- discuss physical fitness, and the methods of teaching and organization of different types of sports,
- explain the importance of physical fitness, describe different components of physical fitness, and identify activities that help maintain physical fitness,
- Recognize the importance of basic health and nutrition and healthy lifestyles and identify food items that help maintain basic health and nutrition among children of different age groups.

UNIT - I
Sports

A. Meaning of sports, importance of sports, types of sports.
B. Different stages of sports (primary and secondary).
C. Psychology of sports, methods of teaching different sports (indoor, outdoor, team and individual), different sports activities (individual and team games).
D. Sports for children with disabilities and inclusion.

UNIT - II
Physical Fitness

A. Meaning and importance of Physical fitness, components of physical fitness, Muscular Strength, Endurance, Flexibility, Body Composition, Cardiovascular Endurance, importance of healthy lifestyle.
B. Coordination of Health and Fitness.

UNIT - III
Nutrition

A. Meaning of nutrition, types of nutrition, importance of nutrition, need of nutrition, methods for teaching nutrition,
B. Nutrition for different age group, nutritious food for sports personalities and common individuals, nutrition and health, nutrition and fitness, nutritious food in schools (midday meals), hostels.

5.8.3 Suggestive Practicum

Reflective Reading of different Sports Personalities. Collections of different types of games (Indoor, Outdoor, Individual, Team); Organizing different games (Play) for different age-groups,

Organizing Group Games for cooperation, Organizing fitness programmes, Exercises at various levels. Collection of different nutritious items food. (Charts, Things, Objects, Models). Programmes organized to promote the use of nutritious food.

5.8.4 Suggestive Mode of Transaction

The mode of transaction should be designed to ensure that should provide a balance between theoretical knowledge and practical skills. The approaches to curriculum transaction may include the following:

- Active learning encourages student teachers to participate in discussions, brainstorming sessions, and problem-solving activities that help them develop critical thinking and problem-solving skills.
- Collaborative learning involves group projects and tasks that encourage student teachers to work collaboratively and learn from each other.

5.8.5 Suggestive Mode of Assessment

Assessment of theoretical aspects and Practicum.

5.8.6 Suggestive Reading Materials

Teachers may suggest books/readings as per the need of the learners and learning content.

5.9 Yoga and Understanding Self

Credits 2
Semester S-8

5.9.1 About the Course

This course focuses on the benefits of Yoga for healthy living and the importance of the practice of yoga for promoting the optimal state of physical, emotional, intellectual, social, and spiritual wellbeing of a person. Yoga as a way of life is characterized by peace and tranquillity, harmony and health, love and happiness, precision, and efficiency. The course seeks to engage student teachers with these ideas. The focus of the course is on being mindful of self (body, mind, emotions, thoughts, and actions). Course components will include brief history of yoga, principles and different types and streams of yoga, practices (Kriyas, Āsana, Prāṇāyāma, Bandha & mudra, Dhāraṇa & Dhyāna, etc), meditation and reflective practices, and the importance of these aspects in becoming an effective teacher. It lays equal weightage to the theory and practicum.

5.9.2 Learning Outcomes

After completion of the course, the student teachers will be able to

- explain the importance of Yoga and how it helps an individual in understanding Self
- describe the importance of practicing Yoga Asana,
- practice basic Yoga Asanas/ Kriyas.

UNIT - I
Philosophy and Historical Perspective of Yoga

A. Concept and Meaning of Yoga, Philosophy of Yoga,
B. Brief history and development of Yoga (Classical Yoga, Post Classical Yoga and Modern Period)
C. Importance of Yoga for healthy living, Yoga and its relevance in the modern times, Traditions in Yoga.

UNIT - II
Schools of Yoga

A. Different streams \schools of Yoga (Gnana, Bhakthi, Karma)
B. Construction of Yoga Practice for all round development.
C. Principals of Yoga: - Ahimsa, Satya, Asteya, Brachmacharya, Aparigraha, Shoucha, Santhosha, Tapas, swadyaya and Isvara Paridhana.

UNIT - III
Modern Principles of Yoga and Meditation

A. Modern Principles: Human Body is a holistic entity, Individuals and their need are Dhāraṇa & Dhyāna, etc, meditation and reflective practices, and the importance of these aspects in becoming an effective teacher, unique Self-empowering, the quality and state of an individual mind is crucial to healing.

B. Meditation: - its Importance, Types, and Process, Pranayama: its importance, types and process, Yoga as a Way of life for Peace, Harmony, Health love and happiness. Yoga in Indian philosophy for understanding Self.

5.9.3 Suggestive Practicum

1. Practice of Basic Yoga Asanas/ Kriyas.

5.9.4 Suggestive Mode of Transaction

Reflective reading of different Yoga practicing Personalities, Learning by doing, Relaxation Techniques for imparting concentration, Understanding Self and personality development.

5.9.5 Suggestive Mode of Assessment

Assessment of practicum; Assessment of practice of basic Yoga Asanas/ Kriyas; Assessment of Reflective level Readings.

5.9.6 Suggested Reading Materials

Teachers may suggest books/readings as per the need of the learners and learning content.

5.10 Citizenship Education, Sustainability, and Environmental Education

Credits 2
Semester S-8

5.10.1 About the Course

This course seeks to orient student teachers to the Constitution of India with a particular emphasis on Fundamental Rights and Fundamental Duties, and to prepare them for their roles and responsibilities as responsible, productive, and effective citizens of India. The course also seeks to enable student teachers to understand the interconnected and interdependent world, India's rich heritage and philosophical foundation of "Vasudaiva Kutumbakam" (Whole world is one family), acquire the knowledge, capacities, values, and dispositions needed to understand global issues and become active promoters of more peaceful, harmonious and sustainable societies. The course also seeks to create among student teachers an awareness of responsible global citizenship required for responding to contemporary global challenges.

The sustainability aspect of the course seeks to develop among student teachers an understanding of the idea of 'Sustainability' in all fields of human activities, including achieving sustainable development in its three dimensions – economic, social, and environmental – in a balanced manner. The environmental education component of the course aims at creating an awareness among student teachers of environmental issues, including actions required for mitigating the effects of climate change, environmental degradation and pollution, and initiatives required for effective waste management, conservation of biological diversity, management of biological/natural resources, forest and wildlife conservation, and sustainable development and living. The course will also deepen the knowledge and understanding of India's environment in its totality, their interactive processes, and effects on the future quality of people's lives.

5.10.2 Learning Outcomes

After completion of the course, student teachers will be able to:

- explain the concept of citizenship and citizenship education,
- describe the aims of and approaches to citizenship education,
- explain the concept and aims of Global Citizenship and Global Citizenship Education,
- describe the aims of and approaches to global citizenship education,
- explain the concept of 'Sustainability' in all fields of human activities, and approaches to achieving sustainable development in its three dimensions – economic, social and environmental – in a balanced manner,
- demonstrate an awareness of environmental issues, and actions required for mitigating the effects of climate change, environmental degradation and pollution, and initiatives required for effective waste management, conservation of biological diversity, management of biological/natural resources, forest and wildlife conservation, and sustainable development and living.

UNIT - I
Citizenship Education

A. Concept of citizenship and citizenship education.
B. Aims of and approaches to citizenship education.
C. Concept of Global Citizenship and Global Citizenship Education.

D. Aims of and approaches to global citizenship education.
E. Concept of *Vasudhaiva Kutumbakam*, its importance in development of a holistic perspective towards local and global communities.

UNIT - II
Sustainability

A. Concept of 'Sustainability' in all fields of human activities.
B. Approaches to achieving sustainable development in its three dimensions – economic, social, and environmental.
C. Sustainable development goals.
D. Sustainable management of natural resources.
E. School- and community-based activities.
F. Education for sustainable development

UNIT - III
Environmental Education

A. Environmental issues.
B. Actions required for mitigating the effects of climate change, reducing environmental degradation, pollution etc.
C. Initiatives required for effective waste management, conservation of biological diversity, management of biological/natural resources, forest and wildlife conservation, and sustainable development and living.
D. Approaches to delivering Environmental Education
E. Role of Mass Media and Technology in delivering environmental education.
F. Roles Governmental and Non-Governmental Organizations in promoting Environmental Education.
G. School and community-based environmental education activities.

5.10.3 Suggestive Practicum

1. Write a report on the roles of governmental and non-governmental organizations in promoting Environmental Education.

5.10.4 Suggestive Mode of Transaction

Lecture-cum- discussion, Focus Group discussions, in-class seminars, Library Work, Assignments, Project Work, Lesson Plan Development, Interaction with different stakeholders, ICT based educational materials, Group Work, critical reflections, group-work, case-based approaches, and enquiry-based learning.

5.10.5 Suggestive Mode of Assessment

Assessment of practicum and assessment of reflective level readings.

5.10.6 Suggestive Reading Materials

Teachers may suggest books/readings as per the need of the learners and learning content.

6.0 SCHOOL EXPERIENCE

Field engagement is an integral part of a teacher education programme. In field engagement of a pre-service teacher education programme, the student teachers are engaged in different kinds of practical tasks or activities relating to the teaching profession in a supervised condition. Through field engagement, the student teachers understand school processes, participate in activities, and internalize school-related ethics, values, and norms. School experience is integral to the Integrated Teacher Education Programme (ITEP); it allows student teachers to experience the school environment and apply theoretical learning.

Objectives

The School Experience will help the student teachers:

1. To understand on the roles of different personnel associated with the academics, resources, and the school system's management.
2. To be conscious of their duties as teachers concerning students, school, community, and other stakeholders.
3. To reflect on diverse school contexts and to appreciate the role of school teachers.
4. To understand and participate in different curricular activities like school assemblies, games and sports, cultural activities, and other events.
5. To participate in different programmes of school like parental engagement, motivating the students from the socio-economically disadvantaged group, and promoting inclusion and equity.
6. To develop skills associated with the profession - adaptation, collaboration, problem-solving, and participative decision-making.
7. To develop contextual learning competencies, skills, and attitudes for becoming effective teachers.
8. To develop ICT and research skills.

Table 1: Outline of Activities under School Experience

Course	Credits	Semester	Description
Pre-Internship	2	5	Orientation and preparation in the institute
School Observation	2	6	Two weeks visit to different types of schools
Internship	10	7	12 weeks of working in school(s) as an integral part of the system
School-based research projects	2	7	Identification of the issue, research design, intervention during the school internship and preparation of the research report
Creating TLM	2	8	Visit different types of local vocational artists/professions, design learning resources using local traditions and connect artists to school.

Post Internship	2	8	In the institute: Sharing of experiences with other student teachers and submission of the report
Total	**20 Credits**		

6.1 Pre-Internship Practice

Credits 2
Semester: S-5

6.1.1 About the Course

Pre-Internship is a vital component of the Teacher Education Programme. It is a prerequisite for the student teachers to experience a simulated classroom environment to prepare them for real-life situations. Student teachers get exposure in a conducive, guided environment to manage a classroom and learn pedagogic and classroom management skills and get an opportunity to have hands-on experience.

6.1.2 Learning Objectives:

After completion of the course, student teachers will be able to:

- acquainted with various pedagogic practices, classroom management skills, assessment tools and learning standards,
- get experience of conducting classes by observing lessons transacted by teacher educators (demonstration lessons),
- develop lesson plans to transact them using appropriate pedagogies and learning resources,
- develop and practice teaching skills in a guided environment to be an effective teacher,
- be prepared for the school internship.

6.1.3 Suggestive Mode of Transaction

- Demonstration lesson (minimum 1 in each pedagogical subject)
- Peer Group teaching and peer observation (minimum 5 in each pedagogical subject)
- Observation of lessons by teacher educators during peer group teaching
- Reflective group discussions/workshops/seminars
- Preparation and presentation of the video content illustrating best classroom practices.

6.1.4 Content

The pre-internship will include activities relating to the stage-specific pedagogy courses, ability enhancement and value-added courses and foundation courses transacted during previous semesters. It will also include knowledge of pedagogy, formats of lesson plans, different ICT tools, schooling systems in India, principles of classroom management, assessment, and other relevant content.

6.1.5 Activities to be conducted:

- Observation of lessons transacted by teacher educators to identify pedagogic skills.
- Exposure to various types of lesson plans through workshops.
- Development of relevant Teaching Learning Materials (TLMs).
- Participation in screening and discussion of educational videos on pedagogy and assessment.
- Learning about inclusiveness in school education
- Orientation for Action Research/case study

6.1.5.1 Foundational Stage

Orientation of student teachers to different pedagogic (flexible, multilevel, play/activity/story-based learning) and classroom management skills

- Observation of the lessons demonstrated by teacher educators/experts in the institute.
- Designing guided play/activities for each class/subject based on learning outcomes.
- Identify local toys/games to facilitate play activities and pedagogical practices.
- Study Foundational Stage Learning Standards in the NCF-FS
- Content analysis and development of the unit plan, concept map and lesson plan.
- Discussion on unit plan and lesson plan with teacher educators/experts
- Preparation of a Portfolio (for self-work) that the student-teacher will use to keep all her/his work.
- Develop a one-day teaching plan that caters to all domains of development and record the difference in children's engagement before and after implementing the new plan.
- Transaction of demonstration lesson plan in a guided situation in the institute in the macro group (get the feedback from the mentor and TE)
- Collection and development of warmup activities and trials with the student trainee for rapport building with the young children.
- Exploring available learning resources, local traditional stories, rhymes, riddles, and educational videos
- Developing local, low-cost, and innovative TLMs
- Reading and reflecting on inspiring books on pedagogic practices like *'Divaswapna'*

6.1.5.2 Preparatory Stage

- Orientation of student teachers to different pedagogic (play, discovery, and activity/project-based) and classroom management skills
- Observation of the lesson demonstrated by teacher educators/experts in the institute.
- Designing guided play/activities for each class/subject based on learning outcomes.
- Identify local toys/games to facilitate play activities and pedagogical practices.
- Study Preparatory Stage Learning Standards from the NCF
- Content analysis and development of the unit plan, concept map and lesson plan.
- Discussion on unit plan and lesson plan with teacher educators/experts
- Preparation of a Portfolio (for self-work) that the student-teacher will use to keep all her/his work.
- Exploring available learning resources and educational videos
- Developing local, low-cost and innovative TLMs
- Reading and reflecting on inspiring books on pedagogic practices like *'Divaswapna'*

6.1.5.3 Middle Stage

- Orientation of student teachers to different pedagogic practices like experiential learning, inter-relationship amongst different subjects, integration of Indian Knowledge Systems (IKS) and values in school subjects, and classroom management skills
- Observation of the lesson demonstrated by teacher educators/experts in the institute.
- Designing guided activities for each class/subject based on learning outcomes.
- Study Middle Stage Learning Standards in the NCF
- Content analysis and development of the unit plan, concept map and lesson plan.
- Discussion on unit plan and lesson plan with teacher educators/experts

- Preparation of a Portfolio (for self-work) that the student-teacher will use to keep all her/his work.
- Participate in discussions/reflective sessions for conceptualizing teaching-learning practices.
- Exploring available learning resources and educational videos
- Developing local, low-cost and innovative TLMs
- Reading and reflecting on inspiring books on pedagogic practices

6.1.5.4 Secondary Stage

- Orientation of student teachers to different pedagogic approaches like storytelling, art-integrated, sports-integrated, project-based, and ICT-integrated for developing critical thinking, attention to life aspirations, and greater flexibility and classroom management skills.
- Observation of the lesson demonstrated by teacher educators/experts in the institute.
- Designing guided activities, including a laboratory for each class/subject based on learning outcomes.
- Study Secondary Stage Learning Standards in the NCF
- Content analysis and development of the unit plan, concept map and lesson plan.
- Discussion on unit plan and lesson plan with teacher educators/experts
- Preparation of a Portfolio (for self-work) that the student-teacher will use to keep all her/his work.
- Participate in discussions/reflective sessions for conceptualizing teaching-learning practices.
- Exploring available learning resources and educational videos
- Developing local, low-cost, and innovative TLM s
- Reading and reflecting on inspiring books on pedagogic practices

6.1.6 Assessment

Competence/Artifact	Method of assessment	Assessed By	Credits
Classroom teaching skills and assessment tools (including learning standards)	Simulated Presentation	Teacher-Educator	1
Reflective group discussions/workshop	Observations	Teacher-Educator	0.5
Artefacts (Lesson Plans, TLM, Curated Videos) and action research procedures.	Evaluation	Teacher-Educator	0.5

6.1.7 Outcomes

After completion of the course, student teachers will be able to:

1. describe the prerequisites of the internship,
2. demonstrate knowledge of pedagogic practices, classroom management skills, assessment tools and learning standards,
3. develop lessons plans and relevant Teaching Learning Materials (TLMs),
4. develop readiness to take up an internship programme.

6.2 School Observation

Credit: 2
Semester: S-6

6.2.1 About the Course

As school is the heart of the teacher education programme, the student teachers need to gain hands-on experiences from various activities organized by the school. School observation offers an opportunity to learn the processes and practices in a school setup. To expose the student teachers to various schooling systems (urban, rural, tribal, residential, non-residential, government, private, affiliated to different school boards like Central Board, State Board, International Board) prevailing in the country. School observation will also prepare the student teachers to build relationships with various stakeholders. The school observation by the student teachers is aimed at helping them build perspective in the schooling system, student needs, pedagogies, and assessment.

6.2.2 Learning Objectives

After completion of school observation program, student teachers will be able to:

- get acquainted with various schooling systems.
- experience the processes, practices, and overall environment of the school.
- establish a rapport with all the stakeholders of the school system.
- observe the process of conducting different activities in the school.
- study availability and the work of human resources, including members of school management (SMC), school head, teachers, administrative and support staff)
- observe the existing infrastructure available in the schools (classrooms, libraries, laboratories, playground, sanitation, drinking water facility, mid-day meal facility, inclusive facilities, safety and security, rainwater harvesting).
- observe and document the availability and usage of TLM, including ICT.
- study the available physical and digital documents, including UDISE data.
- study interpersonal relationships among the stakeholders.
- study various assessment processes adopted in different types of schools for holistic development of children.
- prepare and present a comprehensive profile of the schools observed (including classroom processes)
- study the engagement of parents and other community members in school activities.

6.2.3 Suggestive Mode of Transaction

- Observation
- Interaction
- Discussion
- Reviewing the available literature on the different schooling system
- Collection of relevant documents and data

Preparation for school observation

- Orientation on the school observation process
- Development of the observation formats/tools

School Observation (minimum three types of schools)

- Student teachers will go for school observation in small groups to observe and collect data by using the developed formats/tools.
- Analysis of the collected data
- Preparing a comprehensive profile of the schools observed

Post-school observation session

- Group-wise presentation of the school profile
- Discussion and Feedback
- Reflection on the understanding of various types of schooling systems.

6.2.4 Content

The school observation as a field-based activity will cover observation of school and classroom processes. The student teachers under the mentorship of teacher educators will visit schools, interact with teachers and students and other stakeholders, and relate the observation with the courses studied during the previous semesters, i.e. Foundations of Education, Disciplinary Courses, Pedagogy courses and Ability Enhancement & Value-Added Courses.

- Meaning and Nature of school observation process
- Difference between monitoring and observation
- Theory and practices of school observation components such as:
    1. Schooling system
    2. Rapport with all the stakeholders
    3. Office management procedures of different types of schools
    4. School environment in all perspectives
    5. Process of conducting curricular activities in the schooling process
    6. Existing infrastructure available in the school
    7. Utility of ICT and TLM facilities
    8. Interpersonal relationships among the stakeholders
    9. Various assessment processes adopted in different types of schools.
    10. Engagement of parents and other community members in school activities.

6.2.5 Activities to be conducted.

6.2.5.1 Foundational Stage

- Visit to preschool, Balvatika, and classes I and II (foundational stage/ standalone Anganwadi, standalone preschool, co-located Anganwadi and preschools/Balvatika sections in school set up)
- Collect information on the demography of students in preschool, classes I and II, linkage of foundational with the preparatory stage through interaction with teachers, students, and staff.
- To study the use of print materials like collages, flashcards and activities related to foundational literacy and numeracy through classroom observation.
- Observe the activities related to FLN, use of mother tongue as medium of instruction and handling classrooms with children from different home languages.
- Observation of pedagogic practices at preschool, classes I and II

- Observe the use of local/traditional toys, stories, rhymes, songs, games, riddles in the class.
- Observation of availability and usage of reading corners, fun zones,
- Observation of play areas across the foundational stage (both indoor and outdoor)
- Study the practices followed by the school for the growth and health of children- provision of supplementary nutrition, immunization, health check-ups, and referral services.
- Presentation of the classroom observations (play activities and FLN practices) and discussions in groups
- Observation of assessment tools and practices at foundational stage

6.2.5.2 Preparatory Stage

- Visit three types of schools with observation formats developed in the institute and get acquainted with various schooling systems. Establish rapport with all stakeholders.
- Collect information on the demography of students in classes III to V, the link of the preparatory stage with the foundational and middle stages through interaction with teachers, students, and staff.
- Observation of classroom practices to study toy-based, art-integrated, and sports-integrated pedagogy.
- Observe the activities related to holistic assessment as recommended in NEP 2020 and NCFSE.
- Observation of play areas across the preparatory stage (both indoor and outdoor)
- Observe school processes and the extent of transaction of the curriculum through play, discovery, and activity-based and prepare a report.
- Reflect on effective classroom teaching learning strategies.

6.2.5.3 Middle Stage

- Visit three types of middle schools with observation formats developed in the institute and get acquainted with various schooling systems. Establish rapport with all stakeholders.
- Collect information about the demography of students in classes VI to VIII and understand the linkage of the middle stage with the secondary and preparatory stages through interaction with teachers, students, and staff.
- Observe school processes and curriculum transactions through experiential learning and prepare a report.
- Interact with teachers and students and report on implementing ten bag-less days and skill development courses.
- Reflect on effective classroom teaching learning strategies.
- Observe integration of IKS, values, local resources in teaching learning process
- Observe practice and assessment of vocational education in the school.
- Observe the availability and usage of library resources, laboratories (General Science, Mathematics, Languages, Social Science, Computer), sports facilities, and art and music learning facilities.
- Study the provision of other student support services- guidance and counselling, scouts and guides, and health and wellness programme.

6.2.5.4 Secondary Stage

- Visit three types of secondary schools with observation formats developed in the institute and get acquainted with various schooling systems. Establish rapport with all stakeholders.
- Collect information about the demography of students in classes IX to XII and understand the linkage of the secondary stage with the middle stage and higher education through interaction with teachers, students and staff.
- Observe school processes and transactions of the curriculum through experiential learning and prepare a report.
- Interact with teachers and students and report on implementing ten bag-less days and internship opportunities to learn vocational subjects.
- Study the available opportunities for learning interdisciplinary subjects.
- Observe the availability and usage of library resources, laboratories (Atal Tinkering Lab, Physics, Chemistry, Biology, Mathematics, Languages, Social Science, Computer), sports facilities, and art and music learning facilities.
- Study the provision of other student support services- guidance and counselling, NCC, NSS, health and wellness programme.
- Observe the organization of various activities like classroom teaching-learning processes, laboratory activities, library activities, sports and games, debate/elocution/essay writing and other competitions.
- Interact with School heads and subject teachers to understand how students are evaluated by following different tools and techniques of evaluation, how examinations are conducted, how answers are assessed, and how the result is communicated to parents in at least two different types of schools.

6.2.6 Assessment

Competence/Artifact	Method of assessment	Assessed By	Credits
Involvement and active participation during the school visit	Observations	Teacher Educator	0.5
Comprehensive school profile	Presentation & reflection	Teacher-Educator	1.5

6.2.7 Outcomes

Student teachers will be able to:

- describe various schooling systems,
- describe the processes, practices, and overall environment of the school,
- establish rapport with the stakeholders of the school system state the process of conducting different activities in the school,
- describe the available school infrastructure (classrooms, libraries, laboratories, playground, sanitation, drinking water facility, mid-day meal facility, inclusive facilities, safety and security, rainwater harvesting),
- describe the availability and usage of ICT and TLMs,

- summarize the available documents in both physical and digital modes, including UDISE data,
- reflect upon relationships among the stakeholders,
- analyze various assessment processes adopted in different types of schools,
- prepare and present a comprehensive profile of the schools observed (including classroom processes).

6.2.8 Suggested Components for school observation report

- School information (Context, Vision and Mission, Association with the Board)
- School Infrastructure
- Provision for CWSN/Divyang Children
- Inclusiveness at all levels
- Teacher-Student Ratio
- Teaching-Learning process
    - Academic plan
    - Classroom activities
    - Assessment
- School Development Plan (SDP)
- Academic Calendar
- Administrative processes
    - Maintenance of students' records
    - Maintenance of teachers' records
- Cultural activities
- Sports activities
- Annual Day
- National and Social functions
- School Management
- School Discipline
- Interpersonal Relationships
- Understanding different types (socio-economic status, ability) of students and their needs
- Development of ICT and TLMs
- Engagement of parents and community members in the school activity
- Office Management
- The assessment process includes provision and practices for 360-degree holistic assessment.
- The overall progress of the school (planning, organizing, staffing, directing, motivating and controlling)
- Challenges faced and overcoming them.

6.3 School-Based Research Projects

Credit: 2
Semester: S-7

6.3.1 About the Course

Action research enables teachers to reflect on their wisdom to bring the desired changeover and explore the system when necessary. They may experiment with practices in a controlled environment to improve the transactional processes. Learning about classroom research in action research and case studies practices promotes opportunities to improve the student-teacher learning environment in teacher education institutions. Their involvement in the learning processes during their stay in teacher education institutions becomes more fruitful. It could be individual or collaborative research among the student teachers. Action research and case studies are school-based research, which is acted upon as collective, self-reflective inquiry undertaken in social situations to improve the rationality and justice of their own contextual and educational practices. These two processes explore the answers to the problem and contribute towards theory development. These two methodologies foster critical thinking, problem-solving, collaboration and ethical decision-making skills. The student teachers are placed in schools for internships. School Internship provides the student teachers with a platform to apply theoretical knowledge understanding, techniques, methods, and approaches in an actual classroom situation. It enables them to gain intensive experience in teaching, planning, preparing support materials, and performing other school activities that a regular teacher is expected to do. The student teachers will systematically undertake school-based research to find solutions to contextual problems/challenges. During the school internship, the student teachers will identify school practices and challenges through involvement in different activities, design relevant interventions, analyze data and prepare reports.

6.3.2 Learning Objectives

The student teachers will:

- Identify contextual problems and formulate appropriate research design,
- Prepare the plan of action for undertaking school-based research,
- Develop and use tools and techniques for the collection of relevant data,
- Collect and analyze the data to identify the causes,
- Develop and implement need-based interventions for addressing the problems,
- Study the effectiveness of the intervention(s),
- Reflect and share school-based research experiences through reports and presentations.

6.3.3 Suggestive Mode of Transaction

The following strategies will be used during the school-based research project:

- Discussions with teacher educator, school head, mentors, and peers for identification of problem and development of intervention(s).
- Finalize the school-based research project proposal outline through discussion with mentor teachers/teacher educators.
- Document analysis, interaction with all stakeholders, and field visits.
- Sharing and presentation of the outcomes of school-based research.

6.3.4 Content:

The student teachers during previous semesters have studied different courses in Foundations of Education, Disciplinary Courses, Stage-specific pedagogy courses, Ability Enhancement and Value-Added Courses. The required knowledge of action research and case study includes- the concept and importance of action research/case study, the steps of conducting action research/case study (objectives, methods, research design, design tools, data collection, and data analysis) and report writing.

The research problem will be taken from the day-to-day teaching-learning process of the school. Some of the significant areas may cover:

- Learning progress and outcomes in different subjects
- School-based assessment
- Learners' diversity and inclusion
- Participation in arts, games, sports

6.3.5 Suggestive Mode of Assessment

The assessment of the school-based research project will be continuous. The teacher educators, as well as mentors, will be involved in the assessment of the activities. The following rating scale may be used to assess the student teachers:

Competence/Artifact	Method of assessment	Assessed By	Credits
Observation during the execution of action research	Observation	Teacher-Educator	0.5
Research Report	Presentation of Report	Teacher-Educators (panel of three experts)	1.5

6.3.6 Learning Outcomes

The student teachers will:

- present contextual problems, an appropriate research design and the plan of action for undertaking school-based research,
- demonstrate the tools and techniques used for the collection of relevant data,
- summarize the analyzed data used to identify the causes,
- demonstrate the interventions used for addressing the problems,
- present the effectiveness of the intervention(s),
- share the school-based research experiences through reports and presentation.

6.4 Internship in Teaching

Credit: 10
Semester: S-7

6.4.1 About the Course

Teacher preparation is a reflective and experiential process, and internship is vital to connecting student teachers with school, teachers, students and other stakeholders in various ways. It provides a platform and actual field experience for the student teachers to apply theoretical knowledge and teaching methods. During the internship, student teachers are placed in schools in groups as an integral part of all school activities. This provides them with the opportunity to observe classes taken by school teachers, take independent classes, develop a relationship with students, contribute to everyday school activities (e.g., conducting the assembly, assisting in the mid-day meal scheme, organizing school events) and get exposure to all school administrative practices (e.g., maintaining administration records, creating an annual calendar). This enables them to get intensive experience in all aspects of teaching- preparation, planning, developing/ collecting/localizing Teaching Learning Materials, classroom transactions, assessment, reflection, and review of their experience. The student teachers are exposed to situations where they can observe different roles played by the teacher in the field, which they will also have to undergo. After completing the internship, student teachers will be ready to take up a teacher's responsibility independently.

6.4.2 Suggestive Structure

ITEP 7th semester has an internship programme where student teachers are expected to go to the participating schools and visit the Institute for completion of other courses. ITEP institute can choose suitable option based on their context.

- Four days in schools and two days at ITEP Institute
- Six weeks in one school, three weeks in the institute and six weeks in another school (preferably in two different types of schools)
- Three weeks in the institute and 12 weeks in two types of schools
- Any other option can be adopted by the institute depending on their local conditions keeping 12 weeks of school internship.

6.4.3 Learning Objectives:

On completion of the school internship, student teachers will be able to:

1. explain the overall functioning of the school.
2. describe and appreciate the different roles played by a teacher in the school.
3. experience the importance of teacher-student relationships for effective teaching.
4. develop age-appropriate pedagogic skills.
5. use different pedagogies learnt in real-life classrooms.
6. create appropriate teaching-learning materials.
7. develop necessary planning and execution skills to conduct school activities (assembly, celebrations, cultural programmes).
8. express the school, teacher, parents, and community relationships.
9. create rapport with the stakeholders and understand their roles in the school system.
10. create student portfolios and comprehensive 360-degree (holistic) progress reports.
11. discuss the importance of maintaining different types of records in the school system.

12. develop research aptitude and ability to conduct action research for the situations/problems faced during their school internship experience.

6.4.4 Suggestive Mode of Transaction

- Observation
- Interaction
- Discussion
- Teaching in the classroom
- Analysis and reporting
- Collection of relevant documents and data

6.4.5 Content

1. Pedagogies' different methods and strategies
2. Scheme of lessons
3. Peer lesson observation
4. Management of substitute classes
5. Various TLMs (including ICT tools) and their uses in teaching-learning.
6. Achievement test
7. Diagnostic tests
8. Analysis of the result of the achievement test
9. Assembly activities
10. Action research and case studies.

6.4.6 Activities:

Student teachers are required to undertake the following stage specific activities:

6.4.6.1 Foundational stage

1. Meet the subject-based mentors, collect timetables of preschool, Balvatika, and classes I and II and develop a scheme of lessons from the syllabus to be covered during the internship.
2. Get acquainted with the school within 2-3 days. Observe classroom teaching of school teachers.
3. Plan and transact minimum 80 lessons (40+40), including 4 stray lessons (2+2). Stray lessons are class appropriate lessons on any topic(s) to be transacted by student teachers as per their convenience to build up confidence gradually. The last 5 lessons in each pedagogy course may be transacted using lesson notes.
    - Lesson plans should derive their inspiration from NCF-FS documents.
    - Lesson plans should include a theme/ web chart/concept map for integrating early learning activities related to FLN.
    - Lesson plans must promote education for sustainability, including equity, environment, global citizenship, pride and rootedness in Indian culture and character building.
4. Participate in post-lesson discussions with peers, mentor(s) and teacher educators.
5. Observe peer lessons and discuss with the group.
6. Conduct sports activities and arts and crafts activities.

7. Participate in student support services- guidance and counselling, bunny, health and wellness programmes.
8. Create age and developmentally appropriate TLM that caters to different domains of development, for example, picture reading posters, letter-sound dominoes, number-object dominoes, stories, rhymes, toys, and number puzzles.
9. Identify the toys and TLM available for 3 to 8-year-olds. and map them with different concepts and skills.
10. Develop differential assessment plans based on interest and expected goals/competencies.
11. Identify children with special needs and address their learning needs.
12. Experience classes as a substitute teacher.
13. Participate in the reading corners, fun zones, gallery walks and other activities.
14. Participate in teacher development and training activities.
15. Participate and Organize school assemblies and other events (cultural, sports, yoga, and other development activities).
16. Attend Parents-Teachers Association (PTA) meetings if held during the internship.
17. Attend School Management Committee (SMC) meeting if held during the internship.
18. Study the process of parent and community engagement for the school development programme.
19. Conduct action research /case study.
20. Prepare a sample student portfolio,
21. Write a reflective diary daily and prepare a report of each activity.

6.4.6.2 Preparatory Stage

1. Meet the subject-based mentors, collect timetables of classes III to V and develop a scheme of lessons from the syllabus to be covered during the internship.
2. Get acquainted with the school within 2-3 days. Observe classroom teaching of school teachers.
3. Plan and transact minimum 80 lessons (40+40), including 4 stray lessons (2+2). Stray lessons are class appropriate lessons on any topic(s) to be transacted by student teachers as per their convenience to build up confidence gradually. The last 5 lessons in each pedagogy course may be transacted using lesson notes.
    - Lesson plans should include activities to promote creativity, inquiry, inquisitiveness, experimentation, exploration, analytical thinking.
    - Lesson plans must promote education for sustainability, including equity, environment, global citizenship, pride and rootedness in Indian culture and character building.
4. Participate in post-lesson discussions with peers, mentor(s) and teacher educators.
5. Observe peer lessons and discuss with the group.
6. Conduct sports, arts and crafts activities.
7. Participate in student support services- guidance and counselling, clubs and bulbuls, health, and wellness programmes.
8. Create teaching-learning materials, including ICT tools for opted pedagogic courses.
9. Plan assessment, prepare material and formative and summative assessment tools, and analyze the results.
10. Prepare and conduct diagnostic tests to identify learning difficulties, analyze data and prepare learning enhancement plan.

11. Experience classes as a substitute teacher.
12. Participate in library functioning and literary activities.
13. Participate in teacher development and training activities.
14. Participate and Organize school assemblies and other events (cultural, sports, yoga, and other development activities).
15. Attend Parents-Teachers Association (PTA) meetings if held during the internship.
16. Attend School Management Committee (SMC) meeting if held during the internship.
17. Study the process of parent and community engagement for the school development programme.
18. Conduct action research /case study.
19. Prepare a sample student portfolio,
20. Write a reflective diary daily and prepare a report of each activity.

6.4.6.3 Middle Stage

1. Meet the subject-based mentors, collect timetables of classes VI to VIII and develop a scheme of lessons from the syllabus to be covered during the internship.
2. Get acquainted with the school within 2-3 days. Observe classroom teaching of school teachers.
3. Plan and transact minimum 80 lessons (40+40), including 4 stray lessons (2+2). Stray lessons are class appropriate lessons on any topic(s) to be transacted by student teachers as per their convenience to build up confidence gradually. The last 5 lessons in each pedagogy course may be transacted using lesson notes.
    - Lesson plans should include activities to promote creativity, inquiry, inquisitiveness, experimentation, exploration, analytical thinking, synthesis to understand the coherent whole, problem-solving, and application of knowledge in real-life situations.
    - Lesson plans must promote education for sustainability, including equity, environment, global citizenship, pride and rootedness in Indian culture and character building.
4. Participate in post-lesson discussions with peers, mentor(s) and teacher educators.
5. Observe peer lessons and discuss with the group.
6. Conduct laboratory activities (Atal Tinkering Lab, Science, Mathematics, Languages, Social Science, Computer), sports, and arts and crafts activities.
7. Participate in student support services- guidance and counselling, NCC, health and wellness programme.
8. Create teaching-learning materials, including ICT tools for opted pedagogic courses.
9. Plan assessment, prepare material and formative and summative assessment tools, and analyze the results.
10. Prepare and conduct diagnostic tests to identify learning difficulties, analyze data and prepare learning enhancement plan.
11. Experience classes as a substitute teacher.
12. Participate in library functioning and literary activities.
13. Participate in teacher development and training activities.
14. Organize school assemblies and other events (cultural, sports, yoga, and other development activities).
15. Attend Parents-Teachers Association (PTA) meetings if held during the internship.

16. Attend School Management Committee (SMC) meeting if held during the internship.
17. Study the process of parent and community engagement for the school development programme.
18. Conduct action research /case study.
19. Prepare a sample student portfolio,
20. Write a reflective diary daily and prepare a report of each activity.

6.4.6.4 Secondary Stage

1. Meet the subject-based mentors, collect timetables of classes IX to XII and develop a scheme of lessons from the syllabus to be covered during the internship.
2. Get acquainted with the school within 2-3 days. Observe classroom teaching of school teachers.
3. Plan and transact minimum 80 lessons (40+40), including 4 stray lessons (2+2). Stray lessons are class appropriate lessons on any topic(s) to be transacted by student teachers as per their convenience to build up confidence gradually. The last 5 lessons in each pedagogy course may be transacted using lesson notes.
    - Lesson plans should include the components to develop critical and reflective thinking, problem-solving, differential learning, synthesis, and application of knowledge in real-life situations.
    - Lesson plans must promote education for sustainability, including equity, environment, global citizenship, pride and rootedness in Indian knowledge systems and character building.
4. Participate in post-lesson discussions with peers, mentor(s) and teacher educators.
5. Observe peer lessons and discuss with the group.
6. Conduct laboratory activities (Atal Tinkering Lab, Physics, Chemistry, Biology, Mathematics, Languages, Social Science, Computer), sports, and arts and crafts activities.
7. Participate in student support services- guidance and counselling, NCC, NSS, health and wellness programme.
8. Create teaching-learning materials, including ICT tools for opted pedagogic courses.
9. Plan assessment, prepare material and formative and summative assessment tools, and analyze the results.
10. Prepare and conduct diagnostic tests to identify learning difficulties, analyze data and prepare learning enhancement plan.
11. Experience classes as a substitute teacher.
12. Participate in library functioning and literary activities.
13. Participate in teacher development and training activities.
14. Organize school assemblies and other events (cultural, sports, yoga, and other development activities).
15. Attend Parents-Teachers Association (PTA) meetings if held during the internship.
16. Attend School Management Committee (SMC) meeting if held during the internship.
17. Study the process of parent and community engagement for the school development programme.
18. Conduct action research /case study.
19. Prepare a sample student portfolio,
20. Write a reflective diary daily and prepare a report of each activity.

6.4.7 Suggestive Mode of Assessment:

The activities conducted / skills acquired during the internship by the student teachers will be assessed as per the following scheme:

Competence/Artifact	Method of assessment	Assessed By	Credits
Observation of classroom practices	• Observation of a Minimum of 6 lessons of School Teachers (3+3) • Observation of a Minimum of 10 lessons of Peers (5+5)	Teacher-Educator	Non-evaluative
Unit planning, Lesson Planning & Transaction	40 lessons transaction for each pedagogical subject * Unit plans and lesson plans * Minimum 2 Innovative lesson plans in each pedagogy subject (Eg: Storytelling, Drama based, Arts and crafts, Use of Technology)	Teacher-Educator, School Mentor	6.0
Assessment Planning and execution	Preparation of report on assessment plan in each lesson transacted i.e., within lesson transaction and lesson end activities. Preparation of a Blue Print (For one/two Pedagogical course/s) and preparation of Assessment tools Conduct of Unit Test & analysis of results (for both Pedagogical course/s) Development of plan for learning enhancement of students related to subjects (for both Pedagogical course/s)	Teacher-Educator, School-Mentor	1.5
Participation/Organization of assembly and other school-level activities, PTM & SMC Meetings	Observation & Interaction	School Mentor	0.5
Preparation of Logbook /Teachers diary Min 5 lessons for each pedagogical method	Review	Teacher-Educator, School Mentor	0.5
Overall feedback on student-teacher performance by School	Observation and Interaction	School Head	0.5

Head			
Test lesson (one in each pedagogical method)	Presentation	Teacher-Educator	1.0

6.4.8 Stakeholders Responsibilities

Role of Head of ITEP Institution

- Identification of the adequate number of internship schools
- Signing the MoU with the schools
- Sharing of mutual expectations of ITEP institutions and the participating schools
- Identification of the internship programme coordinator
- Monitor the progress of the entire School Experience Programme

Role of Teacher-Educators of the ITEP Institution

- Guide the student teachers in preparing lessons and activities, assessment, observation of lessons on peer teaching, action research, and case studies conducting school activities preparation and report writing on Teaching Learning Materials.
- Conduct pre- and post-lesson discussions regularly.
- Assess the transaction of lessons for the complete duration of the lesson in the rating proforma developed by the teacher education institute and give feedback/remarks to the student teachers for lesson improvement.
- Submission of monitoring and supervision reports to the institute in time.
- Discuss with the student teachers frequently and organize a phase-end meeting of the student teachers and mentors to assess the progress and performance of the student teachers.

Role of School Head

- To introduce the student teachers to the students and staff of the school in the assembly on the first day.
- To facilitate student teachers to take classes as per stage requirements- Foundational, Preparatory, Middle, and Secondary.
- Ensure the alignment of the timetable, scheme of lessons and plan of activities/ assignments of the student teachers to be carried out during the programme in the school.
- Countersign on the attendance register maintained by the group leader/ mentor of the school.
- Ensure that all facilities and provisions are available to the student teachers to teach their lessons and carry out their assignments smoothly.
- grant of leave applications of the student teachers in exceptional circumstances.
- Involve student teachers in different activities of the school.
- Facilitate phase-end meetings of the student teachers and the mentors to assess the progress and removal of difficulties.
- Countersign/ certify the report/ documents of the activities/ assignments conducted by the student teachers towards the end of the internship programme.
- Provide input about student-teacher performance.
- Provide suggestions for improvement of the programme to the ITEP institution.

Role of Mentors

- Guide student teachers to prepare detailed lesson plans, brief lesson notes and plans of activities/ assignments to be conducted by them in school.
- Review the lesson plan before a student-teacher transacts the lesson in the class.
- Observe the classes of student teachers.
- Assess each lesson on the prescribed proforma and write remarks in the lesson plan book provided by the student teachers.
- Give feedback continuously to the student teachers for their improvement in their teaching and other curricular activities.
- Conduct post-lesson discussions regularly.
- Countersign in the peer-teaching observation schedules after their observations in the classroom.
- Organize frequent meetings with the student teachers and supervisors to discuss the progress, difficulties faced, and experience gained by student teachers.

Role of Student-Teacher

- Report to the school head of the participating school at least one day before the start of the internship placement.
- Seek information about the classes, timetable, and topics to teach in stage-specific pedagogic courses from the mentors on the first day of the internship programme.
- Mark your attendance as per the school practice.
- Plan all the assignments/ activities with the help of the mentor/ supervisors.
- Seek cooperation from mentors and supervisors in case of difficulty.
- Prepare the lesson plan and get approval from the mentor/ supervisor before transacting every lesson.
- Take classes according to the timetable of the participating school.
- Take substitute classes and participate in other school duties assigned by the school.
- Follow the conduct and dress code of the participating school.
- Get prior leave approval from the head of the participating school in case of emergency.
- Maintain a diary and regularly list all the innovations, challenges faced and reflections for improvement.
- Check with your mentor before attempting learning activities that depart from routine classroom procedures.
- Carry out the activities you plan for school students according to your approved plans.
- Maintain cordial relationships with the students and staff of the school.
- Refrain from making negative comments about the school or the school's personnel, especially when talking with fellow student teachers.
- Submit student teaching profiles, one each, to the supervisor and mentor who supervises your teaching.
- Before the completion of the internship programme, make sure to return all textbooks and materials to the school.

6.5 Post Internship

Credit: 2
Semester: S-8

6.5.1 About the Course

After successful completion of internship programme in 7th semester, student teachers compile the learnings, discuss with peers about their experiences, reflect on the experiences, refine the artifacts developed during internship and prepare comprehensive internship report during post internship in 8th semester.

6.5.2 Learning Objectives

After completion of the activities, the student teachers will be able to:

- develop comprehensive understanding of the school ecosystem,
- describe their learning from internship with the peers and teacher educators,
- reflect on school internship sharing learning experiences on each activity undertaken.

6.5.3 Suggestive Mode of Transaction

- Discussion
- Presentation, Gallery walks and Exhibition.
- Report Writing

6.5.4 Activities:

6.5.4.1 Experience Sharing and Reflective Learning

- Presentation of reflective journal summary
    - My Learning Journey: by each student-teacher
- Gallery walks (Exhibition): TLMs, display of participation in school activities (photos/stories) and other artefacts created during the internship by student teachers.
- Sharing of best practices (PPTs, Videos.)
- Survey and collect the local stories and rhymes from the parents and community (in the context of the foundational stage)
- Holding a training workshop for the parents and community and encouraging them to act as volunteers.
- Awareness and advocacy programme in FLN for parents and community: Role play with parents and community on conducting specific FLN activities.
- Organizing a parents /community mela/fair on homemade TLM for FS children

6.5.4.2 Submission of Internship Report

- Reflective Journal
- Lesson Plans and TLMs
- Observation records (Teacher Educator, Mentor, school heads, Teachers, Parents)
- Assessment records and Student Portfolio
- Action research report/case study
- Comprehensive internship report.

i. **Suggestive Mode of Assessment**

Competence/Artifact	Method of assessment	Assessed By	Credits
Artefacts created during the internship. My Learning Journey	Exhibition & Presentation	Teacher-Educator	1
Comprehensive Internship Report	Review	Teacher-Educator	1

6.5.6 Learning Outcomes

The student teachers will be able to:

- demonstrate/Exhibit/Manifest comprehensive understanding of the school ecosystem.
- reflect on school internship experiences in a report.
- share their learning from school internship with peers and teacher educators.

6.6 Creating Teaching Learning Material (TLM)/Work Experience

Credit: 2
Semester: S-8

6.6.1 About the Course

Having developed an understanding of education's philosophical, sociological, and psychological perspectives and gained hands-on experiences from pre-internship school observation and internship phases, the student teachers have developed a comprehensive understanding of education. By utilizing these experiences and understanding, the Student teachers will be in a position to develop/create Teaching Learning Materials (in various forms, Programed Learning Materials, Educational videos, teachers' handbooks, flashcards, story books, toys, games, posters, collages, innovative lesson plans using different pedagogies, to mention a few) which in turn may be helpful to both the school students with whom he/she has interacted during school experiences and the student teachers. Schools provide a systematic teaching environment for the learners to acquire the knowledge, skills and attitude required to meet the varied aspirational needs and educational goals. Work experience fosters basic knowledge, skills and disposition among the students that prepare them to think of becoming skilled entrepreneurs. To orient the school students on work education, the student teachers need exposure to visit the local vocational artisans, crafts person and entrepreneurs and prepare learning resources to enhance their professional skills and competencies. Teaching Learning Materials of good quality with (i) innovations, (ii) the use of low-cost materials, (iii) local context and (iv) modern technology (for digital learning materials) will enhance students' engagement, interest, and practical learning.

6.6.2 Learning Objectives

After completion of the activities, the student teachers will be able to:

- Assess the need for Teaching Learning Materials and prepare innovative TLM,
- Develop an understanding of the importance of work experience and competencies of a local crafts person, artisans and entrepreneurs,

6.6.3 Suggestive Mode of transaction

- Workshop
- Group discussion
- Field visits and interaction
- Analysis of existing local-specific learning resources, toys
- Exhibition of TLM and presentation of reflective reports on the use of learning resources, including toys.

6.6.4 Content

- Understanding how students learn at different stages.
- Knowledge of toys and other TLMs from different parts of the countries
- Knowledge of relevant TLMs for specific groups of children- CWSN, kinesthetic learners, visual learners, auditory learners addressing individual differences.

6.6.5 Activities to be conducted.

The following are a few suggestive activities:

- Orientation workshop on work experience and development of learning resources
- Field visit for interaction with local artisans, craftspeople, and entrepreneurs.
- Observe Traditional work practices and their integration into Local Technologies and Ideas.
- Analysis of available local specific, indigenous learning resources, including toys and their use in the learning-teaching process
- Development of at least two low-cost learning resources as per the local contexts (foundational/preparatory/middle/secondary) and presentation/exhibition
- Prepare the manual of TLM highlighting the objectives that will be achieved by its use, the material used, the process of its development and its use during classroom transaction.

1.6.6 Suggestive Mode of Assessment

Assessment			
Competence/Artifact	**Method of assessment**	**Assessed By**	**Credits**
TLM developed	Presentation /Exhibition	Teacher Educators (panel of three experts including an external expert)	1.5
Manual	Presentation	Teacher Educator	0.5

6.6.7 Outcomes

The student teachers will:

- demonstrate the use of TLM for enhanced learning,
- explain the importance of work experience and competencies of local crafts person.

7.0 CURRICULAR COMPONENT: COMMUNITY ENGAGEMENT AND SERVICE

(This component is common to student teachers across Stage Specialization)

Credits: 2
Semester: S-8

7.1 About the Course

The curricular component of 'community engagement and service' seeks to expose student teachers to the socio-economic issues in society and community-supported development activities so that classroom learnings can be supplemented by life experiences to generate solutions to real-life problems. This course is designed to develop insights into the functions of the community, enhance the ability of student teachers to enlist community support to and participation in school-related activities, make the community aware of the importance of education, issues associated with schooling, gender inequity, health & wellness of children, initiatives for supporting lifelong education etc. It aims at sensitizing the student teachers to initiate actions with the support of the community members to address the social, cultural and educational problems, and develop social leadership skills through community service. The component seeks to enable student teachers to be acquainted with various community development initiatives and organize activities such as *street plays*, *advocacy activities, door-to-door campaigns, and prabhat-pheris* etc. to mobilize community participation in development initiatives.

This curricular component envisages participation of student-teacher in activities undertaken under the National Service Scheme (NSS), New India Literacy Programme, Student the mentoring initiatives, etc. Some of the activities include: Survey of community resources for participation in different school activities, Study of the situation with regard to school dropout and the reason thereof (Stage wise); Survey of a specific settlement to study the socioeconomic and educational status; Survey of non-literates in a specific settlement, including identification of 4-5 non-literate adults who will be supported by student teachers to become literate; training of local youth in First-Aid and other relevant activities; assessment of the situation with regard to Health and wellness of children in a locality, creating awareness of the importance of sustainable development, making the community members aware of the importance of environmental protection, creating awareness of rainwater harvesting, mentoring school students with learning deficits, guidance and counselling to school students etc.

7.2 Learning Outcomes

On successful completion of the 'Community Engagement and Service' programme, the student-teacher should be able to:

- recognize the socio-economic issues in the community and identify initiatives that could help solve problems faced by the community,
- demonstrate an awareness of the functions of the community, and the measures required for enlisting community participation in school-related activities,
- undertake initiatives that are required to make the community aware of the importance of education, issues associated with schooling, gender inequity, health & wellness of children, illiteracy among youth and adults in the community etc.,

- suggest actions in collaboration with community members to address the social, cultural and educational problems in the community,
- organize activities such as *street plays*, *advocacy activities, door-to-door campaigns, and prabhat-pheris* etc. to mobilize community participation in development initiatives,
- demonstrate social leadership quality through community services,
- organize interactions between schools and local communities for generating solutions to problems such as dropout and learning deficits,
- facilitate partnerships between local communities to enhance participation of the community in school-related activities such as PTA meetings,
- recognize the fault lines of the society, such as casteism, social taboos and superstitions etc. and work towards bridging them to establish harmony in the society,
- demonstrate positive feelings towards the local community and appreciate traditional knowledge and practices,
- Recognize the values of public service and active citizenship.

7.3 Approach to curriculum transaction

The student teachers will be provided opportunities to have exposure to community life for ten days in total, two days in Preparation for Community Engagement & Service in the institution, seven days working with the community, and the last day in the institution for sharing their experiences and reflections. The activities may be conducted in groups or individually as appropriate.

Days 1-2: Preparation for community services (In the institution)

- Orientation of student teachers on Community Engagement & Services through discussion and group activities.
- Workshop for developing tools for different activities during the programme.

Days 3-9: Engagement with the community (Mandatory onsite stay with the community)
Students will be divided into smaller groups; They would participate in the planned activities with defined roles for seven days on a rotation basis. These activities include:

- participation of student teachers in activities undertaken under the National Service Scheme (NSS), New India Literacy Programme, Student mentoring initiatives, etc.
- Survey of community resources for supporting school activities.
- Study of the situation regarding school dropout and the reason thereof (Stage wise).
- Survey of specific settlement to assess the situation about non-literates in the settlement, including identification of 4-5 non-literate youth and adults who will be supported by student teachers to become literate,
- Training of local youth in First Aid and other relevant interventions,
- Assessment of the situation about Health and wellness of children in a locality,
- Creating awareness of the importance of sustainable development, and making the community members aware of the need to support initiatives to ensure environmental protection, creating awareness of rainwater harvesting, mentoring school students with learning deficits, guidance and counselling to school students etc.)
- Visit and interact with local artisans and craftsperson.

The above activities typically will include working with the community, collecting data, playing local games, community awareness programmes like nukkad natak, rallies, organizing and participating in the cultural programmes with the community members etc.

The student teachers shall conduct different pre-scheduled activities throughout the day. Morning sessions will be used for activities with the community and data collection. The afternoon session will be devoted to data analysis and preparation of the report, and participation in games & sports activities. Evening session will involve cultural activities with community members.

Day 10: Feedback session and Reflection **(:** In the Institution)

- Sharing experiences and discussion on activities carried out.
- Presentation and submission of report on the activities carried out.
- Evaluation of the activities by collecting feedback on the effectiveness of the campaign from the mentor and the students.
- Reflection of experience (individual/group) of organizing community service

7.4 Assessment components and weightage

- Involvement and active participation in activities relating to Community Engagement and Service: (Assessment method: Observation by teacher educator, teacher and community members); Weightage: 75%; Assessed by the teacher educator, teacher and community members),
- Group Report & Reflections: Method of assessment: Presentation by student teachers); Weightage: 25% (Assessed by Teacher Educator)

7.5 Suggestive Links

- Ministry of Education (2021).Vidyanjali: Guidelines for Promoting Community and Voluntary Participation for Enhancing Quality School Education, Government of India. https://vidyanjali.education.gov.in/assets/pdf/Final_Guidelines_Vidyanjali_%20December.pdf
- RIE Bhubaneswar (2020). Handbook on Field Engagement in Pre-service Teacher Education, Bhubaneswar, Regional Institute of Education.

Institute of Teachers Education

Pt. Ravishankar Shukla University,
Raipur- C.G.

Curriculum Structure of B.Sc. B.Ed. ITEP (4 Year Integrated Teacher Education Program B.Sc. B.Ed.)

S. No.	Curricular Components	Courses	Credits per semester								Total Credits	Total Credits
			S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8		
1	1 Studentinduction Programme	Two Week Induction Programme		-	-	-	-	-	-	-	-	
2.1	2 Foundations of Education	Evolution of Indian Education	4	-	-	-	-	-	-	-	4	30
2.2		Child Development & Educational Psychology	-	-	4	-	-	-	-	-	4	
2.3		Philosophical & Sociological Perspectives of Education-I	-	-	-	4	-	-	-	-	4	
2.4		Assessment & Evaluation	-	-	-	-	-	2	-	-	2	
2.5		Inclusive Education	-	-	-	-	-	2	-	-	2	
2.6		Perspectives on School Leadership and Management	-	-	-	-	-	-	2	-	2	
2.7		Curriculum Planning & Development (textbooks, material development, etc.) -(Secondary Stage)	-	-	-	-	-	-	2	-	2	
2.8		Philosophical & Sociological Perspectives of Education-II	-	-	-	-	-	-	-	4	4	
2.9		Education Policy Analysis	-	-	-	-	-	-	-	2	2	
2.10		One Elective from the offered i. Emerging Technologies in Education ii. Guidance and Counseling iv. Education for Sustainable Development iii. Economics of Education	-	-	-	-	-	-	-	4	4	
3.	3. Disciplinary Courses	1. Physics, Mathematics, Chemistry, 2. Zoology, Botany, Chemistry	12	12	12	12	12	12	-	-	72	72

26/9/24 26/9/24 26/9/24

4.	4.Pedagogy Courses	Stage specific (Secondary Stage)content cum Pedagogy courses	-	-	4	4	4	4	-	-	16	16
5.1	5. Ability Enhancement & Value-added courses	Language 1– English	4	-	-	-	-	-	-	-	4	28
5.2		Language 2-Hindi	-	4	-	-	-	-	-	-	4	
5.3		Art Education (Performing and Visual)	2	-	-	-	-	-	2	-	4	
5.4		Understanding India /Indian Ethos and Knowledge system (IKS)	2	2	-	-		-	-	-	4	
5.5		Teacher and Society	-	2	-	-	-	-	-	-	2	
5.6		ICT in Education	-	-	-	-	2	-	-	-	2	
5.7		Mathematical & Quantitative Reasoning	-	-	-	2	-	-	-	-	2	
5.8		Sports, Nutrition and Fitness (Health and Well being)	-	-	-	-	-	-	2	-	2	
5.9		Yoga and Understanding self	-	-	-	-	-	-	-	2	2	
5.10		Citizenship Education, Sustainability and Environment Education	-	-	-	-	-	-	-	2	2	
6.1	6.School Experience	Pre-internship Practice (Demo lessons, Peer teaching)	-	-	-	-	2	-	-	-	2	20
6.2		School Observation (Field Practice)	-	-	-	-	-	2	-	-	2	
6.3		School based research project	-	-	-	-	-	-	2	-	2	
6.4		Internship in Teaching	-	-	-	-	-	-	10	-	10	
6.5		Post Internship (Review and Analysis)	-	-	-	-	-	-	-	2	2	
6.6		Creating Teaching Learning Material/Work Experience (Educational Toy Making Local/traditional vocations, etc.)	-	-	-	-	-	-	-	2	2	
7	Community Engagement	Community Engagement and Service (Adult Education/New India Literacy Programme etc.)	-	-	-	-	-	-	-	2	2	2
		Total	24	20	20	22	20	22	20	20	168	168

Total Credits= 168

(2)

FOUR YEAR UNDERGRADUATE PROGRAM (NEP–2020)

Program: Bachelor in Life Science (2024 -28)

DISCIPLINE – BOTANY

Session – 2024 -25

DSC -01 to 08		DSE -01 to 12	
Code	**Title**	**Code**	**Title**
BOSC -01T	*Elementary Botany*	BOSE -01T	*Natural resources and management*
BOSC -01P	*Lab. Course -01 (Elementary Botany)*	BOSE -01P	*Lab. Course -01 (Natural resources and management)*
BOSC -02T	*Microbes and Thallophyta*	BOSE -02T	*Microbiology and Phytopathology*
BOSC -02P	*Lab. Course –02 (Microbes and Thallophyta)*	BOSE -02P	*Lab. Course -02 (Microbiology and Phytopathology)*
BOSC -03T	*Archegoniate and Fossils*	B OSE -03T	*Phytopaleontology and Evolutionary Botany*
BOSC -03P	*Lab. Course-03 (Archegoniate and Fossils)*	BOSE -03P	*Lab. Course -03 (Phytopaleontology and Evolutionary Botany)*
BOSC -04T	*Angiosperms*	BOSE -04T	*Ethnobotany and Medicinal plants*
BOSC -04P	*Lab. Course – 04 (Angiosperms)*	BOSE -04P	*Lab. Course-04 (Ethnobotany & Medicinal plants)*
BOSC -05T	*Cytology and Genetics*	B OSE -05T	*Biosystematics and Biodiversity*
BOSC -05P	*Lab. Course -05 (Cytology and Genetics)*	BOSE -05P	*Lab. Course -05 (Biosystematics and Biodiversity)*
BOSC -06T	*Plant Physiology and Economic Botany*	BOSE -06T	*Plant breeding and Seed technology*
B OSC -06P	*Lab. Course -06 (Plant Physiology and Economic Botany)*	BOSE -06P	*Lab. Course -06 (Plant breeding and Seed technology)*
BOSC -07T	*Ecology and Phytogeography*	BOSE -07T	*Instrumentation and biochemical technology*
BOSC -07P	*Lab. Course –07 (Ecology and Phytogeography)*	BOSE -07P	*Lab. Course -07 (Instrumentation and biochemical technology)*
BOSC -08T	*Molecular biology and Biostatistics*	BOSE -08T	*Growth and Stress Physiology*
BOSC -08P	*Lab. Course-08 (Molecular biology and Biostatics)*	BOSE -08P	*Lab. Course -08 (Growth and Stress Physiology)*
		BOSE -09T	*Plant biotechnology and crop improvement*
		BOSE -09P	*Lab. Course -09 (Plant biotechnology and crop improvement)*
		BOSE -10T	*Applied Botany and Intellectual property right (IPR)*
		BOSE -10P	*Lab. Course -10 (Applied Botany and IPR)*
		BOSE -11T	*Biochemistry and Enzymology*
		BOSE -11P	*Lab. Course -11 (Biochemistry and Enzymology)*
		BOSE -12T	*Bioinformatics and Gene Technology*
		BOSE -12P	*Lab. Course-12 (Bioinformatics & Gene Technology)*
GE -01 & 02		VAC	
BOGE -01T	*Elementary Botany*	BOVAC-01	*Herbal Plant & Human Health*
BOGE -01P	*Lab. Course -01 (Elementary Botany)*	SEC	
BOGE -02T	*Microbes and Thallophyta*	BOSEC-01	*Gardening and Floriculture*
BOGE -02P	*Lab. Course –02 (Microbes and Thallophyta)*		

Program Outcomes (PO):

1. Demonstrate and apply the fundamental knowledge of the basic principles of major fields of biology
2. Apply knowledge to solve the issues related to plant sciences with the help of computer technology
3. Apply knowledge for conservation of endemic and endangered plant species

Program Specific Outcomes (PSO):

1. Collaborate effectively on team-oriented projects in the field of life sciences.
2. Communicate scientific information in a clear and concise manner both orally and in writing
3. Explain Biodiversity, climate change and plant pathology.
4. Apply Biotechnology, Ecology, Genetics and Plant breeding techniques in plant sciences
5. Apply knowledge of Medicinal and Economic botany in day to day life.
6. Apply the knowledge to develop the sustainable and eco-friendly technology.

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF BOTANY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Sciences *(Certificate / Diploma / Degree/Honors)*			Semester - I	Session: 2024-2025
1	Course Code	BOSC -01 T		
2	Course Title	Elementary Botany		
3	Course Type	Discipline Specific course (DSC)		
4	Pre-requisite (if, any)	*As per program*		
5	Course Learning. Outcomes (CLO)	At the end of this course, the students will be able to ➢ Understand the Basics of Botany and its branches. ➢ Get acquainted with complex interrelationship between organisms and environment. ➢ Develop a comprehensive understanding of the identification, cultivation, and processing of medicinal plants, and their chemical constituents. ➢ Utilize plants resources for livelihood.		
6	Credit Value	3 Credits	*Credit = 15 Hours - learning & Observation*	
7	Total Marks	Max. Marks: 100	Min Passing Marks: 40	

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**Basics of Plant Science**: Differences and resemblances between; living and nonliving plants and animals, plant and animal cell. Concept of prokaryotes and eukaryotes.Important features of thallophyta, Bryophyta, Pteridophyta, Gymnosperm and Angiosperm.Structure and function of a typical flowering plant.	12
II	**Branches of botany:** General idea, features, and significance; Anatomy, Cytology, Economic Botany, Ethnobotany, Forestry, Genetics, Histology, Microbiology, Paleobotany, Phytochemistry, Phytopathology , Plant biotechnology, Plant breeding, Plant ecology, Plant morphology, Plant physiology, Plant Taxonomy, etc,	11
III	**Plants for human welfare:**Plant Resources for Rural livelihood – Mahua, Tendu patta, Bamboo and Firewood.Ethnobotany in India: Methods to study Ethnobotany, Applications of Ethnobotany, ethnomedicinal plants and ethnoecology. Application of plant products for certain diseases- Cough and cold, Jaundice, Infertility, Diabetes, Blood pressure and Skin diseases.	11
IV	**Ancient Indian Botany:**Indigenous Medicinal Sciences;Definition and Scope-Ayurveda: History, origin, panchamahabhutas, saptadhatu and tridosha concepts, Rasayana, plants used in ayurvedic treatments, Siddha: Origin of Siddha medicinal systems, Basis of Siddha system, plants used in Siddha medicine. Unani: History, concept. Charaksamhita. Ancient and modern Botanists and their contributions.-Charak, Jagdish Chandra Bose, B.P.Pal, Desikachary,K.C. Mehta M.S. Swaminathan etc.	11
Keywords	*Prokaryotes, Ethnobotany, Taxonomy, Ayurveda*	

Signature of Convener & Members (CBoS) :

1
2
3
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PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. College Botany Ganguli Kar and dutta , HIMALAYA Publishers
2. "Handbook of Medicinal Plants" by L.D. Kapoor
3. "Indian Medicinal Plants: An Illustrated Dictionary" by C.P. Khare
4. "Medicinal Plants in India: Conservation and Sustainable Utilization in the Emerging Global Scenario" edited by V.K. Gupta
5. "A Compendium of Medicinal Plants in India: An Introduction to Ayurveda" by S.L. Kochhar
6. A handbook of forest utilization by T. Mehta
7. Plants and human welfare by O.P.Sharma

Reference Books Recommended –

1. Charak Samhita
2. Medicinal Plants of India" by C.P. Khare

Online Resources–

- **e-books and e-learning portals**
- **www.swayam.ac.in**
- **www.ignou.ac.in**
- **www.egyankosh.ac.in**
- **www.iitm.ac.in**
- **www.eskillindia.org**
- **www.eshiksha.mp.gov.in**
- **www.vlab.co.in**
- **www.internshala.com**
- **www.ndl.iitkgp.ac.in**

Online Resources–

e-Resources / e-books and e-learning portals

- https://extension.oregonstate.edu/collection/botany-basics
- https://www.pbs.org/video/botany-basics-iuu2bl/
- https://efaidnbmnnnibpcajpcglclefindmkaj/https://www2.ca.uky.edu/agcomm/pubs/ho/ho96/ho96.pdf
- https://www.botanytoday.com/branches-of-botany/
- https://efaidnbmnnnibpcajpcglclefindmkaj/https://www.unanijournal.com/articles/94/3-1-11-206.pdf
- https://efaidnbmnnnibpcajpcglclefindmkaj/https://wgbis.ces.iisc.ac.in/biodiversity/sahyadri/documents/botany_history.pdf
- https://vedpuran.files.wordpress.com/2016/07/charaksamhitaatridevajigupt-vol-1.pdf
- https://egyankosh.ac.in/handle/123456789/89429

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 100 Marks

Continuous Internal Assessment (CIA): 30 Marks

End Semester Exam (ESE): 70 Marks

Continuous Internal Assessment (CIA): 30 (By Course Teacher)	Internal Test / Quiz-(2): 20 +20 Assignment / Seminar - 10 Total Marks - 30	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
End Semester Exam (ESE): 70	Two section – A & B Section A: Q1. Objective – 10 x1= 10 Mark; Q2. Short answer type- 5x4 =20 Marks Section B: Descriptive answer type qts.,1out of 2 from each unit-4x10=40 Marks	

Name and Signature of Convener & Members of CBoS:

(1) (2) (3) (4) (5) (6) (7) (8) (9) (10)

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF BOTANY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Sciences *(Certificate / Diploma / Degree/ Honors)*			Semester - I	Session: 2024-2025
1	Course Code	BOSC -01		
2	Course Title	Lab. Course -01 (Elementary Botany)		
3	Course Type	Laboratory course		
4	Pre-requisite (if, any)	*As per program*		
5	Course Learning. Outcomes (CLO)	At the end of this course, the students will be able to ➢ Understand structure of plant cell, prokaryotic cell and eukaryotic cell. ➢ Identify pteridophytes of college campus. ➢ Learn about the different types of plant tissues. ➢ Learn about Ayurvedic system of medicine.		
6	Credit Value	1 Credits	*Credit =30 Hours Laboratory or Field learning/Training*	
7	Total Marks	Max. Marks: 50	Min Passing Marks: 20	

PART -B: Content of the Course

Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)

Module	Topics (Course contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course	1. Microscopic study of plant cell. 2. Microscopic study of prokaryotic (Bacteria) and eukaryotic cell (algae and fungi). 3. Study of thallus structure of *Riccia* and *Marchantia*. 4. Identification of different plants growing in college campus. 5. Study of a typical flowering plant and it's parts. 6. Study of internal structure of root and stem. 7. Study of parenchyma, collenchyma and sclerenchyma. 8. Study of medicinal plants of college campus. 9. Study of plants used to cure cough and cold, jaundice and skin diseases. 10. Visit to any local ayurvedic hospital / practitioner to understand Ayurveda.	30
Keywords	*Prokaryotic, Parenchyma, Jaundice, Ayurveda.*	

Signature of Convener & Members (CBoS) :

PART-C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

Text Books Recommended –

1. College Botany Ganguli Kar and dutta , HIMALAYA Publishers
2. "Handbook of Medicinal Plants" by L.D. Kapoor
3. "Indian Medicinal Plants: An Illustrated Dictionary" by C.P. Khare
4. "Medicinal Plants in India: Conservation and Sustainable Utilization in the Emerging Global Scenario" edited by V.K. Gupta
5. "A Compendium of Medicinal Plants in India: An Introduction to Ayurveda" by S.L. Kochhar
6. A handbook of forest utilization by T. Mehta
7. Plants and human welfare by O.P.Sharma

Reference Books Recommended –

1. Charak Samhita
2. Medicinal Plants of India" by C.P. Khare

Online Resources–

- **e-Resources / e-books and e-learning portals**
- www.swayam.ac.in
- www.ignou.ac.in
- www.egyankosh.ac.in
- www.iitm.ac.in
- www.eskillindia.org
- www.eshiksha.mp.gov.in
- www.vlab.co.in
- www.internshala.com
- www.ndl.iitkgp.ac.in

Online Resources–

- **e-Resources / e-books and e-learning portals**
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5871155/
- https://cms.botany.org/home/careers-jobs/careers-in-botany/areas-of-specialization-in-botany.html

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	50 Marks
Continuous Internal Assessment (CIA):	15 Marks
End Semester Exam (ESE):	35 Marks

Continuous Internal Assessment (CIA): 15 (By Course Teacher)	Internal Test / Quiz-(2): 10 & 10 Assignment/Seminar +Attendance - 05 Total Marks - 15	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 15 Marks
End Semester Exam (ESE): 35	Laboratory / Field Skill Performance: On spot Assessment A. Performed the Task based on lab. work - 20 Marks B. Spotting based on tools & technology (written) – 10 Marks C. Viva-voce (based on principle/technology) - 05 Marks	Managed by Course teacher as per lab. status

Name and Signature of Convener & Members of CBoS:

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FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF BOTANY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Sciences *(Certificate / Diploma / Degree/Honors)*		**Semester - II**		Session: 2024-2025
1	Course Code	BOSC -02 T		
2	Course Title	**Microbes and Thallophyta**		
3	Course Type	**Discipline Specific course (DSC)**		
4	Pre-requisite (if, any)	*As per program*		
5	Course Learning. Outcomes (CLO)	At the end of this course, the students will be able to 1. Understand about the Microbes and their Importance. 2. Identify edible mushrooms and learn cultivation techniques. 3. Learn about bio-fertilizers and their uses. 4. Understand life cycles of different algae and fungi.		
6	Credit Value	**3 Credits**	*Credit = 15 Hours - learning & Observation*	
7	Total Marks	**Max. Marks:** 100	**Min Passing Marks:** 40	

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	Viruses: - general characteristics,nature , structure and nomenclature, Bacteriophages and TMV; Lytic and Lysogenic cycles, transmission and replication of viruses, Symptoms of viral diseases on plants , important plant diseases, viroid, prions.Actinomycetes: general characteristics ,Structure, reproduction and economic importance. Mycoplasma, Phytoplasma,: general characteristics , structure, reproduction and their economic uses.	12
II	**Bacteria:** History, general character, classification and morphology, Gram positive and Gram-negative bacteria, structure of bacteria shape, size flagella and ultra structure of bacterial cell; Bacterial Growth curve, factors affecting growth of microbes; sporulation, reproduction, recombination in bacteria- Transformation Conjugation and Transduction, and Economic importance. Cyanobacteria : General characteristics, morphology,Heterocyst, cell structure of Cyanobacteria, reproduction and economic importance of Bacteria.	11
III	**Phycology:** General characteristic features of Algae. Algae in diversified habitat, Salient features, occurrence, classification and range of thallus organization.Prominent pigments found in Algae. Reproduction classification, general character and life cycle of –*Volvox, Oedogonium, Chara, Vaucheria,Ectocarpus*and*Polysiphonia*. Economic importance of algae - Role of algae in soil fertility, algae as biofertilizer , blue green algae and nitrogen fixation. Symbiosis ; algal products - Agar, biofuel	11
IV	**Mycology, Mushroom Cultivation, Lichenology &Mycorrhiza:** General characteristic features of Fungi, Economic importance and Classification of Fungi, Nutrition, Heterothallism, Physiological specialization, Heterokaryosis &Parasexuality in Fungi. Fungi as biocontrol agent. Classification, general character and life cycle of -*Mucor*, Phytophthora*Penicillium, Peziza, Ustilago, Puccinia, Agaricus*; *Colletotrichum, Alternaria*. Edible Mushroom- Button and Oyster mushroom and their cultivation. General account of lichens. General account of Mycorrhiza.	11
Keywords	*Mycoplasma, Transduction, Biofertilizer, Parasexuality.*	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West. Press Pvt. Ltd. Delhi. 2nd edition.
2. Tortora, G.J., Funke, B.R., Case, C.L. (2010). Microbiology: An Introduction, Pearson Benjamin Cummings. U.S.A. 10th edition.
3. Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi & Their Allies, MacMillan Publishers Pvt. Ltd., Delhi.
4. Aggarwal, S. K. 2009. Foundation Course in Biology, A one books Pvt. Ltd., New Delhi.
5. Aneja, K. R. 1993. Experiments in Microbiology, Pathology and Tissue Culture, VishwaPrakashan, NewDelhi.
6. Annie Ragland, 2012. Algae and Bryophytes, Saras Publication, Kanyakumari, India.
7. Basu, A. N. 1993. Essentials of Plant Viruses, Vectors and Plant diseases, New Age International, New Delhi.
8. Chopra. G. L. 1984. A text book of Algae, Rastogi publications, Meerut,India.
9. Dubey, R. C. and Maheshwari. D.K. 2012. Practical Microbiology, S. Chand & Company, Pvt. Ltd., NewDelhi.
10. Fritsch, R. E. 1977. Structure and Reproduction of Algae, Cambridge University Press, London.
11. Sharma, P.D. (2011). Plant Pathology. Meerut, U.P.: Rastogi Publication.
12. Pandey B.P. 2001. College Botany Volume 1, S Chand & Company Pvt.Ltd, New Delhi.

Reference books:

1. Webster, J., Weber, R. (2007). Introduction to Fungi, 3rd edition. Cambridge, U.K.: Cambridge University Press.
2. Pelzar, 1963. Microbiology, Tata McGraw Hill, New Delhi
3. Rangaswamy, G. 2009, Disease of Crop Plants in India, Prientice Hall of India, New Delhi.
4. Microbiology Fundamental and Applications (hindi) (pb) 9. ISBN: 9788188826230 Edition: 03Year : 2016Author : Dr. Purohit SS , Dr. Deo Publisher : Student Edition Language : Hindi
5. Modern Microbiology (hindi) (hb) ISBN: 9788177543599Edition : 1Year : 2018Author : Dr. Purohit SS , Dr. Singh T Publisher : Agrobios (India)
6. Plant pathology by R.S. Mehrotra, Tata McGraw-Hill Publication

Online Resources–

- **e-Resources / e-learning portals**
- www.swayam.ac.in
- www.ignou.ac.in
- www.egyankosh.ac.in
- www.iitm.ac.in
- www.eskillindia.org
- www.eshiksha.mp.gov.in
- www.vlab.co.in
- www.internshala.com
- www.ndl.iitkgp.ac.in

Online Resources–

- **e-Resources / e-books and e-learning portals**

1. https://www.classcentral.com/tag/microbiology
2. https://www.edx.org/learn/microbiology
3. https://www.mooc-list.com/tags/microbiology
4. https://www.udemy.com/topic/microbiology/
5. https://ucmp.berkeley.edu/bacteria/bacteria.html
6. https://www.livescience.com/53272-what-is-a-virus.html
7. https://gclambathach.in/lms/Economic%20importance%20of%20Algae.pdf
8. https://www.slideshare.net/sardar1109/algae-notes-1
9. https://www.onlinebiologynotes.com/algae-general-characteristics-classification/
10. https://www.sciencedirect.com/topics/immunology-and-microbiology/fungus
11. https://ucmp.berkeley.edu/fungi/fungi.html
12. https://agrimoon.com/wp-content/uploads/Mashroom-culture.pdf
13. http://ecoursesonline.iasri.res.in/mod/page/view.php?id=11293
14. http://www.jnkvv.org/PDF/11042020102651plant_pathology.pdf
15. https://www.apsnet.org/edcenter/disimpactmngmnt/topc/EpidemiologyTemporal/Pages/ManagementStrategies.aspx
16. https://www.agrilcareer.com/6-easy-steps-for-mushroom-cultivation/

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	100 Marks
Continuous Internal Assessment (CIA):	30 Marks
End Semester Exam (ESE):	70 Marks

Continuous Internal Assessment (CIA):30 (By Course Teacher)	Internal Test / Quiz-(2): 20 +20 Assignment / Seminar - 10 Total Marks - 30	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
End Semester Exam (ESE): 70	**Two section – A & B** Section A: Q1. Objective – 10 x1= 10 Mark; Q2. Short answer type- 5x4 =20 Marks Section B: Descriptive answer type qts., 1out of 2 from each unit-4x10=40 Marks	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

DEPARTMENT OF BOTANY

COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Sciences *(Certificate / Diploma / Degree/Honors)*		**Semester - II**		Session: 2024-2025
1	Course Code	**BOSC- 02**		
2	Course Title	**Lab. Course –02 (Microbes and Thallophyta)**		
3	Course Type	**Laboratory course**		
4	Pre-requisite (if, any)	*As per program*		
5	Course Learning. Outcomes (CLO)	1. Understand the Viruses, Bacteria, Phycology, Mycology and Plant pathology 2. Learn microbial techniques which will be beneficial for agriculture and industry. 3. Learn life cycles of selected genera of different groups 4. Understand etiology of plant diseases 5. Apply their knowledge in the crop fields to eradicate or avoid the diseases		
6	Credit Value	**1 Credits**	***Credit =30 Hours Laboratory or Field learning/Training***	
7	Total Marks	**Max. Marks: 50**	**Min Passing Marks: 20**	

PART -B: Content of the Course		
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)		
Module	**Topics (Course contents)**	**No. of Period**
Lab./Field Training/ Experiment Contents of Course	1. Collection of viral/ Bactrial /fungal infected plants 2. Study of plant disease symptoms caused by viral/ Bactrial /fungal/ Mycoplasma 3. **BACTERIAL IDENTIFICATION:** Isolation of bacteria Staining techniques: Gram's, staining 4. Study / Slide preparation of available Cyanobacteria 5. **PHYCOLOGY:** Study / Slide preparation and Staining of algae –*Volvox, Oedogonium* and *Chara; Vaucheria;Ectocarpus Polysiphonia* 6. **MYCOLOGY:** Study/ Slide preparation and . Staining of fungi. *Mucor,Phytophthora, Penicillium, Peziza, Ustilago, Puccinia; Agaricus, colletotrichum, Alternaria.*: Study of Button and Oyster Mushroom Lichens: crustose, foliose and fruticose specimens. Study of VAM fungi	30
Keywords	infected plants, VAM, algae, fungi	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. Practical Botany (Part I) ISBN #:81-301-0008-8 Sunil D Purohit, Gotam K Kukda & Anamika Singhvi Edition:2013 Apex Publishing House Durga Nursery Road, Udaipur, Rajasthan (bilingual).
2. Pandey S.K. (2012). Quick Concept of Botany. Publisher LAP LAMBERT Academic Publishing GmbH & Co. KG, Germany (ISBN: 978-3-8484-3104-5).
3. Dubey, R. C. and Maheshwari. D.K. 2012. Practical Microbiology, S. Chand & Company, Pvt. Ltd., New Delhi.
4. Pandey. B.P. 2014 Modern Practical Botany, (Vol-I) S. Chand and Company Pvt. Ltd., New Delhi.

Online Resources–

- **e-Resources / e-books and e-learning portals**
- **www.swayam.ac.in**
- **www.ignou.ac.in**
- **www.egyankosh.ac.in**
- **www.iitm.ac.in**
- **www.eskillindia.org**
- **www.eshiksha.mp.gov.in**
- **www.vlab.co.in**
- **www.internshala.com**
- **www.ndl.iitkgp.ac.in**

Online Resources–

- **e-Resources / e-books and e-learning portals**

1. https://community.plantae.org/tags/moocfuturelearn.com/courses/teaching-biology-inspiring-students-with-plants-in-science
2. https://microbiologysociety.org/publication/education-outreach-resources/basic-practical-microbiology-a-manual.html
3. https://microbiologyonline.org/file/7926d7789d8a2f7b2075109f68c3175e.pdf
4. http://allaboutalgae.com/benefits/
5. https://repository.cimmyt.org/xmlui/bitstream/handle/10883/3219/64331.pdf
6. https://www.mooc-list.com/tags/microbiology\
7. http://www.agrifs.ir/sites/default/files/A%20text%20book%20of%20practical%20botany%201%20%7BAshok%20Bendre%7D%20%5B8
8. https://171339239%5D%20%281984%29.pdf

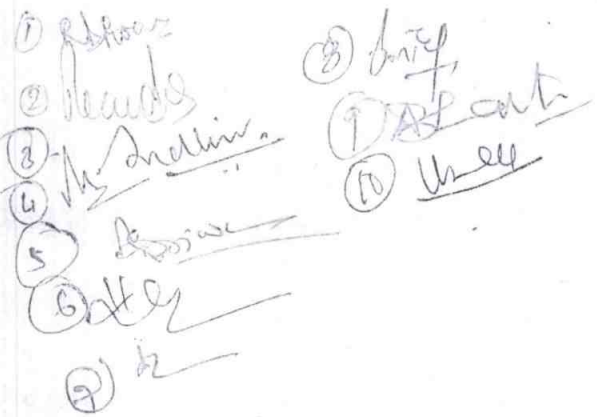
PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): 15 (By Course Teacher)	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - **05** Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 15 Marks
End Semester Exam (ESE): 35	**Laboratory / Field Skill Performance: On spot Assessment** A. Performed the Task based on lab. work - **20 Marks** B. Spotting based on tools & technology (written) – **10 Marks** C. **Viva-voce (based on principle/technology)** - **05 Marks**	Managed by Course teacher as per lab. status

Name and Signature of Convener & Members of CBoS:



FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF BOTANY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Sciences *(Diploma / Degree/Honors)*			Semester - III	Session: 2024-2025
1	Course Code	BOSC-03 T		
2	Course Title	Archegoniate and Fossils		
3	Course Type	Discipline Specific course (DSC)		
4	Pre-requisite (if, any)	*As per program*		
5	Course Learning. Outcomes (CLO)	➢ students will be familiar with amphibians and reptiles plants ➢ progressive evolution in plants ➢ relics of past plants ➢ diversity in plants ➢ development of seeds.		
6	Credit Value	3 Credits	*Credit = 15 Hours - learning & Observation*	
7	Total Marks	Max. Marks: 100	Min Passing Marks: 40	

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**Bryophyta:** Morphology, structure, reproduction and life history, distribution, classification, evolution of gametophytes and sterilization of sporogenous tissue. General account of- Riccia, Marchantia, Anthoceros and Funaria , Economic and ecological importance of bryophytes.	12
II	**Pteridophytes:** Morphology, anatomy and reproduction, classification, evolution of stele, heterospory, telome theory and origin of seed habit, general account and life history of of Psilotum, Lycopodium, Sellaginella, Equisetum Pteris, Marsilea	11
III	**Gymnosperm :** Characteristics of Gymnosperms, the vessel - less & fruitless seed plants, Classification of Gymnosperm; Polyembryony in Gymnosperms and its role; Distribution of Gymnosperm in India; Economic importance of Gymnosperm. General account of Cycas, Pinus, Gnetum Concepts of living fossil (Cycas & Ginkgo); Angiospermic characters of Gnetum.	11
IV	**Fossil:** Fossil and fossilization, types of fossils Geological time table **Brief account of the families of Pteridospermales** –Rhynia, Calamites. **General Account and Affinities -** Cycadeoidales Pentoxylales and Cordaitales	11
Keywords	Archegonia, seedless, heterospory, fossils	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. Puri, P. (1980) Bryophytes, Atma Ram and Sons, Delhi.
2. Vashishtha, B. R. (2005) Pteridophytes S. Chand and Co., Delhi.
3. Bhatnagar, S. P., Moitra, A. (1996) Gymnosperms, New Age International Pvt. Ltd., New Delhi.

Text Books Recommended –

4. Sporne, K. K. (1991) The Morphology of Gymnosperm. B. I. Publishing Pvt. Ltd., Bombay.
5. Stewart, W. N. and Ruthwell, G. W. (1993) Paleobotany and the Evolution of Plants. Cambridge Univ. Press, UK.
6. Singh, H. (1978) Embryology of Gymnosperms; Encyclopedia of Plant Anatomy X. Gebruder Bortraeger. Berlin.

Online Resources–

- **e-Resources / e-books and e-learning portals**
- www.swayam.ac.in
- www.ignou.ac.in
- www.egyankosh.ac.in
- www.iitm.ac.in
- www.eskillindia.org
- www.eshiksha.mp.gov.in
- www.vlab.co.in
- www.internshala.com
- www.ndl.iitkgp.ac.in

Online Resources–

e-Resources / e-books and e-learning portals

- https://study.com/learn/lesson/bryophytes-characteristics-examples.html
- https://bio.libretexts.org/Bookshelves/Introductory_and_General_Biology/Book%3A_General_Biology_(Boundless)/26%3A_Seed_Plants/26.02%3A_Gymnosperms/26.2A%3A_Characteristics_of_Gymnosperms
- https://www.google.com/search?q=fossils&sca_esv=09379ecd0b6efd91&rlz=1C1CHBD_enIN1091IN1093&sxsrf=ACQVn09vtjzqRGwbydx-p0sOZFXGRnmfcw%3A1713546819943&ei=Q6YiZvefOde5vr0PtMuvqAg&oq=fossils&gs_lp=Egxnd3Mtd2l6LXNlcnAiB2Zvc3NpbHMqAggAMg0QABiABBixAxhDGIoFMgoQLhiABBhDGIoFMgUQABiABDIFEAAYgAQyBRAAGIAEMgoQABiABBhDGIoFMgUQABiABDIFEAAYgAQyBRAAGIAEMgUQABiABEjhKlAAWPIUcAB4AJABAJgBgwKgAYcLqgEFMC41LjK4AQHIAQD4AQGYAgegAukLwgIKECMYgAQYJxiKBclCBBAjGCfCAhEQLhiABBixAxjRAxiDARjHAclCCBAAGIAEGLEDwgIKEAAYgAQYFBiHApgDAJIHBTAuMy40oAfSWw&sclient=gws-wiz-serp
- https://www.google.com/search?q=fossils&sca_esv=09379ecd0b6efd91&rlz=1C1CHBD_enIN1091IN1093&sxsrf=ACQVn09vtjzqRGwbydx-p0sOZFXGRnmfcw%3A1713546819943&ei=Q6YiZvefOde5vr0PtMuvqAg&oq=fossils&gs_lp=Egxnd3Mtd2l6LXNlcnAiB2Zvc3NpbHMqAggAMg0QABiABBixAxhDGIoFMgoQLhiABBhDGIoFMgUQABiABDIFEAAYgAQyBRAAGIAEMgoQABiABBhDGIoFMgUQABiABDIFEAAYgAQyBRAAGIAEMgUQABiABEjhKlAAWPIUcAB4AJABAJgBgwKgAYcLqgEFMC41LjK4AQHIAQD4AQGYAgegAukLwgIKECMYgAQYJxiKBclCBBAjGCfCAhEQLhiABBixAxjRAxiDARjHAclCCBAAGIAEGLEDwgIKEAAYgAQYFBiHApgDAJIHBTAuMy40oAfSWw&sclient=gws-wiz-serp
- https://www.google.com/search?q=pteridophytes&sca_esv=09379ecd0b6efd91&rlz=1C1CHBD_enIN1091IN1093&sxsrf=ACQVn0-V0lp75QZG3sbfKrflXB0G:PdZyA%3A1713546628592&ei=hKUiZuvFI9q-juMPkr-DkAY&oq=pter&gs_lp=Egxnd3Mtd2l6LXNlcnAiBHB0ZXIqAggAMg0QABiABBixAxhDGIoFMgoQABiABBhDGIoFMgoQABiABBhDGIoFMgoQABiABBhDGIoFMgUQABiABDIKEAAYgAQYQxiKBTINEC4YgAQYsQMYQxiKBTIFEC4YgAQyChAAGIAEGEMYigUyChAAGIAEGEMYigVI_ihQAFixCnAAeACQAQCYAfQBoAGiBqoBBTAuMi4yuAEBvAEA-AEBmAIEoALgBslCChAjGIAEGCcYigXCAgQQIxgnwgIKEC4YgAQYQxiKBZgDAJIHBTAuMi4yoAfOSg&sclient=gws-wiz-serp
- https://bio.libretexts.org/Bookshelves/Introductory_and_General_Biology/Book%3A_General_Biology_(Boundless)/26%3A_Seed_Plants/26.02%3A_Gymnosperms/26.2A%3A_Characteristics_of_Gymnosperms

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	100 Marks
Continuous Internal Assessment (CIA):	30 Marks
End Semester Exam (ESE):	70 Marks

Continuous Internal Assessment (CIA):30 (By Course Teacher)	Internal Test / Quiz-(2): 20 +20 Assignment / Seminar - 10 Total Marks - 30	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
End Semester Exam (ESE): 70	**Two section – A & B** Section A: **Q1.** Objective – 10 x1= 10 Mark; **Q2.** Short answer type- 5x4 =20 Marks Section B: Descriptive answer type qts., **1 out of 2** from each unit-4x10=40 Marks	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF BOTANY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Sciences *(Diploma / Degree/Honors)*		**Semester - III**		Session: 2024-2025
1	Course Code	**BOSC-03**		
2	Course Title	**Lab. Course-03 (Archegoniate and Fossils)**		
3	Course Type	Laboratory course		
4	Pre-requisite (if, any)	*As per program*		
5	Course Learning. Outcomes (CLO)	At the end of the course students will be familiar ➢ with amphibians and reptiles plants ➢ progressive evolution in plants ➢ relics of past plants ➢ diversity in plants ➢ Development of seeds.		
6	Credit Value	**1 Credits**	*Credit =30 Hours Laboratory or Field learning/Training*	
7	Total Marks	**Max. Marks: 50**		**Min Passing Marks: 20**

PART -B: Content of the Course

Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)

Module	Topics (Course contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course	**Bryophyta:** Comparative study of the anatomy of vegetative and reproductive parts of *Marchantia, Pellia, Anthoceros, Notothylus, Funaria, Polytrichum.* **Pteridophyta:** Comparative study of the anatomy of vegetative and reproductive parts of *Psilotum, Lycopodium, Selaginella, Equisetum, Gleichenia,Pteris, Ophioglossum, Isoetes.* **Gymnosperms:** Comparative study of the anatomy of vegetative and reproductive parts of *Cycas, Ginkgo, Cedrus, Abies, Picea, Cupressus, Araucaria, Cryptomeria, Taxodium, Podocarpus, Agathis, Taxus, Ephedra* and *Gnetum.* ▪ Collection of various gymnospermic plant materials. ▪ Field work – as far practicable conveniently. **Fossil:** Study of important fossil gymnosperms from prepared photographs, slides and specimens.	30
Keywords	Archegonia, venter, bryophytes, pteridophytes	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. The Practical Fossil Finder (Practical Handbook) Hardcover – 1 October 1991by Steve Parker (Author) Publishers Facts On File Inc
2. Practical Botany (Part I) ISBN #:81-301-0008-8 Sunil D Purohit, Gotam K Kukda & Anamika Singhvi Edition:2013 Apex Publishing House Durga Nursery Road, Udaipur, Rajasthan (bilingual).
3. Pandey S.K. (2012). Quick Concept of Botany. Publisher LAP LAMBERT Academic Publishing GmbH & Co. KG, Germany (ISBN: 978-3-8484-3104-5).
4. Dubey, R. C. and Maheshwari. D.K. 2012. Practical Microbiology, S. Chand & Company, Pvt. Ltd., New Delhi.
5. Pandey. B.P. 2014 Modern Practical Botany, (Vol-I) S. Chand and Company Pvt. Ltd., New Delhi.

Reference Books Recommended –

1. Principles of Paleontology Edition 3 Paperback–1 January 2006 by Arnold Miller, Michael Foote Publishers - W.H.Freeman & Co Lt

Online Resources–

- **e-Resources / e-books and e-learning portals**
- **www.swayam.ac.in**
- **www.ignou.ac.in**
- **www.egyankosh.ac.in**
- **www.iitm.ac.in**
- **www.eskillindia.org**
- **www.eshiksha.mp.gov.in**
- **www.vlab.co.in**
- **www.internshala.com**
- **www.ndl.iitkgp.ac.in**

Online Resources–

- **e-Resources / e-books and e-learning portals**

1. **https://efaidnbmnnnibpcajpcglclefindmkaj/https://egyankosh.ac.in/bitstream/123456789/69611/1/Unit-9.pdf**
2. https://www.encyclopedia.com/science/encyclopedias-almanacs-transcripts-and-maps/fossil-and-fossilization
3. https://palaeobotany.org

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): 15 (By Course Teacher)	Internal Test / Quiz-(2): 10 & 10 Assignment/Seminar +Attendance - 05 Total Marks - 15	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 15 Marks
End Semester Exam (ESE): 30	**Laboratory / Field Skill Performance: On spot Assessment** A. **Performed the Task based on lab. work - 20 Marks** B. **Spotting based on tools & technology (written) – 10 Marks** C. **Viva-voce (based on principle/technology) - 05 Marks**	Managed by Course teacher as per lab. status

Name and Signature of Convener & Members of CBoS:

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FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

DEPARTMENT OF BOTANY

COURSE CURRICULUM

PART- A: Introduction

Program: Bachelor in Life sciences *(Diploma / Degree/Honors)*	Semester - IV	Session: 2024-2025

1	Course Code	BOSC-04 T	
2	Course Title	Angiosperms	
3	Course Type	Discipline Specific course (DSC)	
4	Pre-requisite (if, any)	*As per program*	
5	Course Learning. Outcomes (CLO)	At the end of the course, the students will be able : ➢ Understand basics of plant identification, classification and nomenclature ➢ Understand the concept, diversity and evolution of Angiosperm plants. ➢ Become familiar with the internal structure of plants and concept of plant tissues with its revolutionary concept. ➢ Understand the reproductive system in flowering plants.	
6	Credit Value	3 Credits	*Credit = 15 Hours - learning & Observation*
7	Total Marks	Max. Marks: 100	Min Passing Marks: 40

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**Plant taxonomy**: Types of classification-artificial, natural and phylogenetic Bentham & Hooke (upto series), Engler & Prantl (upto series) and Hutchinson system of classification with its merit and demerits.Modern trends of taxonomy and Numerical taxonomy.Binomial nomenclatur system. . Principles and rules (ICBN/ICN)Ranks and names, Typification, author citation, vali publication, principle of priority and its limitations;. Herbarium technique, important herbaria, e herbarium and Botanical gardens of India .	12
II	**Taxonomic Description:** Characteristics, systematics and economic importance of Dicotyledonous families- Brassicaceae, Malvaceae, Fabaceae (subfamily), Apiaceae, Rutaceae, Euphorbiaceae, Lamiaceae, Asteraceae. Monocotyledonous families -Orchidaceae, Liliaceae, Cyperaceae, Musaceae and Poaceae. (Floral features, Floral formulaand floral diagram are essential]	11
III	**Anatomy:**Tissue system features, functions of different types of meristematic and permanent tissues. Internal Structure of dicot and monocot root stem and leaf.Root and shoot apex organization: Structure and function of cambium and secondary growth in root and stem. Wood (heartwood and sapwood, annual rings) Abnormal Secondary Growth (*Dracaena Achyranthes, Nyctanthes, Boerhavia*)	11
IV	**Embryology:** Structure of anther and pollen. Structure and types of ovules, Embryo sacs-types , Pollination and Fertilization, Double fertilization, Endosperm types, structure and functions Development of embryo-Dicot and monocot embryo. Concept of Apomixes and Polyembryony, Seed structure; appendages and dispersal mechanisms.	11
Keywords	*Taxonomy, Herbarium,Tissue,Fertilization*	

Signature of Convener & Members (CBoS) :

(1) (2) (3) (4) (5) (6) (7) (8) (9) (10)

PART-C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. Simpson, M.G. (2006) Plant Systematics. Elsevier Academic Press, San Diego, CA, USA
2. Beck, C.B. (2010). An Introduction to Plant Structure and Development, II edition.
3. Johri, B.M. (1984). Embryology of Angiosperms. Springer-Verlag, Berlin
4. Singh, G. (2012) Plant Systematics. Theory and Practice. Oxford & IBH Pvt. Ltd. New Delhi.
5. Bhojwani, SS. & Bhatnagar, SP (2011). Embryology of Angiosperms. Vikas Publication House Pvt.Lid. New Delhi 5 edition
6. Mauseth. 1.1) (1988) Plant Anatomy. The Benjamin Cummings Publisher. USA
7. Pandey, B. P. (LatesEdt), Plant Anatomy

Reference Books Recommended –

1. Simpson, M.G. (2006) Plant Systematics. Elsevier Academic Press, San Diego, CA, USA
2. Beck, C.B. (2010). An Introduction to Plant Structure and Development, II edition.
3. Mauseth. 1.1) (1988) Plant Anatomy. The Benjamin Cummings Publisher. USA
4. Jeffrey, C. (1982). An Introduction to Plant Taxonomy. Cambridge University Press,Cambridge
5. Judd, W.S., Campbell, C.S., Kellogg, E.A., Stevens, P.F. (2002). Plant Systematics-A Phylogenetic Approach. Sinauer Associates Inc., U.S.A. 2 nd edition.
6. Maheshwari, J.K. (1963). Flora of Delhi. CSIR, New Delhi.
7. Radford, A.E. (1986). Fundamentals of Plant Systematics. Harper and Row, New York
8. Saxena N.B. and Saxena S. (2012). Plant Taxonomy Pragati Prakashan.
9. Sharma O.P. (2013). Plant Taxonomy. MC GRAW HILL INDIA.
10. Sharma, M.K. (2013) Plant Structures (An Introduction to Plant Anatomy). VayuEducation of India.
11. Chopra G.L. (2005) Angiosperm, Pradeep Publication, Jalandhar.

Online Resources–

- **e-Resources / e-books and e-learning portals**
- www.swayam.ac.in
- www.ignou.ac.in
- www.egyankosh.ac.in
- www.iitm.ac.in
- www.eskillindia.org
- www.eshiksha.mp.gov.in
- www.vlab.co.in
- www.internshala.com
- www.ndl.iitkgp.ac.in

Online Resources–

- **e-Resources / e-books and e-learning portals**

https://www.fs.usda.gov/managing-land/wildflowers/pollinators/what-ispollinationhttps://www.pw.live/exams/neet/embryo/#:~:text=Dicot%20and%20monocot%20embryos%20develop,one%20that%20is%20significantly%20smaller.

https://byjus.com/biology/apomixis/

https://examupdates.in/plant-anatomy-and-embryology-book

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Exam (ESE):	**70 Marks**

Continuous Internal Assessment (CIA): 15 (By Course Teacher)	Internal Test / Quiz-(2): 20 +20 Assignment / Seminar - 10 Total Marks - 30	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
End Semester Exam (ESE): 35	**Two section – A & B** Section A: Q1. Objective – 10 x1= 10 Mark; Q2. Short answer type- 5x4 =20 Marks Section B: Descriptive answer type qts.,1out of 2 from each unit-4x10=40 Marks	

Name and Signature of Convener & Members of CBoS:

(1) (2) (3) (4) (5) (6) (7) (8) (9) (10)

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF BOTANY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Sciences *(Diploma / Degree/ Honors)*			**Semester - IV**	Session: 2024-2025
1	Course Code	**BOSC-04**		
2	Course Title	**Lab. Course – 04 (Angiosperms)**		
3	Course Type	**Laboratory Course**		
4	**Pre-requisite** (if, any)	***As per program***		
5	Course Learning. Outcomes (CLO)	At the end of this course, students will be able to: ➢ Understand the systematic status of flowering plants. ➢ Learn collection of local flora , identification and herbarium preparation. ➢ Understand internal structure of different plant parts. ➢ Understand the pollination and seed dispersal mechanism. ➢ Understand about reproduction system in flowering plants.		
6	Credit Value	**1 Credits**	*Credit =30 Hours Laboratory or Field learning/Training*	
7	Total Marks	**Max. Marks: 50**	**Min Passing Marks: 20**	

PART -B: Content of the Course

Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)

Module	Topics (Course contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course	• Description of local plants of the syllabus in semitechnical language, floral formula and floral diagrams should be drawn. • Prepration of herbarium of local flora. • Anatomy of primary and secondary growth in monocuts and dicots stem using hand sections or permanent slides. • Anatomy of root, primary and secondary structure. • Study of placentation. • Study of types of ovule in permanent slide. • Isolation of globular, heart shape and torpedo embryo. • Study of pollination by insects.	30
Keywords	Herbarium, Monocot, Placentation, Pollination	

Signature of Convener & Members (CBoS) :

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PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. Pandey, B.P. (2014). Modern Practical Botany Vol. II. S. Chand and Company Ltd., NewDelhi.
2. Bendre, A.M. and Kumar A. (2003). Manual of Practical Botany Vol. II. RastogiPublications, Meerut.
3. Santra S.C. and Chatterjee (2005). College Botany Practical Vol. II New Central Book Agency Pvt. Ltd

Online Resources–

- **e-Resources / e-books and e-learning portals**
- **www.swayam.ac.in**
- **www.ignou.ac.in**
- **www.egyankosh.ac.in**
- **www.iitm.ac.in**
- **www.eskillindia.org**
- **www.eshiksha.mp.gov.in**
- **www.vlab.co.in**
- **www.internshala.com**
- **www.ndl.iitkgp.ac.in**

Online Resources–

- **e-Resources / e-books and e-learning portals**

https://visiblebody.com/learn/biology/monocot-dicot/roots

https://www.toppr.com/guides/biology/differences-between/monocot-and-dicot-stem/

https://examupdates.in/plant-anatomy-and-embryology-book/

https://jrs.ac.in/working folder/DOWNLOAD-D-12-180- 618C09F700115.pdf

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 50 Marks

Continuous Internal Assessment (CIA): 15 Marks

End Semester Exam (ESE): 35 Marks

Continuous Internal Assessment (CIA):15 (By Course Teacher)	Internal Test / Quiz-(2): 10 & 10 Assignment/Seminar +Attendance - 05 Total Marks - 15	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 15 Marks
End Semester Exam (ESE): 35	**Laboratory / Field Skill Performance: On spot Assessment** A. Performed the Task based on lab. work - 20 Marks B. Spotting based on tools & technology (written) – 10 Marks C. Viva-voce (based on principle/technology) - 05 Marks	Managed by Course teacher as per lab. status

Name and Signature of Convener & Members of CBoS:

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FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF BOTANY
COURSE CURRICULUM

PART- A: Introduction

Program: Bachelor in Life Sciences *(Degree/Honors)*		Semester - V	Session: 2024-2025
1	Course Code	BOSC-05 T	
2	Course Title	Cytology & Genetics	
3	Course Type	Discipline Specific course (DSC)	
4	Pre-requisite (if, any)	*As per program*	
5	Course Learning. Outcomes (CLO)	At the end of the course, the students will be able: ➢. Aquire knowledge of cell and its components. ➢ Learn about the structure and function of membrane and cell division ➢ InterpretMendalian and non Mendelian genetics ➢ Interpret linkage, crossing over and gene interaction	
6	Credit Value	3 Credits	*Credit = 15 Hours - learning & Observation*
7	Total Marks	Max. Marks: 100	Min Passing Marks: 40

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**The cell, cell wall, plasma membrane :** Cell structure and function; Characteristics of prokaryotic and eukaryotic cells; Structure, function and chemical composition of Plant cell wall. Plasma membrane structure and chemical nature; Membrane transport – Passive, active and facilitated transport, endocytosis and exocytosis. Nucleus: Structure-nuclear envelope, nuclear pore complex, nuclear lamina, molecular organization of chromatin; nucleolus. Cytoskeleton: Role and structure of microtubules, microfilaments and intermediary filament	12
II	**Cell organelles, Division of Cell** Mitochondria and Chloroplast; Structure and functions. Endoplasmic Reticulum – Structure, and functions, role in protein synthesis.Golgi Apparatus – organization, protein glycosylation, Lysosomes. Cell cycle, mitosis and meiosis; Regulation of cell cycle- checkpoints, role of protein kinases.	11
III	**Mendelian genetics, Linkage and Crossing over**;Mendelism: History; Principles of inheritance;terminology.Chromosome theory of inheritance; Autosomes and sex chromosomes; Probability and pedigree analysis; Non-Mendelian inheritance: Incomplete dominance and co-dominance.Gene interaction; duplicate,complimentary, supplimentry, epistasis. Linkage and crossing over.	11
IV	**Extrachromosomal Inheritance, Mutation** :Extrachromosomal inheritance: Cytoplasmic inheritance in plants. Mutations; types, Molecular basis of Mutations; Mutagens – physical and chemical.Chromosomal aberration: Deletion, Duplication, Inversion, Translocation, Euploidy and Aneuploidy.	11
Keywords	*Cytology, Cell division, Genetics, Mendelian genetics, Mutation*	

Signature of Convener & Members (CBoS) :

(1) (2) (3) (4) (5) (6) (7) (8) (9) (10)

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. Cell Biology: Powar C. B. and Daginawala H. I., Himalay Pub. House, Bombay
2. Cell biology by Karp, G. 2010.
3. Cell and Molecular Biology: Concepts and Experiments. 6th Edition.John Wiley & Sons. Inc.
4. De Robertis, E.D.P. and De Robertis, E.M.F. 2006.Cell and Molecular Biology.8" edition Lippincott Williams and Wilkins, Philadelphia.
5. Genetics by P. K. Gupta, Rastogi Publication
6. Gytogenetics, Molecular biology and Plant breeding by P. K. Gupta, Rastogi Publication

Reference Books Recommended–

1. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009 The World of of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.
2. L.J. (2012). Becker's World of the Cell, Pearson EducationInc. U.S.A. 8th edition.
3. Hausman, R.E. (2009) The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington,
4. D.C.; Sinauer Associates,-MA. 9. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009) The World of the Cell. 7 th edition. Pearson Benjamin Cummings Publishing, San Francisco

Online Resources–

- **e-Resources / e-books and e-learning portals**
- www.swayam.ac.in
- www.ignou.ac.in
- www.egyankosh.ac.in
- www.iitm.ac.in
- www.eskillindia.org
- www.eshiksha.mp.gov.in
- www.vlab.co.in
- www.internshala.com
- www.ndl.iitkgp.ac.in

Online Resources–

- **e-Resources / e-books and e-learning portals**
- https://www.cytology-iac.org/educational-resources/virtual-slide-library
  https://www.asct.com/ASCTWeb/Content/Cytopreparation_Online_Course.aspx
- https://www.mooc-list.com/tags/genetics
- https://www.coursera.org/learn/genetics-evolution
- https://www.my-mooc.com/en/mooc/introduction-to-genetics-and-evolution
- http://rastogipublications.com/index.php?route=product/product&product_id=50
- https://www.nou.ac.in/sites/default/files/sim/BSCBO
- http://ysmubooks.am/uploads/MEDICAL_BIOLOGY.pilf

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	100 Marks
Continuous Internal Assessment (CIA):	30 Marks
End Semester Exam (ESE):	70 Marks

Continuous Internal Assessment (CIA): 30 (By Course Teacher)	Internal Test / Quiz-(2): 20 +20 Assignment / Seminar - 10 Total Marks - 30	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
End Semester Exam (ESE): 70	Two section – A & B Section A: Q1. Objective – 10 x1= 10 Mark; Q2. Short answer type- 5x4 =20 Marks Section B: Descriptive answer type qts..1out of 2 from each unit-4x10=40 Marks	

Name and Signature of Convener & Members of CBoS:

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FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF BOTANY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Sciences *(Degree/ Honours)*			**Semester - V**	Session: 2024-2025
1	Course Code	**BOSC-05**		
2	Course Title	**Lab. Course -05 (Cytology and Genetics)**		
3	Course Type	**Laboratory Course**		
4	Pre-requisite (if, any)	*As per program*		
5	Course Learning. Outcomes (CLO)	At the end of this course, students will be able to: ➢ Handle the Compound light Microscope and apply microscopy ➢ Achieve elaborate idea about cell staining procedures and mitotic plate observation &analysis ➢ Identify the various stages of cell division karyotype analysis Get practice of genetic crosses and genetic analysis.		
6	Credit Value	**1 Credits**	*Credit =30 Hours Laboratory or Field learning/Training*	
7	Total Marks	**Max. Marks: 50**	**Min Passing Marks: 20**	

PART -B: Content of the Course		
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)		
Module	Topics (Course contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course	1. Staining technique of cell organelles. 2. Study of different stages of Mitosis. 3. Study of different stages of Meiosis. 4. Study of plant cell structure with the help of epidermal peel mount of Onion/Rhoeo/Crinum. 5. Demonstration of the phenomenon of protoplasmic streaming in *Hydrilla* leaves. 6. Counting the cells per unit volume with the help of haemocytometer. (Yeast/pollen grains) 7. Exercise on genetics (Mendelian ratio and test cross) 8. Karyotype of chromosomes. 9. Study of polytene and lampbrush chromosomes.	30
Keywords	***Mitosis, Mendelian ratio, Karyotype, Chromosome.***	

Signature of Convener & Members (CBoS) :

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PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. Laboratory Manual of Cyto-tecnique and Chromosome handling By Sharma A K
2. Manual of Cytology, Ministry of Health & Welfare
3. Cytogenetics By PK Gupta.
4. Cell biology By C. B. Powar

Online Resources–

- **e-Resources / e-books and e-learning portals**
- **www.swayam.ac.in**
- **www.ignou.ac.in**
- **www.egyankosh.ac.in**
- **www.iitm.ac.in**
- **www.eskillindia.org**
- **www.eshiksha.mp.gov.in**
- **www.vlab.co.in**
- **www.internshala.com**
- **www.ndl.iitkgp.ac.in**

Online Resources–

- **e-Resources / e-books and e-learning portals**

- https://ijrbat.in/upload_papers/0410202102153609.%20Basarkar%20UG%20and%20%20Patil-Behere%20KP.pdf
- https://www2.samford.edu/~djohnso2/44962w/334/mitosis.html
- https://www.findel-international.com/product/science/biology/prepared-slides/philip-harris-prepared-microscope-slide-set-meiosis-and-mitosis-set-of-9-slides/e8r06642

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): 15 (By Course Teacher)	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar + Attendance - **05** Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 15 Marks
End Semester Exam (ESE): 35	**Laboratory / Field Skill Performance: On spot Assessment** A. **Performed the Task based on lab. work - 20 Marks** B. **Spotting based on tools & technology (written) – 10 Marks** C. **Viva-voce (based on principle/technology) - 05 Marks**	**Managed by** Course teacher as per lab. status

Name and Signature of Convener & Members of CBoS:

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FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF BOTANY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life sciences *(Degree/Honors)*			Semester - VI	Session: 2024-2025
1	Course Code	BOSC-06 T		
2	Course Title	**Plant Physiology and Economic Botany**		
3	Course Type	**Discipline Specific course (DSC)**		
4	Pre-requisite (if, any)	**As per program**		
5	Course Learning. Outcomes (CLO)	At the end of this course, the students will understand to ➢ Gain a deep understanding of the fundamental physiological processes in plants, including photosynthesis, respiration, transpiration, and nutrient uptake, and their regulation. ➢ Acquire practical skills in conducting experiments and using various techniques. ➢ Develop a comprehensive understanding of the economic value and utilization of plant resources. ➢ Acquire knowledge and skills to identify and classify economically important plant species.		
6	Credit Value	**3 Credits**	*Credit = 15 Hours - learning & Observation*	
7	Total Marks	**Max. Marks: 100**		**Min Passing Marks: 40**

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**Plant-water relations & Mineral nutrition** Importance of water, water potential and its components; Transpiration and its significance; Factors affecting transpiration; Root pressure and guttation. Essential elements, macro and micronutrients; Criteria of essentiality of elements; Role of essential elements; Symptoms of mineral deficiency in major crops, Transport of ions across cell membrane, active and passive transport.	12
II	**Photosynthesis and Lipid Metabolism** Historical background, photosynthetic pigments and their role photochemical reactions, PSI, PSII, Q cycle, C4pathways; Crassulacean acid metabolism; Factors affecting CO_2 reduction. Synthesis and breakdown of triglycerides, β-oxidation, glyoxylate cycle, gluconeogenesis and its role in mobilization of lipids during seed germination, α oxidation	11
III	**Respiration and Nitrogen Metabolism** Glycolysis, anaerobic respiration, TCA cycle; Oxidative phosphorylation, Glyoxylate, Oxidative Pentose Phosphate Pathway. Electron transport and mechanism of ATP synthesis; C3, C4 and CAM pathways of carbon fixation. Photorespiration. Nitrate assimilation, biological nitrogen fixation, Physiology and biochemistry of nitrogen fixation, Ammonia assimilation (GS-GOGAT), reductive amination and transamination, amino acid synthesis.	11
IV	**Economic Botany:** Origin of Cultivated Plants, Examples of major plant introductions; Crop domestication and loss of genetic diversity; evolution of new crops/varieties, importance of germplasm diversity. Brief account of crops, millets, legumes, spice, Beverages, oils, drug, fiber, and timber yielding plant.	11
Keywords	**Osmosis, Transport, Hill reaction, Genetic diversity.**	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. Taiz, L., Zeiger, E., MØller, I.M. and Murphy, A (2015). Plant Physiology and Development. Sinauer Associates Inc. USA. 6th edition.
2. B. P. Pandey (2017) Economic Botany. S. Chand Publication, New Delhi.
3. Kochhar, S.L. (2012). Economic Botany in Tropics, MacMillan & Co. New Delhi, India.
4. Bajracharya, D., (1999). Experiments in Plant Physiology- A Laboratory Manual. Narosa Publishing House, New Delhi.

Reference Books Recommended-

1. . Wickens, G.E. (2001). Economic Botany: Principles & Practices. Kluwer Academic Publishers, The Netherlands.
2. Chrispeels, M.J. and Sadava, D.E. 1994 Plants, Genes and Agriculture. Jones & Bartlett Publishers.
3. Harborne, J.B. (1973). Phytochemical Methods. John Wiley & Sons. New York.
4. Hopkins, W.G., Huner, N.P., (2009). Introduction to Plant Physiology. John Wiley & Sons, U.S.A. 4th Edition.

Online Resources–

- **e-Resources / e-books and e-learning portals**
- **https://education.nationalgeographic.org/resource/photosynthesis/**
- **https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4242210/**
- **https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/nitrogen-metabolism**
- **https://en.wikipedia.org/wiki/Lipid_metabolism**

Online Resources–

- **e-Resources / e-books and e-learning portals**
- **www.swayam.ac.in**
- **www.ignou.ac.in**
- **www.egyankosh.ac.in**
- **www.iitm.ac.in**
- **www.eskillindia.org**
- **www.eshiksha.mp.gov.in**
- **www.vlab.co.in**
- **www.internshala.com**
- **www.ndl.iitkgp.ac.in**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Exam (ESE):	**70 Marks**

Continuous Internal Assessment (CIA): 30 (By Course Teacher)	Internal Test / Quiz-(2): **20 +20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
End Semester Exam (ESE): 70	**Two section – A & B** Section A: Q1. Objective – **10** x1= **10** Mark; Q2. Short answer type- 5x4 =20 Marks Section B: Descriptive answer type qts.,**1out of 2** from each unit-4x10=40 Marks	

Name and Signature of Convener & Members of CBoS:

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FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF BOTANY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Sciences *(Degree/ Honors)*			**Semester - VI**	**Session: 2024-2025**
1	Course Code	**BOSC-06**		
2	Course Title	**Lab. Course -06 (Plant Physiology and Economic Botany)**		
3	Course Type	**Laboratory course**		
4	Pre-requisite (if, any)	**As per program**		
5	Course Learning. Outcomes (CLO)	Acquire practical skills in conducting experiments and using various techniques to measure and analyze plant physiological parameters, enabling students to design and execute experiments in plant physiology research. o Acquire knowledge and skills to identify and classify economically important plant species, and understand their ecological requirements, cultivation techniques, and potential for sustainable utilization. o Apply critical thinking and problem-solving skills to analyze and evaluate the impacts of human activities on plant resources, and develop strategies for the conservation, sustainable management, and utilization of plant biodiversity.		
6	Credit Value	**1 Credits**	*Credit =30 Hours Laboratory or Field learning/Training*	
7	Total Marks	**Max. Marks: 50**	**Min Passing Marks: 20**	

PART -B: Content of the Course

Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)

Module	Topics (Course contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course	1. Determination of osmosis and plasmolysis. 2. Determination of osmotic potential of plant cell sap by plasmolytic method. 3. Demonstration of the process of transpiration. 4. To find out rate of transpiration by potometer method. 5. To find out stomatal frequency and stomatal index. 6. Chemical separation of photosynthetic pigments. 7. To find out that oxygen evolved during the process of photosynthesis. 8. To study the effect of quality and intensity of light on photosynthesis. 9. To find out the effect of carbon dioxide concentration on the rate of photosynthesis. 10. To find out the Respiratory Quotient of different respiratory substrates by respirometer method. 11. To compare the rate of respiration in different parts of a plant. 12. Study of amylase and catalase enzymes. 13. Morphological features and economic importance of cereals, millets, legumes, oil, spices, drug, fiber, and timber yielding plant.	30
Keywords	Physiology, Economic Botany, Beverages, Enzyme.	

Signature of Convener & Members (CBoS) :

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PART-C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. . Bajracharya, D., (1999). Experiments in Plant Physiology- A Laboratory Manual. Narosa Publishing House, New Delhi.
2. Kochhar, S.L. (2012). Economic Botany in Tropics, MacMillan & Co. New Delhi, India.
3. Wickens, G.E. (2001). Economic Botany: Principles & Practices. Kluwer Academic

Reference Books Recommended –

1. Taiz, L., Zeiger, E., MØller, I.M. and Murphy, A (2015). Plant Physiology and Development. Sinauer Associates Inc. USA. 6th edition.
2. Hopkins, W.G., Huner, N.P., (2009). Introduction to Plant Physiology. John Wiley & Sons, U.S.A. 4th Edition.

Online Resources–

- **e-Resources / e-books and e-learning portals**
- www.swayam.ac.in
- www.ignou.ac.in
- www.egyankosh.ac.in
- www.iitm.ac.in
- www.eskillindia.org
- www.eshiksha.mp.gov.in
- www.vlab.co.in
- www.internshala.com
- www.ndl.iitkgp.ac.in

Online Resources–

- **e-Resources / e-books and e-learning portals**
- https://education.nationalgeographic.org/resource/photosynthesis/
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4242210/
- https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/nitrogen-metabolism
- https://en.wikipedia.org/wiki/Lipid_metabolism

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	50 Marks
Continuous Internal Assessment (CIA):	15 Marks
End Semester Exam (ESE):	35 Marks

Continuous Internal Assessment (CIA): 15 (By Course Teacher)	Internal Test / Quiz-(2): 10 & 10 Assignment/Seminar +Attendance - 05 Total Marks - 15	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 15 Marks
End Semester Exam (ESE): 35	Laboratory / Field Skill Performance: On spot Assessment A. Performed the Task based on lab. work - 20 Marks B. Spotting based on tools & technology (written) – 10 Marks C. Viva-voce (based on principle/technology) - 05 Marks	Managed by Course teacher as per lab. status

Name and Signature of Convener & Members of CBoS:

(1) (2) (3) (4) (5) (6) (7) (8) (9) (10)

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF BOTANY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Sciences *(Honors)*			**Semester - VII**	Session: 2024-2025
1	Course Code	**BOSC- 07 T**		
2	Course Title	**Ecology and Phytogeography**		
3	Course Type	**Discipline Specific course (DSC)**		
4	Pre-requisite (if, any)	*As per program*		
5	Course Learning. Outcomes (CLO)	At the end of this course, students will be able to understand: ▪ The interrelationship between organisms and environment. ▪ Methods to study vegetation, community patterns and processes, ecosystem functions, and principles of phytogeography. ▪ Evolving strategies for sustainable natural resource management and biodiversity conservation. ▪ Climatic changes and its restoration ▪ Familiar with sustainable development		
6	Credit Value	**3 Credits**	*Credit = 15 Hours - learning & Observation*	
7	Total Marks	**Max. Marks:** 100	**Min Passing Marks:** 40	

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	Ecological Factors and Management : Climatic- light; temperature, air and water, topographic, edaphic, soil formation soil texture, type of soil, soil profile, classification, physio-chemical properties, soil organic matter, biotic factors, interrelationships, major soil type of the world. Ecological management: Concepts, sustainable development, sustainability indicators.	12
II	Ecosystem Organization : Structure and function, primary production (methods of measurements, global pattern, controlling factors), energy dynamics, trophic organization, energy flow pathways, ecological efficiencies, litter fall and decomposition- mechanism, substrate quality and climate factors, global biogeochemical cycle of C, N, P, S, minerals cycle- pathways, processes, budgets in terrestrial and aquatic ecosystem.	11
III	**Community and Eco-Stability** Concepts of community and continuum, analysis of communities (analytical and synthetic characters), community coefficients, inter-specific associations, ordination, concept of ecological niche. Vegetation Development: Temporal changes (cyclic and non-cyclic), mechanism of ecological successions (relay floristic and initial floristic composition, facilitation, tolerance and inhibition models), changes in ecosystem properties during succession. Ecological Stability: Concept of resistance and resilience, ecological perturbations (natural and anthropogenic) and their impact on plants and ecosystem, ecology of plant invasion, environmental impact assessment, ecosystem restoration.	11
IV	**Phytogeography Pollution, Climatic Changes** Phytogeographical regions of India with reference to Chhattisgarh. Pollution : Air, Water, Soil & Sound - kinds, sources, quality parameters, effect on plans and ecosystem. Climate change: Green house gases(CO_2, CH_4, N_2O, CFCs) sources, trends and role, ozone layer and ozone hole, consequences of climate changes, (CO_2 fertilization, global warming, sea level rise, UV radiation).	11
Keywords	Ecological Factors community and continuum ecosystem ,Phytogeographical ,climate changes	

Signature of Convener & Members (CBoS) :

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PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. Brady, N. C. (1990) The Nature and Properties of Soil Macmillan, Sydney, Australia.
2. Begon, M; Harper, J. L. And Townsend, C. R. (1996) Ecology. Blackwell Science, Cambridge, USA
3. Chapman, J. L. and Raiss, M. J. (1988) Ecology: Principles and Applications. Cambridge Univ. Press, Cambridge, U.K.
4. Kumar, H. D. (1986) Modern Concept of Ecology, Vikas Publishing House Private Ltd., New Delhi.

Reference books:

1. Hill, M. K. (1997) Understanding Environmental Pollution. Cambridge Univ. Press, Cambridge, U. K.
2. Odum, E. P. (1971) Fundamentals of Ecology. Saunders, Phildelphhia.
3. Odum, E. P. (1983) Basic Ecology. Saunders, Philasephia

Online Resources–

- **e-Resources / e-learning portals**
- www.swayam.ac.in
- www.ignou.ac.in
- www.egyankosh.ac.in
- www.iitm.ac.in
- www.eskillindia.org
- www.eshiksha.mp.gov.in
- www.vlab.co.in
- www.internshala.com
- www.ndl.iitkgp.ac.in

Online Resources–

- **e-Resources / e-books and e-learning portals**

- **https://courses.lumenlearning.com/wm-biology2/chapter/community-structure-and-dynamics/**
- https://education.nationalgeographic.org/resource/ecosystem/

- **https://www.embibe.com/exams/ecological-factors/**
- **https://www.sciencedirect.com/topics/earth-and-planetary-sciences/environmental-pollution#:~:text=Environmental%20pollution%20is%20unwarranted%20disposal,both%20quantitatively%20and%20qualitatively%20(Hussain%2C**
- https://onlinecourses.nptel.ac.in/noc24_ce03/preview

- https://onlinecourses.swayam2.ac.in/nou24_ge10/preview

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	100 Marks
Continuous Internal Assessment (CIA):	30 Marks
End Semester Exam (ESE):	70 Marks

Continuous Internal Assessment (CIA): 30 (By Course Teacher)	Internal Test / Quiz-(2): 20 +20 Assignment / Seminar - 10 Total Marks - 30	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
End Semester Exam (ESE): 70	Two section – A & B Section A: Q1. Objective – 10 x1= 10 Mark; Q2. Short answer type- 5x4 =20 Marks Section B: Descriptive answer type qts..1out of 2 from each unit-4x10=40 Marks	

Name and Signature of Convener & Members of CBoS:

(1) (2) (3) (4) (5) (6) (7) (8) (9) (10)

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF BOTANY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Sciences *(Honors)*			**Semester - VII**	Session: 2024-2025
1	Course Code	**BOSC-07**		
2	Course Title	**Lab. Course – 07 (Ecology and Phytogeography)**		
3	Course Type	**Laboratory course**		
4	Pre-requisite (if, any)	*As per program*		
5	Course Learning. Outcomes (CLO)	➢ Students will be able to determine frequency, abundance and density of any area. ➢ Learn community relationships of plants. ➢ Understand IVI and biomass. ➢ Can determine diversity indices. ➢ Biodiversity of different ecosystems ➢ Interaction among different community ➢ Pollution and its effect		
6	Credit Value	**1 Credits**	*Credit =30 Hours Laboratory or Field learning/Training*	
7	Total Marks	**Max. Marks: 50**	**Min Passing Marks: 20**	

PART -B: Content of the Course

Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)

Module	Topics (Course contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course	1. to determine minimum size and number of quadrates required for reliable estimate o biomass in grass land ecosystem. 2. To study the frequency, abundance and density of plants in the local ecosystem by quadrat method. 3. To determine gross and net productivity by light and dark bottle method. 4. To determine soil moisture content, porosity and bulk density of soil collected from different locations. 5. To determine the water holding capacity of various soils. 6. To determine the basal cover, or vegetational cover of one herbaceous community by quadrat method. 7. To determine IVI of the grass land. 8. To measure the above-ground plant biomass in a grassland. 9. To determine diversity indices (richness, Simpson, Shannon-Wiener) in grazed an protected grassland. 10. Experiment on Physico-Chemical Analysis of Water (pH, Temperature, etc. 11. To determine transparency or turbidity of different water bodies. 12. To measure the amount of dissolved oxygen in pond water. 13. To determine the total dissolved solids (TDS) in water 14. To measure the amount of BOD in different types of water. 15. Ombrothermic diagram of your locality.	30
Keywords	*Quadrate, Productivity, Turbidity ,TDS.*	

Signature of Convener & Members (CBoS) :

(1) (2) (3) (4) (5) (6) (7) (8) (9) (10)

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. Bendre and Kumar, 2018. A text book of botany practical , Vol-2
2. Raj Mandeep, 2022. Principles of ecology .
3. Rao K S, 1993 Practical Ecology
4. Ashok K. Rathoure Bioremediation: Current Research and Applications .

Text Books Recommended –

1. Penny A. Cook, James R. Bell , C. Philip Wheater , 2011.Practical Field Ecology: A Project Guide
2. D. D. Gilbertson , M. Kent , F. B. Pyatt, 1985. Practical Ecology for Geography and Biology
3. Masood, A.A. A text book of botany practical , Edn.-5
4. Gaurav Saxena Vineet Kumar and Maulin P. Shah . Bioremediation for Environmental Sustainability: Toxicity, Mechanisms of Contaminants Degradation, Detoxification and Challenges .

Online Resources–

- **e-Resources / e-books and e-learning portals**
- **www.swayam.ac.in**
- **www.ignou.ac.in**
- **www.egyankosh.ac.in**
- **www.iitm.ac.in**
- **www.eskillindia.org**
- **www.eshiksha.mp.gov.in**
- **www.vlab.co.in**
- **www.internshala.com**
- **www.ndl.iitkgp.ac.in**

Online Resources–

- **e-Resources / e-books and e-learning portals**

- https://ecologicalprocesses.springeropen.com/articles/10.1186/s13717-022-00401-0
- https://www.internationalscholarsjournals.com/articles/applied-ecology-and-its-economical-applications-88784.html
- https://link.springer.com/book/10.1007/978-981-15-3372-3
- https://www.jstor.org/stable/2405009
- https://en.wikipedia.org/wiki/Bioremediation
- https://www.sciencedirect.com/topics/earth-and-planetary-sciences/bioremediation
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5026719/
- https://www.ysi.com/parameters/turbidity
- https://www.davidzeleny.net/wiki/doku.php/vegsurvey:materials:how_to_calculate_ivi

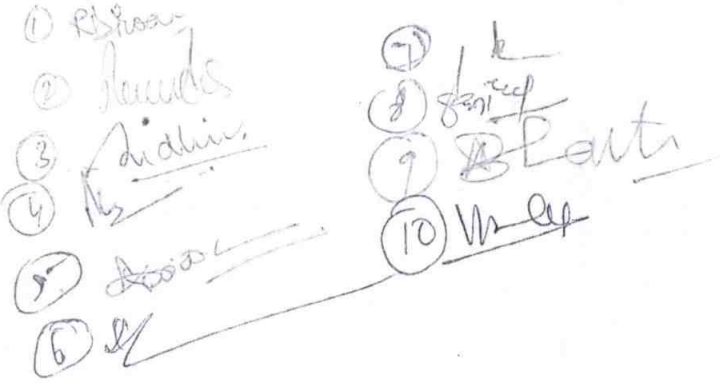
PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): 15 (By Course Teacher)	Internal Test / Quiz-(2): 10 & 10 Assignment/Seminar +Attendance - 05 Total Marks - 15	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 15 Marks
End Semester Exam (ESE): 35	**Laboratory / Field Skill Performance: On spot Assessment** **A. Performed the Task based on lab. work - 20 Marks** **B. Spotting based on tools & technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**	Managed by Course teacher as per lab. status

Name and Signature of Convener & Members of CBoS:



FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF BOTANY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Sciences *(Honors)*			Semester - VIII	Session: 2024-2025
1	Course Code	BOSC –VIII T		
2	Course Title	Molecular biology and Biostatistics		
3	Course Type	Discipline Specific course (DSC)		
4	Pre-requisite (if, any)	*As per program*		
5	Course Learning. Outcomes (CLO)	➢ Students shold know about cellular and gene regulation to understand genomic functions ➢ Understand the concept of 'one gene one enzyme hypothesis' along with the molecular mechanism of mutation ➢ Students will be familiar with the genetic material DNA structure its role and defects and repairing ➢ Students will be familiar with the RNA structure its role ➢ Students will be familiar with data handling.		
6	Credit Value	3 Credits	*Credit = 15 Hours - learning & Observation*	
7	Total Marks	Max. Marks: 100		Min Passing Marks: 40

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	Nucleic acids: Carriers of genetic information. Introduction. DNA as the carrier of genetic information (Griffith's, McLeod & McCarty experiment). The Structures of DNA and RNA / Genetic Material DNA Structure: Watson and Crick model, Salient features of double helix, Organization of DNA Prokaryotes, Viruses, Eukaryotes. Types- A-DNA, B-DNA C- DNA Z- DNA RNA Structure –mRNA, tRNA and rRNA Organelle DNA -- mitochondria and chloroplast DNA The replication of DNA Chemistry of DNA synthesis General principles – bidirectional, semiconservative and semi discontinuous replication Enzymes involved in DNA replication.	12
II	Mutation and DNA repair Structural and numerical changes in the chromosomes- chromosomal aberration- duplication, deletion, inversion, translocation, gene mutation- transition and transversion, polyploidy- euploidy and aneuploidy., DNA damage and repair	11
III	Protein synthesis and gene regulation Genetic code Genetic code (deciphering and salient features) Transcription Concept of central dogma, Transcription in prokaryotes and eukaryotes. Principles of transcriptional regulation; Prokaryotes: Regulation of lactose metabolism and tryptophan synthesis in E.coli. Gene silencing. Processing and modification of RNA Split genes-concept of introns and exons, removal of introns, spliceosome machinery, splicing pathways, group I and group II intron splicing, alternative splicing eukaryotic mRNA processing (5' cap, 3' polyA' tail). Translation Ribosome structure and assembly, mRNA; aminoacyl tRNA synthetases; Various steps in protein synthesis, proteins involved in initiation, elongation and termination of polypeptides; Fidelity of translation; Inhibitors of protein synthesis; Post-translational modifications of proteins.	11
IV	Biostatistics : Graph, central tendancy (Mean, median and mode) Standard Deviation, Standard error Chi square test, regression, degree of freedom	11
Keywords	*DNA, RNA, protein synthesis, gene regulation, central tendancy*	

Signature of Convener & Members (CBoS) :

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PART-C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. Watson J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M., Losick, R. (2007). Molecular Biology of the Gene, Pearson Benjamin Cummings, CSHL Press, New York, U.S.A. 6th edition.
2. Snustad, D.P. and Simmons; M.J. (2010). Principles of Genetics. John Wiley and Sons Inc., U.S.A. 5th ed.
3. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics. John Wiley and Sons, U.K. 5th edition.
4. Sharma A.K. 2005. Text Book Of Biostatistics I, Discovery Publishing House.
5. Annadurai, B. 2007. Text Book of Biostatistics. New Age International.
6. Gurumani, N. 2010. An Introduction to Biostatistics (2nd Edn). MJP Publishers.

Reference books:

1. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. Benjamin Cummings. U.S.A. 9th edition.
2. Russell, P. J. (2010). i-Genetics- A Molecular Approach. Benjamin Cummings, U.S.A. 3rd edition.
3. Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2010). Introduction to Genetic Analysis. 6. W. H. Freeman and Co., U.S.A. 10th edition.
4. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.

Online Resources–

- **e-Resources / e-learning portals**
- www.swayam.ac.in
- www.ignou.ac.in
- www.egyankosh.ac.in
- www.iitm.ac.in
- www.eskillindia.org
- www.eshiksha.mp.gov.in
- www.vlab.co.in
- www.internshala.com
- www.ndl.iitkgp.ac.in

Online Resources–

- **e-Resources / e-books and e-learning portals**
- https://www.springer.com/gp/book/9789811391767
- https://www.springer.com/gp/book/9789811550720
- https://www.asct.com/ASCTWeb/Content/Cytopreparation_Online_Course.aspx
- https://www.mooc-list.com/tags/genetics
- https://www.coursera.org/learn/genetics-evolution
- https://www.my-mooc.com/en/mooc/introduction-to-genetics-and-evolution/

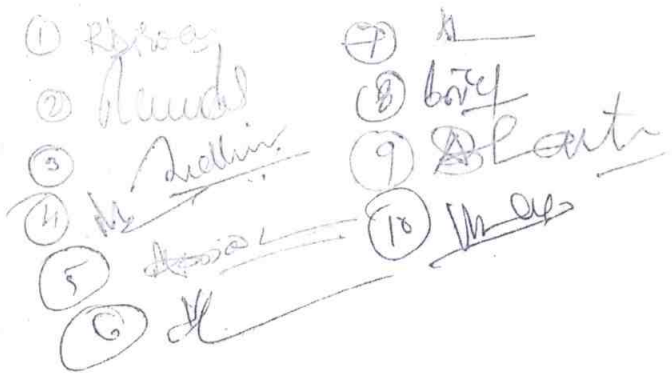
PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	100 Marks
Continuous Internal Assessment (CIA):	30 Marks
End Semester Exam (ESE):	70 Marks

Continuous Internal Assessment (CIA): 30 (By Course Teacher)	Internal Test / Quiz-(2): 20 +20 Assignment / Seminar - 10 Total Marks - 30	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
End Semester Exam (ESE): 70	**Two section – A & B** Section A: Q1. Objective – 10 x1= 10 Mark; Q2. Short answer type- 5x4 =20 Marks Section B: Descriptive answer type qts., 1out of 2 from each unit-4x10=40 Marks	

Name and Signature of Convener & Members of CBoS:



FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF BOTANY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Sciences *(Honors)*			Semester - VIII	Session: 2024-2025
1	Course Code	BOSC -08		
2	Course Title	**Lab. Course-08 (Molecular biology and Biostatics)**		
3	Course Type	**Laboratory course**		
4	Pre-requisite (if, any)	*As per program*		
5	Course Learning. Outcomes (CLO)	After the completion of the course the students will be able to: ➢ Isolate DNA from plant cell and *E.Coli.* ➢ Learn chimera formation in various plants. ➢ Understand the functioning and application of spectrophotometer. ➢ Understand the interpretation of data with the help of statistical data.		
6	Credit Value	**1 Credits**	***Credit =30 Hours Laboratory or Field learning/Training***	
7	**Total Marks**	**Max. Marks: 50**		**Min Passing Marks: 20**

PART -B: Content of the Course

Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)

Module	Topics (Course contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course	➢ Isolation of DNA from plant cells. ➢ Quantitative measurement of DNA by Spectrophotometric method. ➢ Feulgen or hydrolytic staining of DNA. ➢ Chimera formation in Bougainvillea and other ornamental and other different plants. ➢ Isolation of plasmid DNA from *E. coli* . ➢ Isolation of *Rhizobium* from root nodules of leguminous plants. ➢ Isolation of *Agrobacterium tumifaciens* from tumours of dicot plants. ➢ Preparation of LB medium and raising E. Coli. ➢ DNA estimation by diphenylamine reagent/UV Spectrophotometry. ➢ Analysis of statistical data: Statistical tables, Central tendency - mean mode, median, standard deviation and standard error (using seedling population /leaflet size etc). ➢ Calculation of correlation coefficient values and finding out the probability. ➢ Computer application in biostatistics - MS Excel and SPSS	30
Keywords	*Spectrophotometer, Plasmid, colchicine, E.Coli, Central tendencies.*	

Signature of Convener & Members (CBoS) :

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PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. . Raghvan, V. (1997) Molecular Biology of Flowering Plants. Cambridge Univ. Press, New York, USA.
2. Biotechnology by B.D. Singh
3. Biotechnology by R.S.Singh
4. Practical Biotechnology: Principles and Protocols by Swagat Kumar Das Hrudayanath Thatoi, Supriya Dash.

Reference Books Recommended –

1. ***Zar, J.H. (2012). Biostatistical Analysis. Pearson Publication. U.S.A. 4th edition.***
2. Brown, T. A. (1999) Genomes. John Willey and Sons Asia Pvt. Ltd., Singapore.
3. Callow, J. A. Ford-Loyd, B. V. and Newbury, H. J. (1997) Biotechnology and Genetic Resources: Conservation and Use. Cab International, Oxon, UK.
4. Glazer, A. N. and Nikaido, H. (1995) Microbial Biotechnology. Freman and Company, New York, USA.
5. Hennery, R. J. (1997) Practical Applications of Plant Molecular Biology. Chapman and Hall, London UK.
6. Jolles, O. And Jornvali, H. (2000) Proteomics in Functional Genomics. Birkhauser Verlag, Basel, Switzerland.
7. Old, R. W. Primerose, S. B. (1989) Principles of Gene Manipulation. Blackwell Scientific Publications, Oxford UK.
8. Primrose, S. B. (1995) Principles of Genome Analysis, Blackwell Scientific Publications, Oxford, UK

Online Resources–

- **e-Resources / e-books and e-learning portals**
- www.swayam.ac.in
- www.ignou.ac.in
- www.egyankosh.ac.in
- www.iitm.ac.in
- www.eskillindia.org
- www.eshiksha.mp.gov.in
- www.vlab.co.in
- www.internshala.com
- www.ndl.iitkgp.ac.in

Online Resources–

- **e-Resources / e-books and e-learning portals**
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4890884/
- https://www.k-state.edu/wgrc/electronic_lab/feul_stain_prot.html
- https://www.westga.edu/academics/research/vrc/assets/docs/spss_basics.pdf
- https://www.analyticsvidhya.com/blog/2021/11/a-comprehensive-guide-on-microsoft-excel-for-data-analysis/
- https://handelsmanlab.discovery.wisc.edu/wp-content/uploads/2018/01/Arapidmethod1989.pdf
- https://byjus.com/maths/central-tendency/

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): 15 (By Course Teacher)	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - **05** Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 15 Marks
End Semester Exam (ESE):35	**Laboratory / Field Skill Performance: On spot Assessment** A. **Performed the Task based on lab. work - 20 Marks** B. **Spotting based on tools & technology (written) – 10 Marks** C. **Viva-voce (based on principle/technology) - 05 Marks**	Managed by Course teacher as per lab. status

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (NEP–2020)

Program: Bachelor in Life Science (2024 -28)

DISCIPLINE – BOTANY

Session – 2024 -25

DSC -01 to 08		DSE -01 to 12	
Code	**Title**	**Code**	**Title**
BOSC -01T	*Elementary Botany*	BOSE -01T	*Natural resources and management*
BOSC -01P	*Lab. Course -01 (Elementary Botany)*	BOSE -01P	*Lab. Course -01 (Natural resources and management)*
BOSC -02T	*Microbes and Thallophyta*	BOSE -02T	*Microbiology and Phytopathology*
BOSC -02P	*Lab. Course –02 (Microbes and Thallophyta)*	BOSE -02P	*Lab. Course -02 (Microbiology and Phytopathology)*
BOSC -03T	*Archegoniate and Fossils*	B OSE -03T	*Phytopaleontology and Evolutionary Botany*
BOSC -03P	*Lab. Course-03 (Archegoniate and Fossils)*	BOSE -03P	*Lab. Course -03 (Phytopaleontology and Evolutionary Botany)*
BOSC -04T	*Angiosperms*	BOSE -04T	*Ethnobotany and Medicinal plants*
BOSC -04P	*Lab. Course – 04 (Angiosperms)*	BOSE -04P	*Lab. Course-04 (Ethnobotany & Medicinal plants)*
BOSC -05T	*Cytology and Genetics*	B OSE -05T	*Biosystematics and Biodiversity*
BOSC -05P	*Lab. Course -05 (Cytology and Genetics)*	BOSE -05P	*Lab. Course -05 (Biosystematics and Biodiversity)*
BOSC -06T	*Plant Physiology and Economic Botany*	BOSE -06T	*Plant breeding and Seed technology*
B OSC -06P	*Lab. Course -06 (Plant Physiology and Economic Botany)*	BOSE -06P	*Lab. Course -06 (Plant breeding and Seed technology)*
BOSC -07T	*Ecology and Phytogeography*	BOSE -07T	*Instrumentation and biochemical technology*
BOSC - 07P	*Lab. Course –07 (Ecology and Phytogeography)*	BOSE -07P	*Lab. Course -07 (Instrumentation and biochemical technology)*
BOSC -08T	*Molecular biology and Biostatistics*	BOSE -08T	*Growth and Stress Physiology*
BOSC -08P	*Lab. Course-08 (Molecular biology and Biostatics)*	BOSE -08P	*Lab. Course -08 (Growth and Stress Physiology)*
		BOSE -09T	*Plant biotechnology and crop improvement*
		BOSE -09P	*Lab. Course -09 (Plant biotechnology and crop improvement)*
		BOSE -10T	*Applied Botany and Intellectual property right (IPR)*
		BOSE -10P	*Lab. Course -10 (Applied Botany and IPR)*
		BOSE -11T	*Biochemistry and Enzymology*
		BOSE -11P	*Lab. Course -11 (Biochemistry and Enzymology)*
		BOSE -12T	*Bioinformatics and Gene Technology*
		BOSE -12P	*Lab. Course-12 (Bioinformatics & Gene Technology)*
GE -01 & 02		VAC	
BOGE -01T	*Elementary Botany*	BOVAC-01	*Herbal Plant & Human Health*
BOGE -01P	*Lab. Course -01 (Elementary Botany)*	SEC	
BOGE -02T	*Microbes and Thallophyta*	BOSEC-01	*Gardening and Floriculture*
BOGE -02P	*Lab. Course –02 (Microbes and Thallophyta)*		

Program Outcomes (PO):

1. Demonstrate and apply the fundamental knowledge of the basic principles of major fields of biology
2. Apply knowledge to solve the issues related to plant sciences with the help of computer technology
3. Apply knowledge for conservation of endemic and endangered plant species

Program Specific Outcomes (PSO):

1. Collaborate effectively on team-oriented projects in the field of life sciences.
2. Communicate scientific information in a clear and concise manner both orally and in writing
3. Explain Biodiversity, climate change and plant pathology.
4. Apply Biotechnology, Ecology, Genetics and Plant breeding techniques in plant sciences
5. Apply knowledge of Medicinal and Economic botany in day to day life.
6. Apply the knowledge to develop the sustainable and eco-friendly technology.

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

DEPARTMENT OF BOTANY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Diploma / Degree/Honors)*		**Semester - III**		Session: 2024-2025
1	Course Code	BOSE- 01 T		
2	Course Title	Natural resources and management		
3	Course Type	Discipline specific Elective (DSE)		
4	Pre-requisite (if, any)	*As per program*		
5	Course Learning. Outcomes (CLO)	At the end of this course, the students will be able to ➢ Understand natural resources and their sustainable utilization. ➢ Knowledge on land, water, energy, and forest resources. ➢ Students will learn about the practices of natural resource management. ➢ Knowledge on the international and national efforts of natural resource management.		
6	Credit Value	3 Credits	*Credit = 15 Hours - learning & Observation*	
7	Total Marks	Max. Marks: 100	Min Passing Marks: 40	

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**Natural resources** ➢ Definition and types. ➢ Natural resources' conservation Role of an individual in conservation of natural recourses, Significance, ➢ Sustainable utilization of resources' : Concept, approaches economic, ecological, and socio-cultural activities.	12
II	**Land and freshwater resources** ➢ Land as a resource ➢ Soil erosion and desertification ➢ Soil degradation and management. ➢ Forest resources use and over exploitation, deforestation ➢ Water resources, use and overutilization of surface and ground water ➢ Fresh Marine and estuarine ecosystems; ➢ Wetlands threats and management strategies	11
III	**Biological Resources** ➢ Biodiversity-definition and types ➢ Value of biodiversity ➢ Biodiversity at global, national an regional levels ➢ Threats; Management strategies; ➢ Bioprospecting. IPR; CBD; National Biodiversity Action Plan). ➢ Forests: Cover and its significance (with special reference to India); ➢ Major and minor Forest products; ➢ Renewable and non-renewable sources of energy.	11
IV	**Contemporary practices in resource management** ➢ National and international efforts in resource management and conservation. ➢ Waste management practices ➢ Natural resource Accounting ➢ Environmental impact assesement EIA ➢ Geographical information System GIS ➢ Participatory Appraisal of naturl Resource ➢ Ecological Footprint with emphasis on carbon footprint,	11
Keywords	Resources, Biodiversity, Resources management, IPR, CBD.	

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. Vasudevan, N. (2006). Essentials of Environmental Science. Narosa Publishing House, New Delhi.
2. Singh, J. S., Singh, S.P. and Gupta, S. (2006). Ecology, Environment and Resource Conservation. Anamaya Publications, New Delhi.

Reference Books Recommended –

1, Rogers, P.P., Jalal, K.F. and Boyd, J.A. (2008). An Introduction to Sustainable Development. Prentice Hall of India Private Limited, New Delhi.

Online Resources–

- e-Resources / e-books and e-learning portals
- https://www.sciencedirect.com/topics/social-sciences/natural-resource
- https://efaidnbmnnnibpcajpcglclefindmkaj/https://egyankosh.ac.in/bitstream/123456789/66166/2/Unit4.pdf
- https://efaidnbmnnnibpcajpcglclefindmkaj/https://www.ers.usda.gov/webdocs/publications/41964/30289_biological.pdf?v=0#:~:text=16-,What%20Are%20Biological%20Resources%3F,forests%2C%20and%20other%20natural%20lands.
- http://surl.li/spcdd
- https://shorturl.at/ewylP
- https://shorturl.at/cimoF

Online Resources–

- e-Resources / e-books and e-learning portals
- www.swayam.ac.in
- www.ignou.ac.in
- www.egyankosh.ac.in
- www.iitm.ac.in
- www.eskillindia.org
- www.eshiksha.mp.gov.in
- www.vlab.co.in
- www.internshala.com
- www.ndl.iitkgp.ac.in

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	100 Marks
Continuous Internal Assessment (CIA):	30 Marks
End Semester Exam (ESE):	70 Marks

Continuous Internal Assessment (CIA): 30 (By Course Teacher)	Internal Test / Quiz-(2): 20 +20 Assignment / Seminar - 10 Total Marks - 30	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
End Semester Exam (ESE): 70	Two section – A & B Section A: Q1. Objective – 10 x1= 10 Mark; Q2. Short answer type- 5x4 =20 Marks Section B: Descriptive answer type qts., 1 out of 2 from each unit-4x10=40 Marks	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

DEPARTMENT OF BOTANY

COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Diploma / Degree/ Honors)*		**Semester - III**		Session: 2024-2025
1	Course Code	**BOSE -01 P**		
2	Course Title	**Lab course -01 (Natural resources and management)**		
3	Course Type	**Laboratory course**		
4	Pre-requisite (if, any)	*As per program*		
5	Course Learning. Outcomes (CLO)	*at the end og then of the sesn* O To understand natural resources and their sustainable utilization. O Acquire knowledge on land, water, energy, and forest resources. O Students will learn about the practices of natural resource management. O Acquire knowledge on the international and national efforts of natural resource management.		
6	Credit Value	**1 Credits**	*Credit =30 Hours Laboratory or Field learning/Training*	
7	Total Marks	**Max. Marks: 50**	**Min Passing Marks: 20**	

PART -B: Content of the Course

Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)

Module	Topics (Course contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course	1) To compare protected and unprotected grassland stands using community coefficients 2) To estimate IVI of the species in a woodland using point centered quarter method. 3) To find out important grassland species using chi square test. 4) Scientific visits to a protected area, a wet land, a mangrove, NBPGR, BSI, CSIR, ICAR labs and a recognized botanical gardens or a museum. 5) To determine diversity indices (Shannon Wiener, concentration of dominance, species richness, equability and B diversity. 6) Field survey of a part of town or city to make the students aware of the diversity of plants in urban ecosystems. 7) Estimation of solid waste generated by a domestic system (biodegradable and non biodegradable) and its impact on land degradation. 8) Collection of data on forest covers of specific area. 9) Measurement of dominance of woody species by DBH (diameter at breast height) method. 10) Calculation and analysis of ecological footprint. 11) Ecological modeling.	30
Keywords	Community coefficient, IVI, diversity indices	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. A Handbook of Human Resource Management Practice
2. Environmental and Natural Resource Economics_ A Contemporary Approach
3. Sustainable Management of Natural Resources_ Mathematical Models and Methods (Environmental Science and Engineering Environmental Science)

Online Resources–

- **e-Resources / e-books and e-learning portals**

1) https://shorturl.at/uIMTW
2) https://shorturl.at/yFJM3

Online Resources–

- **e-Resources / e-books and e-learning portals**
- **www.swayam.ac.in**
- **www.ignou.ac.in**
- **www.egyankosh.ac.in**
- **www.iitm.ac.in**
- **www.eskillindia.org**
- **www.eshiksha.mp.gov.in**
- **www.vlab.co.in**
- **www.internshala.com**
- **www.ndl.iitkgp.ac.in**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	50 Marks
Continuous Internal Assessment (CIA):	15 Marks
End Semester Exam (ESE):	35 Marks

Continuous Internal Assessment (CIA): 15 (By Course Teacher)	Internal Test / Quiz-(2): 10 & 10 Assignment/Seminar +Attendance - 05 Total Marks - 15	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 15 Marks
End Semester Exam (ESE): 35	Laboratory / Field Skill Performance: On spot Assessment A. Performed the Task based on lab. work - 20 Marks B. Spotting based on tools & technology (written) – 10 Marks C. Viva-voce (based on principle/technology) - 05 Marks	Managed by Course teacher as per lab. status

Name and Signature of Convener & Members of CBoS:

(1) (2) (3) (4) (5) (6) (7) (8) 9 (10)

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

DEPARTMENT OF BOTANY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Diploma / Degree/Honors)*			Semester - IV	Session: 2024-2025
1	Course Code	BOSE- 02 T		
2	Course Title	Microbiology and Phytopathology		
3	Course Type	Discipline specific Elective (DSE)		
4	Pre-requisite (if, any)	*As per program*		
5	Course Learning. Outcomes (CLO)	At the end of this course, the students will be able to get ➢ Basic idea of different microbes present in biotic and abiotic environment. ➢ Knowledge of principle concept and methods in the field of Microbiology and Phytopathology ➢ Idea of living, non living and environmental causes of plant diseases. ➢ Knowledge of different technique to isolate microbes study their cultural characteristics,. ➢ How disease occurs by microbes, their identification and control measures.		
6	Credit Value	3 Credits	*Credit = 15 Hours - learning & Observation*	
7	Total Marks	Max. Marks: 100		Min Passing Marks: 40

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**Microbiology:** ❖ General account, distribution and classification of microorganism. ❖ Major microbes of air soil water and food ❖ Isolation and cultivation of microorganism ❖ Important tools and techniques used in microbiological studies.	12
II	**Plant pathology:** ❖ Nature and concept of diseases in plants, ❖ History and development of plant pathology, contribution of Indian plant pathologist in India and abroad, pathology and trends in 21st century ❖ Symptom of parasitic and non-parasitic diseases, ❖ Classification of plant diseases. ❖ Important plant diseases caused by different Pathogens ❖ Plant quarantine ❖ HR and hypersensitivity	11
III	**Techniques of Studying Plant Diseases:** ❖ Field Studies, Collection of samples and its preservation. ❖ **Sterilization technique**- Standard Methods of sterilization - Physical methods, Chemical methods, Radiation methods, ❖ **Isolation technique:** Preparation of different media for growth of pathogen by using standard inoculation techniques like- plate streak, serial dilution and pour plate methods to obtain a pure culture. ❖ **Staining Technique:** Nature and Types of stains, ❖ **Preservation** : methods of preservation of culture	11
IV	**Host Parasite Relation:** ❖ Terms and concept ❖ Disease cycle and environmental relations ❖ Plant disease dissemination ❖ Role of enzymes and toxins in pathogenesis and mode of infection, ❖ Inoculums and inoculums potential ❖ Koch's postulates ❖ Defense mechanism in plant against pathogens, ❖ Prevention and control of plant diseases	11
Key words	Microorganism, Disease, Pathogens , Culture	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –.

1. Bridges, P. (1998) Molecular Variability Of Fungal Pathogens. CAB
2. Bilgrami, K. S. and Dubey, H. C. (1985) Plant Pathology, Vikas Publ. House, Sahibabad U.P.
3. Ali, s. s. and Kulshereshta, p. (1986) plant pathology, adeeb educational, Raipur.
4. Singh, R. S. (1980) Plant Pathology, Oxford IBH Publ. Co, New Delhi.
5. Malhotra R. Plant Pathology Publisher: McGraw Hill Education India

REference Books Recommended-

1. Agrios, G. N. (1997) Plant Pathology, Academic Press, London

Online Resources–

- **e-Resources / e-books and e-learning portals**
- **www.swayam.ac.in**
- **www.ignou.ac.in**
- **www.egyankosh.ac.in**
- **www.iitm.ac.in**
- **www.eskillindia.org**
- **www.eshiksha.mp.gov.in**
- **www.vlab.co.in**
- **www.internshala.com**
- **www.ndl.iitkgp.ac.in**

Online Resources–

- **e-Resources / e-books and e-learning portals**

1. **https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/plant-pathology#:~:text=Plant%20pathology%20is%20a%20science,parasitic%20microorganisms%20that%20cause%20disease.**
2. **https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4600171/**
3. **https://bnrc.springeropen.com/articles/10.1186/s42269-021-00627-6**
4. **https://www.sciencedirect.com/science/article/abs/pii/S0065308X08604339**
5. **https://www.researchgate.net/publication/371501301_Fundamentals_of_Plant_Pathology**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 100 Marks

Continuous Internal Assessment (CIA): 30 Marks

End Semester Exam (ESE): 70 Marks

Continuous Internal Assessment (CIA): 30 (By Course Teacher)	Internal Test / Quiz-(2): 20 +20 Assignment / Seminar - 10 Total Marks - 30	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
End Semester Exam (ESE): 70	**Two section – A & B** Section A: Q1. Objective – 10 x1= 10 Mark; Q2. Short answer type- 5x4 =20 Marks Section B: Descriptive answer type qts.,1out of 2 from each unit-4x10=40 Marks	

Name and Signature of Convener & Members of CBoS:

(1) [illegible]
(2) [illegible]
(3) [illegible]
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(5) [illegible]
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(7) [illegible]
(8) [illegible]
9 [illegible]
(10) [illegible]

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

DEPARTMENT OF BOTANY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Science *(Diploma / Degree/ Honors)*			Semester - IV	Session: 2024-2025
1	Course Code	BOSE-02 P		
2	Course Title	Lab course 02 (Microbiology and Phytopathology)		
3	Course Type	Discipline specific Elective (DSE)		
4	Pre-requisite (if, any)	*As per program*		
5	Course Learning. Outcomes (CLO)	At the end of this course, the students will be able to get ➢ Basic idea of microbes. ➢ Culture of microbes in the laboratory ➢ How disease occurs by microbes ➢ Basic idea of host parasite interrelationship ➢ Control measure of pathogen by different biological sources.		
6	Credit Value	1 Credits	*Credit =30 Hours Laboratory or Field learning/Training*	
7	Total Marks	Max. Marks: 50		Min Passing Marks: 20

PART -B: Content of the Course

Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)

Module	Topics (Course contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course	❖ Calibration of microscope. ❖ Study of symptoms of various plants disease caused by viruses, bacteria and fungi. ❖ Sterilization of glass wares by detergent, chromic acid and dry sterilization ❖ Preparation and sterilization of culture media NAM, PDA, to culture bacteria and fungi respectively. ❖ Isolation of micro-organism from soil, water and air by using standard inoculation technique. ❖ Identification of the isolated fungi by slide preparation. ❖ Micrometry – measurement of length and width of spore/ conidia of the isolated /given fungi. ❖ Preparation of camera lucida diagram of the isolated / given fungi. ❖ Cultural charecteristics the the cultured bacteria. ❖ Gram staining of Bacteria ❖ Host parasite relationship- slide preparation of infected / diseased portion of the host to study host parasite relationship by smearing and section cutting methods isolated from local field. ❖ Demonstration of the effect of various bio-pesticides (essential oils, neem, turmeric and garlic) against microbe/pathogens ❖ Preparation of herbarium of different plant diseases of local area	30
Keywords	Disease. symptoms, medium, pathogenesis	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. Experiments In Microbiology, Plant Pathology And Biotechnology By K. R. Aneja. Publisher New Age International

Online Resources–

- e-Resources / e-books and e-learning portals

1. https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/plant-pathology#:~:text=Plant%20pathology%20is%20a%20science,parasitic%20microorganisms%20that%20cause%20disease.
2. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4600171/
3. https://bnrc.springeropen.com/articles/10.1186/s42269-021-00627-6
4. https://www.sciencedirect.com/science/article/abs/pii/S0065308X08604339

1) https://www.researchgate.net/publication/371501301_Fundamentals_of_Plant_Pathology

Online Resources–

- e-Resources / e-books and e-learning portals
- https://efaidnbmnnnibpcajpcglclefindmkaj/https://mis.alagappauniversity.ac.in/siteAdmin/dde-
- https://admin/uploads/3/PG_M.Sc._Botony_34631%20MICROBIOLOGY%20AND%20PLANT%20PATHOLOGY.pdf

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 50 Marks

Continuous Internal Assessment (CIA): 15 Marks

End Semester Exam (ESE): 35 Marks

Continuous Internal Assessment (CIA): 15 (By Course Teacher)	Internal Test / Quiz-(2): 10 & 10 Assignment/Seminar +Attendance - 05 Total Marks - 15	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 15 Marks
End Semester Exam (ESE): 35	Laboratory / Field Skill Performance: On spot Assessment A. Performed the Task based on lab. work - 20 Marks B. Spotting based on tools & technology (written) – 10 Marks C. Viva-voce (based on principle/technology) - 05 Marks	Managed by Course teacher as per lab. status

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

DEPARTMENT OF BOTANY

COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Degree/Honors)*			**Semester - V**	Session: 2024-2025
1	Course Code	BOSE -03 T		
2	Course Title	Phytopaleontology and Evolutionary Botany		
3	Course Type	Discipline specific Elective (DSE)		
4	Pre-requisite (if, any)	*As per program*		
5	Course Learning. Outcomes (CLO)	At the end of this course, the students will be able to ➢ have a basic idea of fossils and process of fossilization ➢ Describe how plants evolved including their origin and diversification ➢ Summarize and evaluate information from scientific literature ➢ Identify plat fossil through study of the remains of organisms, anatomical evidence and diversity ➢ Understand and track evolution of species over millions of years identify transional forms of life ➢ Understand how earth's environment has changed over geological time.		
6	Credit Value	**3 Credits**	*Credit = 15 Hours - learning & Observation*	
7	Total Marks	**Max. Marks: 100**	**Min Passing Marks: 40**	

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**Phytopaleontology-** ❖ General account, ❖ Geological time scale; ❖ Brief account of process of fossilization & types of fossils and their study techniques; ❖ Fossils of algae, fungi, bryophytes	12
II	**Fossils and India**: ❖ Fossil plants: *Rhynia, Horneophyton, Williamsonia, Cycadeoidea.* ❖ Contribution of Prof. Birbal Sahni,-*Pentoxyles- Pentoxylon sahnii* ❖ Role of Indian Gondwana Flora in Chhattisgarh with reference to coal mines	11
III	**Brief account of the families of Pteridospermales –** ❖ Lyginopteridaceae, ❖ Medullosaceae, ❖ Caytoniaceae & ➢ Glossopteridaceae	11
IV	**General Account and Affinities –** ❖ Cycadeoidales and Cordaitales. ❖ Paleozoic seeds ❖ Angiospermic and Gymnospermic fossils ❖ Uses of fossils ❖ Evolution : convergent, divergent and parallel evolution ❖ Telome concept	11
Keywords	Fossil, geological time table, gondwana flora, Telome	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. Vashishtha, B. R. (2005) Pteridophytes S. Chand and Co., Delhi.
2. Vashishtha, B. R. (2005) Bryophytes S. Chand and Co., Delhi.
3. Parihar, N.S. (1991). An introduction to Embryophyta. Vol. I. Bryophyta. Central Book Depot, Allahabad.
4. Rashid A (1999) An Introduction to Pteridophyta, Vikas Publishing House Pvt. Ltd. New Delhi.
5. Sharma OP (1990) Textbook of Pteridophyta. MacMillan India Ltd. Delhi.
6. Vashishtha BR, Sinha AK and Kumar A (2010) Botany for Degree Students – Pteridophyta, S. Chand and Company,
7. Vashishtha BR, Sinha AK and Kumar A (2010) Botany for Degree Students – Gymnosperms, S. Chand and
8. Parihar NS (1976) Biology and Morphology of Pteridophytes. Central Book Depot.
9. Bhatnagar SP (1996) Gymnosperms, New Age International Publisher.
10. Pandey BP (2010) College Botany Vol II S. Chand and Company, New Delhi .

Reference Books Recommended –

1. Kumar, H. D. (1988) introductory Phycology, Affliated East-West Press Ltd., New Delhi.
2. Morris, I (1986) An Introduction to Algae, Cambridge Univ. Press, UK.
3. Puri, P. (1980) Bryophytes, Atma Ram and Sons, Delhi.
4. Sporne, K. K. (1991) The Morphology of Pteridophytes, B. I. Publishing Pvt. Ltd. Bombay.
5. Stewart, W. N. and Ruthwell, G. W. (1993) Paleobotany and the Evolution of Plants. Cambridge Univ. Press, UK.
6. Principles of Paleontology Edition 3 Paperback–1 January 2006 by Arnold Miller, Michael Foote Publishers - W.H.Freeman & Co Ltd

Online Resources–

- **e-Resources / e-books and e-learning portals**

1. https://efaidnbmnnnibpcajpcglclefindmkaj/https://egyankosh.ac.in/bitstream/123456789/69611/1/Unit-9.pdf
2. https://www.encyclopedia.com/science/encyclopedias-almanacs-transcripts-and-maps/fossil-and-fossilization
3. https://palaeobotany.org

- **e-Resources / e-books and e-learning portals**
- www.swayam.ac.in
- www.ignou.ac.in
- www.egyankosh.ac.in
- www.iitm.ac.in
- www.eskillindia.org
- www.eshiksha.mp.gov.in
- www.vlab.co.in
- www.internshala.com
- www.ndl.iitkgp.ac.in

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Exam (ESE):	**70 Marks**

Continuous Internal Assessment (CIA): 30 (By Course Teacher)	Internal Test / Quiz-(2): 20 +20 Assignment / Seminar - 10 Total Marks - 30	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
End Semester Exam (ESE): 70	**Two Section – A & B** Section A: Q1. Objective - 10 x1= 10 Mark; Q2. Short answer type- 5x4 =20 Marks Section B: Descriptive answer type qts., **1out of 2** from each unit-4x10=40 Marks	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

DEPARTMENT OF BOTANY

COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Degree/ honors)*			Semester - V	Session: 2024-2025
1	Course Code	BOSE-03 P		
2	Course Title	Lab. Course -03 (Phytopaleontology and Evolutionary Botany)		
3	Course Type	Laboratory course		
4	Pre-requisite (if, any)	*As per program*		
5	Course Learning. Outcomes (CLO)	1. Understand evolutionary trends of plant development and diversification. 2. Study remnant of past and its natural conservation. 3. Phylogenetic relationship with the help of paleontological evidences 4. Understand role of fossil as an educational tool promoting science literacy an appreciation for earth's rich biological heritage.		
6	Credit Value	1 Credits	*Credit =30 Hours Laboratory or Field learning/Training*	
7	Total Marks	Max. Marks: 50	Min Passing Marks:	20

PART -B: Content of the Course		
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)		
Module	Topics (Course contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course	1) Study of important fossil of pteridophytes from prepared slides and specimens 2) Study of important fossil of gymnosperms from prepared slides and specimens 3) Study of important fossil of algae, fungi, bryophytes and angiosperms from prepared slides and specimens 4) Local trip to coal mines or fossil area for collection of fossil specimens and prepare study reports.	30
Keywords	1) Fossil, slides and specimens	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. Principles of Paleontology Edition 3 Paperback–1 January 2006 by Arnold Miller, Michael Foote Publishers - W.H.Freeman & Co Lt
2. The Practical Fossil Finder (Practical Handbook) Hardcover – 1 October 1991by Steve Parker (Author) Publishers Facts On File Inc

Online Resources–

- **e-Resources / e-books and e-learning portals**

1. **https://efaidnbmnnnibpcajpcglclefindmkaj/https://egyankosh.ac.in/bitstream/123456789/69611/1/Unit-9.pdf**
2. https://www.encyclopedia.com/science/encyclopedias-almanacs-transcripts-and-maps/fossil-and-fossilization
3. https://palaeobotany.org

Online Resources–

e-Resources / e-books and e-learning portals

- **www.swayam.ac.in**
- **www.ignou.ac.in**
- **www.egyankosh.ac.in**
- **www.iitm.ac.in**
- **www.eskillindia.org**
- **www.eshiksha.mp.gov.in**
- **www.vlab.co.in**
- **www.internshala.com**
- **www.ndl.iitkgp.ac.in**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	50 Marks
Continuous Internal Assessment (CIA):	15 Marks
End Semester Exam (ESE):	35 Marks

Continuous Internal Assessment (CIA): 15 (By Course Teacher)	Internal Test / Quiz-(2): 10 & 10 Assignment/Seminar +Attendance - 05 Total Marks - 15	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 15 Marks
End Semester Exam (ESE): 35	**Laboratory / Field Skill Performance:** On spot Assessment A. Performed the Task based on lab. work - 20 Marks B. Spotting based on tools & technology (written) – 10 Marks C. Viva-voce (based on principle/technology) - 05 Marks	Managed by Course teacher as per lab. status

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF BOTANY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Degree/Honors)*		**Semester - VI**		Session: 2024-2025
1	Course Code	**BOSE-04 T**		
2	Course Title	**Ethnobotany and Medicinal plants**		
3	Course Type	**Discipline Specific Elective (DSE)**		
4	Pre-requisite (if, any)	***As per program***		
5	Course Learning. Outcomes (CLO)	At the end of this course, the students will be able to • Develop a comprehensive understanding of the identification, cultivation, and processing of medicinal plants, and their chemical constituents responsible for therapeutic properties, enabling the evaluation of their potential for drug development and healthcare applications. • Explore the integration of traditional medicine practices, ethnobotany, and pharmacological principles in the study of medicinal plants, enabling the critical evaluation of their efficacy, safety, and cultural significance in different healthcare systems.		
6	Credit Value	**3 Credits**	***Credit = 15 Hours - learning & Observation***	
7	Total Marks	**Max. Marks: 100**	**Min Passing Marks: 40**	

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**Ethnobotany:** • Introduction, concept, scope and objectives; • Ethnobotany as an interdisciplinary science. • The relevance of ethnobotany in the present context; • Major and minor ethnic groups or Tribals of India, and their life styles. • Plants used by the tribals: • a) Food plants b) intoxicants and beverages c) Resins and oils and miscellaneous uses. Role of ethnobotany in sustainable development	12
II	**Role of ethnobotany in modern Medicine:** • Medico-ethnobotanical sources in India; • Significance of the locally available plants in ethno botanical practices (along with their habitat and morphology • Role of ethnic groups in conservation of plant genetic resources. • Endangered taxa and forest management (participatory in Chhattisgarh). • Role of plant drugs in pharmaceutical industries • Quality, safety and efficacy of herbal medicines.	11
III	**Medicinal Plants:** • History, Scope and Importance of Medicinal Plants. • Indigenous Medicinal Sciences; Definition and Scope- • Traditional system of medicine in India- concept principles and importance of Ayurveda, Shidha, Yunani and Homeopathy • Concept of Herbalism and its significance • Phytomedicines and herbal raw materials , • local health traditions and traditional medicine	11
IV	**Conservation and Propagation of medicinal plants:** • Medicinal plants Conservation – issues and approaches • IUCN criteria - Red list criteria; • *In situ* conservation: Biosphere reserves, sacred groves, National Parks; *Ex situ* conservation: Botanical Gardens, • Ethnomedicinal plant Gardens. • Propagation of Medicinal Plants: Objectives of the nursery, its classification, important components of a nursery, sowing, pricking, use of green house for nursery production, propagation through cuttings, layering, grafting and budding	11
Keywords	Ethnobotany, conservation, Medicinal Plants, Tribals	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended:

1. S.K. Jain, Manual of Ethnobotany, Scientific Publishers, Jodhpur, 1995.
2. S.K. Jain (ed.) Glimpses of Indian. Ethnobotny, Oxford and I B H, New Delhi – 1981 Lone et al, Palaeo ethnobotany
3. S.K. Jain (ed.) 1989. Methods and approaches in ethnobotany. Society of ethnobotanists, Lucknow, India.
4. S.K. Jain, 1990. Contributions of Indian ethnobotny. Scientific publishers, Jodhpur.

Reference Books Recommended:

1. Colton C.M. 1997. Ethnobotany – Principles and applications. John Wiley and sons – Chichester
2. Rama Ro, N and A.N. Henry (1996). The Ethnobotany of Eastern Ghats in Andhra Pradesh, India. Botanical Survey of India. Howrah
3. .Rajiv K. Sinha – Ethnobotany The Renaissance of Traditional Herbal Medicine – INA –SHREE Publishers, Jaipur-1996
4. Trivedi P C, 2006. Medicinal Plants: Ethnobotanical Approach, Agrobios, India.
5. Purohit and Vyas, 2008. Medicinal Plant Cultivation: A Scientific Approach, 2nd edn. Agrobios, India. Approach, 2nd edn. Agrobios, India.
6. Medicinal Plants of India" by C.P. Khare
7. "Handbook of Medicinal Plants" by L.D. Kapoor Rogers, P.P., Jalal, K.F. and Boyd, J.A. (2008). An Introduction to Sustainable Development. Prentice Hall of India Private Limited, New Delhi.

Online Resources–

- **e-Resources / e-books and e-learning portals**
- https://www.fs.usda.gov/wildflowers/ethnobotany/index.shtml
- https://www.researchgate.net/publication/333017295_Role_of_ethnobotany_in_modern_medicines_with_special_reference_to_Rauvolfia_serpentina_Trichopus_zeylanicus_Artemisia_sp_and_Withania_somnifera
- https://www.sciencedirect.com/science/article/abs/pii/S0738081X18300415
- https://www.mdpi.com/journal/diversity/special_issues/ethnobotany_biodiversity

Online Resources–

- **e-Resources / e-books and e-learning portals**
- www.swayam.ac.in
- www.ignou.ac.in
- www.egyankosh.ac.in
- www.iitm.ac.in
- www.eskillindia.org
- www.eshiksha.mp.gov.in
- www.vlab.co.in
- www.internshala.com
- www.ndl.iitkgp.ac.in

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Exam (ESE):	**70 Marks**

Continuous Internal Assessment (CIA): 30 (By Course Teacher)	Internal Test / Quiz-(2): **20** +20 Assignment / Seminar - 10 Total Marks - 30	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE): 70	**Two section** – A & B Section A: **Q1**. Objective – **10** x1= 10 Mark: **Q2**. Short answer type- 5x4 =20 Marks Section B: Descriptive answer type qts.,**1out of 2** from each unit–4x10=40 Marks	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

DEPARTMENT OF BOTANY

COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Degree/ honors)*			Semester - VI	Session: 2024-2025
1	Course Code	**BOSE-04 P**		
2	Course Title	Lab. Course 04 (Ethnobotany and Medicinal plants)		
3	Course Type	**Laboratory course**		
4	Pre-requisite (if, any)	*As per program*		
5	Course Learning. Outcomes (CLO)	At the end of this course, the students will be able to get ➢ Acquire practical skills about the connection between plants and human society. ➢ Acquire knowledge of ethnobotanical research methods. ➢ Apply critical thinking and problem-solving skills of traditional plant uses. ➢ Idea about protection and conservation of medicinal and ethnobotanical plants. ➢ Documentation of cultural knowledge about healing.		
6	Credit Value	**1 Credits**	*Credit =30 Hours Laboratory or Field learning/Training*	
7	Total Marks	**Max. Marks: 50**	**Min Passing Marks: 20**	

PART -B: Content of the Course		
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)		
Module	Topics (Course contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course	1. Identify and collect medicinal plant specimens from various habitats. Documentation for relevant information such as plant parts used, traditional uses, and ecological characteristics. 2. Preparation of herbarium of the collected plants 3. To study the distribution of tribals / ethnic peoples of a selected area. 4. Collection of locally used plants of ethnobotanically important plants 5. To study morphological description and identification of various medicinal plants. 6. Engage with local communities and traditional healers to document their knowledge of medicinal plants. Record their uses, preparation methods, and cultural significance, emphasizing the importance of preserving traditional knowledge. 7. To study common name, botanical name, important varieties and commercially important parts of medicinal and aromatic plants. 8. To study different methods of plant extraction to obtain bioactive compounds 9. Phytochemical and secondary metabolites analysis to determine the chemical potential therapeutic properties of collected specimens of local area. 10. Tribal knowledge towards disease diagnosis, treatment for different medicinal plants and its cultivation and conservation. 11. To find out antimicrobial potential of medicinal plant extracts.	30
Keywords	1. Therapeutic, antimicrobial, medicinal plants. herbarium	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. S.K. Jain, Manual of Ethnobotany, Scientific Publishers, Jodhpur, 1995.
2. Jain, S. K. and V. Mudgal. 1999. A Handbook of Ethnobotany. Bishen Singh Mahendra Pal Singh, Dehradun.

Reference Books Recommended –

1. "Handbook of Medicinal Plants" by L.D. Kapoor.
2. "Indian Medicinal Plants: An Illustrated Dictionary" by C.P. Khare.

Online Resources–

- **e-Resources / e-books and e-learning portals**

1) https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9526633/
2) https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9922502/
3) https://bnrc.springeropen.com/articles/10.1186/s42269-022-00770-8
4) https://emjournal.biomedcentral.com/articles/10.1186/s13020-016-0108-7

Online Resources–

- **e-Resources / e-books and e-learning portals**
- **www.swayam.ac.in**
- **www.ignou.ac.in**
- **www.egyankosh.ac.in**
- **www.iitm.ac.in**
- **www.eskillindia.org**
- **www.eshiksha.mp.gov.in**
- **www.vlab.co.in**
- **www.internshala.com**
- **www.ndl.iitkgp.ac.in**

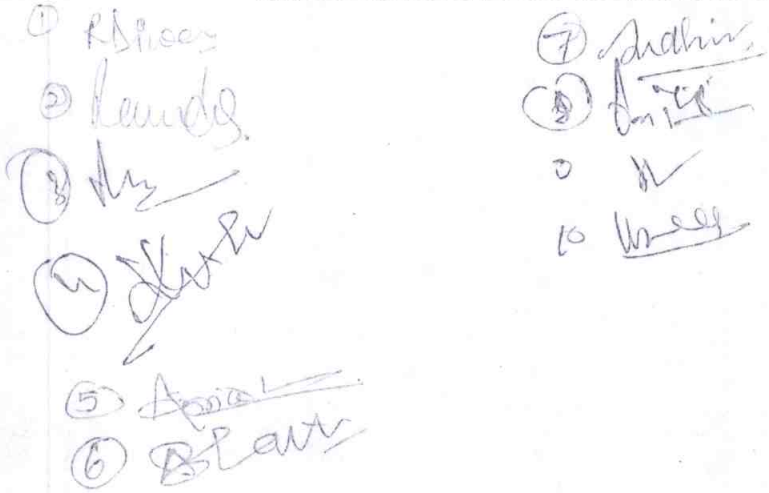
PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): 15 (By Course Teacher)	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar + Attendance - **05** Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 15 Marks
End Semester Exam (ESE): 35	**Laboratory / Field Skill Performance: On spot Assessment** A. **Performed the Task based on lab. work - 20 Marks** B. **Spotting based on tools & technology (written) – 10 Marks** C. **Viva-voce (based on principle/technology) - 05 Marks**	Managed by Course teacher as per lab. status

Name and Signature of Convener & Members of CBoS:



FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

DEPARTMENT OF BOTANY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Honors)*			**Semester - VII**	Session: 2024-2025
1	Course Code	**BOSE-05 T**		
2	Course Title	**Biosystematics and Biodiversity**		
3	Course Type	**Discipline Specific elective (DSE)**		
4	**Pre-requisite** (if, any)	***As per program***		
5	**Course Learning. Outcomes (CLO)**	*At the end of the course, the students will be able :* ➢ Understand different classification and nomenclature system in botany. ➢ Learn plant collection and preservation techniques . ➢ Get knowledge about the biodiversity and its importance. ➢ Analyse the different conservation practices for nature.		
6	Credit Value	**3 Credits**	*Credit = 15 Hours - learning & Observation*	
7	Total Marks	**Max. Marks: 100**	**Min Passing Marks: 40**	

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	Definition and basic concepts of biosystematics taxonomy and classification. History and theories of biological Classification. Difference between botanical and zoological nomenclature system. Trends in biosystematics: Chemotaxonomy, cytotaxonomy and molecular taxonomy. Dimensions of speciation.	12
II	Taxonomic procedures: Taxonomic collections, preservation, process of identification. Taxonomic keys, different types of keys, their merits and demerits. How to use flora, Species concepts: Typological, Nominalist and Biological species concepts. Subspecies and other infra-specific categories.	11
III	Biodiversity : Concept and level, role of biodiversity in ecosystem, function and stability, speciation and extinction, IUCN categories of threat, distribution and global pattern, terrestrial biodiversity, hot spots. Plant biodiversity: Concept, status in India, utilization and concerns.	11
IV	Principal of Conservation: *In-situ* conservation: Strategies for In situ conservation, international efforts and Indian initiatives, protected areas in Indian sanctuaries, national parks, biosphere reserves, wetland, mangroves and coral reefs for conservation of wild biodiversity. Ex-situ Conservation: Strategies for *Ex- situ* conservation, Principles and practices, Botanical gardens, gene bank, seed in vitro repositories, cryo banks.	11
Keywords	***Chemotaxonomy, Cladogram, Biodiversity, Conservation.***	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. Kochar, S. L. (1998) Economic Botany of The Tropics. McMillan India Ltd., New Delhi.
2. Paroda, R. S. and Arora R. K. (1991) Plant Genetic Resources and Conservation and Management IPGRI (publications). South Asia Office, c/o NBPGR, Pusa Campus, New Delhi.
3. Scheri, R. W. (1972) Plants for Man. Englewood Cliffs, New Jersey, Prentice Hall.
4. Annonymous (1997) National Gene Bank. Indian Heritage on Plant Genetic Resources (Booklet) NBPGER, New Delhi.
5. Swaminathan, M. S. And Kocchar (1989) Plants and Society, MacMillan Publication Ltd. London.
6. Kothari, A. (1997) Understanding Bio-Diversity: Life Sustainability and Equity. Orient Longam
7. Johri, B.M. (1984). Embryology of Angiosperms. Springer-Verlag, Berlin
8. Singh, G. (2012) Phant Systematics. Theory and Practice. Oxford & IBH Pvt. Ltd, New Delhi.
9. Bhojwani, SS. & Bhatnagar, SP (2011). Embryology of Angiosperms. Vikas Publication House Pvt. Lid. New Delhi 5 edition
10. Mauseth. 1.1) (1988) Plant Anatomy. The Benjamin Cummings Publisher. USA
11. Pandey, B. P. (LatesEdt), Plant Anatomy
12. Maheshwari, J.K. (1963). Flora of Delhi. CSIR, New Delhi.
13. Saxena N.B. and Saxena S. (2012). Plant Taxonomy Pragati Prakashan.
14. Sharma O.P. (2013). Plant Taxonomy. MC GRAW HILL INDIA.
15. Sharma, M.K. (2013) Plant Structures (An Introduction to Plant Anatomy). VayuEducation of India.
16. Chopra G.L. (2005) Angiosperm, Pradeep Publication, Jalandhar.

Reference Books Recommended –

1. Rogers, P.P., Jalal, K.F. and Boyd, J.A. (2008). An Introduction to Sustainable Development. Prentice Hall of India Private Limited, New Delhi.
2. Radford, A.E. (1986). Fundamentals of Plant Systematics. Harper and Row, New York
3. Jeffrey, C. (1982). An Introduction to Plant Taxonomy. Cambridge University Press,Cambridge.
4. Judd, W.S., Campbell, C.S., Kellogg, E.A., Stevens, P.F. (2002). Plant Systematics-APhylogenetic Approach. Sinauer Associates Inc., U.S.A. 2 nd edition.
5. Simpson, M.G. (2006) Plant Systematics. Elsevier Academic Press, San Diego, CA, USA
6. Beck, C.B. (2010). An Introduction to Plant Structure and Development, II edition.
7. Heywood, V. (1995) Global Bio-Diversity Assessment, UNEP. Cambridge Univ. Press, Cambridge, U.K.
8. Heywood, V.H. and Wyse Jackson, P. S. (1991) Tropical Botanical Garden: Their Role in Conservation and Developinent. Academic Press, San Digo.
9. Barker, H. G. (1978) Plant and Civilization. C. A. Wadsworth, Belmont.
10. Frankel, O. H., Brown, A. H. D. and Burdon, J. J., (1995) Conservation, of Plant Diversity. Cambridge Univ. Press, Cambridge, U. K.
11. Pinstrup- Anderson, P. Et Al (1999) World Food Prospects; Critical Issues for Early 21st Century. International Food Policy Research Institute, Washington D. C. USA.
12. Rogers, N. A. And Panwar, H. S. (1998) Planning A Wild Life Protected Area Network In India Vol. I The Report, Wildlife Institute Of India, Dehradun.

Online Resources–

e-Resources / e-books and e-learning portals

- https://www.sciencedirect.com/topics/social-sciences/natural-resource
- https://efaidnbmnnnibpcajpcglclefindmkaj/https://egyankosh.ac.in/bitstream/123456789/66166/2/Unit4.pdf
- https://efaidnbmnnnibpcajpcglclefindmkaj/https://www.ers.usda.gov/webdocs/publications/41964/30289_biological.pdf?v=0#:~:text=16-,What%20Are%20Biological%20Resources%3F,forests%2C%20and%20other%20natural%20lands.
- http://surl.li/spedd
- https://shorturl.at/ewyIP
- https://shorturl.at/cimoF

Online Resources–

e-Resources / e-books and e-learning portals

- www.swayam.ac.in
- www.ignou.ac.in
- www.egyankosh.ac.in
- www.iitm.ac.in
- www.eskillindia.org
- www.eshiksha.mp.gov.in
- www.vlab.co.in
- www.internshala.com
- www.ndl.iitkgp.ac.in

PART -D: Assessment and Evaluation		
Suggested Continuous Evaluation Methods: Maximum Marks: 100 Marks Continuous Internal Assessment (CIA): 30 Marks End Semester Exam (ESE): 70 Marks		
Continuous Internal Assessment (CIA): 30 (By Course Teacher)	Internal Test / Quiz-(2): 20 +20 Assignment / Seminar - 10 Total Marks - 30	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
End Semester Exam (ESE): 70	**Two section – A & B** Section A: Q1. Objective – 10 x1= 10 Mark; Q2. Short answer type- 5x4 =20 Marks Section B: Descriptive answer type qts., 1out of 2 from each unit-4x10=40 Marks	

Name and Signature of Convener & Members of CBoS:

1. [illegible]
2. [illegible]
3. [illegible]
4. [illegible]
5. [illegible]
6. [illegible]
7. [illegible]
8. [illegible]
9. [illegible]
10. [illegible]

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

DEPARTMENT OF BOTANY

COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Honours)*		Semester - VII	Session: 2024-2025	
1	Course Code	**BOSE-05 P**		
2	Course Title	**Lab course -05 (Biosystematics and Biodiversity)**		
3	Course Type	**Laboratory course**		
4	Pre-requisite (if, any)	*As per program*		
5	Course Learning. Outcomes (CLO)	At the end of this course, students will be able to: ➢ Understand collection and preservation techniques for plants. ➢ Learn use of flora for plant identification. ➢ Understand about protected area of the country ➢ Analyze various IUCN categories of threats.		
6	Credit Value	**1 Credits**	***Credit =30 Hours Laboratory or Field learning/Training***	
7	Total Marks	**Max. Marks: 50**	**Min Passing Marks: 20**	

PART -B: Content of the Course

Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)

Module	Topics (Course contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course	• Herbarium technique. • Non destructive collection of plants • Preservation techniques for plants part . • Prepration of taxonomic keys • How to use flora and digital flora for plant identification. • Use of flora for identification of plants of college campus. • Cladogram and dendrogram • Visit of any botanical garden , national park/wildlife sanctuary/ protected area. • Learn about IUCN categories of threats. 1) Evaluation of alfa, beta and gama biodiversitiy of college campus..	30
Keywords	***Herbarium, Flora, Protected area, IUCN categories.***	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. Kothari, A. (1997) Understanding Bio-Diversity: Life Sustainability and Equity. Orient Longam
2. Singh, G. (2012) Phant Systematics. Theory and Practice. Oxford & IBH Pvt. Ltd, New Delhi.
3. Maheshwari, J.K. (1963). Flora of Delhi. CSIR, New Delhi.

Reference Books Recommended –

1. . flora of India by Botanical Survey of India
2. Judd, W.S., Campbell, C.S., Kellogg, E.A., Stevens, P.F. (2002). Plant Systematics-APhylogenetic Approach. Sinauer Associates Inc., U.S.A. 2 nd edition.
3. Simpson, M.G. (2006) Plant Systematics. Elsevier Academic Press, San Diego, CA, USA

Online Resources–

- **e-Resources / e-books and e-learning portals**

- https://www.worldfloraonline.org/
- https://bsi.gov.in/page/en/digital-resources
- https://indiaflora-ces.iisc.ac.in/FloraPeninsular/
- http://www.efloras.org/
- https://creately.com/guides/what-is-a-dichotomous key/herpsteppp.inflibort.ac.in/Home/VirwSubject?catid=1pBOY7YTBCLSD2K
- https://eppp.inflibert.ac.in/Home/ViewSubjectPratid-10OYJVTRCLSDKUBW
- . httpssivproinflibnet.ac.in/Home/View Subject catid-1pbbyZY1BCS02E
- https://www.amazon.in/Plant-Taxonomy-past-present-future-chook/dp/B016021014
- https://www.instructables.com/How-to-Make-a-Cladogram/
- file:///C:/Users/user/Downloads/ajol-file-journals_452_articles_122070_submission_proof_122070-5365-335203-1-10-20150914%20(1).pdf

Online Resources–

- **e-Resources / e-books and e-learning portals**
- www.swayam.ac.in
- www.ignou.ac.in
- www.egyankosh.ac.in
- www.iitm.ac.in
- www.eskillindia.org
- www.eshiksha.mp.gov.in
- www.vlab.co.in
- www.internshala.com
- www.ndl.iitkgp.ac.in

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	50 Marks
Continuous Internal Assessment (CIA):	15 Marks
End Semester Exam (ESE):.	35 Marks

Continuous Internal Assessment (CIA): 15 (By Course Teacher)	Internal Test / Quiz-(2): 10 & 10 Assignment/Seminar + Attendance - 05 Total Marks - 15	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 15 Marks
End Semester Exam (ESE): 35	**Laboratory / Field Skill Performance: On spot Assessment** A. Performed the Task based on lab. work - 20 Marks B. Spotting based on tools & technology (written) – 10 Marks C. Viva-voce (based on principle/technology) - 05 Marks	Managed by Course teacher as per lab. status

Name and Signature of Convener & Members of CBoS:

(1) (2) (3) (4) (5) (6) (7) (8) (9) (10)

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

DEPARTMENT OF BOTANY

COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Honors)*			Semester - VII	Session: 2024-2025
1	Course Code	BOSE-06 T		
2	Course Title	Plant breeding and Seed technology		
3	Course Type	Discipline specific Elective (DSE)		
4	Pre-requisite (if, any)	*As per program*		
5	Course Learning. Outcomes (CLO)	At the end of this course, the students will be able to ➢ Gain knowledge and comprehension of the breeding systems ➢ knowledge of reproductive biology in angiosperms to address real-world challenges related to plant breeding, crop production, and conservation. provide students with a comprehensive understanding of plant breeding principles and techniques.		
6	Credit Value	3 Credits	*Credit = 15 Hours - learning & Observation*	
7	Total Marks	Max. Marks: 100	Min Passing Marks: 40	

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**Plant breeding:** Introduction and objectives. Breeding systems: modes of reproduction in crop plants. Important achievements and undesirable consequences of plant breeding.	12
II	**Methods of crop improvement:** Introduction: Centers of origin and domestication of crop plants, plant genetic resources;Acclimatization; Selection methods: For self pollinated, cross pollinated and vegetativelypropagated plants; Hybridization: For self, cross and vegetatively propagated plants – Procedure, advantages and limitations. Role of mutations; Polyploidy; Distant hybridization and role of biotechnology in crop improvement.	11
III	**Breeding Methods for Stress Resistance:** Breeding for drought, salinity, heat, cold, disease and insect resistance, breeding forprotein and oil quality. Heterosis and inbreeding depression, hybrid and synthetic varieties.Hardy-Weinberg law, systems of mating.	11
IV	**Seed Technology:** Principle & Concept of Seed Technology. Quality seeds, Indian seed act. Classes of quality seeds - breeder, foundation, registered and certified seeds, operations essential for seed production, seed processing, certification and maintenance storage of improved seeds, seed productions organizations- national and state seed corporations and private seed companies. Artificial seeds, terminator seeds.	11
Keywords	**Breeding,Heterosis, Self incompatibility, Hybridization.**	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. Plant breeding by B.D Singh.
2. BD Singh (2003) Plant Breeding. Kalyani Publishers
3. PLANT BREEDING: PRINCIPLE AND METHODS B D SINGH - IN HINDI
4. Sharma JR (1994) Principles and Practices of Plant Breeding. Tata McGraw-Hill Pub. Co. New Delhi.
5. Chaudhari, H.K. (1984). Elementary Principles of Plant Breeding. Oxford – IBH.
6. Acquaah, G. (2007). Principles of Plant Genetics & Breeding. Blackwell Publishing.
7. Agrawal, P.K. 1993, Hand Book of Seed Technology, Dept. of Agriculture and Cooperation, National Seed Corporation Ltd., New Delhi.

Reference Books Recommended –

1. Allard (1960) Principles of Plant Breeding. John Wikkey and Sons, Inc. New York.
2. Hayes, Immer and Smith (1955) Methods of Plant Breeding, MacGraw- Hil Book Co. Inc. New York.
3. Jonossy and Lupton (1976) Heaterosis in Plant Breeding. Elsevier, Amsterdam.
4. Poehlman and Borthakur (1969) Breeding Asian Field Crops With Special Reference To Crops I India. Oxford and IBH Publishing Company, New Delhi.

Online Resources–

- **e-Resources / e-books and e-learning portals**

1. **https://chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://courseware.cutm.ac.in/wp-content/uploads/2020/05/Download-Notes-8.pdf**
2. **https://chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/http://www.eagri.org/eagri50/GBPR211/lec16.pdf**
3. **https://efaidnbmnnnibpcajpcglclefindmkaj/http://www.eagri.org/eagri50/GBPR211/lec16.pdf**
4. **https://www.sciencelearn.org.nz/resources/77-pollination-and-fertilisation**
5. **https://www.crops.org/about-crops/seed-technology#:~:text=What%20is%20seed%20technology%3F,that%20people%20and%20livestock%20eat.**
6. **https://plantbreeding2010.blogspot.com/2020/12/seed-and-seed-technology-introduction.html**
7. **https://www.nature.com/articles/s41477-018-0309-4**

Online Resources–

- **e-Resources / e-books and e-learning portals**
- **www.swayam.ac.in**
- **www.ignou.ac.in**
- **www.egyankosh.ac.in**
- **www.iitm.ac.in**
- **www.eskillindia.org**
- **www.eshiksha.mp.gov.in**
- **www.vlab.co.in**
- **www.internshala.com**
- **www.ndl.iitkgp.ac.in**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 100 Marks

Continuous Internal Assessment (CIA): 30 Marks

End Semester Exam (ESE): 70 Marks

Continuous Internal Assessment (CIA): 30 (By Course Teacher)	Internal Test / Quiz-(2): 20 +20 Assignment / Seminar - 10 Total Marks - 30	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
End Semester Exam (ESE): 70	Two section – A & B Section A: Q1. Objective – 10 x1= 10 Mark; Q2. Short answer type- 5x4 =20 Marks Section B: Descriptive answer type qts., 1out of 2 from each unit-4x10=40 Marks	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

DEPARTMENT OF BOTANY

COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Honors)*			**Semester - VII**	**Session: 2024-2025**
1	Course Code	**BOSE-06 P**		
2	Course Title	**Lab. Course- 06 (Plant breeding and Seed Technology)**		
3	Course Type	**Laboratory course**		
4	Pre-requisite (if, any)	***As per program***		
5	Course Learning. Outcomes (CLO)	At the end of the course students will be - ➢ Idea of seeds which carries a new generation. ➢ Knowledge of plant breeding techniques. ➢ Knowledge of breeding methods for stress tolerance. ➢ Idea of seed processing and certification of seeds.		
6	Credit Value	**1 Credits**	***Credit =30 Hours Laboratory or Field learning/Training***	
7	Total Marks	**Max. Marks: 50**	**Min Passing Marks: 20**	

PART -B: Content of the Course

Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)

Module	Topics (Course contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course	1. Study of seed parts 2. Collection of different types of mature seeds 3. Techniques of hybridization- Emasculation. 4. Techniques of hybridization - Bagging and tagging. 5. Study of vegetatively grown plants part of your locality 6. Collection of seeds of different varieties of locally grown crops. 7. Inter-varietal cross in an ornamental plant. 8. Visit to state and national seed corporation companies and prepare a report.	30
Keywords	Seed, Emasculation, Bagging and tagging.	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others
Text Books Recommended – 1. Allard (1960) Principles of Plant Breeding. John Wikkey and Sons, Inc. New York. 2. Hayes, Immer and Smith (1955) Methods of Plant Breeding, MacGraw- Hil Book Co. Inc. New York. 3. Plant breeding by B.D Singh *Reference Books Recommended –* 1. Jonossy and Lupton (1976) Heaterosis in Plant Breeding. Elsevier, Amsterdam. 2. Poehlman and Borthakur (1969) Breeding Asian Field Crops With Special Reference To Crops I India. Oxford and IBH Publishing Company, New Delhi.
Online Resources– ➢ **e-Resources / e-books and e-learning portals** ➢ https://www.merriam-webster.com/dictionary/emasculate ➢ https://agritech.tnau.ac.in/crop_improvement/crop_imprv_emasculation_cereals.html ➢ https://www.toppr.com/guides/biology/reproduction-in-organisms/vegetative-propagation/#:~:text=Vegetative%20Propagation%20by%20Roots,example%2C%20Sweet%20potato%20and%20Dahlia.
Online Resources– ➢ **e-Resources / e-books and e-learning portals** ➢ www.swayam.ac.in ➢ www.ignou.ac.in ➢ www.egyankosh.ac.in ➢ www.iitm.ac.in ➢ www.eskillindia.org ➢ www.eshiksha.mp.gov.in ➢ www.vlab.co.in ➢ www.internshala.com ➢ www.ndl.iitkgp.ac.in

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): 15 **(By Course Teacher)**	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - 05 Total Marks - 15	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 15 Marks
End Semester Exam (ESE): 35	**Laboratory / Field Skill Performance:** On spot Assessment A. Performed the Task based on lab. work - 20 Marks B. Spotting based on tools & technology (written) – 10 Marks C. Viva-voce (based on principle/technology) - 05 Marks	Managed by Course teacher as per lab. status

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

DEPARTMENT OF BOTANY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Honors)*		**Semester - VII**	**Session: 2024-2025**	
1	Course Code	**BOSE-07 T**		
2	Course Title	Instrumentation and biochemical technology		
3	Course Type	**Discipline specific Elective (DSE)**		
4	Pre-requisite (if, any)	*As per program*		
5	Course Learning. Outcomes (CLO)	At the end of this course, the students will be able to ➢ Develop a solid understanding of different analytical methods and instruments used in plant sciences. ➢ Acquire practical skills in sample preparation, data collection, and data analysis using analytical techniques. ➢ Understand the working principles of important instrumentation tools ➢ Understand modern technologies in the field of Biochemistry		
6	Credit Value	**3 Credits**	*Credit = 15 Hours - learning & Observation*	
7	Total Marks	**Max. Marks: 100**	**Min Passing Marks: 40**	

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	• Principles of microscopy; Light microscopy; Fluorescence microscopy; Confocal microscopy; • Use of fluorochromes in : (a) Flow cytometry (b) fluorescence microscopy: for Chromosome banding • Phase contrast, electron, scanning and transmission electron microscopy, • Single and double staining techniques for light microscopy for temporary and permanent slides • Stain techniques: Single and double staining.	12
II	Instruments: Salient features, Principle and applications. • Autoclave, • Oven, • Laminar air flow, • Centrifuge. • Colorimetry • Spectrophotometry, • Fermenters., • Water bath, • pH meter	11
III	• Chromatography: Principle and its application in biological research: Paper chromatography, Column chromatography, Affinity chromatography, TLC, GLC, HPLC. • Electrophoresis: AGE, PAGE, SDS-PAGE. • Radioisotopes: Principles and its application in biological research. • ELISA test	11
IV	Biochemical Technology, Biofuel, CRISPR Technology Genetic Engineering, Vaccine, Biodegradable plastics Gene Therapy, DNA fingerprinting, GMO food, Pest resistant crops.	11
Keywords	Microscope, biochemical technology	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. Bioinstrumentation by L. VEERAKUMARI

Reference Books Recommended –

1. Biological Instrumentation & Methodology by Bajpai P. K.

Online Resources–

- e-Resources / e-books and e-learning portals

1. https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SMB2103.pdf
2. https://cbpbu.ac.in/userfiles/file/2020/STUDY_MAT/ZOO/PK%20(4).pdf
3. https://kanchiuniv.ac.in/coursematerials/Biomedical%20instrumentation.pdf

Online Resources–

- e-Resources / e-books and e-learning portals
- www.swayam.ac.in
- www.ignou.ac.in
- www.egyankosh.ac.in
- www.iitm.ac.in
- www.eskillindia.org
- www.eshiksha.mp.gov.in
- www.vlab.co.in
- www.internshala.com
- www.ndl.iitkgp.ac.in

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	100 Marks
Continuous Internal Assessment (CIA):	30 Marks
End Semester Exam (ESE):	70 Marks

Continuous Internal Assessment (CIA): 30 (By Course Teacher)	Internal Test / Quiz-(2): 20 +20 Assignment / Seminar - 10 Total Marks - 30	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
End Semester Exam (ESE): 70	Two section – A & B Section A: Q1. Objective – 10 x1= 10 Mark; Q2. Short answer type- 5x4 =20 Marks Section B: Descriptive answer type qts.,1out of 2 from each unit-4x10=40 Marks	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

DEPARTMENT OF BOTANY

COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Honors)*			Semester - VII	Session: 2024-2025
1	Course Code	BOSE-07 P		
2	Course Title	Lab. course -07(Instrumentation and Biochemical Technology)		
3	Course Type	Laboratory course		
4	Pre-requisite (if, any)	*As per program*		
5	Course Learning. Outcomes (CLO)	At the end of this course,the students will be able to get. ➢ Knowledge about Bio Instruments. ➢ Understand different parameters of instrumentation. ➢ Operation and handing of latest equipments		
6	Credit Value	1 Credits	*Credit =30 Hours Laboratory or Field learning/Training*	
7	Total Marks	Max. Marks: 50		Min Passing Marks: 20

PART -B: Content of the Course

Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)

Module	Topics (Course contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course	1. Calibration of microscope. 2. Handling of microscope and other instruments. 3. Safety measures in laboratory 4. Principle and application of microscope 5. Principle and application of laboratory instruments-Autoclave, Oven, Laminar air flow,Centrifuge. Colorimetry and Spectrophotometry, Water bath,pH meter 6. Concept of pH and buffer formation 7. Separation of chlorophyll pigment by paper chromatography 8. Separation of chlorophyll pigment by thin layer chromatography (TLC) 9. Study of amino acid and calculation of Rf values bypaper chromatography. 10. SDS -PAGE analysis of proteins 11. Quantitative analysis of DNA using colorimeter 12. Preparation of different types of solutions normal,molal and molar. 13. Visit to a nearby well equipped Scientific lab and prepare report.	30
Keywords	microscope,pH,chromatography,solutions,Rf	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. ExperimentsInMicrobiology,PlantPathologyAndBiotechnologyByK.R.Aneja.Publisher New Age International

Reference book recommended

1. Bioinstrumentation: Research, Development and Applications Hardcover Import,31July 1990 by Donald L. Wise

Online Resources–

- **e-Resources / e-books and e-learning portals**
  1. https://www.lumentum.com/en/commercial-lasers/applications/biomedical-and-analytics-instrumentation
  2. **https://www.rgcb.res.in/instraining**
  3. **https://https://admin/uploads/3/PG_M.Sc._Botony_34631%20MICROBIOLOGY%20AND%20PLANT%20PATHOLOGY.pdf**

Online Resources–

- **e-Resources / e-books and e-learning portals**
- www.swayam.ac.in
- www.ignou.ac.in
- www.egyankosh.ac.in
- www.iitm.ac.in
- www.eskillindia.org
- www.eshiksha.mp.gov.in
- www.vlab.co.in
- www.internshala.com
- www.ndl.iitkgp.ac.in

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): 15 (By Course Teacher)	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - **05** Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE): 35	**Laboratory / Field Skill Performance:** On spot Assessment A. **Performed the Task based on lab. work - 20 Marks** B. **Spotting based on tools & technology (written) – 10 Marks** C. **Viva-voce (based on principle/technology) - 05 Marks**	Managed by Course teacher as per lab. status

Name and Signature of Convener & Members of CBoS:

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FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

DEPARTMENT OF BOTANY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Honors)*		**Semester - VII**		Session: 2024-2025
1	Course Code	BOSE -08 T		
2	Course Title	Growth and Stress Physiology		
3	Course Type	Discipline specific Elective (DSE)		
4	Pre-requisite (if, any)	*As per program*		
5	Course Learning. Outcomes (CLO)	At the end of this course, the students will be able to 1. understand the role of Physiological and metabolic processes for plant growth and development under stress. 2. Assimilate about biochemical constitution of plant diversity. 3. Get acquired the students with complex interaction between organism and environment 4. Understand about the role of hormones in plant development.		
6	Credit Value	**3 Credits**	*Credit = 15 Hours - learning & Observation*	
7	Total Marks	**Max. Marks:** 100	**Min Passing Marks:** 40	

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**PlantGrowth and Phytohormone** ➢ Plant growth curve,sigmoid and J shaped growth.Lag,Log and steady stage. Developmental roles of phytohormones ➢ Auxins, ➢ Gibberellins, ➢ Cytokinins, ➢ ABA, ➢ Ethylene,	12
II	Movements, Dormancy & Responses ➢ Photoperiodism (SDP, LDP, Day neutral plants); ➢ Phytochrome (discovery,structure and functions), ➢ Seedand bud Dormancy causes and breaking, ➢ Vernalization ➢ Senescence, ➢ Plant movements	11
III	**Planteco-physiologyand Stress Physiology:** ➢ Concept of Planteco-physiology. ➢ Plant perception, ➢ physiology of ecological considerations. ❖ Hydrophytic, xerophytic morphological and anatomical adaptations in plants	11
IV	StressPhysiology: Plant responses to biotic and abiotic stress, mechanism of biotic and abiotic tolerance, HR (Hypersensitive Response) and SAR Systemic Acquired Resistance), water deficit and ❖ Drought resistance, ❖ Salinity stress, ❖ metal toxicity, ❖ freezing and heat stress, ❖ oxidative stress.	11
Keywords	Growth, Phytohormone, Eco-physiology, Vernalization.	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

TextBooksRecommended-

1. Galston,A.W.,(1989)LifeProcessesinPlants,ScientificAmericanLibrary.Springer-Verlag,NewYork, USA.
2. Hopkins,W.G.,(1995)IntroductiontoPlantPhysiology,JohnWilleyandSons,Inc.NewYork,USA.
3. Salisbury,F.B.andRoss,C.W.,(1992)PlantPhysiology.WadsworthPublishingCo.,California,USA.
4. Denis,D.T.,Turpin,D.H.Lefebvre,D.D.&Layzell,D.B.(1997)PlantMetabolism.Longaman,Essex, England.

Reference Books Recommended –

1, Taiz,L.andZeiger,E.((1998) Plant Physiology.SinaverAssociations,Inc.Pub.,Masssachusetts, USA.
2. Rogers, P.P., Jalal, K.F. and Boyd, J.A. (2008). An Introduction to Sustainable Development. Prentice Hall of India Private Limited, New Delhi.

Online Resources–

- **e-Resources / e-books and e-learning portals**
  https://link.springer.com/book/10.1007/978-3-030-78420-1
  https://uou.ac.in/sites/default/files/slm/MSCBOT-601.pdf
  https://www.researchgate.net/publication/347908867_Stress_Physiology_in_Plants
- **https://www.esalq.usp.br/lepse/imgs/conteudo_thumb/Plant-stress-physiology.pdf**

Online Resources–

- **e-Resources / e-books and e-learning portals**
- **www.swayam.ac.in**
- **www.ignou.ac.in**
- **www.egyankosh.ac.in**
- **www.iitm.ac.in**
- **www.eskillindia.org**
- **www.eshiksha.mp.gov.in**
- **www.vlab.co.in**
- **www.internshala.com**
- **www.ndl.iitkgp.ac.in**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	100 Marks
Continuous Internal Assessment (CIA):	30 Marks
End Semester Exam (ESE):	70 Marks

Continuous Internal Assessment (CIA):70 (By Course Teacher)	Internal Test / Quiz-(2): **20 +20** Assignment / Seminar - 10 Total Marks - 30	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE): 30	**Two section – A & B** Section A: **Q1**. Objective – **10 x1**= 10 Mark; **Q2**. Short answer type- **5x4** =20 Marks Section B: Descriptive answer type qts., **1out of 2** from each unit-4x10=40 Marks	

Name and Signature of Convener & Members of CBoS:

(1) (2) (3) (4) (5) (6) (7) (9) (10)

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

DEPARTMENT OF BOTANY

COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Honors)*			**Semester - VII**	Session: 2024-2025
1	Course Code	**BOSE-08 P**		
2	Course Title	Lab. Course -08 (Growth and stress physiology)		
3	Course Type	**Laboratory course**		
4	Pre-requisite (if, any)	*As per program*		
5	Course Learning. Outcomes (CLO)	After the completion of the course the students will be able to: 1. Understandthe role of Physiological and metabolic processes for plant growth and development under stress. 2. Assimilate about biochemical constitution of plant diversity 3. Effect of phytohormones on plants. 4. Understand different physiological processes of plants.		
6	Credit Value	**1 Credits**	***Credit =30 Hours Laboratory or Field learning/Training***	
7	Total Marks	**Max. Marks: 50**		**Min Passing Marks: 20**

PART -B: Content of the Course		
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)		
Module	Topics (Course contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course	1. *Avena* curvature test of Auxin. 2. Expression of bolting in cabbage. 3. Induction of lateral branches by cytokinin. 4. Demonstration of plasmolysis and deplasmolysis in plant cell. 5. Potato osmoscope for osmosis. 6. Demonstration of transpiration. 7. Measurement of transpiration rate by Farmers/ Ganong's potometer. 8. Extraction of seed proteins depending upon solubility. 9. Fractionation of proteins using gel filtration chromatography 10. Principle of colorimetry, spectrophotometry and fluorimetry.	30
Keywords	*Bolting, chlorophyll, osmosis, chromatography.*	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. Practical Plant Physiology Hardcover – 1 January 2015 by R. Sivakumar, Narendra Publishing
2. PRACTICALS IN PLANT PHYSIOLOGY AND BIOCHEMISTRY MANJU BALA, SUNITA GUPTA, N.K GUPTA & M.K. SANGHA Scientific Publishers
3. A Practical Manual on Fundamentals of Plant Physiology Paperback – 16 September 2022 by R. K. Samaiya Subrata Sharma, Gyanendra Tiwari, R. Shivraj krishnan, Sunil Pandey, Preeti Sagar Nayak (Author) BFC PUBLICATIONS PVT LTD

Reference Books Recommended –

1. **Practical Manual Experimental Plant Physiology and Biochemistry Manual** Paperback – 1 January 2023 by Rajesh Kumar Asok Kumar Bera, Bandana Bose (Author) Publisher- Science Technology

Online Resources–

- **e-Resources / e-books and e-learning portals**
- https://www.britannica.com/science/transpiration
- https://www.frontiersin.org/articles/10.3389/fagro.2022.765068/full
- https://www.sciencedirect.com/science/article/abs/pii/S0176161796802872

Online Resources–

- **e-Resources / e-books and e-learning portals**
- www.swayam.ac.in
- www.ignou.ac.in
- www.egyankosh.ac.in
- www.iitm.ac.in
- www.eskillindia.org
- www.eshiksha.mp.gov.in
- www.vlab.co.in
- www.internshala.com
- www.ndl.iitkgp.ac.in

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	50 Marks
Continuous Internal Assessment (CIA):	15 Marks
End Semester Exam (ESE):	35 Marks

Continuous Internal Assessment (CIA): 35 (By Course Teacher)	Internal Test / Quiz-(2): 10 & 10 Assignment/Seminar +Attendance - 05 Total Marks - 15	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 15 Marks
End Semester Exam (ESE): 15	Laboratory / Field Skill Performance: On spot Assessment A. Performed the Task based on lab. work - 20 Marks B. Spotting based on tools & technology (written) – 10 Marks C. Viva-voce (based on principle/technology) - 05 Marks	Managed by Course teacher as per lab. status

Name and Signature of Convener & Members of CBoS:

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FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

DEPARTMENT OF BOTANY

COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Honors)*			**Semester -VIII**	Session: 2024-2025
1	Course Code	BOSE -09 T		
2	Course Title	Plant Biotechnology and Crop Improvement		
3	Course Type	Discipline specific Elective (DSE)		
4	Pre-requisite (if, any)	*As per program*		
5	Course Learning. Outcomes (CLO)	□ At the end of this course, the students will be able to ➢ The basic concept,scope and significance of Biotechnology. ➢ Micropropagation using meristem and shoot cultureto produce large number of identical individuals. ➢ The role of biotechnology in crop improvement. ➢ Various applications of Biotechnology in different fields.		
6	Credit Value	3 Credits	*Credit = 15 Hours - learning & Observation*	
7	Total Marks	Max. Marks: 100		Min Passing Marks: 40

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**Fundamentals of Biotechnology:** Basic concepts, principles and scope. **Plant Cell and Tissue Culture:** General concept, history, scope, totipotency, concept of cellular differentiation, tissue culture media and explants. Applications of Plant Biotechnology.	12
II	**Organogenesis and Embryogenesis:** Concept of morphogenesis, organogenesis and embryogenesis; Fundamental aspects of organogenesis in plant tissue culture, factors influencing organogenesis; somatic embryogenesis and androgenesis - mechanism, techniques and utility.	11
III	**Somatic Hybridization:** Concept of somatic fusion and hybridization; Protoplast isolation, fusion and culture, hybrid selection and regeneration; progress, possibilities, achievements and limitations of protoplast research.	11
IV	**Application of Plant Tissue Culture in crop improvement:** Clonal propagation, artificial seed, production of hybrids and soma clones, Soma clonal variation – cause & advantages and its application in crop improvement; production of secondary metabolites / natural products, cryopreservation and germplasm storage.	11 (11Hr))
Keywords	Biotechnology, Tissue Culture, Crop improvement, Clonal propagation	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. Bhojwani, S. S and Razdan, N.K. (1996) Plant Tissue Culture: Theory and Practice, Elsevier Science Publishers, New York, USA
2. .Kartha, K.K. (1985) Cryopreservation of Plant Cells and Organs. CRC Press, Boca Raton, Florida, USA.
3. Vasil, I. K. and Thorbe, T. A. (1994) Plant Cell and Tissue Culture. Kluwer Academic Publishers, Netherlands.

Reference Books Recommended –

1. Smith, R. H. (2000) Plant Tissue Culture; Techniques and Experiments, Academic Press,New York.
2. Collins, H.A. and Edwards, S. (1998) Plant Cell Culture, Bios. Scientific Publisher Oxford, U.K.

Online Resources–

- e-Resources / e-books and e-learning portals
- https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/plant-biotechnology#:~:text=Plant%20Tissue%20Culture%2DBased%20Industries&text=Plant%20tissue%20culture%20in%20agricultural,into%20next%20step%20of%20commercialization.
- https://www.nifa.usda.gov/grants/programs/biotechnology-programs/plant-biotechnology
- https://agricultureandfoodsecurity.biomedcentral.com/articles/10.1186/s40066-022-00369-2
-

Online Resources–

- e-Resources / e-books and e-learning portals
- www.swayam.ac.in
- www.ignou.ac.in
- www.egyankosh.ac.in
- www.iitm.ac.in
- www.eskillindia.org
- www.eshiksha.mp.gov.in
- www.vlab.co.in
- www.internshala.com
- www.ndl.iitkgp.ac.in

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	100 Marks
Continuous Internal Assessment (CIA):	30 Marks
End Semester Exam (ESE):	70 Marks

Continuous Internal Assessment (CIA):30 (By Course Teacher)	Internal Test / Quiz-(2): 20 +20 Assignment / Seminar - 10 Total Marks - 30	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
End Semester Exam (ESE): 70	Two section – A & B Section A: Q1. Objective – 10 x1= 10 Mark; Q2. Short answer type- 5x4 =20 Marks Section B: Descriptive answer type qts.,1out of 2 from each unit-4x10=40 Marks	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

DEPARTMENT OF BOTANY

COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Honors)*			**Semester - VIII**	Session: 2024-2025
1	Course Code	**BOSE-09 P**		
2	Course Title	**Lab. Course -09 (Plant biotechnology and crop improvement)**		
3	Course Type	**Laboratory course**		
4	Pre-requisite (if, any)	***As per program***		
5	Course Learning. Outcomes (CLO)	At the end of this course, the students will be able to understand- ➢ The basic techniques of Plant Tissue Culture. ➢ Screening programmes of cells, rather than plants, for advantageous characters. ➢ The biochemical and physiological aspects of plant growth. ➢ How to explore entrepreneurship avenues in this field.		
6	Credit Value	**1 Credits**	***Credit =30 Hours Laboratory or Field learning/Training***	
7	Total Marks	**Max. Marks: 50**		**Min Passing Marks: 20**

PART -B: Content of the Course

Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)

Module	Topics (Course contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course	1. Familiarization with basic equipments in tissue culture. 2. Preparation of tissue culture (MS) medium. 3. Study of techniques of tissue culture: sterilization of glass wares and plant materials, transfer of explants on culture media, incubation Up to callus formation 4. Initiation of organogenesis and embryogenesis using appropriate explants. 5. Isolation of plant protoplast by mechanical and enzymatic method 6. Test of viability by tetrazolium chloride (TZ) method. 7. Counting of protoplast in the suspension by haemocytometre method 8. Effect of physical and chemical factors in protoplast yield. 9. Demonstration of protoplast fusion employing PEG. 10. Visit to any tissue culture lab of your locality and a prepare project report.	30
Keywords	Medium, protoplast, tissue culture, TZ	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. "Plant Tissue and Organ Culture fundamental Methods" by Gamburg OL and Philips GC, Publisher – Springer- verlag Heidelberg GmbH & Co. K
2. Practical Biotechnology by Ramadass Jaypee Brothers Medical Publishers

Reference Books Recommended

1. Biotechnology : fundamental and application by Ashok Ganguli, Publisher- Oxford book company

Online Resources–

- **e-Resources / e-books and e-learning portals**
- https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/plant-biotechnology#:~:text=Plant%20Tissue%20Culture%2DBased%20Industries&text=Plant%20tissue%20culture%20in%20agricultural,into%20next%20step%20of%20commercialization.
- https://www.nifa.usda.gov/grants/programs/biotechnology-programs/plant-biotechnology
- https://agricultureandfoodsecurity.biomedcentral.com/articles/10.1186/s40066-022-00369-2

Online Resources–

- **e-Resources / e-books and e-learning portals**
- www.swayam.ac.in
- www.ignou.ac.in
- www.egyankosh.ac.in
- www.iitm.ac.in
- www.eskillindia.org
- www.eshiksha.mp.gov.in
- www.vlab.co.in
- www.internshala.com
- www.ndl.iitkgp.ac.in

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	50 Marks
Continuous Internal Assessment (CIA):	15 Marks
End Semester Exam (ESE):	35 Marks

Continuous Internal Assessment (CIA): 15 (By Course Teacher)	Internal Test / Quiz-(2): 10 & 10 Assignment/Seminar +Attendance - 05 Total Marks - 15	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 15 Marks
End Semester Exam (ESE): 35	Laboratory / Field Skill Performance: On spot Assessment A. Performed the Task based on lab. work - 20 Marks B. Spotting based on tools & technology (written) – 10 Marks C. Viva-voce (based on principle/technology) - 05 Marks	Managed by Course teacher as per lab. status

Name and Signature of Convener & Members of CBoS:

(1) (2) (3) (4) (5) (6) (7) (8) (9) (10)

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

DEPARTMENT OF BOTANY

COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Honors)*			**Semester - VIII**	Session: 2024-2025
1	Course Code	**BOSE -10 T**		
2	Course Title	Applied Botany and Intellectual property right (IPR)		
3	Course Type	**Discipline specific Elective (DSE)**		
4	Pre-requisite (if, any)	***As per program***		
5	Course Learning. Outcomes (CLO)	At the end of the course,the students will be able to: ➢ Understand the scope and importance of Social forestry and establishment of orchard. ➢Learn silvics of some important timber plants of India. ➢Learn post-harves tmanagement,marketing and value additionof commercial ornamental plants. ➢ Develop a deep understanding of different forms of intellectual property Rights (IPR)		
6	Credit Value	**3 Credits**	***Credit = 15 Hours - learning & Observation***	
7	Total Marks	**Max. Marks: 100**	**Min Passing Marks: 40**	

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**Social forestry:** Introduction, Definition, scope and objectives of social forestry. Classification of social forestry, Economic importance of social forestry, important scheme, choice of species for reclamation of waste land, over damp area, saline and alkaline area **.Layout and Establishment of Orchards**:Pruning and training; propagation, Climatic requirement and cultivation ffruits likeMango,Banana,Citrus, Guava.	12
II	**Sliviculture:**Definition,objective and scope of silviculture. Status of forest in India and their role.Trees and their distinguishing features.Regeneration:Natural,artificial and factors Affecting it.Regeneration Survey.Tending operation:Weeding,cleaning,thinning and improvement felling. Silivcs of important forest tree species e.g. Teak, Shorea, Sheesam .	11
III	**Floriculture;**History of Floriculture. Importance and scope of floriculture in India. Flower production -water and nutrient management, weed management, thinning and pruning, disbudding, use of growth regulators, physiological disorders and remedies,Harvesting techniques,post-harvest handling, pre-cooling,pulsing,packing, storage & transportation. Prolonging the vase life of flowers. Marketing and export potential of flowers, institutional support.	11
IV	IPR: Definition and significance of intellectual propertyrights(IPR), Overview of different types of IPR,including patents and it's filingprocess, copyrights, trademarks their registration and infringement, trade secrets,Historical development and international frame works forprotecting IPR,Salient feature of Patent Act 1970.	11
Keywords	***Social forestry, Orchard, Harvesting technique,Trademark***	

Signature of Convener & Members (CBoS) :

PART-C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended–

1. S, S, Negi: Social forestry
2. S.A.Shah & K .M .Tiwari: Forestry and people
3. G.P.D.Vyas: Social forestry and rural development
4. Jyoti Rattan 2024.Intellectual Property Rights

Reference Books Recommended –

1. Khanna,L.S.(1984).Principles and Practice of Silviculture.Khanna Bhandu,DehraDun.
2. Ram Prakash and L.S.Khanna.(1991)Theory and Practice of Silvicultural systems. International Book Distributors, Dehra Dun.
3. Champman ,G.W.and Allan,T.G.(1978).Establishment Techniques for Forest Plantation F.A.O Forestry Paper No.8. F.A.O Rome.
4. Anonymous.(1976)Indian forest utilization.Volume Iand III CFRE Publication,Dehradun.
5. Mehta,T.(1981)A hand book of forest utilization.Periodical Expert Book Agency,Delhi.298

OnlineResources –

e-Resources/e-books and e-learning portals

www.ipindia.gov.in

www.wipo.int/aboutip/en/

www.india.gov.in /topics/agriculture/floriculture

https://byjus.com/free-ias-prep/ipr-in-india-upsc notes/

https://vikaspedia.in/agriculture/farm-based-enterprises/floriculture

Online Resources–

- **e-Resources / e-books and e-learning portals**
- **www.swayam.ac.in**
- **www.ignou.ac.in**
- **www.egyankosh.ac.in**
- **www.iitm.ac.in**
- **www.eskillindia.org**
- **www.eshiksha.mp.gov.in**
- **www.vlab.co.in**
- **www.internshala.com**
- **www.ndl.iitkgp.ac.in**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Exam (ESE):	**70 Marks**

Continuous Internal Assessment (CIA): 30 (By Course Teacher)	Internal Test / Quiz-(2): **20** +20 Assignment / Seminar - 10 Total Marks - 30	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
End Semester Exam (ESE): 70	**Two section – A & B** Section A: Q1. Objective – 10 x1= 10 Mark; Q2. Short answer type- 5x4 =20 Marks Section B: Descriptive answer type qts ,1 out of 2 from each unit-4x10=40 Marks	

Name and Signature of Convener & Members of CBoS:

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FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

DEPARTMENT OF BOTANY

COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Honors)*			**Semester - VIII**	Session: 2024-2025
1	Course Code	**BOSE-10 P**		
2	Course Title	**Lab. Course -10 (Applied Botany and Intellectual Property Rights)**		
3	Course Type	**Laboratory course**		
4	Pre-requisite (if, any)	*As per program*		
5	Course Learning. Outcomes (CLO)	At the end of this course, students will be able to: ➢ Understand forest structure and composition. ➢ Get knowledge about phenology of various species. ➢ Learn nursery bed preparation technique. ➢ Analyze the density and moisture content of wood.		
6	Credit Value	**1 Credits**	*Credit =30 Hours Laboratory or Field learning/Training*	
7	Total Marks	**Max. Marks: 50**	**Min Passing Marks: 20**	

PART -B: Content of the Course

Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)

Module	Topics (Course contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course	◦ Study of forest composition. ◦ Recording the observations on phenological characteristics of different tree species. ◦ Study of the natural and artificial regeneration. ◦ Lay outing of nursery bed and soil preparation, types of seed sowing in nursery bed. ◦ Study of gross features of different types of wood; straight interlocked, spiral and wavy grain, texture, lusture, etc. ◦ Study ofcharacteristics of trees/shrubs/grasses for agroforestry. ◦ Volume and biomass estimation. ◦ Crown measurement. ◦ Study of vase life extension in cut flower using chemicals. ◦ Study and description of botanical features of floricultural plants studied in theory paper. ◦ Drafting a patent application: Students can learn how to draft a patent application for a new invention . ◦ Trademark registration process: Students can learn how to register a trademark in India.	30
Keywords	*Phenological, Wood grain,Nnursery bed, Regeneration*	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. Chundawat D S and Gautam SK (2010) Textbook of agroforestry. Oxford and IBH publishing co pvt. Ltd.
2. . Nair, P.K.R. (1993) An introduction to agroforestry. Kluwer Academic Publishers. 499 p. 4. Huxley, P. (1999) Tropical agroforestry. Blackwell Science, Oxford.
3. Khosla, P.K. and Khurana, D.K. (1987) Agroforestry for rural needs. Vol. I and II, ISTS, Solan, H.P.
4. Ong, C.K. and Huxley, P.K. (1996) Tree crop interactions - A physiological approach. ICRAF, Kenya.
5. . Ramakrishnan, P.S. (1992) Shifting agriculture and sustainable development. Man and biosphere series. The Parthenon Publishing Group.
6. . SenSarma, P.K. and Jha, L.K. (1993) Agroforestry. Indian Perspectives. Ashish Publishers, Delhi.5. Khanna, L. S. (1984). Principles and Practice of Silviculture, KhannaBhandu. Dehra Dun.
7. 7 . Ram Prakash and L.S. Khanna. (1991) Theory and Practice of Silvicultural systems. International Book Distributors, Dehra Dun.

Reference Books Recommended –

1. Champman, G.W. and Allan, T.G. (1978). Establishment Techniques for Forest Plantation F.A O Forestry Paper No.8. F.A.O Rome.
2. Anonymous. (1976) Indian forest utilization. Volume I and II ICFRE Publication, Dehradun.
3. Mehta, T.(1981) A handbook of forest utilization. Periodical Expert Book Agency, Delhi. 298
4. "Floriculture Principles and Species" by Dhiman Mukherjee
5. "Floriculture in India" by Jyotsna Singh and Ramesh Chandra
6. "Floriculture: A Basic Guide" by K.V. Peter
7. "Handbook of Flowering" by Jitendra Kumar
8. "Commercial Floriculture: Principles and Practices" by A.P. Misra and V.P. Singh
9. Intellectual Property Rights and Biotechnology by Shashikala Gurpur and Sreenivasulu N.S.
10. Intellectual Property Rights and Plant Biotechnology by Ramanujam Srinivasan
11. Intellectual Property Rights: An Overview by Arul George Scaria

Online Resources–

- **e-Resources / e-books and e-learning portals**

- https://ipindia.gov.in/form-and-fees.htm
- https://www.indiafilings.com/trademark-registration?matchtype=e&device
- https://www.youtube.com/watch?v=S7F6bCRBUDg&t=111s
- https://www.youtube.com/watch?v=SrWcYWzJJJ8
- https://www.youtube.com/watch?v=tYysC0dwtU0
- https://www.youtube.com/watch?v=U5_nynPVdTY
- https://www.youtube.com/watch?v=7faqx7N-pS4
- https://www.youtube.com/watch?v=AQdlEXkVFGEw
- https://www.youtube.com/watch?v=uDWilCvc3lQ

Online Resources–

- **e-Resources / e-books and e-learning portals**
- **www.swayam.ac.in**
- **www.ignou.ac.in**
- **www.egyankosh.ac.in**
- **www.iitm.ac.in**
- **www.eskillindia.org**
- **www.eshiksha.mp.gov.in**
- **www.vlab.co.in**
- **www.internshala.com**
- **www.ndl.iitkgp.ac.in**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): 15 (By Course Teacher)	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - **05** Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE): 35	**Laboratory / Field Skill Performance: On spot Assessment** A. **Performed the Task based on lab. work - 20 Marks** B. **Spotting based on tools & technology (written) – 10 Marks** C. **Viva-voce (based on principle/technology) - 05 Marks**	Managed by Course teacher as per lab. status

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

DEPARTMENT OF BOTANY

COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Honors)*			**Semester - VIII**	**Session: 2024-2025**
1	Course Code	BOSE -11 T		
2	Course Title	Biochemistry and Enzymology		
3	Course Type	Discipline specific Elective (DSE)		
4	Pre-requisite (if, any)	*As per program*		
5	Course Learning. Outcomes (CLO)	At the end of this course, the students will be able to ➢ Basic idea of life building block biomolecules. ➢ Energy status of the cell ➢ Basic carbohydrates, lipids and proteins structure ➢ Biocatalyst enzymes		
6	Credit Value	**3 Credits**	*Credit = 15 Hours - learning & Observation*	
7	Total Marks	Max. Marks: 100	Min Passing Marks: 40	

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	• Structure of atoms, molecules and chemical bonds. • Stabilizing interactions (Van der Waals, electrostatic, hydrogen bonding, hydrophobic interaction, etc.). • Principles of biophysical chemistry (pH, buffer, reaction kinetics, thermodynamics, colligative properties).. • Composition, structure and function of biomolecules (carbohydrates,).	12
II	• Bioenergetics, glycolysis, oxidative phosphorylation, coupled reaction, group transfer, biological energy transducers. • Principles of thermodynamics, free energy and chemical potential, redox reactions, structure and function of ATP	11
III	• Lipids : structure and function, alpha and beta oxidation and anabolism. • Nucleic acids : DNA, RNA, Conformation of nucleic acids (helix (A, B,C, Z), t-RNA, mRNA, rRNA, HnRNA micro-RNA).hoogestein bridge, hairpin DNA	11
IV	• Proteins- amino acids, primary, secondary, tertiary and quaternary structure. Conformation of proteins (Ramachandran plot, secondary structure, domains, motif and folds). • Fundamentals of Enzymology: General aspect, classification, nature of enzymes, mode of enzyme action, allosteric mechanism, feedback method of inhibition, regulatory and active sites, isoenzymes, Ribozyme,Abzymes, kinetics of enzymatic catalysis, Michaelis – Menton equation and its significance.	11
Keywords	reaction kinetics, inhibition. active sites, Conformation, ATP	

Signature of Convener & Members (CBoS) :

PART-C: Learning Resources

Text Books, Reference Books and Others

Text Books recommended:

1. Galaston, A. W., (1989) Life Processes in Plants. Scientific American Library, Springer- Verlag, New York, USA.
2. Hopkins, W. G. (1995) Introduction to Plant Physiology John Willey and Sons, Inc. New York, USA.
3. Dennis D. T., Turpin, D. H., Lefebvre D. D. and Layzell, D. B. (1997) Plant Metabolism. Longman, Essex, England.
4. Moore, T. C. (1989) Biochemistry and Physiology of Plant Hormone. Springer Verlog, New York.
5. Nobel, P. S. (1999) Physiochemical and Environmental Plant Physiology. Academic Press, San Diego, USA.
6. Thomas, B. and Vince-Prue(1997) Photoperiodism in Plants. Academic Press; San Diego, USA.

Reference Books Recommended-

1. Taiz, L. and Zeiger, E., (1989) Plant Physiology. Sinaver Associations, Inc. Publishers, Masssachusetts, USA.
2. Salisbury F. B. and Ross, C. W., (1992) Plant Physiology Wadsworth Publishing Co., California, USA
3. Lehninger : Principles Of Biochemistry by David L Nelson, Michael M Cox 2021

Online Resources–

- **e-Resources / e-books and e-learning portals**

1. https://www.mdpi.com/journal/biomolecules
2. https://www.news-medical.net/life-sciences/An-Overview-of-Enzymology.aspx#:~:text=Enzymology%20is%20the%20study%20of,products%20controlled%20by%20equilibrium%20properties.
3. https://bio.libretexts.org/Bookshelves/Introductory_and_General_Biology/Book%3A_General_Biology_(Boundless)/06%3A_Metabolism/6.02%3A_Energy_and_Metabolism_-_Types_of_Energy
4. https://www.thoughtco.com/dna-versus-rna-608191

Online Resources–

- **e-Resources / e-books and e-learning portals**
- www.swayam.ac.in
- www.ignou.ac.in
- www.egyankosh.ac.in
- www.iitm.ac.in
- www.eskillindia.org
- www.eshiksha.mp.gov.in
- www.vlab.co.in
- www.internshala.com
- www.ndl.iitkgp.ac.in

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Exam (ESE):	**70 Marks**

Continuous Internal Assessment (CIA):30 (By Course Teacher)	Internal Test / Quiz-(2): 20 +20 Assignment / Seminar - 10 Total Marks - 30	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
End Semester Exam (ESE): 70	**Two section – A & B** Section A: Q1. Objective – 10 x1= 10 Mark; Q2. Short answer type- 5x4 =20 Marks Section B: Descriptive answer type qts.,1out of 2 from each unit-4x10=40 Marks	

Name and Signature of Convener & Members of CBoS:

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FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

DEPARTMENT OF BOTANY

COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Honors)*		**Semester -VIII**	**Session: 2024-2025**	
1	Course Code	**BOSE -11 P**		
2	Course Title	**Lab. Course -11 P (Biochemistry and enzymology)**		
3	Course Type	**Laboratory course**		
4	Pre-requisite (if, any)	*As per program*		
5	Course Learning. Outcomes (CLO)	➢ Students will be familiar with the common biobuilding block ➢ Biochemical analysis of common biomolecules ➢ Enzyme kinetics and its role ➢ Characterization of light harvesting molecule chlorophyll.		
6	Credit Value	**1 Credits**	*Credit =30 Hours Laboratory or Field learning/Training*	
7	Total Marks	**Max. Marks: 50**	**Min Passing Marks: 20**	

PART -B: Content of the Course

Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)

Module	Topics (Course contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course	1) Biochemical test of carbohydrates, sucrose, glucose proteins, lipids 2) Biochemical test of Catalase, dehydrogenase, peroxidase test 3) Preparation of chlorophyll extract 4) Separation of chlorophyll by paper chromatography. 5) Separation of chlorophyll amino acids by paper chromatography. 6) Effect of temperature on enzyme activity 7) Effect of pH on enzyme activity	30
Keywords	Biochemical test, Catalase, dehydrogenase, chlorophyll, enzyme	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. Practical Biochemistry by Damodaran Geetha K (Author) Jaypee Brothers Medical Publishers
2. *Practical Manual of Biochemistry,* CBS Publishers & Distributors Pvt. Ltd. (1 January 2020); CBS Publishers & Distributors Pvt. Ltd.

Reference Books Recommended –

1. Introductory Practical Biochemistry Paperback – 2 January 2001by S.K. Sawhney (Editor), R. Singh (Editor) Narosa Publishing House
2. Practical Enzymology Author(s): Prof. Dr. Hans Bisswanger First published:23 February 2011Print ISBN:9783527320769 |Online ISBN:9783527659227 |DOI:10.1002/9783527659227 Copyright © 2011 Wiley-VCH Verlag GmbH & Co. KGaA

Online Resources–

- **e-Resources / e-books and e-learning portals**

1) https://www.amazon.in/s/ref=dp_byline_sr_book_1?ie=UTF8&field-author=KAUSHIK+G+G&search-alias=stripbooks
2) https://efaidnbmnnnibpcajpcglclefindmkaj/https://www.mlsu.ac.in/econtents/1616_Biochemical%20Tests%20of%20Carbohydrate,%20protein,%20lipids%20and%20salivary%20amylase.pdf
3) https://alevelbiology.co.uk/notes/tests-for-carbohydrates/
4) https://alevelbiology.co.uk/notes/test-for-proteins/
5) https://studymind.co.uk/notes/test-for-lipids-and-proteins/
6) https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4121948/

Online Resources–

- **e-Resources / e-books and e-learning portals**
- www.swayam.ac.in
- www.ignou.ac.in
- www.egyankosh.ac.in
- www.iitm.ac.in
- www.eskillindia.org
- www.eshiksha.mp.gov.in
- www.vlab.co.in
- www.internshala.com
- www.ndl.iitkgp.ac.in

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	50 Marks
Continuous Internal Assessment (CIA):	15 Marks
End Semester Exam (ESE):	35 Marks

Continuous Internal Assessment (CIA): 15 (By Course Teacher)	Internal Test / Quiz-(2): 10 & 10 Assignment/Seminar +Attendance - 05 Total Marks - 15	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 15 Marks
End Semester Exam (ESE): 35	Laboratory / Field Skill Performance: On spot Assessment A. Performed the Task based on lab. work - 20 Marks B. Spotting based on tools & technology (written) – 10 Marks C. Viva-voce (based on principle/technology) - 05 Marks	Managed by Course teacher as per lab. status

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

DEPARTMENT OF BOTANY

COURSE CURRICULUM

PART- A: Introduction

Program: Bachelor in Life Science (Honors)		Semester - VIII	Session: 2024-2025
1	Course Code	BOSE- 12 T	Genetic
2	Course Title	Bioinformatics and Gene Technology	
3	Course Type	Discipline specific Elective (DSE)	
4	Pre-requisite (if, any)	*As per program*	
5	Course Learning. Outcomes (CLO)	*At the end of the course, the students will be able :* ➢ Understand basics of bioinformatics and it's tools. ➢ Learn application of bioinformatics in various areas. ➢ Analyse and perform RAPD,RFLP,PCR etc. ➢ Understand GMO and ethics behind the cloning.	
6	Credit Value	3 Credits	*Credit = 15 Hours - learning & Observation*
7	Total Marks	Max. Marks: 100	Min Passing Marks: 40

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**Introduction to Bioinformatics:**Introduction, Branches of Bioinformatics, Aim, Scope and Research areas of Bioinformatics. Biological Databases,Basic bimolecular concepts: Protein, and amino acid, DNA & RNA, Sequence Classification format ofBiological Databases.. National Center for Biotechnology Information (NCBI),Examples of related tools(FASTA, BLAST, BLAT, RASMOL), databases(GENBANK, Pubmed, PDB .	12
II	**Applications of Bioinformatics** :Structural Bioinformatics in Drug Discovery, Quantitative structure-activity relationship (QSAR) techniques in Drug Design, Microbial genome applications, protein sequencing, gene sequencing, Crop improvement.	11
III	**Genetic technology** :Recombinant DNA technology; restriction endonuclease, cloning vectors. Blotting techniques: Northern, Southern and Western Blotting, DNA Fingerprinting;Molecular DNA markers i.e. RAPD, RFLP. DNA sequencing, PCR and ReverseTranscriptase-PCR.	11
IV	**Application of genetic technology**: Genetically modified organism; bt cotton and btbrinjal.Transgenic crop; Golden rice. *Agrobacterium* transformation,Hybridomaand monoclonal antibodies, ELISA and Immunodetection. Molecular diagnosis of human disease, Human gene Therapy, social, legal and ethical aspect of cloning.	11
Keywords	***Bioinformatics, Durg design, Crop improvement, ELISA***	

Signature of Convener & Members (CBoS) :

(1) (2) (3) (4) (5) (6) (7) 8 9 (10)

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. Bhojwani, S.S. and Razdan, M.K., (1996). Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands.
2. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
3. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics. John Wiley and Sons, U.K. 5th edition.
4. Stewart, C.N. Jr. (2008). Plant Biotechnology & Genetics: Principles, Techniques and Applications. John Wiley & Sons Inc. U.S.A

Reference Books Recommended –

1. Mount D., Bioinformatics: Sequence and Genome Analysis. Cold Spring Harbor Laboratory Press, New York. (2004).
2. Baxevanis, A.D. and Francis Ouellellette, B.F., Bioinformatics- A Practical Guide to the Analysis of Genes and Proteins. Wiley India Pvt Ltd. (2009).
3. Ghosh Z. and Bibekanand M. (2008) Bioinformatics: Principles and Applications. Oxford University Press.
4. Pevsner J. (2009) Bioinformatics and Functional Genomics. II Edition. Wiley- Blackwell.
5. Campbell A. M., Heyer L. J. (2006) Discovering Genomics, Proteomics and Bioinformatics. II Edition. Benjamin Cummings.

Online Resources–

- **e-Resources / e-books and e-learning portals**
- https://pubmed.ncbi.nlm.nih.gov/24272431/#:~:text=Bioinformatics%20is%20an%20interdisciplinary%20field,a%20computational%20point%20of%20view.
- https://byjus.com/biology/bioinformatics/
- https://www.lkouniv.ac.in/site/writereaddata/siteContent/20200329161234l467kuaum_yadav_Bioinformatics.pdf
- https://www.geeksforgeeks.org/types-of-biological-database-in-bioinformatics/
- https://www.umass.edu/microbio/rasmol/techintr.htm#:~:text=RasMol%20is%20a%20molecular%20graphics,generation%20of%20publication%20quality%20images.
- https://www.intechopen.com/chapters/88596
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9696050/#:~:text=Bioinformatics%2C%20next%2Dgeneration%20sequencing%2C,improving%20crop%20quality%20%5B87%5D.
- https://www.enzolifesciences.com/science-center/technotes/2017/march/what-are-the-differences-between-per-rt-pcr-qpcr-and-rt-qpcr?/
- https://education.nationalgeographic.org/resource/genetically-modified-organisms/

Online Resources–

- **e-Resources / e-books and e-learning portals**
- **www.swayam.ac.in**
- **www.ignou.ac.in**
- **www.egyankosh.ac.in**
- **www.iitm.ac.in**
- **www.eskillindia.org**
- **www.eshiksha.mp.gov.in**
- **www.vlab.co.in**
- **www.internshala.com**
- **www.ndl.iitkgp.ac.in**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Exam (ESE):	**70 Marks**

Continuous Internal Assessment (CIA): 30 (By Course Teacher)	Internal Test / Quiz-(2): **20** +20 Assignment / Seminar - 10 Total Marks - 30	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
End Semester Exam (ESE): 70	**Two section – A & B** Section A: **Q1**. Objective – **10** x1= **10** Mark; **Q2**. Short answer type- 5x4 =20 **Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-4x10=40 **Marks**	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

DEPARTMENT OF BOTANY

COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Honours)*		**Semester - VIII**		Session: 2024-2025
1	Course Code	BOSE -12 P		
2	Course Title	Lab. Course -12 (Bioinformatics and Gene Technology)		
3	Course Type	Laboratory course		
4	Pre-requisite (if, any)	*As per program*		
5	Course Learning. Outcomes (CLO)	At the end of this course, students will be able to: ➢ Retrieve gene and protein from gene bank. ➢ Understand steps of production of GMO. ➢ Learn the isolation of plasmid DNA. ➢ Understand use and application of PCR.		
6	Credit Value	1 Credits	*Credit =30 Hours Laboratory or Field learning/Training*	
7	Total Marks	**Max. Marks:** 50	**Min Passing Marks:**	20

PART -B: Content of the Course

Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)

Module	Topics (Course contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course	• Retrieve the gene from Gene bank and to save the sequence in FASTA format. • Retrieve the protein from Gene bank and to save the sequence in FASTA format. • Find the similarity of sequence for the given nucleotide or protein sequence. • Find the similarity of sequence for the given protein sequence. • Study of steps of genetic engineering for production of Bt cotton, Golden rice through photographs. • Study of methods of gene transfer through photographs: Agrobacterium-mediated, direct gene transfer by electroporation, microinjection, micro projectile, bombardment. • Isolation of plasmid DNA. • Restriction digestion and gel electrophoresis of plasmid DNA. • Demonstration of PCR.	30
Keywords	*Gene bank , FASTA, Agrobacterium, PCR*	

Signature of Convener & Members (CBoS) :

PART-C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. Stewart, C.N. Jr. (2008). Plant Biotechnology & Genetics: Principles, Techniques and Applications. John Wiley & Sons Inc. U.S.A
2. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
3. Baxevanis, A.D. and Francis Ouellellette, B.F., Bioinformatics- A Practical Guide to the Analysis of Genes and Proteins. Wiley India Pvt Ltd. (2009).
4. Ghosh Z. and Bibekanand M. (2008) Bioinformatics: Principles and Applications. Oxford University Press.

Reference Books Recommended –

1. Sarma,P V G K , 2021.A Practical Textbook of Genetic Engineering in Bacteria .
2. Yves Tourte, 2003. Genetically Modified OrganismsTransgenesis in Plants

Online Resources–

- **e-Resources / e-books and e-learning portals**

- https://vyvcollege.org/dbt/LabManual-Bioinformatics.pdf
- https://webstor.srmist.edu.in/web_assets/srm_mainsite/files/files/BI0505%20LAB%20MANUAL.pdf
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7712542/#:~:text=Transfer%20the%20supernatant%20that%20contains,the%20purity%20of%20the%20DNA.
- https://miteshshrestha.wordpress.com/wp-content/uploads/2018/03/flavr-savr-tomato-golden-rice-bt-cotton.pdf
- https://www.deshbandhucollege.ac.in/pdf/resources/1589512616_Z(H)-VI-Biotech-1.pdf
- https://bio.libretexts.org/Bookshelves/Biotechnology/Lab_Manual%3A_Introduction_to_Biotechnology/01%3A_Techniques/1.12%3A_Restriction_Digest_with_Gel_Electrophorisis
- https://www.youtube.com/watch?v=matsiHSuoOw

Online Resources–

- **e-Resources / e-books and e-learning portals**
- **www.swayam.ac.in**
- **www.ignou.ac.in**
- **www.egyankosh.ac.in**
- **www.iitm.ac.in**
- **www.eskillindia.org**
- **www.eshiksha.mp.gov.in**
- **www.vlab.co.in**
- **www.internshala.com**
- **www.ndl.iitkgp.ac.in**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): 15 (By Course Teacher)	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - 05 Total Marks - 15	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 15 Marks
End Semester Exam (ESE): 35	**Laboratory / Field Skill Performance: On spot Assessment** A. **Performed the Task based on lab. work - 20 Marks** B. **Spotting based on tools & technology (written) – 10 Marks** C. **Viva-voce (based on principle/technology) - 05 Marks**	Managed by Course teacher as per lab. status

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF BOTANY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Sciences *(Certificate / Diploma / Degree)*		**Semester -** II//IV/V/VI		Session: **2024-2025**
1	Course Code	**BOSEC-01**		
2	Course Title	**Gardening and Floriculture**		
3	Course Type	**Skill Enhance Course (BOSEC 01)**		
4	Pre-requisite (if, any)	As per program		
5	Course Learning. Outcomes (CLO)	*After completion of this course, the students will be able to -* ➢ *understand the concept of Gardening & Floriculture* ➢ *learn about the gardening technique and familiar with gardening tools* ➢ *adopt the skill of gardening as well as floriculture* ➢ *student may delelop entrepreneurship in this field.*		
6	Credit Value	**2 Credits (1C + 1C)**	*Credit = 15 Hours – Theoretical learning and = 30 Hours Laboratory or Field learning/Training*	
7	Total Marks	Max. Marks: 50		Min Passing Marks: 20

PART -B: Content of the Course

Total No. of Teaching–learning Periods:
Theory – 15 Periods (15 Hrs) and Lab. or Field learning/Training 30 Periods (30 Hours)

Module	Topics (Course contents)	No. of Period
Theory Contents	1. **Concept & Types of Garden:** Concept of Garden & Landscape Gardening, Styles of garden – Formal & Informal garden, Free style gardens, Home garden, Hanging garden; Types of gardens – English, Mughal, Babylonian garden *[Observation & Practices]* 2. **Garden plants:** Ornamental plants - Shrubbery, Fernery, Arches (climbers and creepers), Pergolas, Edges & Hedges and Pot plants, Cacti and Succulents plants, Flower borders and beds, Ground covers and carpet beds *[Observation & Practices]* 3. **Floriculture:** Present situation & scope in India. Various types of flowers – Seasonal flowers, Cut flowers. Flower Crops - Rose, Chrysanthemum, Carnation, Gerbera, Gladioli, Tuberose, Aster, Lilly, Dahlia and Marigold. *[Observation & Practices]*	15
Lab./Field Training Contents	1. Familiarization with different tools and equipments used in gardening work. 2. Design and Plotting of Garden and Preparation of Soil for Garden 3. Soil decontamination techniques, Planting methods, Fertigation method 4. Propagation techniques for selected ornamental plants Weed management 5. Harvesting techniques, Post-harvest handling, Pre cooling, Pulsing, Packing, 6. Preparation of composite mixture and manuring practice in nursery and pots. 7. Practice in budding, cutting, layering and grafting etc. 8. Practice of flower arrangements, flower bouquet.	30
Keywords	*Garden, Flower, Floriculture, Garden tools*	

Signature of Convener & Members (CBoS)

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FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

DEPARTMENT OF BOTANY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life sciences *(Certificate / Diploma / Degree)*			**Semester** - I/III/V	Session: 2024-2025
1	Course Code	BOVAC-01		
2	Course Title	Herbal Plant & Human Health		
3	Course Type	Value Addition Course (BOVAC-01)		
4	Pre-requisite (if, any)	As per program		
5	Course Learning. Outcomes (CLO)	*After completion of this course, the students will be able to –* ➢ *Understand the value of herbs, herbal medicine and use of herbal medicine.* ➢ *Know about botanical medicine professionals in the complementary and alternative medicine (CAM)* ➢ *Demonstrates the knowledge of the toxicity of plant and essential oil ingredients.* ➢ *Understand the possibility for allergic and unpleasant reactions to herbal products and the impact of herbal quality on potential toxicity.* ➢ *Use the herbal plants in their daily life* ➢ *Adopt the value of herbal medicine to save their health.*		
6	Credit Value	**2 Credits**	*Credit = 15 Hours - learning & Observation*	
7	Total Marks	**Max. Marks:** 50	**Min Passing Marks:** 20	

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 30 Periods (30 Hours)

Unit	Topics (Course contents)	No. of Period
I	**Introduction:** Elementary knowledge of Herbal plant and Concept of Herb as medicine. Concept of ethno-medicine, folk medicines, ethno-ecology, ethnic communities of the India & the Chhattisgarh. Concept of Herbal garden. Collection of ethnic information. ***Observation/In Practices - Survey and familiarization with herbs & local herbal plants***	08
II	**Importance of medicinal plants:** Importance of Herbal / Medicinal plant in human health care – health and balanced diet (Role of proteins, carbohydrates, lipids and vitamins). Common plants & plant parts providing metals and vitamins. ***Observation/In Practices - Survey and familiarization with local herbal medicinal plants***	07
III	**Tribal medicine and Traditional knowledge:** Introduction, Concept of Tribal medicine, methods of disease diagnosis and treatment – common Plants in folk religion. Traditional knowledge and utility of some medicinal plants in Chhattisgarh. ***Collection /Identification of Herbal plants commonly used by villagers of the state –*** • *Centella asiatica,* • *Aloe vera,* • *Solanum nigrum,* • *Achyranthus aspera,* • *Withania somnifera,* • *Papaver somniferum,* • *Strychnos nux– vomica,* • *Atropa belladonna;*	08
IV	**Plants in day to day life:** Nutritive and medicinal value of common herbal fruits and vegetables of daily use. Precautions during use of herbal medicinal products. Basic idea of contribution of national research laboratories like CDRI, CIMAP, NBRI, etc. *Collection /Identification of Herbal plants commonly used in daily life - Tulsi, Garlic, Ginger, Turmeric, Ajwain, Methi, Flax, Tea and Coffee.*	08
Keywords	*Herbal medicine, Folk medicine, Ethno-medicine, Tribal medicine*	

Signature of Convener & Members (CBoS)

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PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. Kumar, N.C. (1993). An Introduction to Medical botany and Pharmacognosy. Emkay Publications, New Delhi.
2. Rao, A.P. (1999). Herbs that heal. Diamond Pocket Books (P) Ltd., New Delhi.
3. Iris F. F. Benzie and Sissi Wachtel-Galor. Herbal Medicine, 2nd edition Biomolecular and Clinical Aspects, CRC Press/Taylor & Francis; 2011
4. Fabrizio Donovan (2020) Medicinal Herbs: The Ultimate Guide to Natural Healing, Learn The Benefits of Herbs and Use the Nature's Most Powerful Medicinal Plants in Making Your Own AZ Remedies to Treat Diseases, Author's Republic.
5. Stargrove Mitchell Bebel ND, Herb, Nutrient, and Drug Interactions, Publisher: Elsevier – Health Sciences Division
6. Iris F. F. Benzie (Editor), Herbal Medicine (Oxidative Stress and Disease) 2nd Edition,

Online Resources–

- **e-Resources / e-books and e-learning portals**
- www.swayam.ac.in
- www.ignou.ac.in
- www.egyankosh.ac.in
- www.iitm.ac.in
- www.eskillindia.org
- www.eshiksha.mp.gov.in
- www.vlab.co.in
- www.internshala.com
- www.ndl.iitkgp.ac.in

Online Resources–

- https://pubmed.ncbi.nlm.nih.gov/22593937/
- https://crimsonpublishers.com/acam/pdf/ACAM.000551.pdf
- https://www.researchgate.net/publication/329823398_Medicinal_Plants_Used_in_the_Treatment_of_Mental_and_Neurological_Disorders_in_Ghana
- https://www.sciencedirect.com/science/article/abs/pii/S0378874115003013
- https://core.ac.uk/download/pdf/143841457.pdf
- https://practicalselfreliance.com/medicinal-plants/
- https://practicalselfreliance.com/medicinal-plants/
- https://www.pdfdrive.com/medicinal-plants-books.html

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): 10 & 10 Assignment/Seminar +Attendance - 05 Total Marks - 15	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 15 Marks
End Semester Exam (ESE):	Two section – A & B Section A: Q1. Objective – 05 x1= 05 Mark; Q2. Short answer type- 5x2 =10 Marks Section B: Descriptive answer type qts.,1out of 2 from each unit- 4x05 =20 Marks	

Name and Signature of Convener & Members of CBoS:

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PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. Randhawa, G. S. and Mukhopadhyay, A. (1986)"Floriculture in India." Allied Publisher (India)
2. Bhattacharjee, S. K. (2006) "Advances in Ornamental Horticulture." Vols. I-VI. Pointer Pub.
3. Lauria, A. and Victor, H. R. (2001) "Floriculture – Fundamentals and Practices." Agrobios.
4. Sabina, G. T. and Peter, K. V. (2008) "Ornamental Plants for Gardens." New India pub. India.

Online Resources–

- **e-Resources / e-books and e-learning portals**
- www.swayam.ac.in
- www.ignou.ac.in
- www.egyankosh.ac.in
- www.iitm.ac.in
- www.eskillindia.org
- www.eshiksha.mp.gov.in
- www.vlab.co.in
- www.internshala.com
- www.ndl.iitkgp.ac.in

Online Resources–

- **e-Resources / e-books and e-learning portals**
- https://indiaagronet.com/horticulture/CONTENTS/LANDSCAPE.htm
- https://www.youtube.com/watch?v=ZUIh6ZFO48c&ab_channel=MountainGardens
- https://www.youtube.com/watch?v=EE0oQO6n9iA
- https://www.teachmint.com/tfile/studymaterial/bsc/j1063fog/11styleofgardeningpdf/0dba825bd66d-4180-afe1-28950aa42454
- https://k8449r.weebly.com/uploads/3/0/7/3/30731055/types_of_gardens_[compatibility_mode]_pdf-signed.pdf
- https://www.egyankosh.ac.in/bitstream/123456789/73050/1/Unit-2.pdf
- https://www.academia.edu/40140208/A_HANDBOOK_ON_FLORICULTURE_And_Landscaping
- https://k8449r.weebly.com/uploads/3/0/7/3/30731055/landscape_gardening.pdf
- https://homeguides.sfgate.com/gardening-tools-uses-41745.html
- https://tractorguru.in/blog/floriculture-types-of-flowers-tips-and-importance-of-floriculture/

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	50 Marks
Continuous Internal Assessment (CIA):	15 Marks
End Semester Exam (ESE):	35 Marks

Continuous Internal Assessment (CIA): 15 (By Course Coordinator)	Internal Test / Quiz-(2): 10 & 10 Assignment/Seminar +Attendance - 05 Total Marks - 15	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 15 Marks
End Semester Exam (ESE): 35	Laboratory / Field Skill Performance: On spot Assessment A. Performed the Task based on learned skill - 20 Marks B. Spotting based on tools (written) – 10 Marks C. Viva-voce (based on principle/technology) - 05 Marks	Managed by Coordinator as per skilling

Name and Signature of Convener & Members of CBoS:

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FOUR YEAR UNDERGRADUATE PROGRAM (2024-2028)
DEPT. OF BOTANY: VALUE ADDITION COURSE
COURSE CURRICULUM (2024-25)

PART-A: Introduction				
Program: Undergraduate *(Certificate / Diploma / Degree/Honors)*		Semester - I/III/V		Session: 2024-2025
1	Course Code	BOVAC – 02		
2	Course Title	**Academic Research & Report Writing**		
3	Course Type	**Value Addition Course (VAC)**		
4	Pre-requisite(if,any)	As per Government norms / Institutional scheme		
5	Course Learning. Outcomes (CLO)	***After completion of this course, the students will be able to -*** ➢ *Understand the academic research and its scope & prospects.* ➢ *Know the Importance of Report writing in academic and Research and Necessity of report writing for achievement of academic & research goals* ➢ *Demonstrates the knowledge of the toxicity of plant and essential oil ingredients.* ➢ *Understand the kinds & characteristics of academic and research reports / presentation and its prospective application.* ➢ *Use the tools and techniques of academic research and report writing* ➢ *Adopt the skill of research designing and report/ paper / thesis writing*		
6	Credit Value	**2 Credits**	*Credit = 15 Hours - learning & Observation*	
7	Total Marks	**Max. Marks: 50**		**Min Passing Marks: 20**

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 30 Periods (30 Hours)

Module	Topics (Course contents): Learning and Practices	No. of Hrs
I	**Introduction:** Concept of - Academic Research and Research Project, Component of a concept Paper for academic research, Research–Characteristics, Type, Formulation & Design, Format, Scope, Motivation & Prospects. Popular Scheme & Organization in India promoting Research - INSPIRE, NSF, MEF, DBT, DST, DNES, STARD, ICAR, ICMR, CSIR, INSA.-	08 Hours
II	**Research paper / Review writing:** Steps of writing a research report. Types of Research paper, Structure of Research papers, Research paper formats, Abstract writing, Methodology, Results and Discussion, Different formats referencing, Ways of communicating a research papers, (Assignments)	07 Hours
III	**Report/ Dissertation / Thesis Writing** - Structure of a thesis , Scope of the work, Literature review, Experimental / Computational details, Preliminary studies, Result and Discussion, Figures & Table Preparation, Conclusion and Future works, Bibliography, Appendixes (Assignments)	07 Hours
IV	**Tools, Techniques & Presentation--** Various word processors - MS Office- Word, Excel & PowerPoint, Libra-office, Latex etc. Making effective presentations using Power Point and Beamer. Basic idea of Data collection, Tabulation & Presentation. Plagiarism detection tools (Assignments)	08 Hours
Keywords	*Academic Research, Research report, Project, Thesis/ Dissertation/ Review writing*	

Signature of Convener & Members of CBOS:

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PART–C

BVAC – 02 (Academic Research & Report Writing)

Learning Resources: Text Books, Reference Books and Others

Text Books Recommended –

- Technical Report Writing and Research Methodology by Dr Naushad Alam Dr Quadri Javeed Ahmad Peer Dr Banarsi Lal, Write & Print Publications
- Research Writing A Complete Guide (PB) by Srinivasan R, How Academics
- GUIDE TO REPORT WRITING by Netzley, Snow, PEARSON INDIA
- A Student Guide to Writing Research Reports, Papers, Theses and Dissertations By Cathal Ó Siochrú; ISBN 9780367621049. Published 2022 by Routledge
- **https://www.goodreads.com/shelf/show/report-writing**

Online Resources–

- **e-Resources / e-books and e-learning portals**
  - **https://www.questionpro.com/blog/research-reports/**
  - **https://egyankosh.ac.in/bitstream/123456789/39238/1/Unit-5.pdf**
  - **https://www.studocu.com/in/document/visvesvaraya-technological-university/research-methodology/general-format-of-a-research-report/33791300**
  - **https://students.unimelb.edu.au/academic-skills/resources/report-writing/research-reports**
  - ❖ **Use of following sites**

- https://www.wiley.com/en-ie/Student+Research+and+Report+Writing:+From+Topic+Selection+to+the+Complete+Paper-p-9781118963913
- https://www.researchgate.net/publication/275654158_HAND_BOOK_FOR_WRITING_RESEARCH_PAPER

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - **05** Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 15 Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1.** Objective – **05 x1= 05** Mark; **Q2.** Short answer type- **5x2 =10 Marks** Section B: Descriptive answer type qts., **1 out of 2** from each unit- **4x05 =20 Marks**	

Signature of Convener & Members of CBOS:

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FOUR YEAR UNDERGRADUATE PROGRAM (2024-2028)
DEPT. OF BOTANY: SKILL ENHANCEMENT COURSE
COURSE CURRICULUM (2024-25)

PART-A: Introduction				
Program: Undergraduate *(Certificate / Diploma / Degree/Honors)*		Semester - II/IV		Session: 2024-2025
1	Course Code	**BOSEC–02**		
2	Course Title	**Flower Decoration**		
3	Course Type	**Skill Enhance Course (SEC)**		
4	Pre-requisite (if, any)	As per Government norms / Institutional scheme		
5	Course Learning. Outcomes(CLO)	*After completion of this course, the students will be able to-* ➢ *-understand the concept of Flower arrangement & Decoration* ➢ *-learn the idea, design and style of Flower decoration and its importance* ➢ *-learn the skill of different types Flower arrangement with local/social application, commercial value and social demand* ➢ *-adopt the skill of Indian, Western, Japanese and other/local style of flower arrangement / decoration towards level of entrepreneurs' start-up*		
6	Credit Value	**2 Credits (1C + 1C)**	*Credit = 15 Hours – Theoretical learning and = 30 Hours Laboratory or Field learning/Training*	
7	Total Marks	**Max. Marks:** 50	**Min Passing Marks:** 20	

PART -B: Content of the Course		
Total No. of Teaching–learning Periods: **Theory – 15 Periods (15 Hrs) and Lab. or Field learning/Training 30 Periods (30 Hours)**		
Module	**Topics (Course contents): learning, Observation and Preparation**	**No. of Hrs**
I	**Introduction:** Basic knowledge of Flowering plants, Ornamental plants, Decorative plants- Shade plants, Ferns, Bonsai, Decorative Flowers, Flower shows. Commercial flowers, Common Ornamental plants and flowers of local area /state. Famous flower Gardens of India. *[Learning and Practices]*	04Hours Learning and 07 Hours Practices
II	**Floral ornaments & Flower arrangements:** Garlands, Floral bouquets, Floral rangoli, Flower arrangements – concept, idea , design and style – Western styles, Japanes or Ikebana styles, Common types of Flower arrangement – Elliptical, Vertical, Horizontal Triangular, Crescent, S & Oval shapes and Cascade .flower arrangement. *[Learning and Practices]*	04Hours Learning and 07HoursPractices
III	**Flower decoration:** Flowers used for decoration; Different idea of flower decoration for Home, Festivals, office, Gallery, Stage, Wall, Table, Gate. Flower Pot / Vas / Bottle decoration. *[Learning and Practices]*	03 Hours + 07 Hours
IV	**Creative decorations:** Flower drying and Dry flower decoration, Foliage arrangement; Dry foliage decoration; Flower decoration by Oil Painting, Resin art of Flower decoration Terrarium – concept, design and creation of different forms. Bonsai, Shady foliage, Fern and Water plant/ flower decoration. *[Learning and Practices]*	04Hours Learning and 09 Hours Practices
Keywords	*Floral ornaments, Flower arrangement, Flower decoration*	

Signature of Convener & Members of CBOS:

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PART–C BOSEC–02 (Flower Decoration)

Learning Resources: Text Books, Reference Books and Others

Text Books Recommended

Textbooks:

1. Floriculture in India, G. S. Randhawa and A. Mukhopadhyay, Allied Publishers Pvt. Ltd.
2. Modern Ikebana: A New Wave in Floral Design Hardcover–2020byTom Loxley & VictoriaGaiger
3. On Flowers: Lessons from an Accidental Florist, Illustrated,2019byAmy Merrick(Author)
4. Flower School: A Practical Guide to the Art of Flower Arranging,2020 by Calvert Crary(Author)
5. The Flower Expert: Ideas and Inspiration for a LifeWithFlowers,2019byFleurMcHarg(Author)
6. The Art of FlowerArranging,1992 by Jan Hall(Author)
7. A Personal Guide to Flower Arranging: Volume 2 Spring and Summer, 2021 by Wendy Markby
8. The Flower Chef: A Modern Guide to Do-It-Yourself Floral Arrangements,2016byCarlyCylinder
9. Easy Ikebana: 30Beautiful FlowerArrangements,2020 by Shinichi Nagatsuka(Author)

Reference Book:

https://www.gardensillustrated.com/reviews/the-best-new-floristry-books

Online Resources–

❖ **e-Resources/e-books and e-learning portals Use of following sites**

- **https://en.wikipedia.org/wiki/Ikebana**
- **https://www.artsy.net/article/artsy-editorial-thriving-art-ikebana-japanese-tradition-flower-arranging**
- **https://agritech.tnau.ac.in/horticulture/horti_Landscaping_dryflower_tech.html**
- **https://library.ihbt.res.in/Institute%20Brochures/dry%20flower.pdf**
- **https://static.vikaspedia.in/media/files_en/agriculture/farm-based-enterprises/value-added-products/dry-flower-production-1.pdf**
- **https://www.researchgate.net/publication/362645798_Dry_Flower_Technology_A_Value_Addition_to_Floriculture_Industry**
- **https://in.pinterest.com/smsastry/flower-decoration/**
- **https://in.pinterest.com/galisreelatha/flower-decoration/**
- **https://www.britannica.com/art/floral-decoration**
- **https://homebnc.com/best-creative-flower-decoration-ideas/**
-

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 50 Marks

Continuous Internal Assessment (CIA): 15 Marks

End Semester Exam (ESE): 35 Marks

Continuous Internal Assessment (CIA): **(By Course Coordinator)**	Internal Test / Quiz-(2): 10 & 10 Assignment/Seminar +Attendance - 05 Total Marks - 15	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 15 Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **A. Performed the Task based on learned skill - 20 Marks** **B. Spotting based on tools (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**	Managed by Coordinator as per skilling

Name and Signature of Convener & Members of CBOS:

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FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

DEPARTMENT OF BOTANY

COURSE CURRICULUM

PART- A: Introduction		
Program: Bachelor in Life Sciences *(Diploma / Degree/Honors)*	Semester – III/IV/V/VI/VII/VIII	Session: 2024-2025

1	Course Code	BOGE -01 T		
2	Course Title	Elementary Botany		
3	Course Type	Generic elective (GE)		
4	Pre-requisite (if, any)	*As per program*		
5	Course Learning. Outcomes (CLO)	At the end of this course, the students will be able to ➢ Understand the Basics of Botany and its branches. ➢ Get acquainted with complex interrelationship between organisms and environment. ➢ Develop a comprehensive understanding of the identification, cultivation, and processing of medicinal plants, and their chemical constituents. ➢ Utilize plants resources for livelihood.		
6	Credit Value	3 Credits	*Credit = 15 Hours - learning & Observation*	
7	Total Marks	Max. Marks: 100	Min Passing Marks: 40	

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**Basics of Plant Science**: Differences and resemblances between; living and nonliving plants and animals, plant and animal cell. Concept of prokaryotes and eukaryotes.Importan features of thallophyta, Bryophyta, Pteridophyta, Gymnosperm and Angiosperm.Structure an function of a typical flowering plant.	12
II	**Branches of botany:** General idea, features, and significance; Anatomy, Cytology, Economic Botany, Ethnobotany, Forestry, Genetics, Histology, Microbiology, Paleobotany, Phytochemistry, Phytopathology , Plant biotechnology, Plant breeding, Plant ecology, Plant morphology, Plant physiology, Plant Taxonomy, etc,	11
III	**Plants for human welfare:** Plant Resources for Rural livelihood – Mahua, Tendu patta, Bamboo and Firewood.Ethnobotany in India: Methods to study Ethnobotany, Applications of Ethnobotany, ethnomedicinal plants and ethnoecology. Application of plant products for certain diseases- Cough and cold, Jaundice, Infertility, Diabetes, Blood pressure and Skin diseases.	11
IV	**Ancient Indian Botany:** Indigenous Medicinal Sciences;Definition and Scope-Ayurveda: History, origin, panchamahabhutas, saptadhatu and tridosha concepts, Rasayana, plants used in ayurvedic treatments, Siddha: Origin of Siddha medicinal systems, Basis of Siddha system, plants used in Siddha medicine. Unani: History, concept. Charaksamhita. Ancient and modern Botanists and their contributions.-Charak, Jagdish Chandra Bose, B.P.Pal, Desikachary,K.C. Mehta M.S. Swaminathan etc.	11
Keywords	*Prokaryotes, Ethnobotany, Taxonomy, Ayurveda*	

Signature of Convener & Members (CBoS) :

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PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. College Botany Ganguli Kar and dutta , HIMALAYA Publishers
2. "Handbook of Medicinal Plants" by L.D. Kapoor
3. "Indian Medicinal Plants: An Illustrated Dictionary" by C.P. Khare
4. "Medicinal Plants in India: Conservation and Sustainable Utilization in the Emerging Global Scenario" edited by V.K. Gupta
5. "A Compendium of Medicinal Plants in India: An Introduction to Ayurveda" by S.L. Kochhar
6. A handbook of forest utilization by T. Mehta
7. Plants and human welfare by O.P.Sharma

Reference Books Recommended –

1. Charak Samhita
2. Medicinal Plants of India" by C.P. Khare

Online Resources–

- **e-books and e-learning portals**
- www.swayam.ac.in
- www.ignou.ac.in
- www.egyankosh.ac.in
- www.iitm.ac.in
- www.eskillindia.org
- www.eshiksha.mp.gov.in
- www.vlab.co.in
- www.internshala.com
- www.ndl.iitkgp.ac.in

Online Resources–

e-Resources / e-books and e-learning portals

- https://extension.oregonstate.edu/collection/botany-basics
- https://www.pbs.org/video/botany-basics-iuu2bl/
- https://efaidnbmnnnibpcajpcglclefindmkaj/https://www2.ca.uky.edu/agcomm/pubs/ho/ho96/ho96.pdf
- https://www.botanytoday.com/branches-of-botany/
- https://efaidnbmnnnibpcajpcglclefindmkaj/https://www.unanijournal.com/articles/94/3-1-11-206.pdf
- https://efaidnbmnnnibpcajpcglclefindmkaj/https://wgbis.ces.iisc.ac.in/biodiversity/sahyadri/documents/botany_history.pdf
- https://vedpuran.files.wordpress.com/2016/07/charaksamhitaatridevajigupt-vol-1.pdf
- https://egyankosh.ac.in/handle/123456789/89429

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Exam (ESE):	**70 Marks**

Continuous Internal Assessment (CIA): 30 (By Course Teacher)	Internal Test / Quiz-(2): 20 +20 Assignment / Seminar - 10 Total Marks - 30	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
End Semester Exam (ESE): 70	**Two section** – A & B Section A: Q1. Objective – 10 x1= 10 Mark; Q2. Short answer type- 5x4 =20 Marks Section B: Descriptive answer type qis..**1out of 2** from each unit–4x10=40 Marks	

Name and Signature of Convener & Members of CBoS:

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FOUR YEAR UNDERGRADUATE PROGRAM (2024–28)

DEPARTMENT OF BOTANY

COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Sciences *(Diploma / Degree/ Honors)*		Semester – III, IV, V, VI,VII,VIII	Session: 2024-2025	
1	Course Code	BOGE -01 P		
2	Course Title	Lab. Course -01 (Elementary Botany)		
3	Course Type	Laboratory course		
4	Pre-requisite (if, any)	*As per program*		
5	Course Learning. Outcomes (CLO)	At the end of this course, the students will be able to ➢ Understand structure of plant cell, prokaryotic cell and eukaryotic cell. ➢ Identify pteridophytes of college campus. ➢ Learn about the different types of plant tissues. ➢ Learn about Ayurvedic system of medicine.		
6	Credit Value	1 Credits	*Credit =30 Hours Laboratory or Field learning/Training*	
7	Total Marks	Max. Marks: 50	Min Passing Marks: 20	

PART -B: Content of the Course

Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)

Module	Topics (Course contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course	1. Microscopic study of plant cell. 2. Microscopic study of prokaryotic (Bacteria) and eukaryotic cell (algae and fungi). 3. Study of thallus structure of *Riccia* and *Marchantia*. 4. Identification of different plants growing in college campus. 5. Study of a typical flowering plant and it's parts. 6. Study of internal structure of root and stem. 7. Study of parenchyma, collenchyma and sclerenchyma. 8. Study of medicinal plants of college campus. 9. Study of plants used to cure cough and cold, jaundice and skin diseases. 10. Visit to any local ayurvedic hospital / practitioner to understand Ayurveda.	30
Keywords	*Prokaryotic, Parenchyma, Jaundice, Ayurveda.*	

Signature of Convener & Members (CBoS) :

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PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

Text Books Recommended –

1. College Botany Ganguli Kar and dutta , HIMALAYA Publishers
2. "Handbook of Medicinal Plants" by L.D. Kapoor
3. "Indian Medicinal Plants: An Illustrated Dictionary" by C.P. Khare
4. "Medicinal Plants in India: Conservation and Sustainable Utilization in the Emerging Global Scenario" edited by V.K. Gupta
5. "A Compendium of Medicinal Plants in India: An Introduction to Ayurveda" by S.L. Kochhar
6. A handbook of forest utilization by T. Mehta
7. Plants and human welfare by O.P.Sharma

Reference Books Recommended –

1. Charak Samhita
2. Medicinal Plants of India" by C.P. Khare

Online Resources–

- **e-Resources / e-books and e-learning portals**
- www.swayam.ac.in
- www.ignou.ac.in
- www.egyankosh.ac.in
- www.iitm.ac.in
- www.eskillindia.org
- www.eshiksha.mp.gov.in
- www.vlab.co.in
- www.internshala.com
- www.ndl.iitkgp.ac.in

Online Resources–

- e-Resources / e-books and e-learning portals
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5871155/
- https://cms.botany.org/home/careers-jobs/careers-in-botany/areas-of-specialization-in-botany.html

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 50 Marks

Continuous Internal Assessment (CIA): 15 Marks

End Semester Exam (ESE): 35 Marks

Continuous Internal Assessment (CIA): 15 (By Course Teacher)	Internal Test / Quiz-(2): 10 & 10 Assignment/Seminar +Attendance - 05 Total Marks - 15	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 15 Marks
End Semester Exam (ESE): 35	Laboratory / Field Skill Performance: On spot Assessment A. Performed the Task based on lab. work - 20 Marks B. Spotting based on tools & technology (written) – 10 Marks C. Viva-voce (based on principle/technology) - 05 Marks	Managed by Course teacher as per lab. status

Name and Signature of Convener & Members of CBoS:

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FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

DEPARTMENT OF BOTANY

COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Sciences *(Diploma / Degree/Honors)*			**Semester –** III/ IV/V/VI/VII/VIII	Session: 2024-2025
1	Course Code	**BOGE -02 T**		
2	Course Title	**Microbes and Thallophyta**		
3	Course Type	**Generic elective (GE)**		
4	Pre-requisite (if, any)	*As per program*		
5	Course Learning. Outcomes (CLO)	At the end of this course, the students will be able to 1. Understand about the Microbes and their Importance. 2.. Identify edible mushrooms and learn cultivation techniques. 3. Learn about bio-fertilizers and their uses. 4. Understand life cycles of different algae and fungi.		
6	Credit Value	**3 Credits**	*Credit = 15 Hours - learning & Observation*	
7	Total Marks	**Max. Marks: 100**	**Min Passing Marks: 40**	

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	Viruses: - general characteristics,nature , structure and nomenclature, Bacteriophages and TMV; Lytic and Lysogenic cycles, transmission and replication of viruses, Symptoms of viral diseases on plants , important plant diseases, viroid, prions.Actinomycetes: general characteristics ,Structure, reproduction and economic importance. Mycoplasma, Phytoplasma, general characteristics , structure, reproduction and their economic uses.	12
II	Bacteria: History, general character, classification and morphology, Gram positive and Gram-negative bacteria, structure of bacteria shape, size flagella and ultra structure of bacterial cell; Bacterial Growth curve, factors affecting growth of microbes; sporulation, reproduction, recombination in bacteria- Transformation Conjugation and Transduction, and Economic importance. Cyanobacteria : General characteristics, morphology,Heterocyst, cell structure of Cyanobacteria, reproduction and economic importance of Bacteria.	11
III	Phycology: General characteristic features of Algae. Algae in diversified habitat, Salient features, occurrence, classification and range of thallus organization.Prominent pigments found in Algae. Reproduction classification, general character and life cycle of –*Volvox, Oedogonium, Chara, Vaucheria,Ectocarpus*and*Polysiphonia*. Economic importance of algae - Role of algae in soil fertility, algae as biofertilizer , blue green algae and nitrogen fixation. Symbiosis ; algal products - Agar, biofuel	11
IV	**Mycology, Mushroom Cultivation, Lichenology &Mycorrhiza:** General characteristic features of Fungi. Economic importance and Classification of Fungi, Nutrition, Heterothallism, Physiological specialization, Heterokaryosis &Parasexuality in Fungi. Fungi as biocontrol agent. Classification, general character and life cycle of -*Mucor*, Phytophthora*Penicillium, Peziza. Ustilago, Puccinia, Agaricus; Colletotrichum, Alternaria*. Edible Mushroom- Button and Oyster mushroom and their cultivation. General account of lichens. General account of Myccorrhiza.	11
Keywords	*Mycoplasma, Transduction, Biofertilizer, Parasexuality.*	

Signature of Convener & Members (CBoS) :

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PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West. Press Pvt. Ltd. Delhi. 2nd edition.
2. Tortora, G.J., Funke, B.R., Case, C.L. (2010). Microbiology: An Introduction, Pearson Benjamin Cummings, U.S.A. 10th edition.
3. Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi & Their Allies, MacMillan Publishers Pvt. Ltd., Delhi.
4. Aggarwal, S. K. 2009. Foundation Course in Biology, A one books Pvt. Ltd., New Delhi.
5. Aneja, K. R. 1993. Experiments in Microbiology, Pathology and Tissue Culture, VishwaPrakashan, NewDelhi.
6. Annie Ragland, 2012. Algae and Bryophytes, Saras Publication, Kanyakumari, India.
7. Basu, A. N. 1993. Essentials of Plant Viruses, Vectors and Plant diseases, New Age International, New Delhi.
8. Chopra. G. L. 1984. A text book of Algae, Rastogi publications, Meerut,India.
9. Dubey, R. C. and Maheshwari. D.K. 2012. Practical Microbiology, S. Chand & Company, Pvt. Ltd., NewDelhi.
10. Fritsch, R. E. 1977. Structure and Reproduction of Algae, Cambridge University Press, London.
11. Sharma, P.D. (2011). Plant Pathology. Meerut, U.P.: Rastogi Publication.
12. Pandey B.P. 2001. College Botany Volume 1, S Chand & Company Pvt.Ltd, New Delhi.

Reference books:

1. Webster, J., Weber, R. (2007). Introduction to Fungi, 3rd edition. Cambridge, U.K.: Cambridge University Press.
2. Pelzar, 1963. Microbiology, Tata McGraw Hill, New Delhi
3. Rangaswamy, G. 2009, Disease of Crop Plants in India, Prientice Hall of India, New Delhi.
4. Microbiology Fundamental and Applications (hindi) (pb) 9. ISBN: 9788188826230 Edition: 03Year : 2016Author : Dr. Purohit SS , Dr. Deo Publisher : Student Edition Language : Hindi
5. Modern Microbiology (hindi) (hb) ISBN: 9788177543599Edition : 1Year : 2018Author : Dr. Purohit SS , Dr. Singh T Publisher : Agrobios (India)
6. Plant pathology by R.S. Mehrotra, Tata McGraw-Hill Publication

Online Resources–

- **e-Resources / e-learning portals**
- www.swayam.ac.in
- www.ignou.ac.in
- www.egyankosh.ac.in
- www.iitm.ac.in
- www.eskillindia.org
- www.eshiksha.mp.gov.in
- www.vlab.co.in
- www.internshala.com
- www.ndl.iitkgp.ac.in

Online Resources–

- **e-Resources / e-books and e-learning portals**

1. https://www.classcentral.com/tag/microbiology
2. https://www.edx.org/learn/microbiology
3. https://www.mooc-list.com/tags/microbiology
4. https://www.udemy.com/topic/microbiology/
5. https://ucmp.berkeley.edu/bacteria/bacteria.html
6. https://www.livescience.com/53272-what-is-a-virus.html
7. https://gclambathach.in/lms/Economic%20importance%20of%20Algae.pdf
8. https://www.slideshare.net/sardar1109/algae-notes-1
9. https://www.onlinebiologynotes.com/algae-general-characteristics-classification/
10. https://www.sciencedirect.com/topics/immunology-and-microbiology/fungus
11. https://ucmp.berkeley.edu/fungi/fungi.html
12. https://agrimoon.com/wp-content/uploads/Mashroom-culture.pdf
13. http://ecoursesonline.iasri.res.in/mod/page/view.php?id=11293
14. http://www.jnkvv.org/PDF/11042020102651plant_pathology.pdf
15. https://www.apsnet.org/edcenter/disimpactmngmnt/topic/EpidemiologyTemporal/Pages/ManagementStrategies.aspx
16. https://www.agrilcareer.com/6-easy-steps-for-mushroom-cultivation/

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	100 Marks
Continuous Internal Assessment (CIA):	30 Marks
End Semester Exam (ESE):	70 Marks

Continuous Internal Assessment (CIA):30 (By Course Teacher)	Internal Test / Quiz-(2): 20 +20 Assignment / Seminar - 10 Total Marks - 30	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
End Semester Exam (ESE): 70	**Two section – A & B** Section A: Q1. Objective – 10 x1= 10 Mark; Q2. Short answer type- 5x4 =20 Marks Section B: Descriptive answer type qts., 1out of 2 from each unit-4x10=40 Marks	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024–28)

DEPARTMENT OF BOTANY

COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Sciences *(Diploma / Degree/Honors)*			**Semester –** III/IV/ V/VI/VII/VIII	Session: 2024-2025
1	Course Code	**BOGE- 02 P**		
2	Course Title	**Lab. Course –02 (Microbes and Thallophyta)**		
3	Course Type	**Laboratory course**		
4	Pre-requisite (if, any)	*As per program*		
5	Course Learning. Outcomes (CLO)	1. Understand the Viruses, Bacteria, Phycology, Mycology and Plant pathology 2. Learn microbial techniques which will be beneficial for agriculture and industry. 3. Learn life cycles of selected genera of different groups 4. Understand etiology of plant diseases 5. Apply their knowledge in the crop fields to eradicate or avoid the diseases		
6	Credit Value	**1 Credits**	*Credit =30 Hours Laboratory or Field learning/Training*	
7	Total Marks	**Max. Marks: 50**	**Min Passing Marks: 20**	

PART -B: Content of the Course

Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)

Module	Topics (Course contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course	1. Collection of viral/ Bactrial /fungal infected plants 2. Study of plant disease symptoms caused by viral/ Bactrial /fungal/ Mycoplasma 3. **BACTERIAL IDENTIFICATION:** Isolation of bacteria Staining techniques: Gram's, staining 4. Study / Slide preparation of available Cyanobacteria 5. **PHYCOLOGY:** Study / Slide preparation and Staining of algae – *Volvox, Oedogonium* and *Chara; Vaucheria;Ectocarpus Polysiphonia* 6. **MYCOLOGY:** Study/ Slide preparation and . Staining of fungi. *Mucor,Phytophthora, Penicillium, Peziza, Ustilago, Puccinia; Agaricus, colletotrichum, Alternaria.* Study of Button and Oyster Mushroom Lichens: crustose, foliose and fruticose specimens. Study of VAM fungi	30
Keywords	infected plants, VAM, algae, fungi	

Signature of Convener & Members (CBoS) :

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PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. Practical Botany (Part I) ISBN #:81-301-0008-8 Sunil D Purohit, Gotam K Kukda & Anamika Singhvi Edition:2013 Apex Publishing House Durga Nursery Road, Udaipur, Rajasthan (bilingual).
2. Pandey S.K. (2012). Quick Concept of Botany. Publisher LAP LAMBERT Academic Publishing GmbH & Co. KG, Germany (ISBN: 978-3-8484-3104-5).
3. Dubey, R. C. and Maheshwari. D.K. 2012. Practical Microbiology, S. Chand & Company, Pvt. Ltd., New Delhi.
4. Pandey. B.P. 2014 Modern Practical Botany, (Vol-I) S. Chand and Company Pvt. Ltd., New Delhi.

Online Resources–

- **e-Resources / e-books and e-learning portals**
- **www.swayam.ac.in**
- **www.ignou.ac.in**
- **www.egyankosh.ac.in**
- **www.iitm.ac.in**
- **www.eskillindia.org**
- **www.eshiksha.mp.gov.in**
- **www.vlab.co.in**
- **www.internshala.com**
- **www.ndl.iitkgp.ac.in**

Online Resources–

- **e-Resources / e-books and e-learning portals**

1. https://community.plantae.org/tags/mooc futurelearn.com/courses/teaching-biology-inspiring-students-with-plants-in-science
2. https://microbiologysociety.org/publication/education-outreach-resources/basic-practical-microbiology-a-manual.html
3. https://microbiologyonline.org/file/7926d7789d8a2f7b2075109f68c3175e.pdf
4. http://allaboutalgae.com/benefits/
5. https://repository.cimmyt.org/xmlui/bitstream/handle/10883/3219/64331.pdf
6. https://www.mooc-list.com/tags/microbiology\
7. http://www.agrifs.ir/sites/default/files/A%20text%20book%20of%20practical%20botany%201%20%7BAshok%20Bendre%7D%20%5B8
8. https://171339239%5D%20%281984%29.pdf

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): 15 (By Course Teacher)	Internal Test / Quiz-(2): 10 & 10 Assignment/Seminar +Attendance - 05 Total Marks - 15	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 15 Marks
End Semester Exam (ESE): 35	**Laboratory / Field Skill Performance: On spot Assessment** A. Performed the Task based on lab. work - 20 Marks B. Spotting based on tools & technology (written) – 10 Marks C. Viva-voce (based on principle/technology) - 05 Marks	Managed by Course teacher as per lab. status

Name and Signature of Convener & Members of CBoS:

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NEP 2020

FOUR YEAR UNDERGRADUATE PROGRAM (NEP–2020)

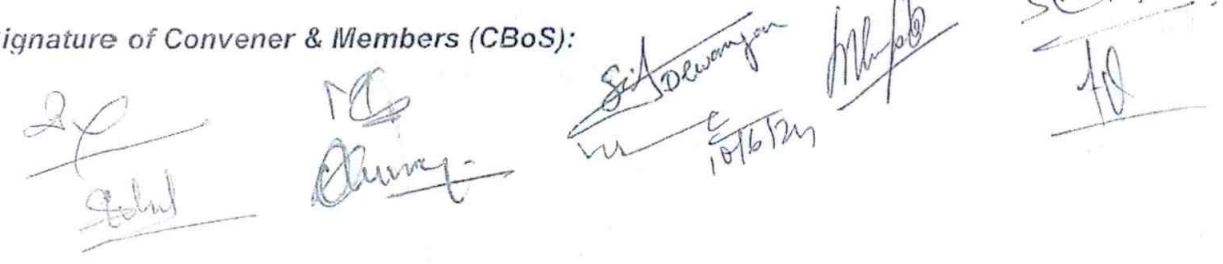
Program: Bachelor in Science (2024 -28)

DISCIPLINE – ZOOLOGY

FOUR YEAR UNDERGRADUATE PROGRAM (NEP- 2020)
PROGRAM: BACHELOR IN SCIENCE (2024 – 28)
DISCIPLINE – PHYSICS
SESSION - 2024 – 25

DSC- 01 to 08		DSE- 01 to 12		DGE- 01 to 02	
Code	Course Title	Code	Course Title	Code	Course Title
PHSC- 01 T	Mechanics	PHSE- 01	Introduction to Statistical Mechanics	PHGE- 01 T	Mechanics
PHSC- 01P	Lab Course			PHGE- 01 P	Lab Course
PHSC- 02 T	Electricity & Magnetism	PHSE- 02	Mathematical Physics-I	PHGE- 02 T	Electricity & Magnetism
. HSC- 02 P	Lab Course			PHGE- 02 P	Lab Course
PHSC- 03 T	Heat & Thermodynamics	PHSE- 03	Nuclear Physics		
PHSC- 03 P	Lab Course				
PHSC- 04 T	Waves & Optics	PHSE- 04 T	Numerical Methods &C Programming	VAC	
PHSC- 04 P	Lab Course	PHSE- 04 P	Lab Course		
PHSC- 05 T	Introduction to Quantum Mechanics	PHSE- 05	Mathematical Physics-II	PHVAC- 01	Renewable Energy and Energy Harvesting
PHSC- 05 P	Lab Course				
HSC- 06 T	Solid State Physics &SolidStateDevices	PHSE- 06	Classical Electrodynamics & Electromagnetic theory	SEC	
PHSC- 06 P	Lab Course				
PHSC- 07	Classical Mechanics	PHSE- 07 T	Digital Electronics		
		PHSE- 07 P	Lab Course		
PHSC- 08	Quantum Mechanics	PHSE- 08 T	Operational Amplifier& Its Applications	PHSEC- 01	BasicElectrical Skill
		PHSE- 08 P	Lab Course		
		PHSE- 09 T	Solid State Physics		
		PHSE- 09 P	Lab Course		
		PHSE- 10	Atomic and Molecular Physics		
		PHSE- 11	Statistical Mechanics		
		PHSE- 12 T	Microprocessor		
		PHSE- 12 P	Lab Course		

Signature of Convener & Members (CBoS):

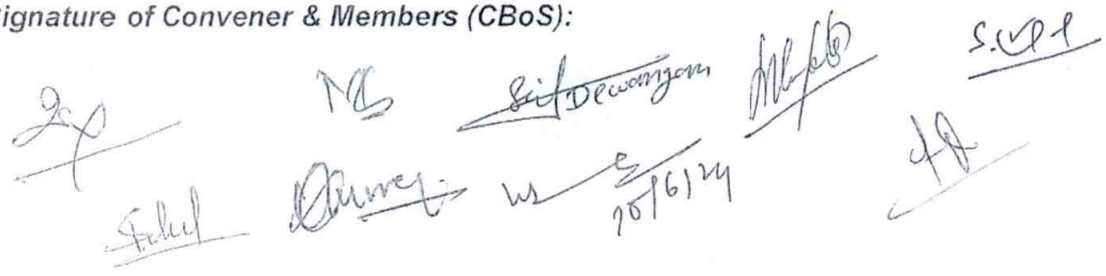


Program Outcomes (PO):

The learning outcomes of the undergraduate degree course in physics are as follows:

- **In-depth disciplinary knowledge**: The student will acquire comprehensive knowledge and understanding of the fundamental concepts, theoretical principles and processes in the main and allied branches of physics.
- **Hands-on/ Laboratory Skills**: Comprehensive hands-on/ laboratory exercises will impart analytical, computational and instrumentation skills. The students will be able to demonstrate mature skills for the collation, evaluation, analysis and presentation of information, ideas, concepts as well as quantitative and/or qualitative data.
- **Role of Physics**: The students will develop awareness and appreciation for the significant role played by physics in current societal and global issues. They will be able to address and contribute to such issues through the skills and knowledge acquired during the programme
- **Communication and Skills**: Various DSCs, DSEs, SECs, and GEs have been designed to enhance student's ability to write methodical, logical and precise reports. The courses will, in addition, guide the student to communicate effectively through presentations, writing laboratory/ project reports and dissertations.
- **Critical and Lateral Thinking**: The programme will develop the ability to apply the underlying concepts and principles of physics and allied fields beyond the classrooms to real life applications, innovation and creativity.
- **Research skills**: The course provides an opportunity to students to hone their research and innovation skills through assignment/internship/dissertation. It will enable the students to demonstrate mature skills in literature survey, information management skills, data analysis and research ethics.

Signature of Convener & Members (CBoS):



FOUR YEARS UNDERGRADUATE PROGRAM (2024-28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART – A: INTRODUCTION				
Program: Bachelor in Science (Certificate/ Diploma/ Degree/ Honors)			**Semester: I**	**Session: 2024-25**
1	**Course Code**	**PHSC-01T**		
2	**Course Title**	**Mechanics**		
3	**Course Type**	**Discipline Specific Course**		
4	**Pre-requisite (if any)**	**As per Program**		
5	**Course Learning Outcomes (CLO)**	*After going through the course, the student should be able to:* ➢ *Analyze and apply the laws of motion to various dynamical situations.* ➢ *Explain and demonstrate the principle of conservation of momentum and energy including their application in real-world scenario such as collision and energy transformation.* ➢ *Evaluate and calculate moment of inertia for objects of different shapes and analyze how these properties affect the motion of rotating bodies.* ➢ *Analyze flow of fluids.* ➢ *Describe special relativistic effects and their effects on the mass and energy of a moving object.*		
6	**Credit Value**	**03 Credits**	**1 Credit= 15 Hours for Learning &Observation**	
7	**Total Marks**	**Maximum Marks: 100**	**Minimum Pass Marks: 40**	

PART – B: CONTENT OF THE COURSE

TotalNo.of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Periods
I	**Historical Background:** Contribution of Aryabhatta and Varahmihir to science and society, Brief biography of Vikram Sarabhai with his contribution.**Vectors:** Scalar and vector quantities &fields, Scalar & Vector products of two vectors, Derivatives of a vector, Gradient of scalar field and its physical significance.**Laws of Motion:** Review of Newton's Laws of motion, Dynamics of a system of particles, Concept of Center of Mass, Motion of center of mass, Conservation of linear momentum, Motion of Rocket.**Work and Energy:** Work-Energy theorem for conservative forces, Force as a gradient of Potential Energy, Conservation of energy, Elastic and in-elastic Collisions	12
II	**Rotational Dynamics**: Angular momentum, Torque, Conservation of angular momentum, Moment of Inertia, Theorem of parallel and perpendicular axes(statements only), Calculation of Moment of Inertia of discrete and continuous objects (Rectangular lamina, disc, solid cylinder, solid sphere).**Elasticity:** Stress & Strain, Hooke's law, Elastic constants, Poisson's Ratio,Relationship between various elastic modulii (without derivation), Work done in twisting a cylinder.**Fluid Dynamics**: Flow of fluids, Coefficient of viscosity,Derivation of Poiseulli's formula, Motion of a spherical body falling in a viscous fluid, Stoke's law, Expression for terminal velocity.	12
III	**Gravitation**: Newton's Law of Gravitation, Motion of a particle in a central force field (motion is in a plane, angular momentum is conserved, areal velocity is constant), Kepler's Laws (statements only), Satellite in circular orbit and applications, Geosynchronous orbits. **Oscillations**: Simple harmonic motion, Differential equation of SHM and its solutions, Kinetic and Potential Energy, Total Energy and their time averages, Compound pendulum, Differential equations of damped oscillations and forced oscillations (Conceptual only).	11
IV	**Special Theory of Relativity:** Frame of reference, Galilean Transformations, Inertial and Non-inertial frames, Outcomes of Michelson Morley's Experiment, Postulates of Special Theory of Relativity, Lorentz Transformation, Length contraction, Time dilation, Relativistic transformation of velocity, Relativistic variation of mass, Mass-energy equivalence, Transformation of Energy and Momentum.	10
Keywords:	Aryabhatta, Vectors, Newton's Laws, Angular Momentum, Elasticity, Gravitation, Oscillations, Relativity	

SignatureofConvener&Members (CBoS) :

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FOUR YEARS UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART – A: INTRODUCTION

Program:Bachelor in Science (Certificate/ Diploma/ Degree/ Honors)		Semester: I	Session: 2024-25
1	Course Code	PHSC- 01P	
2	Course Title	Mechanics	
3	Course Type	Discipline Specific Course	
4	Pre-requisite (if any)	As per Program	
5	Course Learning Outcomes (CLO)	After the completion of the course, Students are expected to understand working mechanism and laws of classical mechanics. The Students will be able to ➢ Assemble required parts/devices and arrange them to perform experiments. ➢ Record/ observe data as required by the experimental objectives. ➢ Analyze recorded data and formulate it to get desired results. ➢ Interpret results and check for attainment of proposed objectives related to laws of mechanics and its applications	
6	Credit Value	01 Credit	1 Credit = 30 HoursLaboratory Work
7	Total Marks	Maximum Marks: 50	Minimum Pass Marks: 20

PART – B: CONTENT OF THE COURSE

TotalNo.of learning-Training/performance Periods-30 Periods (30 Hours)

Sr. No.	Objects (At least 10 of the following or related Experiments)	No. of Period
1	Measurements of length (or diameter) using vernier caliper, screw gauge and travelling microscope.	30
2	To study the random error in observations.	
3	To study the motion of the spring and calculate (a) Spring constant and, (b) g.	
4	To determine the Moment of Inertia of a Flywheel.	
5	To determine g and velocity for a freely falling body using Digital Timing Technique.	
6	To determine Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).	
7	To determine the Young's Modulus of a Wire by Optical Lever Method.	
8	To determine the Modulus of Rigidity of a Wire by Maxwell's needle.	
9	To determine the elastic constants of a wire by Searle's method	
10	To determine the value of g using Bar Pendulum.	
11	To determine the value of g using Kater's Pendulum.	
12	Study of bending of a beam/ cantilever	
13	To determine Moment of Inertia of an irregular body by Inertia Table	
Keywords	Moment of Inertia, Pendulum, VernierCallipers, Screw Gauge, Travelling microscope, Elastic Constant, Searle's Method, Stoke's Method, Cappilary Rise Method, Viscosity, Surface Tension	

SignatureofConvener&Members (CBoS) :

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PART – C: LEARNING RESOURCES

Text Books, Reference Books Recommended and Others

Text Books Recommended-

1. Mechanics & Properties of matter, D.C. Tayal & P. Tayal, 2023, Pub. By Authors.
2. Unified Physics I –R.P.Goyal, Shivlal Agrawal Publication
3. Unified Physics I, Navbodh Publication

Reference Books Recommended-

1. Mechanics, Berkeley Physics, vol.1, C.Kittel, W.Knight, et.al. 2007, Tata McGraw-Hill.
2. Physics, Resnick, Halliday and Walker 8/e. 2008, Wiley.
3. Introduction to Special Relativity, R. Resnick, 2005, John Wiley and Sons.

Online Resources (e-books/ learning portals/ other e-resources)

1. All e-books of physics https://www.e-booksdirectory.com/listing.php?category=2
2. Free physics text book in PDF
3. https://www.motionmountain.net/?gclid=CjwKCAjwmq3kBRB_EiwAjkNDp5v8Yy6xK1s0Kma0VR0AWGlichRwFfCC0-vpZK1jrPoEOAnBq8fcqRoCILsQAvD_BwE
4. Cambridge University Books for Physics https://www.cambridgeindia.org/
5. Books for solving physics problems https://bookboon.com/en/physics-ebooks
6. NPTEL Online courses https://nptel.ac.in/courses/115105098; https://archive.nptel.ac.in/courses/115/106/115106123/;
7. BSc Lectures by Prof. H C Verma: https://bsc.hcverma.in/index.php/course/relativity; https://bsc.hcverma.in/index.php/course/cm1

PART – D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:

Maximum Marks: 100Marks

Continuous Internal Assessment (CIA):30 Marks

End Semester Examination (ESE): 70 Marks

Continuous Internal Assessment (CIA): (By course teacher)	Internal Test/ Quiz (2): **20~~/20~~** Assignment/ Seminar (1): **10** Total Marks: **30**	Better marks out of the two Test / Quiz + marks obtained in Assignment shall be considered against **30 Marks**
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20Marks** Section B: Descriptive answer type,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener & Members of CBoS:

PART – C: Learning Resources

Text Books, Reference Books and others

Text Books Recommended-

1. Advanced Practical Physics for students, B.L.Flint&H.T.Worsnop, 1971, Asia Publishing House.
2. Engineering Practical Physics, S.Panigrahi& B.Mallick,2015, Cengage Learning India Pvt. Ltd.
3. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
4. Practical Physics B.Sc. I : R P Goyal, Shivlal Publications

Reference Books Recommended-

1. Advanced Practical Physics for Students by B.L. Worsnop and H.T. Flint
2. Practical Physics by G.L. Squires
3. An Introduction to Error Analysis: The Study of Uncertainties in Physical Measurements by John R. Taylor
4. Mechanics and Properties of Matter by J.C. Upadhyaya

Online Resources (e-books/ learning portals/ other e-resources)

1. Link for e-Books for Physics:Physics Practical:
   https://www.uou.ac.in/sites//default/files/slm/BSCPH-104.pdf
2. Virtual Lab :https://vlab.amrita.edu/?sub=1&brch=74
3. https://vlab.amrita.edu/?sub=1&brch=74&sim=571&cnt=1
4. https://www.ae.msstate.edu/vlsm/

PART – D : ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:
Maximum Marks: 50 Marks
Continuous Internal Assessment(CIA):15 Marks
EndSemester Exam(ESE):35 Marks

Continuous InternalAssessment(CIA): (By Course Teacher)	Internal Test / Quiz - (2): **10 & 10** Assignment/Seminar +Attendance –**05** Total Marks - **15**	Better marks out of the two Test/Quiz **+Marks** obtained in Assignment shall be considered against **15** Marks

End Semester Exam (ESE):	**Laboratory Performance: On spot Assessment** **Performed the Task based on lab. work -20 Marks** **Spotting based on tools & technology (written) – 10 Marks** **Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS:

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FOUR YEARS UNDERGRADUATE PROGRAM (2024-28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART – A: INTRODUCTION

Program: Bachelor in Science (Certificate/ Diploma/ Degree/ Honors)		Semester: II	Session: 2024-25
1	Course Code	PHSC-02T	
2	Course Title	ELECTRICITY AND MAGNETISM	
3	Course Type	Discipline Specific Course	
4	Pre-requisite (if any)	As per Program	
5	Course Learning Outcomes (CLO)	After going through the course, the student should be able to: ➢ State various laws related with electrostatics, dielectric, electric current, magnetism and electromagnetic induction. ➢ Apply vector (electric fields, Coulomb's law) and scalar (electric potential, electric potential energy) formalisms of electrostatics. ➢ Compare rise and decay of current in LR, CR, LCR circuits. ➢ Apply Biot-Savart law for calculation of magnetic field in simple geographic situations. ➢ Derive and analyze Maxwell's equations.	
6	Credit Value	03 Credits	1 Credit= 15 Hours for Learning &Observation
7	Total Marks	Maximum Marks: 100	Minimum Pass Marks: 40

PART – B: CONTENT OF THE COURSE

TotalNo.of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Periods
I	**Power plants in Chhattisgarh:** An overview of thermal and hydroelectric power plants in Chhattisgarh. **Vector Analysis**: Divergence & Curl of Vector fields, Line, surface and volume integrals of Vector fields, Gauss-divergence theorem and Stoke's theorem of vectors and its application in electrostatics and magnetostatics.**Electrostatics field:** Electrostatic Field, electric flux, Gauss's theorem of electrostatics, Applications of Gauss theorem- Electric field due to point charge, infinite line of charge, plane charged sheet, charged conductor.	12
II	**Electrostatic potential:**Electric potential as line integral of electric field, potential due to a point charge, Calculation of electric field from potential, Capacitance of Parallel plate capacitor, Energy per unit volume in electrostatic field. **Dielectric & Electric Currents:** Dielectric medium, Polarisation, Displacement vector, Gauss's theorem in dielectrics, Parallel plate capacitor completely filled with dielectric.Steady current, current density J, non – steady current and Continuity equation, Rise and decay of current in LR, CR, LCR circuits.	13
III	**Magnetism:** Magnetostatics: Biot-Savart's law and its applications- straight conductor, circular coil, solenoid carrying current, Divergence and curl of magnetic field, Magnetic vector potential, Ampere's circuital law, Magnetic properties of materials: Magnetic intensity, magnetic induction, permeability, magnetic susceptibility, Brief introduction of dia, para and ferro-magnetic materials.	10
IV	**Electromagnetic Induction:** Faraday's laws of electromagnetic induction, Lenz's law, self and mutual inductance, L of single coil, M of two coils, Energy stored in magnetic field. **Maxwell's equations and Electromagnetic wave propagation:** Equation of continuity of current, Displacement current, Maxwell's equations, Wave equation in free space.	10

Keywords:	Vector calculus, Electrostatics, Dielectrics and Electric Current, Magnetism, Electromagnetic Induction, Maxwell's Equation and Electromagnetic Wave Propagation

SignatureofConvener&Members (CBoS) :

10/6/24

PART – C: LEARNING RESOURCES

Text Books, Reference Books and Others

Text Books

1. Electricity and Magnetism, D C Tayal, 1988, Himalaya Publishing House.
2. Unified Physics – Part II, R. P.Goyal, Shivlal Agrawal and Sons
3. Unified Physics – Navbodh Publications
4. Introduction to Electrodynamics and Electromagnetism, H.C.Verma,

Reference Books

1. Vector analysis – Schaum's Outline, M.R. Spiegel, S. Lipschutz, D. Spellman, 2nd Edn., 2009, McGraw- Hill Education.
2. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.

Online Resources (e-books/ learning portals/ other e-resources)

1. *All e-books of physics* https://www.e-booksdirectory.com/listing.php?category=2
2. *Free physics text book in PDF* https://www.motionmountain.net/?gclid=CjwKCAjwmq3kBRB_EiwAjkNDp5v8Yy6xK1s0Kma0VR0AWGlichRwFfCC0-vpZK1jrPoEOAnBq8fcqRoCILsQAvD_BwE
3. *Cambridge University Books for Physics* https://www.cambridgeindia.org/
4. *Books for solving physics problems* https://bookboon.com/en/physics-ebooks
5. *NPTEL Online courses:* https://onlinecourses.nptel.ac.in/noc21_ph05/preview
6. https://archive.nptel.ac.in/courses/115/104/115104088/
7. *Classical Electromagnetism - 1 (Electrostatics)* https://bsc.hcverma.in/course/cee1
8. *Classical Electromagnetism - 2 (Electrostatics)* https://bsc.hcverma.in/course/cee2

PART – D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:
Maximum Marks: 100Marks
Continuous Internal Assessment (CIA):30 Marks
End Semester Examination (ESE): 70 Marks

Continuous Internal Assessment (CIA): (By course teacher)	Internal Test/ Quiz (2): **20+20**Assignment/ Seminar (1): **10** Total Marks: **30**	Better marks out of the two Test / Quiz + marks obtained in Assignment shall be considered against **30** Marks
End Semester Examination (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20Marks** Section B: Descriptive answer type,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener & Members of CBoS:

FOUR YEARS UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART – A: INTRODUCTION

Program: Bachelor in Science (Certificate/ Diploma/ Degree/ Honors)	Semester: II	Session: 2024-25

1	Course Code	PHSC- 02P	
2	Course Title	Electricity & Magnetism	
3	Course Type	Discipline Specific Course	
4	Pre-requisite (if any)	As per program	
5	Course Learning Outcomes (CLO)	*After the completion of the course, Students are expected to understand working laws of Electricity, Magnetism and EMWs. The students will also be able to* ➢ *Verify various circuit laws, network theorems, using simple electric circuits. Assemble required parts/devices and arrange them to perform experiments.* ➢ *Verify various laws in electricity and magnetism such as Lenz's law, Faraday's law and learn about the construction, working of various measuring instruments* ➢ *Record/ observe data as required by the experimental objectives. Analyze recorded data and formulate it to get desired results.* ➢ *Interpret results and check for attainment of proposed objectives related to laws of Electricity, Magnetism and its applications*	
6	Credit Value	01 Credit	1 Credit = 30 Hours Laboratory Work
7	Total Marks	Maximum Marks: 50	Minimum Pass Marks: 20

PART – B: CONTENT OF THE COURSE

TotalNo.of learning-Training/performance Periods -30 Periods (30 Hours)

Sr. No.	Objects (At least 10 of the following or related Experiments)	No. of Periods
1	To use a Multimeter for measuring (a) Resistances, (b) AC and DCVoltages,(c) DC Current, and (d) checking electrical fuses.	30
2	To compare capacitances using De'Sauty's bridge.	
3	Measurement of field strength B and its variation in a Solenoid Determine (dB/dx).	
4	To study the Characteristics of a Series RC Circuit.	
5	To study a series LCR circuit and determine its (a) Resonant Frequency, (b) Quality Factor.	
6	To study a parallel LCR circuit and determine its (a) Anti-resonant frequency and(b) Quality factor Q.	
7	To determine a Low Resistance by Carey Foster's Bridge.	
8	To verify the Thevenin and Norton theorem.	
9	To verify the Superposition, and Maximum Power Transfer Theorem.	
10	To use a vibration magnetometer and study magnetic field.	
11	Study of magnetic field due to a current loop.	
12	Study of magnetic fields using Deflection Magnetometer	
13	Mini Project: Construction and Study of Solenoid and measurement of its magnetic field	

Keywords:	Multimeter, Capacitance Comparison, Magnetic Field, RC Circuit, Series LCR Circuit, Parallel LCR Circuit, Low Resistance Measurement, Electrical Theorems

SignatureofConvener&Members (CBoS) :

PART – C: LEARNING RESOURCES

Text Books, Reference Books and Others

Text Books Recommended-

1. Engineering Practical Physics, S.Panigrahi&B.Mallick,2015, Cengage Learning India Pvt. Ltd.
2. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
3. Unified Practical Physics : R P Goyal, Shivlal Agrawal & Sons
4. Unified Practical Physics: YugbodhPrakashan
5. Unified Practical Physics: NavbodhPrakashan

Reference Books Recommended-

1. Basic Electrical and Electronics Engineering by S. K. Bhattacharya
2. A Textbook of Electrical Technology by B.L. Theraja and A.K. Theraja (Volumes 1 and 2)
3. Engineering Circuit Analysis by William H. Hayt, Jack E. Kemmerly, and Steven M. Durbin
4. Practical Physics by G.L. Squires

Online Resources (e-books/ learning portals/ other e-resources)

1. Link for e-Books for Physics: Physics Practical:
   https://www.uou.ac.in/sites//default/files/slm/BSCPH-104.pdf
2. Virtual Lab :https://vlab.amrita.edu/index.php?sub=1&brch=192
3. http://emv-au.vlabs.ac.in/#
4. https://www.ae.msstate.edu/vlsm/
5. https://nationalmaglab.org/magnet-academy/watch-play/interactive-tutorials
6. https://jigyasa-csir.in/cgcri/n12-t4-a3/

PART – D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:
Maximum Marks: 50 Marks
Continuous Internal Assessment(CIA):15 Marks
EndSemester Exam(ESE):35 Marks

Continuous InternalAssessment(CIA): (By Course Teacher)	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance –**05** Total Marks - **15**	Better marks out of the two Test / Quiz **+Marks** obtained in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory Performance: On spot Assessment** **Performed the Task based on lab. work - 20 Marks** **Spotting based on tools & technology (written) –10 Marks** **Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS:

10/6/24

FOUR YEARS UNDERGRADUATE PROGRAM (2024-28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART – A: INTRODUCTION

Program: Bachelor in Science (Diploma/ Degree/ Honors)	Semester: III	Session: 2024-25

1	Course Code	PHSC-03T		
2	Course Title	Heat and Thermodynamics		
3	Course Type	Discipline Specific Course		
4	Pre-requisite (if any)	As per Program		
5	Course Learning Outcomes (CLO)	After going through the course, the student should be able to: • Demonstrate a deep comprehension of the fundamental principles of thermodynamics, including concepts such as energy, entropy and laws of thermodynamics. • Apply the laws of thermodynamics to analyze and solve problems related with energy transfer, heat engines, refrigeration system and other thermodynamic processes. • Analyze basic aspects of kinetic theory and transport phenomenon in gases.		
6	Credit Value	03 Credits	1 Credit= 15 Hours for Learning &Observation	
7	Total Marks	Maximum Marks: 100		Minimum Pass Marks: 40

PART – B: CONTENT OF THE COURSE

TotalNo.of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**Historical background:** A brief historical background of thermodynamics and statistical physics in the context of India and Indian culture, Contribution of S. N. Bose in Statistical mechanics. **Laws of Thermodynamics:** Thermodynamic Description of system, Zeroth Law of thermodynamics and temperature. First law and internal energy, conversion of heat into work, various Thermodynamical Processes, Work Done during Isothermal and Adiabatic Processes, Reversible & irreversible processes. Second law of thermodynamics & Entropy, Carnot's cycle, Carnot's theorem, Entropy changes in reversible & irreversible processes, Entropy-temperature diagrams, Third law of thermodynamics.	12
II	**Thermodynamic Potentials:** Internal Energy, Enthalpy, Helmholtz Free Energy and Gibbs function. Maxwell's relations & applications, Clausius- Clapeyron Equation, Expression for ($C_P - C_V$), C_P/C_V, TdS equations, Thermodynamic energy equation- change in internal energy of an ideal and Vander Waal's gas, Joule-Thompson Effect, Cooling by adiabatic demagnetization.	11
III	**Kinetic Theory of Gases:** Maxwellian distribution of speeds in an ideal gas: distribution of speeds and velocities, experimental verification, distinction between mean, rms and most probable speed values, Molecular Collision and Mean Free Path. **Transport Phenomena in gases**: Viscosity, Conduction and Diffusion, Law of equipartition of energy.	11
IV	**Theory of Radiation:** Blackbody radiation, Spectral distribution, Concept of Energy Density, Stefan Boltzmann Law, Newton's law of cooling from Stefan Boltzmann's law. Wien's displacement law and Rayleigh-Jeans Law (Only qualitative). Planck's radiation Law, Deduction of Wien's distribution law and Rayleigh- Jeans Law from Planck's law. Experimental verification of Planck's radiation law.	11

Keywords:	Zeroth and First Law of Thermodynamics, Second Law of Thermodynamics,Entropy, Thermodynamic Potentials, Maxwell's Thermodynamic RelationsKinetic Theory of Gases, Distribution of Velocities, Molecular Collisions, Real Gases, Laws of radiation

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PART – C: LEARNING RESOURCES

Text Books, Reference Books and Others

Text Books

1. Heat and Thermodynamics: Singhal, Agrawal and Satya Prakash, Pragati Prakashan 1984
2. Physics (Part-2): Editor, Prof. B.P.Chandra, M.P. Hindi Granth Academy
3. Unified Physics –II ,R.P.Goyal, Shivlal Agrawal &Sons
4. Unified Physics –II. NovbodhPrakashan

Reference Books

1. Thermodynamics, Kinetic theory & Statistical thermodynamics, F.W.Sears&G.L.Salinger. 1988, Narosa
2. Energy Science in Vedas: A Treatise on Vedic Thermodynamics and Free Energy (Exploring Lost Science and Technology in Vedas), Ramesh Kumar Mineria; Priya Veda Publications

Online Resources (e-books/ learning portals/ other e-resources)

1. Basics of thermodynamics *https://www.youtube.com/watch?v=9GMBpZZtjXM&list=PLD8E646BAB3366BC8*
2. Thermodynamics *https://www.youtube.com/watch?v=E9cOAMhFUz0*
3. Second law of thermodynamics *https://www.youtube.com/watch?v=F_flGosPY8o*
4. *NPTEL Online Lectures: https://archive.nptel.ac.in/courses/115/105/115105129/*
5. *https://archive.nptel.ac.in/courses/115/106/115106090/*
6. *https://bsc.hcverma.in/course/penopcyc*
7. Vedic Science and Thermodynamics :*https://www.puranavedas.com/vedic-physics/*
8. *https://www.amazon.in/Vedic-Physics-Raja-Ram-Mohan/dp/0968412009?asin=1988207045&revisionId=&format=4&depth=2*
9. https://ia903100.us.archive.org/3/items/wholelottabooks/The%20Astronomical%20Code%20of%20the%20Rgveda%20-%20Shubash%20Kak.pdf

PART – D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:
Maximum Marks: 100Marks
Continuous Internal Assessment (CIA): 30 Marks
End Semester Examination (ESE): 70 Marks

Continuous Internal Assessment (CIA): (By course teacher)	Internal Test/ Quiz (2): **20~~+20~~** Assignment/ Seminar (1): **10** Total Marks: **30**	Better marks out of the two Test / Quiz+ marks obtained in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20Marks** Section B: Descriptive answer type,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener & Members of CBoS:

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FOUR YEARS UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART – A: INTRODUCTION

Program: Bachelor in Science (Diploma/ Degree/ Honors)		Semester: III	Session: 2024-25
1	Course Code	PHSC- 03P	
2	Course Title	Heat and Thermodynamics	
3	Course Type	Discipline Core Course	
4	Pre-requisite (if any)	As per Program	
5	Course Learning Outcomes (CLO)	➢ Lab Proficiency: Thermometers, pressure gauges, calorimeters, heat transfer apparatus, experimental setup, data acquisition. ➢ Hands-on Learning**: Heat transfer, work done, entropy, phase transitions, experiments. ➢ Data Analysis: Experimental data, theoretical discrepancies, analysis. ➢ Predictive Skills: Thermodynamic behavior, varying conditions, experimentation. ➢ Theory-Practice Integration: Theoretical knowledge, practical lab work, synthesis, applications.	
6	Credit Value	01 Credit	1 Credit = 30 HoursLaboratory Work
7	Total Marks	Maximum Marks: 50	Minimum Pass Marks: 20

PART – B: CONTENT OF THE COURSE

TotalNo.of learning-Training/performance Periods -30 Periods (30 Hours)

Sr. No.	Objects (At least 10 of the following or related Experiments)	No. of Periods
1	To determine the thermal conductivity of a non-conducting material by Lee's disc method.	30
2	To study the variation of thermo emf across two junctions of a thermocouple with temperature.	
3	To verify Newton's law of cooling.	
4	To determine the temperature co-efficient of resistance by Platinum resistance thermometer.	
5	To determine the coefficient of thermal conductivity(k) of a rubber tube.	
6	To study the heat efficiency of an electric kettle with varying voltage.	
7	To determine the ratio of specific heat at constant pressure and constant volume (γ=Cp/Cv) of air Clement and Desorme's method.	
8	To determine the coefficient of thermal conductivity of copper by Searle's Apparatus.	
9	To study the variation of thermos-Emf of thermos couple with Difference of Temperature of its Two Junctions.	
10	To determine Mechanical Equivalent of Heat, J, by Callender and Barne's constant flow method.	
11	Measurement of Planck's constant using black body radiation.	
12	To determine Stefan's Constant.	

Keywords: Thermal conductivity, Thermocouple, Newton's law of cooling, Temperature coefficient of resistance, Heat efficiency, Specific heat ratio, Mechanical equivalent of heat, Planck's constant

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PART – C: LEARNING RESOURCES

Text Books, Reference Books and Others

Text Books Recommended-

1. Advanced Practical Physics for students, B.L.Flint&H.T.Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
3. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
4. A Laboratory Manual of Physics for Undergraduate Classes, D.P. Khandelwal, 1985, Vani Publication.
5. Unified Practical Physics B.Sc II : R P Goyal, Shivlal Agrawal &Sons Publications

Reference Books Recommended-

1. Practical Physics by C.L. Arora
2. Practical Physics by S.L. Gupta and Vijay Kumar
3. Advanced Practical Physics for Students by B.L. Worsnop and H.T. Flint

Online Resources (e-books/ learning portals/ other e-resources)

Link for e-Books for Physics Practicaland Virtual labs

1. Thermal Physics and Statistical Mechanics: Laboratory Collectionhttps://egyankosh.ac.in/handle/123456789/67450
2. Virtual Lab :https://vlab.amrita.edu/index.php?sub=1&brch=194
3. https://vlab.amrita.edu/index.php?sub=1&brch=194&sim=802&cnt=1
4. https://vlab.amrita.edu/index.php?sub=1&brch=194&sim=801&cnt=4
5. https://srmap.edu.in/seas/physics-virtual-lab/
6. https://sites.google.com/view/vlab-bnmitmech/home/heat-transfer-lab
   https://www.pbslearningmedia.org/resource/lsps07-sci-phys-thermalenergy/thermal-energy-transfer/#.WdJiOJIrLIU

PART – D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:
Maximum Marks: 50 Marks
Continuous Internal Assessment(CIA):15 Marks
EndSemester Exam(ESE):35 Marks

Continuous InternalAssessment(CIA): (By Course Teacher)	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance –**05** Total Marks - **15**	Better marks out of the two Test / Quiz **+Marks** obtained in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory Performance: On spot Assessment** **Performed the Task based on lab. work - 20 Marks** **Spotting based on tools & technology (written) – 10 Marks** **Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS:

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FOUR YEARS UNDERGRADUATE PROGRAM (2024-28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART – A: INTRODUCTION			
Program: Bachelor in Science (Diploma/ Degree/ Honors)		Semester: IV	Session: 2024-25
1	Course Code	PHSC-04T	
2	Course Title	Waves and Optics	
3	Course Type	Discipline Specific Course	
4	Pre-requisite (if any)	As per Program	
5	Course Learning Outcomes (CLO)	After going through the course, the student should be able to: ➢ Analyze the behavior of waves propagating through different mediums and predict how factors such as density, elasticity, and temperature affect wave propagation. ➢ Demonstrate an understanding of interference phenomena, including constructive and destructive interference, and apply this knowledge to solve problems involving wave superposition. ➢ Explain the concept of diffraction and its implications for wave propagation, including how waves bend around obstacles and spread out after passing through narrow openings. ➢ Describe the polarization of waves, including linear, circular, and elliptical polarization, and apply polarization concepts to analyze and manipulate electromagnetic waves.	
6	Credit Value	03 Credits	1 Credit= 15 Hours - Learning &Observation
7	Total Marks	Maximum Marks: 100	Minimum Pass Marks: 40

PART – B: CONTENT OF THE COURSE

TotalNo.of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**Contribution of C. V. Raman:** Brief biography of C. V. Raman with his contribution in field of acoustics and optics. **Waves in Medium:** Speed of transverse waves on uniform string, Speed of longitudinal waves in a fluid, Energy density and energy transmission in waves. Group velocity and phase velocity and relationship between them. **Reflection, refraction and diffraction of sound:** Acoustic impedance of a medium, percentage reflection & refraction at a boundary, diffraction of sound, principle of a sonar system.	11
II	**Interference:** Principle of superposition, Division of wavefront and division of amplitude, Young's Double Slit experiment. Fresnel's Biprism, Phase change on reflection, Stokes' treatment. Interference in Thin Films: parallel and wedge-shaped films. Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes). Newton's Rings, measurement of wavelength and refractive index. Michelson's Interferometer, Formation of fringes, Determination of wavelength, Wavelength difference.	12
III	**Diffraction:** Fresnel Diffraction; Half-period zones. Zone plate. Fresnel Diffraction pattern of a straight edge, a slit and a wire using half-period zone analysis. Fraunhofer diffraction; Single slit, Double slit. Multiple slits & Plane Diffraction Grating, Resolving Power of Grating.	11
IV	**Polarization:** Polarized light and its mathematical representation, Electromagnetic theory of double refraction, Nicol Prism, Double image prism, Polaroid, Phase retardation plates, Circular and elliptical polarization. Polarization by double refraction and Huygens's theory, Rotation of plane of polarization, Biquartz polarimeter.	11
Keywords:	*Longitudinal and transverse waves, principle of superposition, Haidinger Fringes, Fresnel Diffraction, Fraunhofer diffraction, Polarization*	

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PART – C: LEARNING RESOURCES

Text Book, Reference Book and Others

Text Books Recommended-

1. Berkely Physics Course: Vol.-III, 'Waves and Oscillations'
2. Principles of Optics, B.K. Mathur, 1995, Gopal Printing
3. Fundamentals of Optics, H.R. Gulati and D.R. Khanna, 1991, S. Chand Publication
4. Physical Optics, A.K. Ghatak
5. Unified Physics- II, R. P. Goyal, Shivlal Agrawal Publications
6. Unified Physics- II, Navbodh Publications

Reference Books Recommended

1. Concepts of Physics by H.C. Verma
2. Fundamentals of Physics by R. Shankar
3. Optics by Ajoy

Online Resources (e-books/ learning portals/ other e-resources)

1. Wave an introductionhttps://youtu.be/SuQE7eUEriU
2. Interference https://youtu.be/hvpYKPyT-vc
3. Diffraction https://youtu.be/3RZZQvEVrEA
4. Polarization https://youtu.be/nELYaf_N528
5. Waves and Oscillations- https://archive.nptel.ac.in/courses/115/106/115106119/
6. Optics- https://archive.nptel.ac.in/courses/115/107/115107131/

PART – D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:
Maximum Marks: 100Marks
Continuous Internal Assessment (CIA):30 Marks
End Semester Examination (ESE): 70 Marks

Continuous Internal Assessment (CIA): (By course teacher)	Internal Test/ Quiz (2): **20+20**Assignment/ Seminar (1): **10** Total Marks: **30**	Better marks out of the two Test / Quiz + marks obtained in Assignment shall be considered against **30** Marks
End Semester Examination (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20Marks** Section B: Descriptive answer type,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener & Members of CBoS:

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FOUR YEARS UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART – A: INTRODUCTION

Program: Bachelor in Science (Diploma/ Degree/ Honors)		Semester: IV	Session: 2024-25
1	Course Code	PHSC- 04P	
2	Course Title	Waves and Optics	
3	Course Type	Discipline Specific Course	
4	Pre-requisite (if any)	As per program	
5	Course Learning Outcomes (CLO)	After the completion of the course, Students are expected to understand laws and principles behind various optical phenomena, specially related to wave nature of light. The students will also be able to ➢ Gain proficiency in operating laboratory equipment such as light source i.e. mercury, sodium and Laser, spectrometers, polarimeter, demonstrating competence in setting up experiments, calibrating instruments, and collecting accurate data. ➢ Develop a deep understanding of optical principles such as refraction, diffraction, dispersion, and interference, as well as their applications in various scientific disciplines ➢ Analyze recorded data and formulate it to get desired results.	
6	Credit Value	01 Credit	1 Credit = 30 HoursLaboratory Work
7	Total Marks	Maximum Marks: 50	Minimum Pass Marks: 20

PART – B: CONTENT OF THE COURSE

TotalNo.of learning-Training/performance Periods -30 Periods (30 Hours)

Sr. No.	Objects (At least 10 of the following or related Experiments)	No. of Period
1	To determine the Frequency of AC mains with the help of Sonometer.	30
2	Determination of angle of prism using spectrometer.	
3	To determine the Refractive Index of the Material of a given Prism using Spectrometer.	
4	To determine Dispersive Power of the Material of a given Prism using Spectrometer	
5	To determine the value of Cauchy Constants of a material of a prism.	
6	To determine the Resolving Power of a Prism.	
7	To determine wavelength of sodium light using Fresnel Biprism.	
8	To determine wavelength of sodium light using Newton's Rings Method.	
9	To determine the wavelength of Laser light using Single Slit Diffraction.	
10	To determine wavelength of Sodium light by laser diffraction.	
11	To determine wavelength of spectrum of Mercury light using plane diffraction Grating and Spectrometer.	
12	To determine the Resolving Power of a Plane Diffraction Grating.	
13	To determine the thickness of a thin paper by measuring the width of the interference fringes produced by a wedge-shaped Film.	
14	Determination of resolving power telescope.	
15	Study of polarization of sugar solution using polarimeter.	

Keywords: Waves Motion – General, Velocity of Waves, Wave Optics, Interference, Interferometer, Diffraction, Polarization, Spectrometer.

SignatureofConvener&Members (CBoS) :

PART – C: LEARNING RESOURCES

Text Books, Reference Books and Others

Text Books Recommended

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House
2. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
4. A Laboratory Manual of Physics for undergraduate classes, D.P.Khandelwal, 1985, Vani Pub.
5. Practical Physics B.Sc II : R P Goyal, Shivlal Publications

Reference*Books Recommended*

1. Practical Physics by S.L. Gupta and V. Kumar
2. Advanced Practical Physics for Students by B.L. Worsnop and H.T. Flint
3. B.Sc. Practical Physics by C.L. Arora
4. Experimental Physics: Modern Methods by R.A. Dunlap

Online Resources (e-books/ learning portals/ other e-resources)

1. Link for e-Books for Physics:Physics Practical: https://egyankosh.ac.in/handle/123456789/82374; https://www.lightandmatter.com/lab_223.pdf;
2. Virtual Lab : https://vlab.amrita.edu/index.php?sub=1&brch=281
3. https://www.compadre.org/books/?ID=70&FID=63273
4. https://www.edutech.com/category/higher-education/engineering-labs/virtual-labs-1
5. https://phet.colorado.edu/en/simulations/wave-interference
6. https://egyankosh.ac.in/handle/123456789/82374

PART – D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:
Maximum Marks: 50 Marks
Continuous Internal Assessment(CIA):15 Marks
EndSemester Exam(ESE):35 Marks

Continuous InternalAssessment(CIA): (By Course Teacher)	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance –**05** Total Marks - **15**	Better marks out of the two Test / Quiz **+Marks** obtained in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory Performance: On spot Assessment** **Performed the Task based on lab. work - 20 Marks** **Spotting based on tools & technology (written) – 10 Marks** **Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS:

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FOUR YEARS UNDERGRADUATE PROGRAM (2024-28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART – A: INTRODUCTION

Program: Bachelor in Science *(Degree/ Honors)*		Semester: V	Session: 2024-25
1	Course Code	PHSC-05T	
2	Course Title	Introduction to Quantum Mechanics	
3	Course Type	Discipline Specific Course	
4	Pre-requisite (if any)	As per Program	
5	Course Learning Outcomes (CLO)	At the end of this course, the students will be able to: ➢ Explain the basic postulates of quantum mechanics ➢ Explain the concept of the wave packet ➢ Describe the principle of Heisenberg's uncertainty principle and its applications ➢ Gain knowledge about physical quantities as operators ➢ Apply the Schrodinger equation to various quantum systems	
6	Credit Value	03 Credits	1 Credit = 15 Hours - Learning & Observation
7	Total Marks	Maximum Marks: 100	Minimum Pass Marks: 40

PART – B: CONTENT OF THE COURSE

Total No. of Teaching-learning Periods (01 Hr. per period) – 45 Periods (45 Hours)

Unit	Topics	No. of Period
I	**Wave-particle duality:** Limits of classical mechanics, Theoretical and experimental consequences and their explanation such as black body radiation, Planck's law, Photoelectric effect, Compton's effect, Specific heat of solids at low temperatures, wave-particle duality and demonstration of matter waves, Bohr's complementary principle and correspondence principle, Concept of the wave packet and its spread with time, Gaussian wave packet, Phase and Group velocity, de-Broglie wavelength using phase velocity and group velocity.	12
II	**Uncertainty principle:** Heisenberg uncertainty principle (Uncertainty relations involving Canonical pair of variables), Experiments for the verification of uncertainty principle, mathematical derivation of uncertainty principle for the one-dimensional wave packet, Applications and consequences of the uncertainty principle.	10
III	**Schrodinger equation:** Representation of dynamic variables by operators (operators for the position, momentum, energy, angular momentum), Schrodinger's wave equation, Wave function, Probabilistic interpretation of wave function, Probability current densities in one dimension, Equation of continuity, Normalization of wave function, Orthogonality property of wave function, Expectation value of dynamical variables, Ehrenfest's theorem, Postulates of Quantum Mechanics.	11
IV	**Application of Schrodinger wave-equation** Solution for free particle, Free particle in a box and density of states, Transmission through potential step, Rectangular potential barrier and tunnelling phenomena, Linear harmonic oscillator with the concept of zero-point energy and parity, Schrodinger equation in spherical polar co-ordinates, spherical symmetric potential, energy states of hydrogen using Schrodinger equation.	12

Keywords:	Black body radiation, Planck's, Photoelectric effect, de-Broglie wavelength, Uncertainty principle, Schrodinger equation.

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PART – C: LEARNING RESOURCES

Text Books, Reference Books and Others

Text Books *Recommended*

1. Unified Physics- III, R. P. Goyal, Shivlal Agrawal Publications
2. Unified Physics- III, Navbodh Publications

Reference Books*Recommended*

1. Quantum Physics, Berkeley Physics Course Vol.4. E.H. Wichman, 2008, Tata McGraw-Hill Co.
2. Modern Physics, G. Kaur and G.R. Pickrell, 2014, McGraw Hill
3. Quantum Mechanics: Theory & Applications, A.K.Ghatak&S.Lokanathan, 2004, Macmillan

Online Resources (e-books/ learning portals/ other e-resources)

1. All e-books of physics https://www.e-booksdirectory.com/listing.php?category=2
2. Free physics textbook in PDFhttps://www.motionmountain.net/?gclid=CjwKCAjwmq3kBRB_EiwAjkNDp5v8Yy6xK1s0Kma0VR0AWGlichRwFfCC0-vpZK1jrPoEOAnBq8fcqRoCILsQAvD_BwE
3. Cambridge University Books for Physics https://www.cambridgeindia.org/
4. Books for solving physics problems https://bookboon.com/en/physics-ebooks
5. NPTEL Online courses: https://onlinecourses.nptel.ac.in/noc21_ph05/preview
6. Quantum Mechanics https://archive.nptel.ac.in/courses/115/101/115101107/
7. Quantum Mechanics https://nptel.ac.in/courses/115106066

PART – D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:
Maximum Marks: 100Marks
Continuous Internal Assessment (CIA): 30 Marks
End Semester Examination (ESE): 70 Marks

Continuous Internal Assessment (CIA): (By course teacher)	Internal Test/ Quiz (2): **20+20** Assignment/ Seminar (1): **10** Total Marks: **30**	Better marks out of the two Test / Quiz + marks obtained in Assignment shall be considered against **30** Marks
End Semester Exam(ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20Marks** Section B: Descriptive answer type, **1 out of 2** from each unit- **4x10 =40 Marks**	

Signature of Convener & Members (CBoS) :

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FOUR YEARS UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART – A: INTRODUCTION				
Program : Bachelor in Science (Degree/ Honours)			**Semester: V**	**Session: 2024-25**
1	Course Code	**PHSC- 05 P**		
2	Course Title	**Introduction to Quantum Mechanics**		
3	Course Type	**Discipline Specific Course**		
4	Pre-requisite (if any)	**As per Program**		
5	Course Learning Outcomes (CLO)	After the completion of the course, get opportunity to perform the following experiments on measurement and verification basicconcepts of Quantum mechanics. The studentsare expected to: ➢ Assemble required parts/devices and arrange them to perform experiments. Record/ observe data as required by the experimental objectives. ➢ Analyze recorded data and formulate it to get desired results. ➢ Interpret results and check for attainment of proposed objectives related to laws of Quantum Mechanics and its applications ➢ Apply the learnt concepts for different problems in laser systems, nuclear physics and EMW related problems.		
6	Credit Value	**01 Credit**	**1 Credit = 30 Hours Laboratory Work**	
7	Total Marks	**Maximum Marks: 50**	**Minimum Pass Marks: 20**	

PART – B: CONTENT OF THE COURSE

Total No.of learning-Training/performance Periods - 30 Periods (30 Hours)

Sr. No.	Objects (At least 10 of the following or related Experiments)	No. of Period
1	Measurement of Planck's constant using black body radiation and photo-detector	30
2	Photo-electric effect: photo current versus intensity and wavelength of light; maximum energy of photo-electrons versus frequency of light	
3	To determine work function of material of filament of directly heated vacuum diode.	
4	To determine the Planck's constant using LEDs of at least 4 different colours.	
5	To determine the wavelength of H-alpha emission line of Hydrogen atom.	
6	To determine the ionization potential of mercury.	
7	To determine the absorption lines in the rotational spectrum of Iodine vapour.	
8	To determine the value of e/m by (a) Magnetic focusing or (b) Bar magnet.	
9	To setup the Millikan oil drop apparatus and determine the charge of an electron.	
10	To show the tunneling effect in tunnel diode using I-V characteristics.	

Keywords: Planck's constant, tunneling effect, Photo-electric effect, spectrum –Rotational and vibrational, e/m

Signature of Convener & Members (CBoS) :

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PART – C: LEARNING RESOURCES

Text Books, Reference Books and Others

Text Books Recommended-

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
3. A Text Book of Practical Physics, I. Prakash& Ramakrishna, 11th Edn, 2011,Kitab Mahal
4. Practical Physics B. Sc III : R P Goyal, Shivlal Publications

Reference Books Recommended-

1. Practical Physics by Dr. Giasuddin Ahmad and Md. Shahabuddin
2. Practical Physics by Dr. Harnam Singh
3. Practical Physics by R. K. Shukla and N. K.

Online Resources (e-books/ learning portals/ other e-resources)

1. Virtual Lab :https://vlab.amrita.edu/?sub=1&brch=195
2. https://mpv-au.vlabs.ac.in/
3. https://mpv-au.vlabs.ac.in/modern-physics/Hall_Effect_Experiment/
4. https://www.falstad.com/qmatomrad/
5. https://www.falstad.com/mathphysics.html : Quantum mechanics

PART – D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:
Maximum Marks: 50 Marks
Continuous Internal Assessment(CIA):15 Marks
End Semester Exam(ESE):35 Marks

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance – **05** Total Marks - **15**	Better marks out of the two Test / Quiz **+Marks** obtained in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory Performance: On spot Assessment** **Performed the Task based on lab. work - 20 Marks** **Spotting based on tools & technology (written) – 10 Marks** **Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS:

10/6/24

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FOUR YEARS UNDERGRADUATE PROGRAM (2024-28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART – A: INTRODUCTION

Program: Bachelor in Science *(Degree/ Honors)*		Semester: VI	Session: 2024-25
1	Course Code	PHSC-06 T	
2	Course Title	Solid State Physics and Solid State Devices	
3	Course Type	Discipline Specific Course	
4	Pre-requisite (if any)	As per Program	
5	Course Learning Outcomes (CLO)	At the end of this course, the students will be able to: ➢ To give knowledge of some basic electronic components and circuits. Understand the basic principles and industrial applications of semiconductor diode, Zener diode and transistor ➢ Use diodes and transistors in electronic circuits ➢ Understand the construction working and applications of transistor ➢ Understand the construction and working principles of various instruments that are used in the physics laboratory ➢ Gain knowledge on importance of filter a circuit. Describe the working of oscillators	
6	Credit Value	03 Credits	1 Credit = 15 Hours- Learning & Observation
7	Total Marks	Maximum Marks: 100	Minimum Pass Marks:40

PART – B: CONTENTSOF THE COURSE

Total No. of Teaching-learning Periods (01 Hr. per period) – 45 Periods (45 Hours)

Unit	Topics	No. of Period
I	**India Semiconductor Mission** Vision, objectives and schemes of India Semiconductor Mission (ISM). **Crystallography** Amorphous and crystalline solids, Elements of symmetry, seven crystal system, Cubic lattice, crystal planes, Miller indices, Laue's equation for X-ray diffraction, Bragg's law, Bonding in solids, Classification, Cohesive energy of solids, Madelung constant, evaluation of parameters, vibrational modes of one-dimensional monoatomic lattice, Dispersion relation, Brillouin Zone.	11
II	**Introduction to semiconductors** Intrinsic and extrinsic semiconductors, concept of Fermi level, generation and recombination of electron hole pairs in semiconductors, Mobility of electrons and holes, drift and diffusion currents, Carrier Concentration at Normal Equilibrium inIntrinsic Semiconductors, Dependence of Fermi Level on Temperature and Doping Concentration, Temperature Dependence of Carrier Concentrations. **Semiconductor Diodes** p and n type semiconductors, Barrier Formation in PN Junction Diode. Quaiitative Idea of Current Flow Mechanism in Forward and Reverse Biased Diode, PN junction and its characteristics, depletion width and potential barrier, junction capacitance, Structure and working of Zener diode and Tunnel diode.	12

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III	**Opto-electronic devices** Construction, working and applications of LEDs, Photodiode and Solar cell. **Power Supply** Half-wave Rectifier, Full-wave Rectifiers, Central-tapped and Bridge rectifier, Calculation of Ripple Factor and Rectification Efficiency,Zener diode as voltage regulator. Basic idea about capacitor filter, L-section filter and π-section filter.	10
IV	**Transistors:** n-p-n and p-n-p Transistors. Characteristics of CB, CE and CC Configurations. Active, Cutoff, and Saturation Regions. Current gains α, β and γ. Relations between α, β and γ. Load Line analysis of Transistors. DC Load line and Q-point, FET, **Bipolar transistor as amplifier**: h-parameters (low frequency), h-parameter equivalent circuit (CE small signal amplifier), Classification of Amplifiers: Class A, B, and C **Sinusoidal Oscillator** Barkhausen's criterion for Self-sustained oscillations, Determination frequency of RC oscillator. Wein Bridge Oscillator, Hartley oscillator and Phase shift oscillator.	12
Keywords:	Crystalline solids, Miller indices, Bragg's law, semiconductors, Fermi level, junction diodes, transistors, filter circuits, amplifiers, oscillators	

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PART – C: LEARNING RESOURCES

Text Books, Reference Books and Others

Text Books Recommended-

1. Basic electronics (Solid state), B L Thareja
2. Electronics: Fundamentals and Applications, D Chattopadhyay, PC Rakshit
3. Basic Electronics A Simplified Approach, Raghunandan G. H, Chaithanya G. H.
4. Basic Electronics, D.P. Kothari, I. Nagrath
5. Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill.
6. Electronic devices and circuits, S. Salivahanan and N. Suresh Kumar, 2012, Tata Mc-Graw Hill.

Reference Books Recommended-

1. Fundamentals of Solid State Physics by B.S. Saxena, R.C. Gupta, P.N. Saxena
2. Solid State Physics by S.O. Pillai
3. Semiconductor Physics and Devices by K. Purushothaman
4. Electronic Devices and Circuits by S. Salivahanan, N. Suresh Kumar
5. Optoelectronics and Optical Communication by B.P. Singh, Rekha Singh
6. Basic Electronics and Linear Circuits by N.N. Bhargava, D.C. Kulshreshtha, S.C. Gupta
7. Electronic Devices and Circuits by J.B. Gupta
8. Principles of Electronics by V.K. Mehta, Rohit Mehta

Online Resources (e-books/ learning portals/ other e-resources)

1. https://nptel.ac.in/courses/122106025
2. https://archive.nptel.ac.in/courses/108/101/108101091/
3. http://www.digimat.in/nptel/courses/video/117103063/L31.html
4. https://archive.nptel.ac.in/courses/117/103/117103063/

PART – D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:

Maximum Marks: 100 Marks

Continuous Internal Assessment (CIA): 30 Marks

End Semester Examination (ESE) : 70 Marks

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test/ Quiz (2): **20+20** Assignment/ Seminar (1): **10** Total Marks: **30**	Better marks out of the two Test / Quiz + marks obtained in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type, **1 out of 2** from each unit- **4x10 =40 Marks**	

Name and Signature of Convener & Members of CBoS:

10.06.24

FOUR YEARS UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART – A: INTRODUCTION

Program: Bachelor in Science (Degree/ Honors)	Semester: VI	Session: 2024-25

1	Course Code	PHSC- 06 P	
2	Course Title	Solid State Physics and Solid State Devices	
3	Course Type	Discipline Specific Course	
4	Pre-requisite (if any)	As per Program	
5	Course Learning Outcomes (CLO)	After the completion of the course, the students are expected to: ➢ Assemble required parts/devices and arrange them to perform experiments. Record/ observe data as required by the experimental objectives. ➢ Analyse recorded data and formulate it to get desired results. ➢ Interpret results and check for attainment of proposed objectives related to theory of semiconductors. ➢ Apply theory and principle of semiconductors for various device applications ➢ Verify various I/P, O/P and other characteristics of various semiconductor (solid state) devices and interpret the phenomena.	
6	Credit Value	01 Credit	1 Credit = 30 Hours Laboratory Work
7	Total Marks	Maximum Marks: 50	Minimum Pass Marks: 20

PART – B: CONTENT OF THE COURSE

Total No. of learning-Training/performance Periods - 30 Periods (30 Hours)

Sr. No.	Objects (At least 10 of the following or related Experiments)	No. of Periods
1	To measure the resistivity of a semiconductor (Ge) with temperature by four-probe method (room temperature to 150°C) and to determine its band gap.	30
2	To determine the Hall coefficient of a semiconductor sample.	
3	To study V-I characteristics of PN junction diode, and Light emitting diode.	
4	To study the V-I characteristics of a Zener diode and its use as voltage regulator.	
5	Study of V-I & power curves of solar cells, and find maximum power point & efficiency.	
6	To study the characteristics of a Bipolar Junction Transistor in CE configuration.	
7	To study the various biasing configurations of BJT for normal class A operation.	
8	To design a CE transistor amplifier of a given gain (mid-gain) using voltage divider bias.	
9	To study the frequency response of voltage gain of a RC-coupled transistor amplifier.	
10	To design and study a Wien bridge oscillator.	
11	To design a phase shift oscillator of given specifications using BJT.	
12	To study the Colpitt`s oscillator.	

Keywords:	Semiconductor Resistivity, Hall Coefficient, Diode Characteristics, Zener Diode Voltage Regulation, Solar Cell Efficiency, Bipolar Junction Transistor (BJT), BJT Biasing Configurations, Oscillator Design

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PART – C: LEARNING RESOURCES

Text Books, Reference Books and Others

Text Books Recommended

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
3. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
4. Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India.
5. Practical Physics B.Sc III : R P Goyal, Shivlal Agrawal Publications

Reference Books Recommended-

1. Semiconductor Physics and Devices by Donald A. Neamen
2. Electronic Devices and Circuit Theory by Robert L. Boylestad and Louis Nashelsky
3. Microelectronic Circuits by Adel S. Sedra and Kenneth C. Smith
4. Practical Electronics for Inventors by Paul Scherz and Simon Monk

Online Resources (e-books/ learning portals/ other e-resources)

1. Virtual Lab : https://vlab.amrita.edu/?sub=1&brch=282
2. https://vlab.amrita.edu/index.php?sub=1&brch=282&sim=370&cnt=3
3. https://bop-iitk.vlabs.ac.in/exp/energy-band-gap/simulation.html
4. http://vlabs.iitkgp.ac.in/ssd/index.html#
5. http://vlabs.iitkgp.ac.in/psac/newlabs2020/ssds/#
6. https://ae-iitr.vlabs.ac.in/List%20of%20experiments.html
7. https://da-iitb.vlabs.ac.in/List%20of%20experiments.html

PART – D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance – **05** Total Marks - **15**	Better marks out of the two Test / Quiz **+Marks** obtained in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory Performance: On spot Assessment** **Performed the Task based on lab. work - 20 Marks** **Spotting based on tools & technology (written) – 10 Marks** **Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

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FOUR YEARS UNDERGRADUATE PROGRAM (2024-28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART – A: INTRODUCTION				
Program: Bachelor in science *(Honors/Honors with Research)*			**Semester: VII**	**Session: 2024-25**
1	Course Code	**PHSC-07**		
2	Course Title	**Classical Mechanics**		
3	Course Type	**Discipline Specific Course**		
4	Pre-requisite (if any)	**As per Program**		
5	Course Learning Outcomes (CLO)	At the end of this course, the students will be able to: ➢ The ideas and concepts in classical physics ➢ Explain Newtonian Mechanics, Lagrangian, and Hamiltonian formulation ➢ Gain knowledge about central force problems and its application in scattering phenomena ➢ Explain small oscillations and its applications. Apply mechanics to solve various physical problems		
6	Credit Value	**04 Credits**	**1 Credit = 15 Hours for Learning & Observation**	
7	Total Marks	**Maximum Marks: 100**	**Minimum Pass Marks: 40**	

PART – B: CONTENT OF THE COURSE

Total No. of Teaching-learning Periods (01 Hr. per period) – 60 Periods (60 Hours)

Unit	Topics	No. of Period
I	**Preliminaries of classical mechanics** Review of Newtonian Mechanics; Conservation laws; Constraints and their classification; Principle of virtual work; Generalized coordinates and velocities, D' Alembert's principle, Lagrangian and the Euler-Lagrangeequations, Simple applications of Lagrangian formulation, Hamilton's principle, Lagrange's equation from Hamilton's principle; Legendre transformations and Hamilton's equation of motion; Hamilton's equation from Hamilton's principle; The principle of least action simple applications of Hamiltonian formulation; Conservation theorems, cyclic coordinates and symmetry properties	15
II	**Canonical transformations and relativistic mechanics** Canonical transformations; Poisson's Bracket; equation of motion and Conservation theorems in the Poisson Bracket formulation; Hamilton Jacobi (HJ) theory; Harmonic oscillator as an example of HJ method Four vectors; Four velocity and acceleration; Lorentz Covariant form of equation of motion.	15
III	**Central forces** Two-body central force problems and their reduction to the equivalent one-body problem; The equations of motion and first integrals; one-dimensional problems and classification of orbits; The differential equation of the orbit, Closure and stability of orbits; Kepler's laws and planetary motion; Scattering in central force; Rutherford's scattering	15
IV	**Rigid body and Periodic motion** Euler's angles, Euler's theorem on the motion of a rigid body; The Coriolis force; The Euler equations of motion of rigid bodies; Small oscillations; normal modes; Formulation of the problem of small oscillations; Vibrating string; normal vibrations; dispersion; Coupled vibrating systems, free vibration of a linear triatomic molecule.	15

Keywords:	Newtonian Mechanics, Lagrangian formulation, Hamiltonian formulation, Poisson's bracket, central force problems, small oscillations

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PART – C: LEARNING RESOURCES

Text Books, Reference Books and Others

Text Books Recommended-

1. Classical Mechanics by Herbert Goldstein, Charles Poole, and John Safko
2. Mechanics by L.D. Landau and E.M. Lifshitz
3. Classical Mechanics: Systems of Particles and Hamiltonian Dynamics by Walter Greiner
4. Introduction to Classical Mechanics: With Problems and Solutions by David Morin
5. Classical Dynamics of Particles and Systems by Jerry B. Marion and Stephen T. Thornton
6. Classical Mechanics by R. Douglas Gregory
7. Analytical Mechanics by Grant R. Fowles and George L. Cassiday

Reference Books Recommended

1. Classical Mechanics, H. Goldstein, C.P. Poole, J.L. Safko, 3rd Edn. 2002, Pearson Education.
2. Classical Mechanics, P.S. Joag, N.C. Rana, 1st Edn., McGraw Hall.
3. Classical Mechanics, R. Douglas Gregory, 2015, Cambridge University Press.
4. Classical Mechanics: An Introduction, Dieter Strauch, 2009, Springer.

Online Resources (e-books/ learning portals/ other e-resources)

1. Classical Mechanics-https://archive.nptel.ac.in/courses/115/106/115106123/
2. Classical Mechanics- https://archive.nptel.ac.in/courses/115/105/115105098/
3. Classical Mechanics- https://archive.nptel.ac.in/courses/122/106/122106027/

PART – D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:

Maximum Marks: **100 Marks**
Continuous Internal Assessment (CIA): **30 Marks**
End Semester Examination (ESE): **70 Marks**

Continuous Internal Assessment (CIA): (By course teacher)	Internal Test/ Quiz (2): **20+20** Assignment/ Seminar (1): **10** Total Marks: **30**	Better marks out of the two Test / Quiz + marks obtained in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20Marks** Section B: Descriptive answer type, **1 out of 2** from each unit- **4 x 10 =40 Marks**	

Name and Signature of Convener & Members of CBoS:

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FOUR YEARS UNDERGRADUATE PROGRAM (2024-28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART – A: INTRODUCTION

Program: Bachelor in Science *(Honors/ Honors with Research)*		Semester: VIII	Session: 2024-25
1	Course Code	PHSC-08	
2	Course Title	Quantum Mechanics	
3	Course Type	Discipline Specific Course	
4	Pre-requisite (if any)	As per Program	
5	Course Learning Outcomes (CLO)	At the end of this course, the students will be able to: ➢ Explore uncertainty relations and states with minimum uncertainty. Learn and apply commutation relationships ➢ Master matrix representation of operators and solve the harmonic oscillator. Comprehend angular momentum in quantum mechanics. ➢ Explore spin angular momentum and Pauli's matrices. Master the concept of Clebsch- Gordon coefficients. ➢ Analyze central force problems and spherically symmetric potentials in 3D. Explore parity, square-well potentials, and hydrogen atom solutions	
6	Credit Value	04 Credits	1 Credit = 15 Hours- Learning & Observation
7	Total Marks	Maximum Marks: 100	Minimum Pass Marks: 40

PART – B: CONTENT OF THE COURSE

Total No. of Teaching-learning Periods (01 Hr. per period) – 60 Period (60 Hours)

Unit	Topics	No. of Period
I	Super position principle, State with minimum uncertainty product, commutation relationship, completeness and normalization of eigen functions, Dirac-delta function,Bra& Ket notation, matrix representation of an operator, harmonic oscillator and its solutionby matrix method, Heisenberg equation of motion.	15
II	Angular momentum in quantum mechanics, matrix representation of angular momentum, commutation relationships of orbital angular momentum, eigen values and eigen functions of L^2 and L_z, Spin angular momentum: basic introduction, Total angular momentum and its commutation relationship, Pauli`s spin matrices, addition of angular momentum, Clebsch-Gordon coefficients. Applied problem based on momentum and positions.	15
III	Central force problem, spherically symmetric potentials in three dimensions, separation of wave equation, parity, three-dimensional square-well potential and energy levels, the hydrogen atom; solution of the radial equation, energy levels and stationery state wave functions, discussion of bound states, degeneracy.	15
IV	Time- independent perturbation theory, non-degenerate case, first order and second perturbations with the example of an oscillator, degenerate cases, removal of degeneracy in second order, Zeeman effect without electron spin, first-order Stark effect in hydrogen, perturbed energy levels, correct eigen function, occurrence of permanent electric dipole moments.	15

Keywords: Uncertainty principle, normalization of wavefunction, angular momentum spherically symmetric potential, Time independent perturbation theory, Zeeman effect

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PART – C: LEARNING RESOURCES

Text Books, Reference Books and Others

Text Books Recommended -

1. Principles of Quantum Mechanics by R. Shankar
2. Modern Quantum Mechanics" by J. J. Sakurai and Jim Napolitano
3. Introduction to Quantum Mechanics" by David J. Griffiths and Darrell F. Schroeter
4. Quantum Mechanics: A Modern Development" by Leslie E. Ballentine
5. Quantum Mechanics by Leonard I. Schiff

Reference Books Recommended -

1. L. I. Schiff : Quantum mechanics (McGraw-Hill).
2. S. Gasiorowicz, Quantum Physics (Wiley).
3. Landau and Lifshitz : Non-relativistic quantum mechanics.
4. B. Crasemanand Z. D. Powell: Quantum mechanics (Addison Wesley)
5. A. P. Messiah : Quantum Mechanics.
6. J. J. Sakurai : Modern Quantum Mechanics.
7. Mathews and Venkatesa: Quantum Mechanics.
8. G. Aruldhas: Quantum Mechanics (II Edition)

Online Resources (e-books/ learning portals/ other e-resources)

1. All e-books of physics https://www.e-booksdirectory.com/listing.php?category=2
2. Free physics textbook in PDF https://www.motionmountain.net/?gclid=CjwKCAjwmq3kBRB_EiwAjkNDp5v8Yy6xK1s0Kma0VR0AWGlichRwFfCC0-vpZK1jrPoEOAnBq8fcqRoCILsQAvD_BwE
3. Cambridge University Books for Physics https://www.cambridgeindia.org/
4. Books for solving physics problems https://bookboon.com/en/physics-ebooks
5. NPTEL Online courses: https://onlinecourses.nptel.ac.in/noc21_ph05/preview
6. Quantum Mechanics https://archive.nptel.ac.in/courses/115/101/115101107/
7. Quantum Mechanics https://nptel.ac.in/courses/115106066

PART – D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Examination (ESE):	**70 Marks**

Continuous Internal Assessment (CIA): (By course teacher)	Internal Test/ Quiz (2): Assignment/ Seminar (1): Total Marks:	**20+20** **10** **30**	Better marks out of the two Test / Quiz + marks obtained in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20Marks** Section B: Descriptive answer type, **1 out of 2** from each unit- **4x10 =40 Marks**		

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART-A: INTRODUCTION

Program : Bachelor in Science *(Diploma / Degree/Honors)*	Semester - III	Session: 2024-2025

1	Course Code	PHSE-01		
2	Course Title	Introduction to Statistical Mechanics		
3	Course Type	Discipline Specific Elective		
4	Pre-requisite (if, any)	As per Program		
5	Course Learning. Outcomes(CLO)	➢ Differentiate between macrostate and microstate and calculate their numbers ➢ Comprehend the concept of ensembles and its requirement in study of physical phenomenon ➢ Correlate and compare the classical and quantum statistical distribution laws. ➢ Apply concepts of statistical distribution laws for different physical systems.		
6	Credit Value	4 Credits	*Credit = 15 Hours -learning & Observation*	
7	Total Marks	Max. Marks: 100		Min Passing Marks: 40

PART -B: CONTENT OF THE COURSE

Total No.of Teaching–learning Periods (01 Hr. per period) – 60 Periods (60 Hours)

Unit	Topics (Course Contents)	No. of Period
I	**Maxwellian Distribution of Speeds In An Ideal Gas**: Distribution of speeds and velocity, experimental verification, distinction between mean, rms and most probable speeds, Doppler broadening of spectral lines, transport phenomena in gases: molecular collision, collision cross section, estimates of molecular diameter and mean free path; transport of mass , momentum and energy and inter-relationship, dependence on temperature and pressure. **Behaviour of Real Gases** :deviation from ideal gas equation, the Virial equation, Andrew's experiment on CO_2 gas; critical constants.	15
II	**Macrostate & Microstate** Macrostate, Microstate, Number of accessible microstates and Postulate of equal a priori. **Concept of Ensemble:** Concept of Gibb's ensemble, postulate of ensemble average, Micro Canonical, Canonical & Grand Canonical ensembles. Thermodynamic Probability, Postulate of Equilibrium and Boltzmann Entropy relation. Phase space, Phase trajectory, Volume element in phase space, Quantization of phase space and number of accessible microstates for free particle in 1D, free particle in 3D.	15

III	**Transition to quantum statistics:** h as a natural constant and its implications, cases of particle in 1D and 1Dimensional harmonic oscillator, **Quantum Statistical Distribution Laws:** In-distinguishability of particles and its consequences, Bose-Einstein & Fermi Dirac statistics. Comparison of statistical distribution laws and their physical significance. Canonical Distribution Law: Boltzmann's Canonical Distribution Law, Boltzmann's Partition Function, Proof of Equipartition Theorem (Law of Equipartition of energy) and relation between Partition function and Thermodynamic potentials.	15
IV	**Bose-Einstein Distribution Law and its Applications:** Bose-Einstein Statistics: Heat capacity, Bose Einstein condensation, Radiation as a photon gas, Quantum Theory of Radiation: Spectral Distribution of Black Body Radiation. Planck's Quantum Postulates. Planck's Law of Blackbody Radiation: Deduction of (1) Wien's Distribution Law, (2) Rayleigh-Jeans Law, (3) Stefan-Boltzmann Law, (4) Wien's Displacement law from Planck's law **Fermi-Dirac Distribution Law and its Applications:** Free electrons in a metal, Definition of Fermi energy, Determination of Fermi energy at absolute zero, Kinetic energy of Fermi gas at absolute zero and concept of Density of States, Specific Heat of Metals (Density of Orbitals).	15
Keywords	Macrostate & Microstate, ensemble, distribution laws, Bose-Einstein Statistics, Fermi-Dirac Statistics	

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PART–C:LEARNING RESOURCES

Text Books, Reference Books and Others

Text Books Recommended –

1. Unified Physics –II, R P Goyal, Shivlal Agrawal & Sons Publication
2. Unified Physics-II, Yugbodh Prakashan
3. Unified Physics-II, Navbodh Prakashan

Reference Books Recommended–

1. F. Reif, "Statistical Physics (In SI Units): Berkeley Physics Course Vol 5", McGraw Hill, 2017
2. B.B. Laud, "Fundamentals of Statistical Mechanics", New Age International Private Limited, 2020
3. B.K. Agarwal, M. Eisner, "Statistical Mechanics", New Age International Private Limited, 2007

Online Resources–e-Resources / e-books and e-learning portals

1. MIT Open Learning - Massachusetts Institute of Technology, https://ocw.mit.edu/courses/8-333-statistical-mechanics-i-statistical-mechanics-of-particles-fall-2013/
2. National Programme on Technology Enhanced Learning (NPTEL), https://archive.nptel.ac.in/courses/115/103/115103113/,
3. https://onlinecourses.nptel.ac.in/noc19_ph10/preview,
4. https://archive.nptel.ac.in/courses/115/106/115106126/
5. Uttar Pradesh Higher Education Digital Library, http://heecontent.upsdc.gov.in/SearchContent.aspx
6. Swayam Prabha - DTH Channel, https://www.swayamprabha.gov.in/index.php/program/current_he/8

PART-D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:
Maximum Marks: 100 Marks
Continuous Internal Assessment(CIA): 30 Marks
End Semester Exam (ESE): 70 Marks

Continuous Internal Assessment(CIA): (By Course Teacher)	Internal Test / Quiz-(2): **20 & 20** Assignment/Seminar- **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – 10 x1= **10** Mark; **Q2**. Short answer type- **5x4 =20Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40Marks**	

Name and Signature of Convener & Members of CBoS:

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FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART-A: INTRODUCTION

Program: Bachelor in Science *(Diploma /Degree/Honors)*	Semester - IV	Session: 2024-2025

1	Course Code	PHSE-02		
2	Course Title	Mathematical Physics-I		
3	Course Type	Discipline Specific Elective		
4	Pre-requisite (if, any)	As per Program		
5	Course Learning Outcomes(CLO)	➢ Revise and apply the knowledge of calculus, vectors, vector calculus, probability and probability distributions in various cases. ➢ Illustrate proficiency in writing and solving Differential equation and solving them for a given physical system. ➢ Apply and interpret the curvilinear coordinates in problems with spherical and cylindrical symmetries. ➢ Use Dirac Delta function for various physical situation, especially in quantum mechanical approaches.		
6	Credit Value	4 Credits	*Credit = 15 Hours -learning & Observation*	
7	Total Marks	Max. Marks: 100		Min Passing Marks: 40

PART -B: CONTENT OF THE COURSE

Total No. of Teaching–learning Periods(01 Hr. per period) – 60 Periods (60 Hours)

Unit	Topics (Course Contents)	No. of Period
I	**Calculus:** **Recapitulation:** Limits, continuity, average and instantaneous quantities, differentiation. Plotting functions, Intuitive ideas of continuous, differentiable, etc. functions and plotting of curves. Approximation: Taylor and binomial series (statements only). **Calculus of functions of more than one variable:** Partial derivatives, exact and inexact differentials. Integrating factor, with simple illustration. Constrained Maximization using Lagrange Multipliers. **Origin and Evolution of Mathematical concepts in Ancient India:** Bhaskaracharya, the Inventor of Calculus: some examples on calculus	16
II	**First Order and Second Order Differential equations:** First Order Differential Equations and Integrating Factor. Homogeneous Equations with constant coefficients. Wronskian and general solution. Statement of existence and Uniqueness Theorem for Initial Value Problems.Particular Integral. **Orthogonal Curvilinear Coordinates:** Orthogonal Curvilinear Coordinates. Derivation of Gradient, Divergence, Curl andLaplacian in Cartesian, Spherical and Cylindrical Coordinate Systems.	16

III	**Introduction to probability**: Independent random variables: Probability distribution functions; binomial, Gaussian, and Poisson, with examples. Mean and variance. Dependent events: Conditional Probability. Bayes' Theorem and the idea of hypothesis testing.	15
IV	**Dirac Delta function and its properties**: Definition of Dirac delta function. Representation as limit of a Gaussian function and rectangular function. Properties of Dirac delta function. Problems based on dirac-delta function and its application	13
Keywords	Calculus, Lagrange Multipliers, Homogeneous Equations, Particular Integral, Probability distribution, Dependent events, Dirac delta function	

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PART–C: LEARNING RESOURCES

Text Books, Reference Books and Others

Text Books Recommended –

1. Advanced Engineering Mathematics, D.G. Zill and W.S. Wright, 5 Ed., 2012, Jones and Bartlett Learning
2. Mathematical Physics, Goswami, 1st edition, Cengage Learning
3. Engineering Mathematics, S. Pal and S.C. Bhunia, 2015, Oxford University Press
4. Advanced Engineering Mathematics, Erwin Kreyszig, 2008, Wiley India.
5. Essential Mathematical Methods, K. F. Riley & M.P.Hobson, 2011, Cambridge Univ. Press.
6. Mathematical Physics, H.K. Dass and R. Verma, S. Chand & Company

Reference Books Recommended–

1. Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris, 2013, 7th Edn., Elsevier.
2. An introduction to ordinary differential equations, E.A. Coddington, 2009, PHI learning
3. Differential Equations, George F. Simmons, 2007, McGraw Hill.
4. Mathematical Tools for Physics, James Nearing, 2010, Dover Publications.

Online Resources–e-Resources / e-books and e-learning portals

1. NPTEL online Courses: https://archive.nptel.ac.in/courses/115/105/115105097/
2. NPTEL online Courses: https://nptel.ac.in/courses/115103036
3. e-gyankosh- https://egyankosh.ac.in/handle/123456789/97951
4. Origin and Evolution of Calculus in India: http://mathematical-forum.org/wp-content/uploads/2021/01/Paper-1.pdf
5. https://iks.iitgn.ac.in/wp-content/uploads/2016/02/Development-of-Calculus-in-India-K-Ramasubramanian-MD-Srinivas-2010.pdf
6. Indian Mathematics: NPTEL Course : https://nptel.ac.in/courses/111101080

PART-D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Exam (ESE):	**70 Marks**

Continuous Internal Assessment(CIA): (By Course Teacher)	Internal Test / Quiz-(2): **20 & 20** Assignment/Seminar- **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – 10 x1= **10** Mark; **Q2**. Short answer type- **5x4 =20Marks** Section B: Descriptive answer type qts.,**1 out of 2** from each unit-**4x10=40Marks**	

Name and Signature of Convener & Members of CBoS:

10/6/22

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART-A: INTRODUCTION			
Program: Bachelor in Science *(Degree/Honors)*		Semester - V	Session: 2024-2025
1	Course Code	PHSE-03	
2	Course Title	Nuclear Physics	
3	Course Type	Discipline Specific Elective	
4	Pre-requisite (if, any)	*As per Program*	
5	Course Learning. Outcomes (CLO)	➢ Describe nuclear constituents and their intrinsic properties.Analyze binding energy variations with mass number and understand the N/Z plot. ➢ Explain and apply nuclear models for clear understanding of stability of nuclei and nuclear processes.Differentiate alpha, beta, and gamma decay and interpret energy spectra. ➢ Apply conservation laws to compute Q-values, and analyze reaction mechanism.Explain significance of scattering and reaction cross section. ➢ Calculate and compare nuclear fission and fusion energy.Describe nuclear detectors and particle accelerators. ➢ Gain insights into cutting-edge research, accelerator technology, and interdisciplinary applications and apprehend the role of accelerators in advancing scientific knowledge and contributing to societal well-being.	
6	Credit Value	4 Credits	*Credit = 15 Hours - learning & Observation*
7	Total Marks	Max. Marks: 100	Min Passing Marks: 40

PART -B: CONTENT OF THE COURSE

Total No. of Teaching–learning Periods (01 Hr. per period) – 60 Periods (60 Hours)

Unit	Topics (Course Contents)	No. of Period
I	**General Properties of Nuclei:** Constituents of nucleus and their Intrinsic properties, quantitative facts about mass, radii, charge density (matter density), binding energy, average binding energy and its variation with mass number, main features of binding energy versus mass number curve, N/A plot, angular momentum, parity, magnetic moment, electric moments.	15
II	**Nuclear Models:** Liquid drop model approach, semi empirical mass formula and, significance of its various terms, condition of nuclear stability, two nucleon separation energies, Fermi gas model, evidence for nuclear shell structure, nuclear magic numbers, basic assumption of shell model, concept of mean field.	15

III	**Nuclear decay and Reactions:** Alpha, beta, gamma decay, energy spectrum, Geiger-Nuttel law, disintegration energy, quantum theory of alpha decay, types of beta decay and energy spectrum, Pauli's prediction of neutrino. Types of Reactions, Conservation Laws, kinematics of reactions, Q-value, reaction rate, reaction cross section, Concept of compound and direct Reaction, resonance reaction, Coulomb scattering (Rutherford scattering). **Nuclear Energy Reactions:** Nuclear Fission, Calculation of energy released, Nuclear fusion, Energy released in Fusion, Comparison of Fission and fusion energy, Fusion as source of stellar Energy, Nuclear reactors in India, Contribution of nuclear energy in total energy requirement.	15
IV	**Nuclear Detector and Particle Accelerators:** Interaction of charge particle through matter, Gas detectors: estimation of electric field, mobility of particle, for ionization chamber and GM Counter. Basic principle of Scintillation, Detectors and construction of photo-multiplier tube (PMT), Semiconductor Detectors. Accelerator facility available in India: Van-de Graaff generator, Pelletron accelerator, Linear accelerator, Cyclotron accelerator **Nuclear Accelerators in India:** RRCAT, VECC, BARC TIFR Pelletron Facility, IUC : working, evolution and contribution.	15
Keywords	Properties of Nucleus, Nuclear forces, Nuclear Models, Decay reaction, detectors and accelerators	

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Signature of Convener & Members (CBoS) :

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PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. Introduction to Nuclear and Particle Physics V.K. Mittal, R. C. Verma, S. C. Gupta, Eastern Economy Edition.
2. Basic ideas and concepts in Nuclear Physics - An Introductory Approach by K. Heyde (IOP-Institute of Physics Publishing, 2004)
3. Nuclear Physics by S.N. Ghoshal, S. Chand Publishing, 2019
4. Unified Physics-III by R P Goyal, Shivlal Agrawal & Sons Publication
5. Nuclear Physics -6Ed by D. C. Tayal, Himalaya Publishing House

Reference Books Recommended –

1. Introductory nuclear Physics by Kenneth S. Krane (Wiley India Pvt. Ltd., 2008).
2. Concepts of nuclear physics by Bernard L. Cohen. (Tata Mc-Graw Hill, 1998).
3. Introduction to the physics of nuclei & particles, R.A. Dunlap. (Thomson Asia, 2004).
4. Nuclear Physics An Introduction S. B. Patel New Age International Publishers.

Online Resources– e-Resources / e-books and e-learning portals

1. NPTEL :: Physics - NOC:Nuclear and Particle Physics
2. NPTEL :: Physics - Nuclear Physics: Fundamentals and Applications
3. Fundamentals of Nuclear Power Generation - Course (nptel.ac.in)
4. eGyanKosh: Unit-13 Nuclear Physics
5. eGyanKosh: Block-4 Nuclear Physics
6. NPTEL :: Physics - Nuclear Science & Engineering
7. Official Websites of Raja Ramanna Centre for Advanced Technology (RRCAT),Variable Energy Cyclotron Centre (VECC),BARC–TIFR Pelletron Facility, Inter-University Accelerator Centre (IUAC)

PART -D:vAssessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Exam (ESE):	**70 Marks**

Continuous Internal Assessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2):	**20 & 20**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
	Assignment / Seminar -	**10**	
	Total Marks -	**30**	
End Semester Exam (ESE):	**Two section – A & B**		
	Section A: **Q1**. Objective – 10 x1= **10** Mark; **Q2**. Short answer type- **5x4 =20Marks**		
	Section B: Descriptive answer type qts.,**1 out of 2** from each unit-**4x10=40 Marks**		

Name and Signature of Convener & Members of CBoS:

10/6/19

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART-A: INTRODUCTION

Program : Bachelor in Science *(Degree/Honors)*	Semester - VI	Session: 2024-2025

1	Course Code	PHSE-04 T		
2	Course Title	Numerical Methods and C Programming		
3	Course Type	Discipline Specific Elective		
4	Pre-requisite(if,any)	*As per Program*		
5	Course Learning. Outcomes(CLO)	At the end of this course, the students will be able to: ➢ Analyse the convergence of solutions to numerical methods.Understand the principles of Gaussian elimination, pivoting, and iterative methods to solve linear systems ➢ Use interpolation methods, Perform numerical differentiation and integration using Newton-Cotes formulae ➢ Explain the roles of compilers, interpreters, and operating systems, Learn the basics of C programming		
6	Credit Value	3 Credits	*Credit = 15 Hours -learning & Observation*	
7	Total Marks	Max. Marks : 100		Min Passing Marks:40

PART -B: CONTENT OF THE COURSE

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	Methods for determination of zeroes of linear and nonlinear algebraic equations and transcendental equations, convergence of solutions. Solution of simultaneous linear equations, Gaussian elimination, pivoting, iterative method, matrix inversion, Finite differences, interpolation with equally spaced and unevenly spaced points, curve fitting, polynomial least squares and cubic spline fitting. Numerical differentiation and integration, Newton-Cotes formulae, error estimates, Gauss method.	13
II	Numerical solution of ordinary differential equations, Euler and Runga-Kutta methods, Solution of related problems, Predictor-corrector method, Solution of related problems, Elementary ideas of solutions of partial differential equations	10
III	Problem analysis and solving scheme. Computational procedure, programming outline, flow chart. Branching and looping writing. Character set, constants, (numeric string) variables (numeric string) rules for arithmetic expressions and hierarchy of operators, rational expressions, logical expressions, and operators, library functions. Identifiers, qualifiers, define statements, value Initialized variables, operators, and expressions. Operator precedence and associativity. scanf with specifier, search set arrangements and suppression Character, format specifier for scanf. Control structure, if statement, if else statement, multiway decision, compound statement.	10
IV	Loops: for loop, while loop, do while loop, break statement, compound statement continue statement, go to statement, Function - function main, function accepting more than one parameter, user defined and library function concept associatively with functions, function parameter, return value, recursion comparison. Arrays, strings, multidimensional array, array of strings function in string	12

Keywords	Transcendental equations, Ordinary differential equations, Numerical integration, Numerical differentiation, Flow charts, C - Statement.

Signature of Convener & Members (CBoS):

PART–C: LEARNING RESOURCES

Text Books, Reference Books and Others

Text Books Recommended –

1. Numerical Methods for Scientists and Engineers by R. W. Hamming
2. Numerical Methods for Engineers by Steven C. Chapra and Raymond P. Canale
3. Numerical Methods for Scientific and Engineering Computation by M. K. Jain, S. R. K. Iyengar, and R. K. Jain
4. Programming in ANSI C by E. Balagurusamy
5. Let Us C" by Yashavant Kanetkar
6. Numerical Methods and Programming by P. B. Patil and U. P. Verma
7. Numerical Methods with Programs in C by T. Veerarajan and T. Ramachandran
8. Numerical Methods by B S Grewal

Reference Books Recommended –

1. Sastry: Introductory Methods of Numerical Analysis
2. Rajaraman: Numerical Analysis
3. Numerical Methods by Dr. P. Kandasamy, Dr. K Thilagavathy, Dr. K. Gunvanthi
4. Fundamentals of Numerical Methods by Rajeev K Bansal

Online Resources–

e-Resources / e-books and e-learning portals

1. Numerical methods https://archive.nptel.ac.in/courses/111/107/111107105/
2. Numerical analysis https://archive.nptel.ac.in/courses/111/101/111101165/
3. Numerical Methods for Engineers https://archive.nptel.ac.in/courses/127/106/127106019/
4. Introduction to Numerical Methods https://nptel.ac.in/courses/105105043

PART-D:ASSESSMENT ANDEVALUATION

Suggested Continuous Evaluation Methods:

Maximum Marks: **100 Marks**

Continuous Internal Assessment (CIA): **30 Marks**

End Semester Exam (ESE): **70 Marks**

Continuous Internal Assessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2):	**20 +20**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
	Assignment/Seminar-	**10**	
	Total Marks -	**30**	

End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 = 20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit- **4 x 10=40 Marks**

Name and Signature of Convener & Members of CBoS:

10/6/17

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART-A: INTRODUCTION				
Program : Bachelor in Science *(Degree/Honors)*			**Semester - VI**	Session: 2024-2025
1	**Course Code**	**PHSE-04 P**		
2	**Course Title**	**Numerical Methods and C Programming**		
3	**Course Type**	**Discipline Specific Elective**		
4	**Pre-requisite** (if, any)	**As per Program**		
5	**Course Learning. Outcomes(CLO)**	At the end of this course, the students will be able to: ➢ Get experimental Knowledge of computational methods in physics ➢ Learn C language ➢ Use C programming to solve various equations ➢ Perform Interpolation and curve fittings through various tools.		
6	**Credit Value**	**1 Credits**	***Credit =30 Hours Laboratory or Field learning/Training***	
7	**Total Marks**	**Max. Marks:50**		**Min Passing Marks:20**

PART -B: CONTENT OF THE COURSE		
Total No. of learning-Training/performance Periods- 30 Periods (30 Hours)		
Module	**Topics (Course Contents)** **At least 10 of the following or related Experiments**	**No. of Period**
Lab./ Experiment Contents of Course	Any 8 program from the list given below or similar program. 1. To solve Simultaneous Linear equation by Gauss Elimination Method 2. To calculate the root of Transcendental equation by Newton-Raphsons Method 3. Solving the system of Linear simultaneous equation by Gauss-Serdel Method 4. Numerical Integration by Simposon's 1/3 rule 5. Solving simultaneous Linear equation by Gauss-Jordan method 6. Solution of differential equation by Euler's Method 7. To invert a given Matrix by Gauss-Jordan Method 8. Solution of differential equation by Runge-Kutte Method 9. To fit the given data in straight line by Linear Regression Method (a) Write a program to find the largest of n number of series. (b) To calculate the standard deviation of a given set of data 10. To write a program to compute the complex roots of a given polynomial of Nth degree by Graffe's method 11. To write a program to compute the Eigen Values a given Matrix 12. To integrate a given function by (a) Trapezoidal method or by (b) Gauss quadrature 13. To find solutions of first order, ordinary differential equation by Taylor method	**30**
Keywords	Gauss Elimination, Newton-Raphson, Numerical Integration, Euler's Method, Runge-Kutta, Linear Regression, Eigenvalues, Differential Equations	

Signature of Convener & Members (CBoS):

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PART–C: LEARNING RESOURCES

Text Books, Reference Books and Others

Text Books Recommended –

1. Introductory Methods of Numerical Analysis: Sastry:
2. Numerical Analysis : Rajaraman
3. Numerical methods : Antia
4. Numerical Methods by Dr. P. Kandasamy, Dr. K Thilagavathy, Dr. K. Gunvanthi
5. Fundamentals of Numerical Methods by Rajeev K Bansal
6. Numerical Methods in Engineering & Science: with Programs in C, C++, and MATLAB by B S Grewal
7. Raja Raman: FORTRAN programming

Reference Books Recommended –

1. Numerical Methods: Problems and Solutions by M.K. Jain, S. R. K. Iyengar, and R. K. Jain
2. Numerical Methods for Scientific and Engineering Computation by M. K. Jain, S. R. K. Iyengar, and R. K. Jain
3. Numerical Methods: Principles, Analysis, and Algorithms by A. Singaravelu
4. Numerical Methods for Engineers by Steven C. Chapra and Raymond P. Canale

Online Resources–

e-Resources / e-books and e-learning portals

1. Numerical methods https://archive.nptel.ac.in/courses/111/107/111107105/
2. Numerical analysis https://archive.nptel.ac.in/courses/111/101/111101165/
3. Numerical Methods for Engineers https://archive.nptel.ac.in/courses/127/106/127106019/
4. Introduction to Numerical Methods https://nptel.ac.in/courses/105105043

PART-D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2):	**10 & 10**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
	Assignment/Seminar +Attendance-	**05**	
	Total Marks -	**15**	
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **A. Performed the Task based on lab. work - 20 Marks** **B. Spotting based on tools& technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**		**Managed by Course teacher as per lab. status**

Name and Signature of Convener &Members of CBoS:

10/6/17

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART-A: INTRODUCTION			
Program : Bachelor in Science *(Honors/Honors with Research)*		**Semester - VII**	Session: **2024-2025**
1	**Course Code**	**PHSE- 05**	
2	**Course Title**	**Mathematical Physics -II**	
3	**Course Type**	**Discipline Specific Elective**	
4	**Pre-requisite** (if, any)	***As per Program***	
5	**Course Learning. Outcomes (CLO)**	➢ Apply Fourier analysis of periodic functions in physical problems such as vibrating strings etc. ➢ Solve the beta, gamma and the error functions and their applications in doing integrations. ➢ Relate basic theory of errors, their analysis, and estimation with examples of simple experiments in Physics. ➢ Solve partial differential equations with the examples of important partial differential equations in Physics	
6	**Credit Value**	**4 Credits**	***Credit = 15 Hours - learning & Observation***
7	**Total Marks**	**Max. Marks: 100**	**Min Passing Marks: 40**

PART -B: CONTENT OF THE COURSE

Total No. of Teaching–learning Periods (01 Hr. per period) - 60 Periods (60 Hours)

Unit	Topics (Course contents)	No. of Period
I	Calculus of functions of more than one variable: Partial derivatives, exact and inexact differentials. Integrating factor, with simple illustration. Constrained Maximization using Lagrange Multipliers. **Partial Differential Equations**: Solutions to partial differential equations, using separation of variables: Laplace's Equation in problems of rectangular, cylindrical and spherical symmetry	15
II	**Fourier Series:** Periodic functions. Orthogonality of sine and cosine functions, Dirichlet Conditions (Statement only). Expansion of periodic functions in a series of sine and cosine functions and determination of Fourier coefficients. Complex representation of Fourier series. Expansion of functions with arbitrary period. Expansion of non-periodic functions over an interval. Even and odd functions and their Fourier expansions. Application. Summing of Infinite Series	15
III	**Frobenius Method and Special Functions**: Singular Points of Second Order Linear Differential Equations and their importance. Frobenius method and its applications to differential equations. Legendre, Bessel, Hermite & Laguerre Differential Equations. Properties of Legendre Polynomials: Rodrigues Formula, Orthogonality. Simple recurrence relations. **Some Special Integrals:** Beta and Gamma Functions and Relation between them. Expression of Integrals in terms of Gamma Functions. Error Function (Probability Integral).	15
IV	**Complex Analysis**: Brief Revision of Complex Numbers and their Graphical Representation. Euler's formula, De Moivre's theorem, Roots of Complex Numbers. Functions of Complex Variables. Analyticity and Cauchy-Riemann Conditions. Examples of analytic functions. Singular functions: poles and branch points, order of singularity, branch cuts. Integration of a function of a complex variable. Cauchy's Inequality. Cauchy's Integral formula	15
Keywords	Calculus, Partial derivatives, Differential equations, Periodic function, Singular point, Beta and Gamma function, Complex number, Complex variables.	

Signature of Convener & Members (CBoS) :

10/6/24

PART–C: LEARNING RESOURCES

Text Books, Reference Books and Others

Text Books Recommended–

1. Calculus of Several Variables and Partial Differential Equations by M.L. Krasnov, S.G. Miskin, and A.I. Gromova
2. Fourier Series and Boundary Value Problems by James Brown and Ruel Churchill
3. Differential Equations with Boundary Value Problems by Dennis G. Zill and Warren S. Wright
4. Complex Variables and Applications by James Ward Brown and Ruel V. Churchill

Reference Books Recommended–

1. Mathematical Methods for Physicists: Arfken, Weber, 2005, Harris, Elsevier.
2. Fourier Analysis by M.R. Spiegel, 2004, Tata McGraw-Hill.
3. Mathematics for Physicists, Susan M. Lea, 2004, Thomson Brooks/Cole.
4. An Introduction to Ordinary Differential Equations, E.A Coddington, 1961, PHI Learning
5. Differential Equations, George F. Simmons, 2006, Tata McGraw-Hill.
6. Partial Differential Equations for Scientists and Engineers, S.J. Farlow, 1993, Dover Publications.
7. Mathematical methods for Scientists & Engineers, D.A. Mc Quarrie, 2003, Viva Books

Online Resources–

e-Resources / e-books and e-learning portals

1. NPTEL Online Courses: Dr Saurabh Basu (Complex analysis) https://nptel.ac.in/courses/115103036
2. NPTEL Online Course: V. Balkrishanan (Fourier Transform) :https://nptel.ac.in/courses/115106086
3. NOC: Mathematical Methods in Physics 1, IISER Bhopal, Prof. Auditya Sharma https://nptel.ac.in/courses/111106148
4. Vector Calculus, egyankosh: https://egyankosh.ac.in/handle/123456789/25388
5. e-PG pathshala: Mathematical Physics, https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=+4mIqRALksfwQH9v8YSMrw==

PART -D:Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 100 Marks
Continuous Internal Assessment (CIA): 30 Marks
End Semester Exam (ESE): 70 Marks

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2):	**20 +20**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
	Assignment / Seminar -	**10**	
	Total Marks -	**30**	
End Semester Exam (ESE):	**Two section – A & B**		
	Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20Marks**		
	Section B: Descriptive answer type qts.,**1 out of 2** from each unit-**4x10=40 Marks**		

Name and Signature of Convener & Members of CBoS:

10/6/19

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART-A: INTRODUCTION				
Program : Bachelor in Science *(Honors/Honors with Research)*			**Semester - VII**	Session: **2024-2025**
1	**Course Code**	**PHSE- 06**		
2	**Course Title**	**Classical Electrodynamics & Electromagnetic Theory**		
3	**Course Type**	**Discipline Specific Elective**		
4	**Pre-requisite** (if, any)	*As per Program*		
5	**Course Learning. Outcomes (CLO)**	➢ Calculate the reflection and transmission of waves at the media interface. ➢ Understand the aspects related to Polarized lights and its generation as the superposition of different waves. ➢ Understanding the plasma state, the concept of Debye screening, and collective behavior		
6	**Credit Value**	**4 Credits**	*Credit = 15 Hours - learning & Observation*	
7	**Total Marks**	**Max. Marks: 100**		**Min Passing Marks: 40**

PART -B: CONTENT OF THE COURSE

Total No. of Teaching–learning Periods (01 Hr. per period) – 60 Periods (60 Hours)

Unit	Topics (Course Contents)	No. of Period
I	**Maxwell Equations:** Review of Maxwell's equations. Vector and Scalar Potentials. Maxwell's equations in terms of scalar and vector potentials. Concept of Gauge. Gauge Transformations: Lorentz and Coulomb Gauge; four-vectors, mathematical properties of space-time in special relativity; matrix representation of Lorentz transformation; Poynting Theorem and Poynting Vector. Electromagnetic (EM) Energy Density and Momentum Density. Radiation Pressure. **Radiation by moving charges:** Lienard-Wiechert potential and fields for a point charge; total power radiated by an accelerated charge- Larmor's formula and its relativistic generalization	15
II	**EM Wave Propagation in Unbounded :** Transverse nature of plane EM waves, refractive index and dielectric constant, wave impedance. Propagation through conducting media, skin depth.Propagation of E.M. Waves in Anisotropic Dielectrics. **EM Wave in Bounded Media:** Boundary Conditions at Interface between two Media.Reflection & Refraction of plane waves at plane interface between two dielectric media-Laws of Reflection& Refraction. Brewster's law. Total internal reflection, Metallic reflection (normal Incidence)	15
III	**Polarization of Electromagnetic Waves:** Description of Linear, Circular and Elliptical Polarization. Double Refraction. Polarization by Double Refraction. Nicol Prism. Ordinary & extra – ordinary refractive indices. Phase Retardation Plates: Quarter-Wave and Half-Wave Plates. Babinet Compensator and its Uses. Optical Rotation. Fresnel's Theory of optical rotation. Specific rotation. Laurent's half-shadepolarimeter	15
IV	**Plasma:** Definition, Debye Shielding phenomena and criteria for plasma, motion of charged particles in electromagnetic field, Uniform E and B fields, electric field drift, non-uniform magneto-static field, Gradient B drift, parallel acceleration and magnetic mirror effect, Elementary concepts of plasma kinetic theory, the Boltzmann equation, the basic plasma phenomena, plasma oscillations; Fundamental equations of magneto - hydrodynamics (MHD); Plasma confinement schemes	15
Keywords	*Maxwell Equations,scalar and vector potentials, Lienard-Wiechert potential, EM wave propagation, Polarization, Debye Shielding phenomena, magnetohydrodynamics*	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. Introduction to Electrodynamics, D.J. Griffiths, 3rd Ed., 1998, Benjamin Cummings.
2. Elements of Electromagnetics, M.N.O. Sadiku, 2001, Oxford University Press.
3. Introduction to Electromagnetic Theory, T.L. Chow, 2006, Jones & Bartlett Learning
4. Electromagnetic Theory, Chopra & Agrawal, K. Nath Publishing
5. Classical Electrodynamics J. D. Jackson, Wiley

Reference Books Recommended –

1. Electromagnetics, J.A. Edminster, Schaum Series, 2006, Tata McGraw Hill.
2. Electromagnetic field theory fundamentals, B. Guru and H. Hiziroglu, 2004, Cambridge University Press
3. Plasma Physics, Bittencourt
4. Plasma Physics, Chen

Online Resources– e-Resources / e-books and e-learning portals

1. All e-books of physics https://www.e-booksdirectory.com/listing.php?category=2
2. Free physics textbook in PDF https://www.motionmountain.net/?gclid=CjwKCAjwmq3kBRB_EiwAjkNDp5v8Yy6xK1s0Kma0VR0AWGlichRwFfCC0-vpZK1jrPoEOAnBq8fcqRoCILsQAvD_BwE
3. Cambridge University Books for Physics https://www.cambridgeindia.org/
4. Books for solving physics problems https://bookboon.com/en/physics-ebooks
5. NPTEL Online courses: https://onlinecourses.nptel.ac.in/noc21_ph05/preview
6. https://archive.nptel.ac.in/courses/115/104/115104088/
7. Classical Electromagnetism - 1 (Electrostatics) https://bsc.hcverma.in/course/cee1
8. Plasma Physics and Applicationshttps://onlinecourses.nptel.ac.in/noc24_ph20/preview

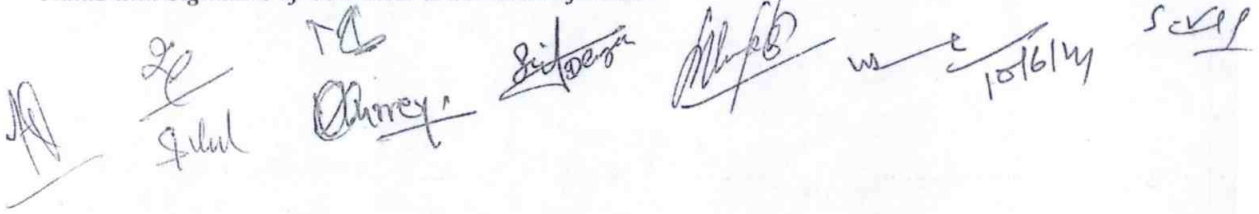
PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment(CIA):	**30 Marks**
End Semester Exam(ESE):	**70 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **20 &20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – 10 x1= **10** Mark; **Q2**. Short answer type- **5x4 =20Marks** Section B: Descriptive answer type qts.,**1 out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener & Members of CBoS:



FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART-A: INTRODUCTION

Program : Bachelor in Science *(Honors/Honors with Research)*	Semester - VII	Session: 2024-2025

1	Course Code	PHSE- 07 T		
2	Course Title	DIGITAL ELECTRONICS		
3	Course Type	Discipline Specific Elective		
4	Pre-requisite (if, any)	*As per Program*		
5	Course Learning. Outcomes (CLO)	➢ *Understand basics of logic gates, Boolean algebra, and simplifying complex Boolean functions.* ➢ *Learn about combinational circuits, logic families, and digital ICs.* ➢ *Understand the working of flip-flops and thus memory* ➢ *Capable to know the various sequential circuits an Ads & DAs*		
6	Credit Value	3 Credits	*Credit = 15 Hours - learning & Observation*	
7	Total Marks	Max. Marks: 100		Min Passing Marks: 40

PART -B: CONTENT OF THE COURSE

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**Number system:** Decimal, Binary, Octal and Hexadecimal Number System with mutual conversion, Mathematics of number systems (addition, subtraction, multiplication and division), 1's and 2's compliments, addition and subtraction using 1's and 2's compliments. **Binary Codes:** Binary Coded Decimal (BCD), its addition and subtraction, Excess –3 code, its addition and subtraction, Gray code, binary to gray code and gray code to binary code conversion. **Logic gates:** Positive and negative logic, Basic gates, Universal building block. Basic laws of Boolean Algebra, De-Morgan's Theorem	12
II	**Simplification of Boolean Functions:** Simplification of Boolean functions through Boolean laws, Realization through logic gates, Minterms and Maxterms, Two, Three and Four variable Karnough Map (K-Map), and minimization of SOP and POS expressions. **Combinational Logic Circuits:** Half-adder, Full-adder, Binary serial and parallel adders, Half Subtractor, Full Subtractor. Multiplexers (2:1, 4:1 and 16:1), Demultiplexer (1:2, 1:4 and 1:16), Encoders (Octal to Binary encoder, Decimal to BCD), Binary decoders BCD to Decimal, BCD to Seven Segment)	11
III	**Digital logic Families:** Introduction, Basic concepts of RTL, DTL, TTL, ECL and CMOS logic families and their characteristics (Fan-in, Fan-out, Supply voltage range, Power dissipation, Input/ Output logic levels, Noise margin, Speed of operation) **Flip-flop and timing diagram:** RS flip-flop, R-S flip-flop using NOR gate, RS flip-flop using NAND gate, Clocked RS flip-flop, D- latch flip-flop, Flip-flop with Preset and Clearinputs, JK flip-flop, Positive and negative edge triggered flop-flops., JK Master Slave flip-flop	11
IV	**Sequential Circuits: Counters:** Synchronous and Asynchronous counters: Binary ripple counter, up counter, down counter, up-down counter and ring counter with their time diagrams. **Registers:** Shift Register, PIPO, SIPO, PISO, SISO and Bi-directional shift Register, Application of shift register (Serial Adder, Sequence generator) **Digital to analog converter and Analog to Digital converters:** D/A converters using binary weighted resistor network and R-2R ladder Network; Counter type A/D converter, applications of DACs and ADCs	11

Keywords	Number System, Logic gates, Codes, Digital Logic Families, Flip flops, Registers, counters

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended–

1. Digital Design by M. Morris Mano and Michael D. Ciletti
2. Modern Digital Electronics by R.P. Jain
3. Digital Electronics: Principles, Devices and Applications by Anil K. Maini

Reference Books Recommended–

1. Digital and Analogue Technique- Navneet Gokhale and Kale, Kitab Mahal
2. Digital Electronics and Micro-Computers- R K Gaur, Dhanpat Rai Publications
3. Digital electronics- D K Kaushik, Dhanpat Rai Publication Company
4. Digital Electronics: Principles, Devices and Applications- A K Maini, John Wiley & Sons Ltd.
5. Digital Principles and applications – Malvino and Leach, Tata McGraw Hills, New Delhi
6. Hand Book of Electronics – Gupta and Kumar, Pragati Prakashan, Meerut
7. Digital integrated Electronics _ Taub and Schilling, McGraw International Edition
8. Fundamentals of Digital Circuits – A.Anand Kumar, Prentice Hall of India, New Delhi
9. Modern Digital Electronics- R P Jain, Tata McGraw Hill Publication, New Delhi

Online Resources–

e-Resources / e-books and e-learning portals

1. https://www.freebookcentre.net/Electronics/Digital-CircuitsBooks.html#google_vignette
2. https://www.researchgate.net/profile/Dk Kaushik/publication/264005171_Digital_Electronics/links/53fca84a0cf2364ccc04b6dd/Digital-Electronics.pdf
3. https://www.freebookcentre.net/electronics-ebooks-download/Digital-Electronics-Notes.html
4. https://www.academia.edu/40001993/Digital_Electronics
5. https://www.technicalbookspdf.com/electronic-engineering/digital-electronics/
6. https://www.tutorialspoint.com/digital_circuits/digital_circuits_multiplexers.htm
7. https://www.electronics-tutorials.ws/combination/comb_3.html
8. https://www.youtube.com/watch?v=Eb56gaw6JrQ
9. https://www.tutorialspoint.com/computer_logical_organization/digital_counters.htm
10. https://www.youtube.com/watch?v=bAQfPQqKCHs
11. https://www.youtube.com/watch?v=K2wPxfiggAU

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 100 Marks

Continuous Internal Assessment (CIA): 30 Marks

End Semester Exam(ESE): 70 Marks

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2):	**20 +20**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall b considered against **30** Marks
	Assignment / Seminar -	**10**	
	Total Marks -	**30**	
End Semester Exam (ESE):	**Two section – A & B**		
	Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20Marks**		
	Section B: Descriptive answer type qts.,**1 out of 2** from each unit-**4x10=40 Marks**		

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART-A: INTRODUCTION			
Program : Bachelor in Science *(Honors/Honors with Research)*		**Semester - VII**	Session: **2024-2025**
1	**Course Code**	**PHSE- 07 P**	
2	**Course Title**	**DIGITAL ELECTRONICS**	
3	**Course Type**	**Discipline Specific Elective**	
4	**Pre-requisite** (if,any)	**As per Program**	
5	**Course Learning. Outcomes(CLO)**	**After completion of this course a student will be able to-** ➢ Understand the working of logic gates and realization of Functions ➢ Clarify the concept of combinational logic circuits ➢ Understand the differences between MUX, DMUX, Encoder and Decoder and their uses ➢ Familiar with basic memory elements (Flip-flop) ➢ Understand the concept of counters and shift registers, Able to use D/A and A/D convertors.	
6	**Credit Value**	**1 Credits**	***Credit =30 Hours Laboratory or Field learning/Training***
7	**Total Marks**	**Max. Marks: 50**	**Min Passing Marks:20**

PART -B: CONTENT OF THE COURSE

Total No. of learning-Training/performance Periods:30 Periods (30 Hours)

Module	Topics (Course Contents) **At least 10 of the following or related Experiments**	No. of Period
Lab./Field Training/ Experiment Contents of Course	1. To study and verify the truth-tables of various logic gates 2. To study the Binary to Gray and Gray to Binary conversion 3. To verify the Boolean Laws with the help of logic gates 4. To realize Half Adder and Full Adder 5. To realize Half and Full subtractor 6. To verify the working and truth table of a Multiplexer 7. To verify the working and truth table of a Demultiplexer 8. To study the Decimal to BCD Encoder 9. To study the BCD to Seven Segment Decoder 10. To verify the truth table of (i) R-S flip-flop, (ii) Data latch and (iii) Edg triggered flip-flop 11. To verify the truth table of (i) J-K flip-flop, (ii) J-K Master-Slave flip-flop an (iii) T flip-flop 12. To understand the working of Ripple counter and verify its truth table 13. To understand the working of Up-Down counter and verify its truth table 14. To understand the working of Left/Right Shift Register and verify its truth table 15. To understand the working of SIPO/ PIPO Shift Register and verify its trut table 16. To understand the working of Sequence generator 17. To study the R-2R ladder Digital to Analog convertor 18. To study Counter type Analog to Digital convertor	**30**
Keywords	***Logic gates, Boolean algebra, Adders, Multiplexer, Flip-flop, Counter, Shift register. Convertors.***	

Signature of Convener & Members (CBoS):

10/6/24

PART–C:LEARNING RESOURCES

Text Books, Reference Books and Others

Text Books Recommended–

1. Digital Electronics: Theory and Practical- Virendra Kumar, New Age International Publications
2. Digital Electronics – A Comprehensive Lab Manual- Cherry Bhargava, B S Publication
3. Digital electronics experiment manual- Toger Tokheim, McGraw Hill
4. Handbook of Experiments in Electronics and Communication- B Sasikala & S P Rao, Vikas Publishing
5. Practical Digital Electronics Manual- Nigel P Cook, Prentice Hall

Reference Books Recommended–

1. Digital Design by M. Morris Mano and Michael D. Ciletti
2. Fundamentals of Digital Circuits by A. Anand Kumar
3. Digital Electronics: Principles and Integrated Circuits" by Anil K. Maini
4. Digital Fundamentals by Thomas L. Floyd
5. Modern Digital Electronics by R. P. Jain
6. Digital Logic Design by B. Somanathan Nair

Online Resources–

- **e-Resources / e-books and e-learning portals**

1. https://nationallibraryopac.nvli.in/cgi-bin/koha/opac-detail.pl?biblionumber=15445&query_desc=Provider%3ANew%20Age%20International%2
2. https://books.google.com/books/about/Digital_Electronics.html?id=b7WwzQEACAAJ
3. https://ssit.edu.in/dept/assignment/declabmanual.pdf

PART-D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2):	**10 & 10**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 15 Marks
	Assignment/Seminar +Attendance-	**05**	
	Total Marks -	**15**	
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **A. Performed the Task based on lab. work - 20 Marks** **B. Spotting based on tools& technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**		**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS:

10/6/24

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART-A: INTRODUCTION

Program : Bachelor in Science *(Honors/Honors with Research)*	**Semester -VII**	Session: **2024-2025**

1	**Course Code**	**PHSE- 08 T**
2	**Course Title**	**Operational Amplifier & Its Applications**
3	**Course Type**	**Discipline Specific Elective**
4	**Pre-requisite** (if, any)	***As per Program***
5	**Course Learning. Outcomes (CLO)**	**After completion of the course students will be able to –** ➢ The Idea and concepts of differential amplifier ➢ Basic concepts of Ideal operational amplifier and Practical operational amplifier with its electrical parameters ➢ Gain the knowledge of op-amp with feedback and its effect on different parameters ➢ Understand the concept of various oscillators and their applications ➢ Know the uses of Timer circuits and their applications
6	**Credit Value**	**3 Credits** — ***Credit = 15 Hours - learning & Observation***
7	**Total Marks**	**Max. Marks: 100** — **Min Passing Marks: 40**

PART -B: CONTENT OF THE COURSE

TotalNo.of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course Contents)	No. of Period
I	**Differential amplifier:** Basic idea of direct coupled amplifier and its drawbacks, Circuit configurations of Differential amplifier, need for dual power supply, Basics of different configurations, dual input-balanced output differential amplifier, Its DC analysis and AC analysis. Inverting and Non-Inverting inputs, CMRR, need for constant current bias level transistor circuit Level translator	11
II	**Operational Amplifier:** Introduction, Block diagram, Functions of each block, Electrical parameters, Ideal op-amp, it's characteristics and equivalent circuit, **Open-loop configurations:** Differential, Inverting and Non-inverting amplifiers, **Op-Amp with negative feedback:** Block diagrams of feedback configurations, Voltage series feedback and its effect on Input resistance, Output resistance, Bandwidth, Total output offset voltage. Voltage follower, Voltage shunt feedback, Inverting input terminal at virtual ground, its effect on Input resistance, Output resistance, Bandwidth, Total output offset voltage	12
III	**Practical Op-Amp:** Input offset voltage, Input bias current, Input offset current, Total output offset voltage, Thermal drift, Error voltage, Common mode configuration and CMMR, **Linear Applications:** Summing, Scaling and Averaging amplifiers, Basics of Instrumentation amplifier, Instrumentation amplifier using Transducer bridge, Its uses, Voltage to current converter, Theory of Integrator and Differentiator	11
IV	**Active Filters Using Op-Amp:** Idea of active filters and their classification, First order and Second order low-pass Butterworth filter **Op-Amp Oscillators:** Oscillator block diagram and condition for sustained oscillations, Phase Shift oscillator, Wien Bridge oscillator and calculation for their frequency of oscillations. Square-wave generator, Triangular wave generator. **The 555 Timer:** Block diagram of 555, The 555 as a Monostable Multivibrator, Its use as pulse stretcher, 555 as a Stable Multivibrator, Its use as Square-wave oscillator	11
Keywords	***Differential Amplifier, Operational Amplifier, Configuration, Feedback, Practical op-amp, Integrator, differentiator, Filters, Oscillators.***	

Signature of Convener & Members (CBoS) :

10/6/24

PART–C: LEARNING RESOURCES

Text Books, Reference Books and Others

Text Books Recommended–

1. Op-amps and Linear Integrated Circuits- Ramakant A Gayakwad, Prentice Hall, India
2. Op-amps and Linear Integrated Circuits- R F Coughlin & F F Driscoll, Prentice Hall, India
3. Op- Amp and Linear Integrated circuits: K. Lal. Kishore, Pearson Education, Delhi
4. Op- Amp with Linear Integrated circuits: William D. Stanly, Pearson Education, Delhi
5. Linear Integrated circuits: D. Roy Choudhury and Shail B. Jain, New Age International Publications, New Delhi.
6. Op- Amp and Linear Integrated circuits: concept and applications- James N Flore, Cengage Learning India Pvt. Ltd

Reference Books Recommended–

1. Microelectronic Circuits by Adel S. Sedra and Kenneth C. Smith
2. Electronic Devices and Circuit Theory by Robert L. Boylestad and Louis Nashelsky
3. Operational Amplifiers and Linear Integrated Circuits by Robert F. Coughlin and Frederick F. Driscoll
4. Design with Operational Amplifiers and Analog Integrated Circuits by Sergio Franco
5. Op-Amps and Linear Integrated Circuits by Ramakant A. Gayakwad
6. Operational Amplifiers with Linear Integrated Circuits" by William D. Stanley**
7. Analog Filter Design" by M.E. Van Valkenburg\

Online Resources–

e-Resources / e-books and e-learning portals

1. https://www.reddit.com/r/AskElectronics/comments/aevtj1/looking_for_some_books_to_learn_about_opamps/
2. https://open.umn.edu/opentextbooks/textbooks/574
3. https://community.element14.com/learn/publications/ebooks/w/documents/27823/a-quick-beginner-s-introduction-to-op-amps---ebook
4. https://www.analog.com/en/resources/technical-books/op-amp-applications-handbook.html
5. https://mgcub.ac.in/pdf/material/202004041708263c4d2b87a6.pdf
6. https://mrcet.com/downloads/digital_notes/ECE/III%20Year/10082021/LINEAR%20&%20DIGITAL%20IC.pdf
7. https://alan.ece.gatech.edu/ECE3040/Lectures/Lecture28-Operational%20Amplifier.pdf

PART -D:ASSESSMENT ANDEVALUATION

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Exam (ESE):	**70 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **20 +20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener & Members of CBoS:

10/6/23

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART-A: INTRODUCTION			
Program: Bachelor in Science *(Honors/ Honors with Research)*		**Semester - VII**	Session: **2024-2025**
1	**Course Code**	**PHSE- 08 P**	
2	**Course Title**	**Operational Amplifier & Its Applications**	
3	**Course Type**	**Discipline Specific Elective**	
4	**Pre-requisite** (if, any)	**As per Program**	
5	**Course Learning. Outcomes(CLO)**	**After completion of this course a student will be able to-** ➢ Understand the working of differential amplifier and its inverting and non-inverting configurations. ➢ Know the importance of negative feedback ➢ Know the uses of op-amp IC. Understand the idea of Oscillators ➢ Understand the working of active filters ➢ Have the idea about Multivibrators	
6	**Credit Value**	**1 Credits**	***Credit =30 Hours Laboratory or Field learning/Training***
7	**Total Marks**	**Max.Marks:50**	**Min Passing Marks:20**

PART -B: CONTENT OF THE COURSE		
Total No. of learning-Training/performance Periods - Periods (30 Hours)		
Module	**Topics(Course Contents)** **At least 10 of the following or related Experiments**	**No. of Period**
Lab./ Experiment Contents of Course	1. To study the differential amplifier and to find the voltage gain 2. To study Inverting and Non-Inverting op-amp 3. To study Voltage series feedback and its effect on Input resistance, Output resistance using op-amp 4. To study Summing op-amp (IC741) and verify their theoretical and practical output 5. To study Subtractor op-amp (IC741) and verify their theoretical and practical output 6. To study Scaling op-amp (IC741) and verify their theoretical and practical output 7. To study the operation of the Integrator & differentiator using op-amp and trace the output wave forms for sine and square wave inputs 8. To study the operation of RC phase shift oscillators using op-amp and trace the output wave forms 9. To study the operation of Wien bridge oscillators using op-amp and trace the output wave forms 10. To study the First order low-pass Butterworth filter 11. To study the Second order low-pass Butterworth filter 12. To study the function of Square wave generator and trace the expected wave form 13. To study the function of Triangular wave generator and trace the expected wave form 14. To use 555 timer as Monostable multivibrator and trace the expected wave form 15. To use 555 timer as Astable multivibrator and trace the expected wave form	**30**
Keywords	Differential amplifier, Feedback, Op-amp, Integrator, Differentiator, Oscillator, Waveforms, Filters, Multivibrators.	

Signature of Convener & Members (CBoS):

10/6/24

PART–C:LEARNING RESOURCES

Text Books, Reference Books and Others

Text Books Recommended–

1. Handbook of operational amplifier applications- Bruce Carter and Thomas R. Brown, Texas Instruments
2. Operational Amplifier: Theory and Experiments- Shrikrishna Yawale & Sangita Yawale, Springer
3. Op-Amps for Everyone- Ron Mancini, Texas Instruments

Reference Books Recommended–

1. Op-Amps and Linear Integrated Circuits by Ramakant A. Gayakwad
2. Design with Operational Amplifiers and Analog Integrated Circuits by Sergio Franco
3. Operational Amplifiers and Linear Integrated Circuits by Robert F. Coughlin and Frederick F. Driscoll
4. Op Amps for Everyone by Ron Mancini
5. Op Amp Applications Handbook by Analog Devices Inc.
6. Practical Electronics for Inventors by Paul Scherz and Simon Monk
7. Electronic Devices and Circuits by David A. Bell
8. Electronic Principles by Albert Malvino and David J. Bates

Online Resources–

e-Resources / e-books and e-learning portals

1. https://www.scribd.com/document/370796028/Op-Amp-Lab-Manual
2. https://gnindia.dronacharya.info/ECE/Downloads/Labmanuals/EC_%20LAB_(EEC-451)_IVSem_18012013.pdf
3. https://www.researchgate.net/publication/282055366_7_Lab_Experiments_with_Op-amp_A_manual_for_undergrad_students_teaching_staff
4. https://www.utdallas.edu/~rmh072000/EE3101/exp5.pdf
5. https://www.csun.edu/sites/default/files/ECE340%20Lab%20Manual.pdf
6. https://link.springer.com/book/10.1007/978-981-16-4185-5

PART-D:ASSESSMENT ANDEVALUATION

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2):	**10 & 10**	Better marks out of the two Test / Quiz +obtained marks in Assignment shall be considered against **15** Marks
	Assignment/Seminar +Attendance-	**05**	
	otal Marks -	**15**	
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **A. Performed the Task based on lab. work - 20 Marks** **B. Spotting based on tools& technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**		**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART-A: INTRODUCTION				
Program: Bachelor in Science *(Honors/Honors with Research)*			**Semester - VIII**	Session: 2024-2025
1	**Course Code**	**PHSE- 09 T**		
2	**Course Title**	**Solid State Physics**		
3	**Course Type**	**Discipline Specific Elective**		
4	**Pre-requisite** (if, any)	***As per Program***		
5	**Course Learning. Outcomes (CLO)**	By course end, students will master: ➢ Energy band concept in solids, including energy gap analysis. ➢ Bloch function, Kronig-Penny model application for electron description. ➢ Hall effect in semiconductors, Fermi-Dirac distribution temperature impact, and free electron gas behavior in 3D. ➢ Zone schemes exploration, Fermi surface construction, and understanding of nearly free electrons, holes, and open orbits.		
6	**Credit Value**	**3 Credits**	***Credit = 15 Hours - learning & Observation***	
7	**Total Marks**	**Max. Marks: 100**	**Min Passing Marks: 40**	

PART -B: CONTENT OF THE COURSE

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**Electrical Properties of solid** Free electron model; Solution of one-dimensional Schrodinger equation in a constant potential; density of states; Fermi energy; Energy bands and origin of energy gap and its magnitude, Bloch function, Kronig-Penny model, Wave equation of electron in periodic potential, crystal moment of an electron, Hall effect **Magnetic properties of solids** Dia, para and ferromagnetism; Langevin's theory of dia and paramagnetism, Curie-Weiss law	11
II	Effect of temperature on F-D distribution, free electron gas in three dimensions. Different zone schemes, reduced and periodic zones, construction of Fermi surfaces, nearly free electrons, electron, hole, open orbits, Calculation of energy bands, Tight binding, Wigner-Seitz, cohesive energy, pseudo potential methods. Experimental methods in Fermi surface studies, quantization of orbits in a magnetic field, de Haas van Alphen Effect, External orbits, Fermi surface of copper	11
III	Lattice dynamics in monoatomic and diatomic lattice: two atoms per primitive basis, optical and acoustic modes, quantization of elastic waves, phonon momentum, inelastic neutron scattering by phonons, Anharmonic crystal interactions-thermal expansion, thermal conductivity, thermal resistivity of phonon gas, umklapp processes, imperfections	11
IV	**Superconductivity** Experimental survey: occurrence of superconductivity, Destruction of superconductivity by magnetic field, Meissner effect, heat capacity, energy gap, MW, and IR properties, isotope effect. Theoretical survey: thermodynamics of superconducting transition, London equation, Coherence length, Cooper pairing due to phonons, BCS theory of superconductivity, BCS ground state, flux quantization of superconducting ring, duration of persistent currents, Type II superconductors, Vortex states, estimation of Hc1 and Hc2, single particle and Josephson superconductor tunneling, DC/AC Josephson effect, Macroscopic quantum interference. High-temperature superconductors, critical fields and currents	12
Keywords	*Free electron model, Kronig Penny Model, Hall effect, Zone schemes, fermi surfaces, optical and acoustic modes, Superconductivity, BCS theory*	

Signature of Convener & Members (CBoS) :

10/09/24

PART–C: LEARNING RESOURCES

Text Books, Reference Books and Others

Text Books Recommended–

1. Solid State Physics by Neil W. Ashcroft and N. David Mermin
2. Introduction to Solid State Physic by Charles Kittel
3. Solid State Physics by J. S. Blakemore
4. Quantum Theory of Solids by Charles Kittel
5. Introduction to Superconductivity by Michael Tinkham

Reference Books Recommended–

1. Principles of the Theory of Solids by J. M. Ziman
2. Electronic Properties of Materials by Rolf E. Hummel
3. Solid State Physics: An Introduction by Philip Hofmann
4. Lattice Dynamics by A. A. Maradudin
5. Superconductivity, Second Edition by J. B. Ketterson and S. N. Song
6. Fundamentals of Superconductivity by John Robert Schrieffer
7. The Physics of Solids by Richard Turton
8. Solid State Physics: Structure and Properties of Materials by M. A. Wahab

Online Resources–

e-Resources / e-books and e-learning portals

1. Condensed Matter Physics https://archive.nptel.ac.in/courses/115/106/115106061/
2. Advanced Condensed Matter Physicshttps://archive.nptel.ac.in/courses/115/103/115103102/
3. Introduction to condensed matter physics https://homepages.iitb.ac.in/~kdasgupta/pdf/PH409[Aug2013].pdf
4. Introduction to solid state physics https://archive.nptel.ac.in/courses/115/104/115104109/

PART -D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment(CIA):	**30 Marks**
EndSemester Exam(ESE):	**70 Marks**

Continuous Internal Assessment(CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): Assignment / Seminar - Total Marks -	**20 +20** **10** **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20Marks** Section B: Descriptive answer type qts.,**1 out of 2** from each unit-**4x10=40 Marks**		

Name and Signature of Convener & Members of CBoS:

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FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART-A: INTRODUCTION			
Program: Bachelor in Science *(Honors/ Honors with Research)*		**Semester - VIII**	Session: 2024-2025
1	**Course Code**	**PHSC-09 P**	
2	**Course Title**	**Solid State Physics**	
3	**Course Type**	**Discipline Specific Elective**	
4	**Pre-requisite** (if, any)	**As per Program**	
5	**Course Learning. Outcomes(CLO)**	After the completion of the course, the Students are expected to : ➢ Analyse recorded data and formulate it to get desired results. ➢ Interpret results and check for attainment of proposed objectives related to theory of semiconductors. ➢ Apply theory and principle of semiconductors for various device applications ➢ Various electronics experiments and some advanced experiments in Physics	
6	**Credit Value**	**1 Credits**	***Credit =30 Hours Laboratory or Field learning/Training***
7	**Total Marks**	**Max. Marks:50**	**Min Passing Marks:20**

PART -B: CONTENT OF THE COURSE		
Total No. of learning-Training/performancePeriods:30 Periods (30 Hours)		
Module	**Topics(Course Contents)** **At least 10 of the following or related Experiments**	**No. of Period**
Lab./ Experiment Contents of Course	1. Measurement of susceptibility of paramagnetic solution (Quinck`s Tube Method) 2. To measure the Magnetic susceptibility of Solids 3. To determine the Coupling Coefficient of a Piezoelectric crystal 4. To measure the Dielectric Constant of a dielectric Materials with frequency 5. To study the PE Hysteresis loop of a Ferroelectric Crystal 6. To draw the BH curve of Fe using Solenoid & determine energy loss from Hysteresis 7. Determination of ionization potential of Lithium/Mercury 8. To study I-V characteristics of photovoltaic solar cell and its efficiency 9. Study of optoelectronic devices and verification of inverse square law 10. Determination of 'h' Planck's constant by Photoelectric effect 11. Determination of 'e/m' by Thomson method 12. Determination of Ionization Potential using Thyratron valve 13. Study of absorption coefficient of KMnO4	**30**
Keywords	*Magnetic susceptibility, Dielectric constant, PE hysteresis loop, BH curve, Resistivity, Hall coefficient, Ionization potential, Planck's constant*	

Signature of Convener & Members (CBoS):

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PART–C: LEARNING RESOURCES

Text Books, Reference Books and Others

Text Books:

1. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
2. Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India.
3. Practical Physics B.Sc III : R P Goyal, Shivlal Agrawal Publications
4. B.L. Worsnop, H.T. Flint, "Advanced Practical Physics for Students", Methuen & Co., Ltd.,
5. London, 1962.
6. S. Panigrahi, B. Mallick, "Engineering Practical Physics", Cengage Learning India Pvt. Ltd., 2015.
7. Indu Prakash: Practical Physics
8. S.L. Gupta, V. Kumar, "Practical Physics", Pragati Prakashan, Meerut, 2014

Reference Books:

1. Experimental Methods for Engineers by J.P. Holman
2. Semiconductor Physics and Devices by Donald A. Neamen
3. Optoelectronics and Photonics: Principles and Practices by Safa O. Kasap
4. Piezoelectricity: Evolution and Future of a Technology by Walter Heywang, Karl Lubitz, and Wolfram Wersing

Online Resources–
e-Resources / e-books and e-learning portals

1. Link for e-Books for Physics: Physics Practical:
   https://www.iiserkol.ac.in/~ph324/experiment_list.html
2. Virtual Lab :https://vlab.amrita.edu/?sub=1&brch=282
3. https://vlab.amrita.edu/index.php?sub=1&brch=282&sim=370&cnt=3
4. https://bop-iitk.vlabs.ac.in/exp/energy-band-gap/simulation.html
5. http://vlabs.iitkgp.ac.in/ssd/index.html#
6. http://vlabs.iitkgp.ac.in/psac/newlabs2020/ssds/#
7. https://ae-iitr.vlabs.ac.in/List%20of%20experiments.html
8. https://da-iitb.vlabs.ac.in/List%20of%20experiments.html
9. Virtual Labs at Amrita Vishwa Vidyapeetham, https://vlab.amrita.edu/?sub=1&brch=74

PART-D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2):	**10 &10**	Better marks out of the two Test / Quiz +obtained marks in Assignment shall be considered against **15** Marks
	Assignment/Seminar +Attendance-	**05**	
	Total Marks -	**15**	
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **A. Performed the Task based on lab. work -** **B. Spotting based on tools& technology (written) –** **C. Viva-voce (based on principle/technology) -**	 **20 Marks** **10 Marks** **05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS:

10/6/24

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART-A: INTRODUCTION			
Program: Bachelor in Science *(Honors/Honors with Research)*		**Semester - VIII**	Session: **2024-2025**
1	**Course Code**	**PHSE- 10**	
2	**Course Title**	**Atomic and Molecular Physics**	
3	**Course Type**	**Discipline Specific Elective**	
4	**Pre-requisite** (if, any)	**As per Program**	
5	**Course Learning. Outcomes (CLO)**	➢ Explain Vector atom model and use it for analyzing hydrogen spectra. ➢ Analyze various spectra and check for possibility of a given transition ➢ Explain and Apply Raman's effect and spectroscopy for various application. ➢ Appreciate the extraordinary characteristic of lasers and differentiate it from an ordinary light. ➢ Explore more about scientific contribution of Sir C V Raman	
6	**Credit Value**	**4 Credits**	***Credit = 15 Hours - learning & Observation***
7	**Total Marks**	**Max. Marks: 100**	**Min Passing Marks: 40**

PART -B: CONTENT OF THE COURSE

Total No. of Teaching–learning Periods (01 Hr. per period) – 60 Periods (60 Hours)

Unit	Topics (Course contents)	No. of Period
I	Vector atom model, quantum numbers associated with vector atom model, Spectra of hydrogen, deuteron and alkali atoms spectral terms, doublet fine structure, screening constants for alkali spectra for s, p, d and f states, selection rules, singlet, triplet fine structure in alkaline earth spectra, L-S and J-J coupling	**15**
II	Different types of Spectra, Discrete set of electronic energies of molecules, quantization of vibrational energies, determination of inter-nuclear distance, Transition rules for vibration and electronic vibration spectra. Pure rotational and rotation vibration spectra, Quantization of States Dissociation limit for the ground and other electronic states, transition rules for pure rotation and electronic- rotation Spectra	**15**
III	Raman effect, Stokes and anti-Stokes lines, complimentary character of Raman and infrared spectra, experimental arrangements for Raman spectroscopy. Application of Raman Spectroscopy, Resonance Spectroscopy, X-Rays, Production of X-rays, X-ray spectra, Mosley's law, X-Ray Spectroscopy,	**15**
IV	Atom Radiation interactions: Semi-classical description of radiation. Absorption, spontaneous and stimulated emissions, Einstein's A and B coefficients, Coherent and Incoherent emissions, LASERs and MASERs, Line widths, various types of line broadening, two-level atoms in a radiation field	**15**

Keywords	Vector atom model, hydrogen spectra, electronic transitions, vibrational spectra, rotational spectra, Raman effect

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PART–C: LEARNING RESOURCES

Text Books, Reference Books and Others

Text Books Recommended –

1. Atomic Physics by J.B. Rajam
2. Molecular Spectroscopy by Ira N. Levine
3. Fundamentals of Molecular Spectroscopy by C.N. Banwell and E.M. McCash
4. Lasers: Theory and Applications by K. Thyagarajan and A.K. Ghatak
5. Spectroscopy by B.P. Straughan and S. Walker
6. Modern Spectroscopy by J. Michael Hollas.

Reference Books Recommended –

1. Concepts of Modern Physics, Arthur Beiser, 2009, McGraw-Hill
2. Modern Physics, John R. Taylor, Chris D. Zafiratos, Michael A.Dubson,2009, PHI Learning
3. Modern Physics, R.A. Serway, C.J. Moses, and C. A. Moyer, 2005, Cengage Learning
4. Modern Physics, G. Kaur and G.R. Pickrell, 2014, McGraw Hill

Online Resources– e-Resources / e-books and e-learning portals

1. https://archive.nptel.ac.in/courses/115/105/115105100/
2. https://archive.nptel.ac.in/courses/115/101/115101003/#

PART -D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:

Maximum Marks: **100 Marks**

Continuous Internal Assessment(CIA): **30 Marks**

EndSemester Exam(ESE): **70 Marks**

Continuous InternalAssessment(CIA): (By Course Teacher)	Internal Test / Quiz-(2): **20 & 20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – 10 x1= **10** Mark; **Q2**. Short answer type- **5x4 =20Marks** Section B: Descriptive answer type qts.,**1 out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART-A: INTRODUCTION			
Program: Bachelor in Science *(Honors/Honors with Research)*		**Semester - VIII**	Session: 2024-2025
1	**Course Code**	**PHSE-11**	
2	**Course Title**	**Statistical Mechanics**	
3	**Course Type**	**Discipline Specific Elective**	
4	**Pre-requisite** (if, any)	*As per Program*	
5	**Course Learning. Outcomes (CLO)**	At the end of this course, the students will be able to: ➢ Explain the connection between statistics and thermodynamics. Define the phase space of the classical system. ➢ Define three different types of Ensembles and discuss corresponding theories. Define partition functions for different canonical systems. ➢ Explain energy, energy-density fluctuations, and correspondence of various ensembles. Explain statistics of different quantum mechanical ensembles. ➢ Discuss Bose-Einstein (BE) Condensate w.r.t. liquid Helium II, Define and discuss electron gas behavior w.r.t. Fermi Dirac Statistics ➢ Discuss Virial expansion of the equation of state. Discuss Brownian motion and Einstein and Smoluchowski theory	
6	**Credit Value**	**4 Credits**	***Credit = 15 Hours - learning & Observation***
7	**Total Marks**	**Max. Marks: 100**	**Min Passing Marks: 40**

PART -B: CONTENT OF THE COURSE

Total No. of Teaching–learning Periods (01 Hr. per period) – 60 Periods (60 Hours)

Unit	Topics (Course Contents)	No. of Period
I	**Foundation of Statistical Mechanics** Macroscopic and microscopic states, contact between statistics and thermodynamics, physical significance of Ω (N,V, E), the classical gas, entropy of mixing and Gibb's paradox, phase space of classical system, Liouville`s theorem and its consequences, quantum states and phase space.	15
II	**Elements of ensemble theory** A system in microcanonical, canonical, and grand canonical ensembles, partition functions, physical significance of statistical quantities, example of classical system, energy and energy-density Fluctuations and mutual correspondence of various ensembles	15
III	**Formulation of quantum statistics** Quantum mechanical ensemble theory, density matrix, statistics of various quantum mechanical ensembles, system composed of indistinguishable particles. Maxwell-Boltzmann, Bose-Einstein, Fermi-Dirac distributions Thermodynamic behavior of an ideal Bose gas, Bose-Einstein condensation and, elementary excitations in liquid helium II, Thermodynamic behavior of an ideal Fermi gas, the electron gas, non-relativistic and relativistic degenerate electron gas, theory of white dwarf stars.	15
IV	**Statistical Mechanics of interacting systems** The method of cluster expansion for a classical gas, Virial expansion of the equation of state. Theory of phase transition – general remark on the problem of condensation, Fluctuations: thermodynamic fluctuations, Spatial correlation in a fluid Brownian motion: Einstein Smoluchowski's theory of Brownian motion	15
Keywords	*Macro and microstates, ensembles, phase space, partition function, Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac statistics, Fluctuations, Brownian motion*	

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PART–C: LEARNING RESOURCES

Text Books, Reference Books and Others

Reference Books Recommended –

1. L. D. Landau & E. M. Lifshitz (Butter worth and Heinemann Press).
2. Federick Reif, Fundamental of statistical and thermal physics (McGraw-Hill publishers)
3. Kerson Huang, Statistical Mechanics (Wiley Eastern)
4. Charles Kittel, Elemental Statistical Physics

Text Books Recommended –

1. Brij Lal, N. Subrahmanyam, P S Hemne; Heat and Thermodynamics and Statistical Physics
2. R. K. Pathria, Statistical Mechanics (Pergamon Press)
3. Statistical and Thermal Physics an introduction; Michael J R Hoch

Online Resources– e-Resources / e-books and e-learning portals

1. Statistical Mechanicshttps://archive.nptel.ac.in/courses/115/106/115106126/
2. Introduction to Statistical Mechanics https://archive.nptel.ac.in/courses/115/103/115103113/
3. Statistical Mechanics https://archive.nptel.ac.in/courses/115/106/115106111/
4. Statistical mechanics http://www.digimat.in/nptel/courses/video/115106126/L01.html

PART -D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment(CIA):	**30 Marks**
EndSemester Exam(ESE):	**70 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2):	**20 & 20**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
	Assignment / Seminar -	**10**	
	Total Marks -	**30**	

End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – 10 x1= **10** Mark; **Q2**. Short answer type- **5x4 =20Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**

Name and Signature of Convener & Members of CBoS:

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FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART-A: INTRODUCTION			
Program : Bachelor in Science *(Honors/Honors with Research)*		**Semester -VIII**	Session: 2024-2025
1	Course Code	PHSE-12 T	
2	Course Title	Microprocessor	
3	Course Type	Discipline Specific Elective	
4	Pre-requisite (if, any)	*As per program*	
5	Course Learning. Outcomes (CLO)	**After completion of this course a student will be able to-** ➢ *Understand the basics of digital computer, Clarify the concept of memories used in computer system* ➢ *Familiar with buses and registers available in microprocessor* ➢ *Understand the addressing modes, data transfer group, arithmetic group, logical group etc.Know about Assembly Language, High-Level and Area of applications of various languages* ➢ *Able to use Assembly Language for programming of microprocessor*	
6	Credit Value	**3 Credits**	***Credit = 15 Hours - learning & Observation***
7	Total Marks	**Max. Marks: 100**	**Min Passing Marks: 40**

PART -B: CONTENT OF THE COURSE

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**Digital Computer:** Generation of computer, Digital Computer, Its basic components: Input and output devices, Central Processing Unit (CPU) and its organization, **Primary memory:** Introduction, Types of Primary memory - RAM, SDRAM, SGRAM, DDR SDRAM, SIMM, DIMM, ROM, PROM, EPROM, EEPROM, **Secondary memory:** Construction and working principles of Hard Disc, Floppy Disc, Optical Disc, Magnetic Bubble Memory. Cache memory, Real and Virtual Memory. Memory hierarchy	11
II	**Microprocessor:** Introduction and evaluation, Architecture and functional organization of Intel 8085, ALU, Timing and Control unit, **Buses:** Address Bus, Data Bus and Control Bus. Bus architecture: PCI, ISA, USB and AGP. **Registers:** ACC, General purpose register, Stack pointer, Program counter, Instruction register, Temporary register. Processing speed of processor, Types of processors (Basic Idea), Opcode and Operand, Pin Diagram and Pin Configuration of 8085, Intel 8085 instructions, Instruction cycle, Timing diagram	12
III	**Instruction set of 8085:** Addressing modes, Data transfer group, Arithmetic group, Logical group, Branch group, Stack, I/O and Machine control group. **Programming of Microprocessor:** Assembly Language, High-Level languages. Advantages and Disadvantages of high-level languages, Area of applications of various languages, Stack, Subroutines, Modular programing, Structured programing	11
IV	**Assembly Language Programs:** Addition of two 8-bit number; sum 8-bit, Addition of Two 8-bit number; sum 16-bit, 8-bit subtraction, Shift an 8-bit/ 16-bit number left by 1-bit, Shift an 8-bit/ 16-bit number left by 2-bit,Find larger number of two numbers, Find the largest number in a data array, Find smaller number of two numbers, Find the smallest number in a data array, To arrange a series of numbers in Descending order, To arrange a data array in ascending order, 8-bit multiplication; product in 16-bit, 8-bit division	11
Keywords	***CPU, Memory, Microprocessor, Buses, Registers, Opcode, Instructions, Addressing mode, Assembly language, Programming.***	

Signature of Convener & Members (CBoS):

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PART–C: LEARNING RESOURCES

Text Books, Reference Books and Others

Text Books Recommended–

1. MicroprocessorArchitectureProgrammingandapplicationswith8085,R.S.Goankar,2002,PrenticeHall
2. Digital electronics and Microcomputers, R K Gaur, Dhanpat Rai Publications
3. Fundamentals of Microprocessors and Microcontrollers, B Ram, Dhanpat Rai Publications

Reference Books Recommended –

1. Introduction to microprocessor – Aditya Mathur, Tata McGraw Hills, New Delhi
2. Microprocessor8085: Architecture, Programming and interfacing, A.Wadhwa,2010,PHILearning
3. Microprocessors and Interfacing Devices, Rupender Singh & Sunita Jain, CBS Publications

Online Resources–

e-Resources / e-books and e-learning portals

1. https://www.freebookcentre.net/Electronics/MicroProcessors-Books.html
2. https://www.phindia.com/Books/ShoweBooks/MTMyNg/Microprocessors-Microcontrollers
3. https://books.google.co.in/books?id=P-n3kelycHQC&printsec=frontcover&redir_esc=y#v=onepage&q&f=false
4. https://www.youtube.com/watch?v=UjagUR2i_Ok
5. https://www.youtube.com/watch?v=dLGw66gKKkQ
6. https://www.classcentral.com/course/swayam-microprocessors-and-microcontrollers-9894
7. https://www.youtube.com/watch?v=hwwhsNOqqm8
8. https://www.youtube.com/watch?v=wUmi3roAqmk

PART -D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Exam(ESE):	**70 Marks**

Continuous Internal Assessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2):	**20 +20**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
	Assignment / Seminar -	**10**	
	Total Marks -	**30**	
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**		

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDER GRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART-A: INTRODUCTION				
Program : Bachelor in Science *(Honors/Honors with Research)*			Semester - VIII	Session: 2024-2025
1	Course Code	PHSE-12 P		
2	Course Title	Microprocessors		
3	Course Type	Discipline Specific Elective		
4	Pre-requisite (if, any)	As per Program		
5	Course Learning. Outcomes(CLO)	After completion of this course a student will be able to- ➢ *Understand the working of logic gates and realization of Functions* ➢ *Clarify the concept of combinational logic circuits* ➢ *Understand the differences between MUX, DMUX, Encoder and Decoder and their use* ➢ *Familiar with basic memory elements (Flip-flop)*		
6	Credit Value	1 Credits	*Credit =30 Hours Laboratory or Field learning/Training*	
7	Total Marks	Max. Marks:50		Min Passing Marks:20

PART -B: CONTENT OF THE COURSE

Total No. of learning-Training/performance Periods:30 Periods (30 Hours)

Module	Topics (Course Contents) At least 10 of the following or related Experiments	No. of Period
Lab./ Experiment Contents of Course	1. Write the program using 8085 Microprocessor for Addition and Subtraction of numbers using direct addressing mode 2. Write the program using 8085 Microprocessor for Addition and Subtraction of numbers using indirect addressing mode 3. Write the program using 8085 Microprocessor for Multiplication by repeated addition 4. Write the program using 8085 Microprocessor for Division by repeated subtraction 5. Write the program using 8085 Microprocessor for Handling of 16-bit Numbers 6. Write the program using 8085 Microprocessor to Use of CALL and RETURN Instruction 7. Write the program using 8085 Microprocessor to add two hexa decimal & decimal numbers 8. Write the program using8085Microprocessor to subtract two hexadecimal & decimal numbers 9. Write the program using 8085 Microprocessor for Addition of two 8-bit numbers 10. Writetheprogramusing8085Microprocessor for Addition of two 16-bit numbers 11. Write a program to perform multiplication of two 8-bit numbers using bit addition method 12. Write a program to perform multiplication of two 8-bit numbers using bit rotation method 13. Write a program to perform division of two 8-bit numbers using Repeated Subtraction method 14. Write a program for Finding the largest and smallest number from an array 15. Write a program for Find 1's & 2's complement of a 8 bit number 16. Write a program to Transfer Block of data bytes from one memory location to another 17. Any Similar programming	30
Keywords	***Microprocessor, Addressing mode, CALL, RETURN, Programming***	

Signature of Convener & Members (CBoS):

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PART–C: LEARNING RESOURCES

Text Books, Reference Books and Others

Text Books Recommended–

1. Microprocessor Architecture, Programming, and Applications with the 8085 by Ramesh S. Gaonkar
2. Microprocessors and Microcontrollers: Architecture, Programming and System Design 8085, 8086, 8051, 8096 by Krishna Kant
3. Fundamentals of Microprocessors and Microcontrollers by B. Ram
4. 8085 Microprocessor and its Applications by A. Nagoor Kani
5. The 8085 Microprocessor: Architecture, Programming and Interfacing by K. Udaya Kumar and B.S. Umashankar

Reference Books Recommended–

1. Digital Electronics: Theory and Practical- Virendra Kumar, New Age International Publications
2. Digital Electronics – A Comprehensive Lab Manual- Cherry Bhargava, B S Publication
3. Digital electronics experiment manual- Toger Tokheim, McGraw Hill
4. Handbook of Experiments in Electronics and Communication- B Sasikala & S P Rao, Vikas Publishing
5. Practical Digital Electronics Manual- Nigel P Cook, Prentice Hall

Online Resources–

e-Resources / e-books and e-learning portals

1. https://www.ssit.edu.in/dept/assignment/8085labmanual.pdf
2. https://gnindia.dronacharya.info/ECE/Downloads/Labmanuals/Microprocessor_Lab_Manual.pdf
3. https://people.iitism.ac.in/~download/lab%20manuals/ece/5.%20ECC211%20Microprocessor%20&%20Microcontroller%20Lab.pdf
4. https://www.technicalsymposium.com/microprocessor_lab.pdf
5. https://mjcollege.ac.in/images/labmannuals/MICROPROCESSORLABMANUALBIT281.pdf

PART-D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2):	**10 & 10**	Better marks out of the two Test / Quiz +obtained marks in Assignment shall be considered against 15 Marks
	Assignment/Seminar +Attendance-	**05**	
	Total Marks -	**15**	

End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment**		**Managed by Course teacher as per lab. status**
	A. Performed the Task based on lab. work -	**20 Marks**	
	B. Spotting based on tools& technology (written) –	**10 Marks**	
	C. Viva-voce (based on principle/technology) -	**05 Marks**	

Name and Signature of Convener & Members of CBoS:

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FOUR YEARS UNDERGRADUATE PROGRAM (2024-28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART – A: INTRODUCTION				
Program: Bachelor in Science (Certificate/ Diploma/ Degree/ Honors)			Semester: I	Session: 2024-25
1	Course Code	PHGE-01 T		
2	Course Title	Mechanics		
3	Course Type	Generic Elective Course		
4	Pre-requisite (if any)	As per Program		
5	Course Learning Outcomes (CLO)	*After going through the course, the student should be able to:* ➢ *Analyze and apply the laws of motion to various dynamical situations.* ➢ *Explain and demonstrate the principle of conservation of momentum and energy including their application in real-world scenario such as collision and energy transformation.* ➢ *Evaluate and calculate moment of inertia for objects of different shapes and analyze how these properties affect the motion of rotating bodies.* ➢ *Analyze flow of fluids.* ➢ *Describe special relativistic effects and their effects on the mass and energy of a moving object.*		
6	Credit Value	03 Credits	1 Credit= 15 Hours for Learning & Observation	
7	Total Marks	Maximum Marks: 100	Minimum Pass Marks: 40	

PART – B: CONTENT OF THE COURSE

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Periods
I	**Historical Background:** Contribution of Aryabhatta and Varahmihir to science and society, Brief biography of Vikram Sarabhai with his contribution. **Vectors:** Scalar and vector quantities &fields, Scalar & Vector products of two vectors, Derivatives of a vector, Gradient of scalar field and its physical significance. **Laws of Motion:** Review of Newton's Laws of motion, Dynamics of a system of particles, Concept of Center of Mass, Motion of center of mass, Conservation of linear momentum, Motion of Rocket. **Work and Energy:** Work-Energy theorem for conservative forces, Force as a gradient of Potential Energy, Conservation of energy, Elastic and in-elastic Collisions	12
II	**Rotational Dynamics**: Angular momentum, Torque, Conservation of angular momentum, Moment of Inertia, Theorem of parallel and perpendicular axes (statements only), Calculation of Moment of Inertia of discrete and continuous objects (Rectangular lamina, disc, solid cylinder, solid sphere). **Elasticity:** Stress & Strain, Hooke's law, Elastic constants, Poisson's Ratio, Relationship between various elastic modulii (without derivation), Work done in twisting a cylinder. **Fluid Dynamics**: Flow of fluids, Coefficient of viscosity, Derivation of Poiseulli's formula, Motion of a spherical body falling in a viscous fluid, Stoke's law, Expression for terminal velocity.	12
III	**Gravitation**: Newton's Law of Gravitation, Motion of a particle in a central force field (motion is in a plane, angular momentum is conserved, areal velocity is constant), Kepler's Laws (statements only), Satellite in circular orbit and applications, Geosynchronous orbits. **Oscillations**: Simple harmonic motion, Differential equation of SHM and its solutions, Kinetic and Potential Energy, Total Energy and their time averages, Compound pendulum, Differential equations of damped oscillations and forced oscillations (Conceptual only).	11
IV	**Special Theory of Relativity:** Frame of reference, Galilean Transformations, Inertial and Non-inertial frames, Outcomes of Michelson Morley's Experiment, Postulates of Special Theory of Relativity, Lorentz Transformation, Length contraction, Time dilation, Relativistic transformation of velocity, Relativistic variation of mass, Mass-energy equivalence, Transformation of Energy and Momentum.	10
Keywords:	Aryabhatta, Vectors, Newton's Laws, Angular Momentum, Elasticity, Gravitation, Oscillations, Relativity	

Signature of Convener & Members (CBoS) :

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PART – C: LEARNING RESOURCES

Text Books, Reference Books Recommended and Others

Text Books Recommended-

1. Mechanics & Properties of matter, D.C. Tayal & P. Tayal, 2023, Pub. By Authors.
2. Unified Physics I –R. P. Goyal, Shivlal Agrawal Publication
3. Unified Physics I, Navbodh Publication

Reference Books Recommended-

1. Mechanics, Berkeley Physics, vol.1, C. Kittel, W. Knight, et.al. 2007, Tata McGraw-Hill.
2. Physics, Resnick, Halliday and Walker 8/e. 2008, Wiley.
3. Introduction to Special Relativity, R. Resnick, 2005, John Wiley and Sons.

Online Resources (e-books/ learning portals/ other e-resources)

1. All e-books of physics https://www.e-booksdirectory.com/listing.php?category=2
2. Free physics text book in PDF
3. https://www.motionmountain.net/?gclid=CjwKCAjwmq3kBRB_EiwAjkNDp5v8Yy6xK1s0Kma0VR0AWGlichRwFfCC0-vpZK1jrPoEOAnBq8fcqRoCILsQAvD_BwE
4. Cambridge University Books for Physics https://www.cambridgeindia.org/
5. Books for solving physics problems https://bookboon.com/en/physics-ebooks
6. NPTEL Online courses https://nptel.ac.in/courses/115105098; https://archive.nptel.ac.in/courses/115/106/115106123/;
7. BSc Lectures by Prof. H C Verma: https://bsc.hcverma.in/index.php/course/relativity; https://bsc.hcverma.in/index.php/course/cm1

PART – D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Examination (ESE):	**70 Marks**

Continuous Internal Assessment (CIA): (By course teacher)	Internal Test/ Quiz (2):	**20 + 20**	Better marks out of the two Test / Quiz + marks obtained in Assignment shall be considered against **30 Marks**
	Assignment/ Seminar (1):	**10**	
	Total Marks:	**30**	
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 = 20 Marks** Section B: Descriptive answer type,**1 out of 2** from each unit-**4 x 10=40 Marks**		

Name and Signature of Convener & Members of CBoS:

10/6/24

FOUR YEAR UNDERGRADUATE PROGRAM (NEP–2020)
Program: Bachelor in Science (2024 -28)
DISCIPLINE – ZOOLOGY
Session – 2024 -25

DSC -01 to 08		DSE -01 to 12	
Code	Title	Code	Title
ZOSC -01T	Life on Earth and Unique Attributes of Animal Kingdom	ZOSE -01T	Parasitology
ZOSC -01P	Life on Earth and Unique Attributes of Animal Kingdom	ZOSE -01P	Parasitology
ZOSC -02T	Cell Biology and Histology	ZOSE -02T	Ecology and Wild life Conservation & Management
ZOSC -02P	Cell Biology and Histology	ZOSE -02P	Ecology and Wild life Conservation & Management
ZOSC -03T	Diversity of Invertebrates	ZOSE -03T	Biochemistry
ZOSC -03P	Diversity of Invertebrates	ZOSE -03P	Biochemistry
ZOSC -04T	Diversity of Chordates and Comparative Anatomy	ZOSE -04T	Evolutionary Biology
ZOSC -04P	Diversity of Chordates and Comparative Anatomy	ZOSE -04P	Evolutionary Biology
ZOSC -05T	Vertebrate Physiology	ZOSE -05T	Endocrinology
ZOSC -05P	Vertebrate Physiology	ZOSE -05P	Endocrinology
ZOSC -06T	Genetics	ZOSE -06T	Immunology
ZOSC -06P	Genetics	ZOSE -06P	Immunology
ZOSC -07T	Biosystematics and Taxonomy	ZOSE -07T	Biotechnology and Genetic Engineering
ZOSC -07P	Biosystematics and Taxonomy	ZOSE -07P	Biotechnology and Genetic Engineering
ZOSC -08T	Biotechniques	ZOSE -08T	Applied Zoology
ZOSC -08P	Biotechniques	ZOSE -08P	Applied Zoology
		ZOSE -09T	Basics of Computer & Biostatistics
		ZOSE -09P	Basics of Computer & Biostatistics
		ZOSE -10T	Behaviour & Chronobiology
		ZOSE -10P	Behaviour & Chronobiology
		ZOSE -11T	Developmental Biology
		ZOSE -11P	Developmental Biology
		ZOSE -12T	Molecular Biology
		ZOSE -12P	Molecular Biology
GE -01 & 02		VAC	
ZOGE -01T	Life on Earth and Unique Attributes of Animal Kingdom	ZOVAC-01	Public health and Hygiene
ZOGE -01P	Life on Earth and Unique Attributes of Animal Kingdom	SEC	
ZOGE -02T	Cell Biology and Histology	ZOSEC-01	Vermiculture
ZOGE -02P	Cell Biology and Histology		

Program Outcomes (PO):

- Demonstrate and apply the fundamental knowledge of the basic principles of major fields of Zoology and Modern tools and techniques
- Analyse complex interactions among the various animals of different phyla, their distribution and their relationship with the environment.
- Gain knowledge of small scale industries like sericulture, fish farming, bee keeping, aquaculture, animal husbandry, poultry farm.
- Apply the knowledge and understanding of Zoology to one's own life and work.
- Develops empathy and love towards the animals and consciousness for wild life conservation

Program Specific Outcomes (PSO):

- Perform procedures as per laboratory standards in the areas of Taxonomy, Physiology, Ecology, Cell biology, Genetics, Applied Zoology, Behaviour, Endocrinology, Immunology, Biostatistics, Parasitology, Biochemistry, Evolution, Developmental Biology, Animal biotechnology, Tools and Techniques of Zoology.
- Understand the applications of biological sciences in Apiculture, Aquaculture, Sericulture, Animal Husbandry, Poultry Farm.
- Understand the applications of Zoology in Medicine and daily life
- Contributes the knowledge for Nation building and sustainable development

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF ZOOLOGY
Course Curriculum

PART- A: Introduction				
Program: Bachelor in Life Science *(Certificate / Diploma / Degree/Honors)*		**Semester - I**		Session: **2024-2025**
1	**Course Code**	**ZOSC-01T**		
2	**Course Title**	**Life on Earth and Unique Attributes of Animal Kingdom**		
3	**Course Type**	**Discipline Specific Course**		
4	**Pre-requisite** (if, any)	*As per program*		
5	**Course Learning. Outcomes (CLO)**	**After successfully completing this course, the students will be able to-** ➢ Develop an understanding of concepts, mechanisms, evolutionary significance and relevance of Origin of life. ➢ Understand General Idea about Invertebrate and Vertebrate animals with special reference and their specific qualities. ➢ Understand and appreciate diversity of life forms. ➢ Apply the knowledge about animals Sciences in daily life.		
6	**Credit Value**	**3 Credits**	***Credit = 15 Hours - learning & Observation***	
7	**Total Marks**	**Max. Marks: 100**		**Min Passing Marks: 40**

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**Origin of life: Theories of Origin of life:** **Ancient Theory** Theory of Special Creation (Mythological approach),Theory of Panspermia or Cosmozoic Theory, Theory of Directed Panspermia, Theory of Catastrophism, Theory of Spontaneous Generation (Abiogenesis or Autogenesis), Theory of Biogenesis: Redi's Experiment and Pasture's Experiment. **Modern Theory: Origin of Universe:** Big Bang Hypothesis in Brief, **Origin of Solar System and The Earth:** Nebular hypothesis, **Atomosphere and Eneargy Sources on Primitive Earth, Biochemical Origin of Life:** Oparin and Haldane Theory, **Chemogeny:** Formation of simple and complex organic compounds (Stanely Miller and Ure's Experiment), Formation of Coacervates, Nucleic Acids. **Biogeny:** Origin of primitive prokaryotic cell. **Evolution of modes of Nutrition:** Chemohetertrophs, Anaerobic and Aerobic Photoautotrophs. Evolution of Eukaryotes.	12
II	**Systematics & Unique attributes of Invertebrate and Vertebrate animals with special reference to Coelentrata, Mollusca and Pisces:** Definition and difference between Invertebrate and Vertebrate. **Nomenclature:** Binomial and Trinomial Nomenclature and International code of Nomenclature **Corals:** Meaning of Coral, Structure of Coral polyp, Coral Skeleton, Types of corals: Hydrozoan Coral, Example- Millipora, Octocorallian Coral, Example- Alcyonium, Hexacorallian Corals, Example- Gorgonia. **Torsion in Mollusca:** Definition, Mechanism of Torsion, Effects of Torsion, Significance of Torsion. **Pisces: Migration in fishes**: Catadromous: Eel fish and Anadromous: Salmon fish and **Parental care in fishes:** By nest formation, Coiling round eggs, Attachment to body, Integumentary cups, Shelter in mouth, Brood pouch, Mermaids purses, Viviparity.	11
III	**Unique attributes of Vertebrate animals with special reference to Amphibia & Reptilia:** **Parental care in Amphibia:** by Nest, by Nursery or Shelter and by Parents **Neoteny in Amphibia**: Definition, Partial and Total Neotony, Factors Affecting Neotony, Examples- Axolotal larva, Necturus and Siren. **Reptilia: Venomous & Non-venomous Snakes:** Identification, Poison apparatus: Poison Glands, Poison ducts and Fangs, Biting Mechanism.	11
IV	**Unique attributes of Vertebrate animals with special reference to Aves and Mammals:** **Birds:** Flight Adaptation, Migration and Perching Mechanism, Flightless Birds (Morphology and Special Characters of Emu, Ostrich and Penguins), Discuss-Birds are glorified reptiles: Archaeopteryx. **Monotremes or Egg laying mammals:** Morphology and Special Characters of Echidna and Duck bill platypus. **Aquatic Mammals:** Morphology and Special Characters of Whale and Dolphin. **Mammals: Flying Mammals:** Morphology and Special Characters of Bat.	11
Keywords	*Origin of life, Invertebrate, Vertebrate, Corals, Torsion, parental care, Neotony, Fangs, Aves, Mammals*	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books Recommended

- E. J. W. Barrington , Invertebrate structure and function, English Language Book Society UK
- Robert Barnes, Invertebrate Zoology, Robert Barnes IVth edition Holt Saunders International Edition Japan
- Park Haswell, Marshall and Williams, A textbook on Zoology Invertebrate, AITBS Publishing and Distributers, Delhi
- Park Haswell, Marshall and Williams, A textbook on Zoology Vertebrate, AITBS Publishing and Distributers, Delhi

Reference Books Recommended

- Prof R. L. Kotpal, Protozoa to Echinodermata, Rastogi Publication Meerut
- E.L. Jordan, Dr. P. S. Verma,Invertebrate Zoology , S. Chand Publications, New Delhi
- N. Arumugam, N. C. Nair S. - Invertebrate Zoology, Saras Publication.
- N. Arumugam, N. C. Nair S. - vertebrate Zoology, Saras Publication.
- Barrington E. J. W., Invertebrate Structure and Function, Nelson London
- Barnes, R. D., Invertebrate Zoology –Saunders Philadelphia
- R. L. Kotpal, Invertebrate, Rastogi Publications
- R. L. Kotpal, Vertebrate, Rastogi Publications
- H. S. Bhampah, KavitaJuneja, Recent trends in vertebrates vol 1 – 9, Anmol Publication
- S. N. Prasad, Life of invertebrates, Vikash Publication House Pvt Ltd New Delhi
- G. S. Sandhu, HarshwardhanBhagskar – Advanced invertebrate zoology –Campus books international

Online Resources–

- **https://www.coursera.org/lecture/emergence-of-life/4-5-invertebrates-successes-of-life-without-a-backbone-WQHqS**
- **https://www.shiksha.com/online-courses/introduction-to-biology-biodiversity-course-courl5385**
- **https://www.youtube.com/watch?v=k121Qv6loBA**
- **https://www.youtube.com/watch?v=uK-Xx_OCYcI**
- **https://www.youtube.com/watch?v=vybbBil5Elk**
- **https://www.youtube.com/watch?v=WxMSckEeio4**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 100 Marks

Continuous Internal Assessment (CIA): 30 Marks

End Semester Exam (ESE): 70 Marks

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **20 +20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Signature of Convener & Members (CBoS) :

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DPARTMENT OF ZOOLOGY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Certificate / Diploma / Degree / Honors)*		**Semester - I**	Session: **2024-2025**	
1	Course Code	**ZOSC-01P**		
2	Course Title	**Life on Earth and Unique Attributes of Animal Kingdom**		
3	Course Type	**Discipline Specific Lab Course**		
4	Pre-requisite (if, any)	***As per Program***		
5	Course Learning Outcomes (CLO)	**After successfully completing this course, the students will be able to-** ➢ *To demonstrate comprehensive understanding of the current theories and hypotheses regarding the origin of life on Earth,* ➢ *Understand diversity of life forms* ➢ *Identify some distinctive invertebrate and vertebrate animals* ➢ *Apply this Understanding to broader context of life*		
6	Credit Value	**1 Credits**	***Credit =30 Hours Laboratory or Field learning/Training***	
7	Total Marks	**Max. Marks: 50**	**Min Passing Marks: 20**	

PART -B: Content of the Course

Total No. of learning-Training / performance Periods: 30 Periods (30 Hours)

Module	Topics (Course Contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course	➢ Study of origin of life through chart and models ➢ Study of different Invertebrates and Vertebrates animals through models and museum specimens in the laboratory with details of biogeography and diagnostic features: Millipora, Alcyonium, Gorgonia, Hippocampus, Ichthyophis (Female), Alytes (Male), Axolotal larva, Necturus, Siren, Cobra, Viper (pit & Pitless), Sea Snake, Rattle Snake, Archaeopteryx, Emu, Ostrich and Penguins, Echidna and Duck bill platypus, Whale, Dolphin, Bat. ➢ Preparation and Demonstration of Key for Identification of Venomous and Non-venomous snakes. ➢ Study of Coral Reefs through Models, Photographs ➢ Study of Fossils through chart/ Models ➢ An "**Animal album or Practical Record**" containing sketches, photographs, cut outs, with appropriate write up about the above mentioned taxa. ➢ Study of some videos to develop understanding and acquired knowledge on the animals salient features as mentioned above. ➢ Group discussion/Viva or Seminar presentation on related topics mentioned in Theory paper.	**30**
Keywords	*Museum specimens, Invertebrates, Vertebrates, Venomous and Non-venomous, Seminar*	

Name and Signature of Convener & Members of CBoS:

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- S.S. Lal, Practical Zoology, Invertebrate. 12th Edition Rastogi Publications, Meerut,
  - New Delhi.
- A manual of practical Zoology. Dr. P.S Verma, S. Chand Publication, New Delhi

Reference *Books Recommended* –

- Park Haswell, Marshall and Williams, A textbook on Zoology Invertebrate, AITBS Publishing and Distributers, Delhi
- Park Haswell, Marshall and Williams, A textbook on Zoology Vertebrate, AITBS Publishing and Distributers, Delhi

Online Resources–

- http://ndl.iitkgp.ac.in/he_document/swayamprabha/swayam_prabha/gc5ua6m873i?e=3|*|||
- https://www.youtube.com/watch?v=JUdp3U6A1EA

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - **05** Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **A. Performed the Task based on lab. work - 20 Marks** **B. Spotting based on tools & technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF ZOOLOGY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Certificate / Diploma / Degree / Honors)*		**Semester - II**		Session: **2024-2025**
1	Course Code	**ZOSC- 02T**		
2	Course Title	**Cell Biology and Histology**		
3	Course Type	**Discipline Specific Course**		
4	Pre-requisite (if, any)	***As per Program***		
5	Course Learning Outcomes (CLO)	**After successfully completing this course, the students will be able to-** ➢ Acquire knowledge of Cell membrane and function ➢ Understand the functioning of nucleus and extra nuclear organelles and understand the intricate cellular mechanisms involved. ➢ Gain Knowledge of key processes like cell division, ➢ Learn about various tissues of body their structural significance		
6	Credit Value	**3 Credits**	***Credit = 15 Hours - learning & Observation***	
7	Total Marks	**Max. Marks:**	**100**	**Min Passing Marks: 40**

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**Cell Structure, Cell Membrane and Extra Nuclear Cell Organelles:** General structure of Prokaryotes and Eukaryotes. **Cell membrane organization: O**rigin, structure (Lipid-Lipid Bilayer Model, Dannelli & Davson Model, Unit Membrane Model and Fluid mosaic model), chemical composition and function of cell membrane, Specialization of cell membrane: microvilli desmosomes, Hemidesmosome, Septate Desmosome, plasmodesmata, tight and gap junction. **Extra Nuclear Cell Organelles:** Ultra structure and functions of Endoplasmic reticulum and Golgi apparatus.	11
II	**Extra Nuclear Cell Organelles:** Ultra structure and functions of Ribosome, Lysosome, Peroxisomes, Mitochondria: Origin, structure and function.	11
III	**Nuclear Organization and Cell Division:** Size, shape, structure and functions of interphase nucleus. Ultra structure of nuclear membrane and pore complex. Nucleolus: general organization, chemical composition and functions, Chromosome Morphology, Cell cycle, Cell division- Mitosis and Meiosis. Cell division checks points and their regulation. Programmed cell death (Apoptosis).	12
IV	**Introduction to tissues.** Epithelial tissue: types, structure and characteristics. surface modifications. Basement membrane: structure and characteristics. Connective tissue cells. Structure and function of loose, dense and adipose tissue. Cartilage and bone: classification, and fine structure. Blood: plasma, blood cells, lymph– their structure and function. Bone marrow and haemopoesis. Structure and function of spleen. Muscular tissue: ultrastructure of smooth, skeletal and cardiac muscles. Muscle-tendon attachment. Structure and classification of neurons.	11
Keywords	*Cell Biology, Cell Membrane, Cell organelle, Nucleus, endoplasmic reticulum and Golgi apparatus, ribosome, lysosome, peroxisomes, Mitochondria, tissues.*	

Name and Signature of Convener & Members of CBoS:

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. Gupta P.K. Cell and Molecular Biology, Himalaya Publication
2. Arumugam.N, Cell biology and Molecular Biology, Saras Publication
3. Rastogi V.B. Cell Biology, Rastogi Publication
4. Verma P.S. and Agrawal Cell Biology, S. Chand Publication

Reference Books Recommended –

5. Karp, G. (2010) Cell and Molecular Biology: Concepts and Experiments (6th edition) John Wiley & Sons. Inc.
6. De Robertis, E.D.P. and De Robertis, E.M.F. (2006) Cell and Molecular Biology (8th edition) Lippincott Williams and Wilkins, Philadelphia.
7. Cooper, G.M. and Hausman, R.E. (2009) The Cell: A Molecular Approach. (5th edition) ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
8. Becker, W.M.; Kleinsmith, L.J.; Hardin. J. and Bertoni, G. P. (2009) The World of the Cell. (7th edition) Pearson Benjamin Cummings Publishing, San Francisco. Practical

Online Resources–

1. National digital Library.- http://ndl.iitkgp.ac.in/document/Qkh4R2FGUkRNZjFicFUvWmpzQ2loY0poaUVtYlByc1BZNXk3TnZMWVFzQXpZNjhhQUplR1BTOERHelZXZUp5Nw
2. http://ndl.iitkgp.ac.in/document/Qkh4R2FGUkRNZjFicFUvWmpzQ2loZFJyVGFmaDFwbXpBS0kwNi9tbi91UGYxaFl6OC9Sb25QWUlXLzF1V3NUZw
3. https://www.youtube.com/watch?v=GYY627IeAKg
4. E-PG Pathshala. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=2rAs1Puvga4LW93zMe83aA==

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Exam (ESE):	**70 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **20** +**20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
Department of ZOOLOGY
Course Curriculum

PART- A: Introduction				
Program: Bachelor in Life Science *(Certificate / Diploma / Degree / Honors)*			**Semester - II**	Session: **2024-2025**
1	**Course Code**	**ZOSC-02P**		
2	**Course Title**	**Cell Biology and Histology**		
3	**Course Type**	**Discipline Specific Lab Course**		
4	**Pre-requisite** (if, any)	***As per Program***		
5	**Course Learning Outcomes (CLO)**	**After successfully completing this course, the students will be able to-** ➢ Understand ultra structure of prokaryote and Eukaryote cell, undertake microscopic study to gain knowledge ➢ learn to identify cell organelles ➢ Explain and demonstrate mitosis and meiosis division in onion root tip, Grass hopper testis, etc ➢ Gain knowledge of Microtomy		
6	**Credit Value**	**1 Credits**	***Credit =30 Hours Laboratory or Field learning/Training***	
7	**Total Marks**	**Max. Marks: 50**	**Min Passing Marks: 20**	

PART -B: Content of the Course

Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)

Module	Topics (Course contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course	1. Study of prokaryotic and eukaryotic cell types with the help of chart, slide and video. 2. Separation and isolation of cells by sedimentation velocity in unit gravity. 3. Disruption of cells, isolation and identification of subcellular components, isolation of nuclei. 4. Isolation of mitochondria by differential centrifugation and identification of succinic dehydrogenase in the mitochondrial pellet. 5. Chromosome segregation in mitosis and meiosis. 6. Preparation of chromosome squashes from Onion Root tip for observation of stages of Mitosis 7. Preparation of chromosome squashes from grasshopper/cockroach testes for the observation of stages of meiosis. 8. Isolation and estimation of DNA. 9. Study of types of tissue through permanent slides: epithelial, connective, muscular, Nervous etc. 10. Preparation of Practical Record 11. Group discussion/Viva or Seminar presentation on related topics mentioned in Theory paper	**30**
Keywords	*Prokaryote, Eukaryote, cell division, Mitosis, Meiosis, DNA Separation, Histology of Tissue, Microtomy.*	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. Debarati Das Essential Practical Handbook of Cell Biology & Genetics, Biometry & Microbiology, A Laboratory Manual, Academic Publishers.
2. Mohan P Arora Cytogenetics:, Himalayan Publishing House

Reference Books Recommended –

3. Karp, G. (2010) Cell and Molecular Biology: Concepts and Experiments (6th edition) John Wiley & Sons. Inc.

Online Resources– National Digital Library

- http://ndl.iitkgp.ac.in/he_document/inflibnet_epgp/inflibnet_epgp/IN_I_e_P_P_1_Z_51296_P_1_P_o_e_51600_M_0_P_g_51604_51605?e=13|*|||

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - **05** Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **A. Performed the Task based on lab. work - 20 Marks** **B. Spotting based on tools & technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of BoS :

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF ZOOLOGY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Diploma / Degree/ Honors)*			**Semester - III**	Session: **2024-2025**
1	**Course Code**	**ZOSC-03T**		
2	**Course Title**	**Diversity of Invertebrates**		
3	**Course Type**	**Discipline Specific Course**		
4	**Pre-requisite** (if, any)	*As per Program*		
5	**Course Learning. Outcomes (CLO)**	**After successfully completing this course, the students will be able to -** ➢ Develop understanding on Invertebrate Animals on the basis of classification and Nomenclature. ➢ Develop understanding how simple/unicellular animals changed into multicellular and diploblastic forms through their anatomy and physiology. ➢ Gain Knowledge of key processes like formation of triploblastic animals (simple to complex form of body plan). ➢ Develop understanding on parasitic adaptations and life cycle of Helminthes. ➢ Develop understanding on the diversity in Artropoda, Mollusca and Echinodermata.		
6	**Credit Value**	**3 Credits**	*Credit = 15 Hours - learning & Observation*	
7	**Total Marks**	**Max. Marks: 100**		**Min Passing Marks: 40**

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**General Characters, Classification up to order and Type Study of Phylum Protozoa and Porifera with some special features: Protozoa:** General Characters and Classification of Phylum Protozoa up to order. **Type study:** Paramoecium, Protozoa and Disease. **Porifera:** General Characters and Classification of Phylum Porifera up to order. **Type study: Sycon.**	11
II	**General Characters, Classification and Type Study of Phylum Coelenterata, Helminthes and Annelida: Coelenterata** - General Characters and Classification of Phylum Coelenterata up to order. **Type Study:** Obelia. **Helminthes** - Classification of Phylum Helminthes up to order. **Type study:** Fasciola. **Annelida**- Classification of Phylum Annelida up to order. **Type study:** Pheretima (Earthworm).	11
III	**General Characters, Classification and Type Study of Phylum Arthropoda and Mollusca: Arthropoda** - General Characters and Classification of Phylum Arthropoda up to order. **Type study: Prawn. Mollusc**- General Characters and Classification of Phylum Mollusca up to order. **Type study: Pila.**	12
IV	**General Characters, Classification and Type Study of Phylum Echinodermata and Hemichordata:** General Characters and Classification of Phylum Echinodermata up to order. **Type Study:** Asterias (Starfish). General Characters and Classification of Phylum Hemichordata **Type Study:** Balonoglossus	11
Keywords	*Taxonomy, Nomenclature, Canal System, Protozoa, Balanoglossus, Torsion*	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- R.L. Kotpal, Modern Textbook of Zoology Invertebrates. Rastogi Publication, Gangotri, Shivaji Road, Meerut
- V.K. Tiwari, Unified Zoology, Shivlal Agrawal and Company, Pustak Prakashak, Khajuri Bazar, Indore.
- Dr. S.M. Saxsen, Zoology, Ist Year, by a, Ram Prasad and Sons, Aagra and Bhopal.
- N. Arumugam, M.G. Ragunathan, T. Murugan, B. Ramnathan, A Textbook of Invertebrates by Saras Publication

Reference Books Recommended –

- Barrington, E.J.W. (1979). Invertebrate Structure and Functions. II Edition. E.L.B.S. and Nelson.
- Boradale, L.A. and Potts, E.A.(1961) Invertebrates: A Manual for the use of Students. Asia Publishing Home.
- Bushbaum, R. (1964). Animals without Backbones. University of Chicago Press.
- Hyman, L H. (1940-67). The Invertebrates, Vol. I-VI. McGraw-Hill, New York.
-

Online Resources–

- http://ndl.iitkgp.ac.in/he_document/inflibnet_epgp/inflibnet_epgp/IN_I_e_P_P_1_Z_512_96_P_0_B_o_p_51542_M_1_M_L_c_P_D_a_P_o_E_P_1_51562_51563?e=9|*|||

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 100 Marks

Continuous Internal Assessment (CIA): 30 Marks

End Semester Exam (ESE): 70 Marks

Continuous Internal Assessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **20 +20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz **+** obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF ZOOLOGY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in life Science *(Diploma / Degree/ Honors)*		**Semester - III**	Session: **2024-2025**	
1	**Course Code**	**ZOSC-03P**		
2	**Course Title**	**Diversity of Invertebrates**		
3	**Course Type**	**Discipline Specific Lab Course**		
4	**Pre-requisite** (if, any)	***As per Program***		
5	**Course Learning. Outcomes (CLO)**	**After successfully completing lab course the students will be able to-** ➢ Develop understanding on the diversity of life with regard nonchordates. ➢ Gain Knowledge of grouping of animals on the basis of their morphological characteristics. ➢ Develop critical understanding how animals have changed from simple form to complex body plan. ➢ Acquired the detailed knowledge to think and interpret different animal species individually.		
6	**Credit Value**	**1 Credits**	***Credit =30 Hours Laboratory or Field learning/Training***	
7	**Total Marks**	**Max. Marks: 50**	**Min Passing Marks: 20**	

PART -B: Content of the Course

Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)

Module	Topics (Course contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course	**List of labs to be conducted** • Study of different non-chordate taxa animals through models, slides and museum specimens in the laboratory. Emphasising classification, biogeography and diagnostic features of: Protozoa, Porifera, Coelenterata (also with special reference to Corals of Cnidarians), Helminthes, Annelida, Arthropoda, Mollusca and Echinodermata. • Histological slides of different Non chordate Taxa, slides of various larval forms of Helminthes, Crustacea and Echinodermata • **Dissection** of *Pheretima* to expose Alimentry canal and circum pharyngeal ganglia through Alternative methods of dissection. • Dissection of *Periplaneta* to expose the digestive system, salivary glands and Mouth Parts through Alternative methods of dissection. • Dissection of Prawn to expose appendages and statocyst through Alternative methods of dissection • Dissection of *Pila* to expose Nervous System through Alternative methods of dissection. • Study of Invertebrate animals in nature during a survey of a National Park/ Forest area/College campus. • **Group discussion/Viva or Seminar presentation on two related topics:** Polymorphism, Parasitic adaptations, Freshwater sponges, Biodiversity and climate change, Tree of Life, Marine zooplanktons and their ecological importance including oxygen evolution. • An "**animal album or Practical Record**" containing sketches, photographs, cut outs, with appropriate write up about the above mentioned taxa. • Study of some videos to develop understanding on the animals of different taxa.	**30**
Keywords	*Museum specimens, Histological slides, Alternative of Dissection, Animal album*	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- S.S. Lal, Practical Zoology, Invertebrate. 12th Edition Rastogi Publications, Meerut, New Delhi.
- A manual of practical Zoology. Dr. P.S Verma, S. Chand Publication, New Delhi

Reference Books Recommended-

- Barrington, E.J.W. (1979). Invertebrate Structure and Functions. II Edition. E.L.B.S. and Nelson.
- Hyman, L H. (1940-67). The Invertebrates, Vol. I-VI. McGraw-Hill, New York.

Online Resources–

- https://www.youtube.com/watch?v=GC5Ua6m873I
- https://www.youtube.com/watch?v=-qyM2Hskj84

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - **05** Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **A. Performed the Task based on lab. work - 20 Marks** **B. Spotting based on tools & technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF ZOOLOGY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Diploma / Degree/ Honors)*		**Semester - IV**		Session: **2024-2025**
1	**Course Code**	**ZOSC-04T**		
2	**Course Title**	**Diversity of Chordates and Comparative Anatomy**		
3	**Course Type**	**Discipline Specific Course**		
4	**Pre-requisite** (if, any)	*As per Program*		
5	**Course Learning. Outcomes (CLO)**	**After successfully completing this course, the students will be able to:** ➢ Develop understanding of the characters used to classify and differentiate the organisms belonging to different taxa and the evolutionary history and relationship between the different classes of chordates. ➢ Acquire knowledge and Develop critical understanding of the comparative anatomy and functioning of complex systems of Pisces to Mammalia. ➢ Learn the comparative account of integument with its derivatives, digestive system and Skeletal and Muscular System. ➢ Understand the Digestive system and its anatomical specializations with respect to different diets and feeding habits and respiratory organs in vertebrates used in aquatic, terrestrial and aerial vertebrates. ➢ Understand the evolution of heart, aortic arches, and Learn the evolution of brain, sense organs and urinogenital system.		
6	**Credit Value**	**3 Credits**	*Credit = 15 Hours - learning & Observation*	
7	**Total Marks**	**Max. Marks: 100**		**Min Passing Marks: 40**

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**Diversity in Protochordates and Chordates:** General characteristics & classification of Chordata up to orders with examples. **Cephalochordates:** Type study – Amphioxus and its affinities, **Agnatha:** Comparative account of Petromyzon and Myxine	11
II	**Structure and function of integument and skeletal systems Alimentary canal:** Structure of integument from fishes to mammals with an account on epidermal and dermal derivatives and their functional significance, Anatomy of Axial skeleton from fishes to mammals. Comparative anatomy of appendicular skeleton: limbs and girdles from fishes to mammals. Comparative account with structure of alimentary canal and digestive glands in vertebrates.	11
III	**Comparative anatomy and functional Significance of, Respiratory organs, Heart Aortic Arches and Endocrine Glands:** Structure of Gills, Lungs, Air sacs and Swim bladder in Vertebrates, Structure and evolution of heart in vertebrates, Evolution of aortic arches and their significance in vertebrates. Endocrine Glands & their function. Disorders of Thyroid, Adrenal, Pancreas and Pituitary.	11
IV	**Comparative anatomy and functional Significance of Urinogenital System, Brain & Sense Organ:** Types and development of kidneys and their ducts in anamniotes and amniotes. Nephron- structure, types and their function, Comparative anatomy of Urinogenital system. Comparative anatomy of Brain of vertebrates, Structure of Ear and Eye.	12
Keywords	*Chordates, Protochordates, Petromyzon And Myxine, Comparative Anatomy,Integument Lungs, Air Sacs Aortic Arches, Kidney, Brain*	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- Jordan, E. L. and Verma, P. S. (2013) Chordate Zoology (14th edition).
- Saxena, R. K. and Saxena, S. (2015) Comparative Anatomy of Vertebrates (2nd edition).
- R.L. Kotpal, Modern Text Book of Zoology, Vertebrates, Rastogi Publication, Merut
- Tiwari, V.K. Unified Zoology, B.Sc. Part I, Shivlal Agarwal and Company, Indore

Reference Books Recommended –

- Young, J. Z. (2004). *The Life of Vertebrates*. III Edition. Oxford university press.
- Weichert, C.K. (1970) Anatomy of Chordates (4th edition).

Online Resources–
e-Resources / e-books and e-learning portal

- https://swayamias.com/zoology-optional-coaching/
- https://www.swayamprabha.gov.in/index.php/program/archive/9
- https://www.acsedu.co.uk/Courses/Environmental/VERTEBRATE-ZOOLOGY-BEN104-528.aspx
- https://www.nu.edu/degrees/mathematics-and-natural-sciences/courses/bio416/
- https://www.youtube.com/watch?v=qSY5iXHHi88
- https://www.youtube.com/watch?v=tz8liJXbBCQ
  https://www.youtube.com/watch?v=mXECx3s8yEQ

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Exam (ESE):	**70 Marks**

Continuous Internal Assessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **20 +20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF ZOOLOGY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Diploma / Degree / Honors)*			**Semester - IV**	Session: **2024-2025**
1	Course Code	**ZOSC-04P**		
2	Course Title	**Diversity of Chordates and Comparative Anatomy**		
3	Course Type	**Discipline Specific Lab Course**		
4	Pre-requisite (if, any)	*As per Program*		
5	Course Learning Outcomes (CLO)	**After successfully completing lab course the students will be able to -** ➢ Develop understanding on the diversity of life with regard to different classes of vertebrates. ➢ Gain knowledge to identify and classify the animals on the basis of their morphological characteristics. ➢ Acquire the detailed knowledge about evolutionary history and relationship between the different classes of vertebrates through salient features some important animals. ➢ Learn comparative account of various systems in all the classes of vertebrates.		
6	Credit Value	**1 Credits**	*Credit =30 Hours Laboratory or Field learning/Training*	
7	Total Marks	**Max. Marks: 50**	**Min Passing Marks: 20**	

PART -B: Content of the Course

Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)

Module	Topics (Course contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course	**List of labs to be conducted** ➢ Study of animals through models, slides and museum specimens in the laboratory with details on their classification, biogeography and diagnostic features of different class of Vertebrate. ➢ Study of histological slides of different class of Vertebrate. ➢ Study of Axial skeleton of Amphibia, Reptilia, Aves and Mammals. Comparative study of Appendicular skeleton Girdles and limb bones) of Amphibia, Reptilia, Aves and Mammals. ➢ Comparative study of heart of Fish, Amphibia, Reptilia, Aves and Mammals with the help of models and charts. ➢ Comparative study of Aortic Arches Fish, Amphibia, Reptilia, Aves and Mammals with the help of models and charts. ➢ Comparative study of brain of Fish, Amphibia, Reptilia, Aves and Mammals with the help of models and charts. ➢ Comparative study of Urinogenital system of Fish, Amphibia, Reptilia, Aves and Mammals with the help of models and charts. ➢ Histological study of Endocrine tissue ➢ Study of Vertebrate animals in nature during a survey of a National Park/ Forest area/College campus. ➢ **Group discussion/Viva or Seminar presentation on any one of above topics** ➢ An "**animal album or Practical Record**" containing sketches, photographs, cut outs, with appropriate write up about the above mentioned taxa. ➢ Study of some videos to develop understanding on the animals of different taxa.	**30**
Keywords	*Museum specimens, Histological slides, Alternative of Dissection, Practical Record*	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- S.S. Lal, Practical Zoology, Vertebrate. 12th Edition Rastogi Publications, Meerut, New Delhi.
- A manual of practical Zoology. Dr. P.S Verma, S. Chand Publication, New Delhi
- Saxena, R. K. and Saxena, S. (2015) Comparative Anatomy of Vertebrates (2nd edition).
- R.L. Kotpal, Modern Text Book of Zoology, Vertebrates, Rastogi Publication, Merut
- Tiwari, V.K. Unified Zoology, B.Sc. Part I, Shivlal Agarwal and Company, Indore

Reference Books Recommended –

- Young, J. Z. (2004). *The Life of Vertebrates*. III Edition. Oxford university press.
- Weichert, C.K. (1970) Anatomy of Chordates (4th edition).

Online Resources–

- **https://www.youtube.com/watch?v=W4gQxADcryw**
- **https://www.youtube.com/watch?v=Ts9GsrBviI8**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - **05** Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **A. Performed the Task based on lab. work - 20 Marks** **B. Spotting based on tools & technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF ZOOLOGY
COURSE CURRICULUM

PART- A: Introduction

Program: Bachelor in life Science *(Degree / Honors)*	Semester - V	Session: 2024-2025

1	Course Code	ZOSC- 05T		
2	Course Title	Vertebrate Physiology		
3	Course Type	Discipline Specific Course		
4	Pre-requisite (if, any)	*As per Program*		
5	Course Learning. Outcomes (CLO)	**After successfully completing this course, the students will be able to-** ➢ Understand the physiological mechanism at cellular and system level. ➢ Learn the significance ofnutrients, breathing mechanism, blood coagulation. ➢ Understand the water balance in body and working of different senses response. ➢ Understand the reproductive physiology and muscles contraction. ➢ Apply this knowledge to understand working and disorders of physiological activities.		
6	Credit Value	3 Credits	*Credit = 15 Hours - learning & Observation*	
7	Total Marks	Max. Marks: 100		Min Passing Marks: 40

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**Cell Physiology: Cell membrane and transport mechanism:** Transport across membrane: osmosis, passive diffusion- simple and facilitated, & Active transport Mechanism of active transport Primary & secondary active transport, endocytosis and exocytosis, Vescicular Transport: Protein sorting from ER to Golgi, Retrograde transport, Transport across Mitochondrial membrane; pH and its biological significance, Buffer: buffers in biological system, Regulation of pH by Lung and Kidney.	12
II	**Physiology of Digestion Respiration and Circulation:** **Physiology of Digestion:** Biological significance of nutrients: carbohydrates, proteins, fats, vitamins and minerals. Physiology of digestion with special reference to enzyme involved, Absorption of Carbohydrate, protein and lipid. **Breathing mechanism:** Pulmonary ventilation, Respiratory volumes and capacities. Transport of Oxygen and Carbon dioxide in blood. **Composition of blood**, blood groups, Theories of blood coagulation. Conduction and Regulation of Heart beat, Cardiac cycle, Cardiac output, Integration of cardiovascular function, electrocardiogram (ECG).	11
III	**Physiology of Excretion, nerve impulse transmission and Receptor Physiology:. Physiology of excretion: Nephron:** Structure, Types and their functions Mechanism of Urine formation, Counter-current Mechanism, role of ADH and Renin-Angiotensin-Aldosterone system in Excretion, **Mechanism of Osmoregulation** in fresh water and marine and terrestrial vertebrates, Stenohalinity and Euryhalinity. **Nerve Physiology:** Structure and functions of neuron, ionic basis of resting and action potentials, nerve impulse and its transmission, synapse and synaptic transmission, Reflex action. **Receptor physiology-** Physiology of Vision, Physiology of Hearing and balancing, Mechano, chemo reception, Bioluminescence.	11
IV	**Physiology of Reproduction, Muscle Contraction and Tharmoregulation: Physiology of Reproduction:** male reproduction: hormonal control of Spermatogenesis, female reproduction: hormonal Control of Oogenesis, menstrual cycle and its hormonal control. **Muscle Contraction:** Structure and types of muscles, striated, non-striated and cardiac muscles. Molecular structure of muscles protein Actin and Myosin. Physiology of muscles contraction. **Theories of Muscles Contraction. Thermoregulation:** Mechanism in Homeotherms and Poikilotherm.	11
Keywords	*Vertebrate Physiology, Physiology of Respiration, Digestion, Circulation, Blood, Cardiac Cycle, Excretion, Nerve impulse, Thermoregulation, Muscle Contraction, Physiology of Reproduction & Endocrine Glands*	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- Verma P S , Tyagi B S, Agarwal VK *Animal Physiology. Author,*. Edition, illustrated. Publisher, S. Chand Publishing, 2000 - Science - 432 pages
- *Berry AK,* A Textbook of *Animal Physiology By* (Second edition Emkay publication
- Dr. C. C. Chatterjee, Human physiology, Vol. I & II, 1980, 12th Edn., Medical Applied Agency, Kolkata
- Nagabhushanam, S. V. S. Rana, S. Kalavathy Text book of Animal Physiology, 2008, 2nd Edn., Oxford University Press, India.

Reference Books Recommended –

- Ian Kay, 2000, Introduction to Animal Physiology, Bios Scientific Publishers Limited.
- Guyton A. C. & Hall J. E., 2006, Textbook of Medical Physiology, 11th Edition, Hercourt Asia Pvt. Ltd. / W. B. Saunders Company
- Tortora G. J. & Grabowski S.,Principles of Anatomy & Physiology, 2006, 11th Edition, John Wiley & sons, Inc.
- Schmidt-Nielsen, Knut, Animal Physiology: Adaptation and Environment, 1997, Cambridge University Press.
- Hoar W. S., General and Comparative Physiology, 1983, 3rd Edn., Prentice Hall, UK.7.
- Barret, K.; Brooks, H.; Boitano, S. and Barman, S. (2010) Ganong's Review of Medical Physiology (23rd edition) Lange Medical.
- Guyton, A.C. and Hall, J.E. (2006) A text book of Medical Physiology (11th edition) Saunders.
- Keele, C.A. & Neil, E. (1989) Samson Wright's Applied Physiology (13th edition) Oxford.

Online Resources–

- **E PG Pathshala:**
  https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=2rAs1Puvga4LW93zMe83aA==
- **https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=2rAs1Puvga4LW93zMe83aA==**

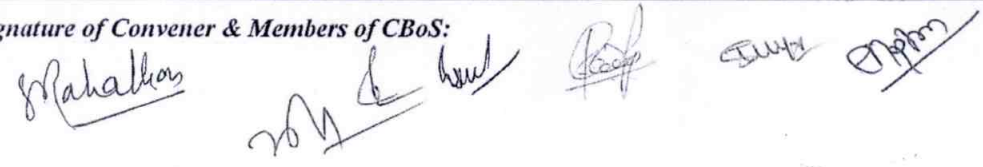
PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Exam (ESE):	**70 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **20 +20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz **+** obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener & Members of CBoS:



FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DPARTMENT OF ZOOLOGY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Degree / Honors)*		**Semester - V**	Session: **2024-2025**	
1	Course Code	ZOSC-05 P		
2	Course Title	Vertebrate Physiology		
3	Course Type	Discipline Specific Lab Course		
4	Pre-requisite (if, any)	*As per Program*		
5	Course Learning Outcomes (CLO)	**After successfully completing this course, the students will be able to-** ➢ Perform and demonstrate some physiological exercises ➢ Learn to record Blood pressure and analyze it ➢ Calculate Oxygen Consumption in model animal ➢ Learn the structure and working of eye and ear. ➢ Apply this knowledge to identify tissues by learning Histological details		
6	Credit Value	**1 Credits**	***Credit = 15 Hours - learning & Observation***	
7	Total Marks	**Max. Marks: 50**	**Min Passing Marks: 20**	

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 30 Periods (30 Hours)

Unit	Topics (Course contents)	No. of Period
	• Hematological practical : Determine blood group, RBC and WBC counting technique, clotting time • Preparation of haemine crystal • Measurement of Blood Pressure through sphygmomanometer. • Action of salivary amylase on starch • Biochemical analysis of food • Determination of oxygen consumption with the help of Respirometer • Preparation of casein from milk • Study of permanent histological section slides of (esophagus , stomach, duodenum, ilium , pancreas ,liver trachea kidney spinal cord, bone, cartilage & blood cells) mammal, • Demonstration of technique of microtome to have hands-on experience and learning of the technique • Glycolysis, Krebs's cycle, electron transportation demonstrate through Chart / Photographs • Preparation of Practical record • group discussion /quiz / A small project report applying the knowledge	15
Keywords	*Vertebrate Physiology, Human Physiology, Physiology of Respiration, Digestion, Circulation, Blood, Cardiac Cycle, Excretion, Nerve impulse, Thermoregulation, Muscle Contraction, Physiology of Reproduction & Endocrine Glands*	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- Hoar W. S., General and Comparative Physiology, 1983, 3rd Edn., Prentice Hall, UK.7.
- Keele, C.A. & Neil, E. (1989) Samson Wright's Applied Physiology (13th edition) Oxford.
- Verma P S , Tyagi B S, Agarwal VK *Animal Physiology. Author*,. Edition, illustrated. Publisher, S. Chand Publishing, 2000 - Science - 432 pages
- Berry AK, A Textbook of Animal Physiology By (Second edition Emkay publication
- Pal GK & Pal Parvati, Text book of Practical Physiology, Universities Press
- V P Varshaney and Mona Bedi, Ghai's Text Book of Practical Physiology, Jaypee Brothers Medical Publication

Reference Books Recommended –

- Ian Kay, 2000, Introduction to Animal Physiology, Bios Scientific Publishers Limited.
- Guyton A. C. & Hall J. E., 2006, Textbook of Medical Physiology, 11th Edition, Hercourt Asia Pvt. Ltd. / W. B. Saunders Company
- Tortora G. J. & Grabowski S.,Principles of Anatomy & Physiology, 2006, 11th Edition, John Wiley & sons, Inc.
- Dr. C. C. Chatterjee, Human physiology, Vol. I & II, 1980, 12th Edn., Medical Applied Agency, Kolkata
- Nagabhushanam, S. V. S. Rana, S. Kalavathy Text book of Animal Physiology, 2008, 2nd Edn., Oxford University Press, India.
- Schmidt-Nielsen, Knut, Animal Physiology: Adaptation and Environment, 1997, Cambridge University Press.

Online Resources–

- **http://ndl.iitkgp.ac.in/he_document/swayam_prabha/m_zly6dppqu**
- **http://ndl.iitkgp.ac.in/he_document/swayam_prabha/y_0ag_clvw0**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - **05** Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **A. Performed the Task based on lab. work - 20 Marks** **B. Spotting based on tools & technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF ZOOLOGY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Degree / Honors)*		**Semester - VI**		Session: **2024-2025**
1	**Course Code**	**ZOSC-06T**		
2	**Course Title**	**Genetics**		
3	**Course Type**	**Discipline Specific Course**		
4	**Pre-requisite (if, any)**	*As per Program*		
5	**Course Learning Outcomes (CLO)**	**After successfully completing this course, the students will be able to:** ➢ Understand and grasp the principles of Mendelian inheritance and interaction of genes. ➢ Understand the sources and consequences of genetic variation, including mutations, genetic recombination, and gene flow. ➢ Know various methods of sex determination in animal kingdom. ➢ Analyse the cause and effect of alterations in chromosome number and structure ➢ Understand DNA structure and function, gene expression, and genetic inheritance patterns ➢ Know the Recent Assisted Reproductive Techniques		
6	**Credit Value**	**3 Credits**	***Credit = 15 Hours - learning & Observation***	
7	**Total Marks**	**Max. Marks: 100**		**Min Passing Marks: 40**

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**Concept of Genes and Genomics:** Scope and importance. Elements of heredity and variation: Classical and Modern concept of Gene (Cistron, Muton, Recon), Alleles. Mendel's laws of inheritance, Chromosomal basis of inheritance and its applications. Exceptions to Mendelian Inheritance: Incomplete dominance, Codominance, Multiple allelism. Ineraction of Gene-Lethal alleles, Pleiotropy, Epistasis- Dominant and Recessive, Supplimentary, Complementary, Inhibitory gene and polygene. Define Penetrance, Expressivity and Phenocopy.	12
II	**The recombination and interaction of Genes:**Linkage and crossing over, cytological basis of crossing over. Organelle inheritance (Mitochondrial), Sex Chromosomes and sexlinked Gene X-linked dominant and X-linked recessive. Sex determination: Theories of sex determination: Chromosomal Theory (XX/XO, XX/XY, ZZ/ZW, ZZ/ZO), Genetic balance theory, intersex, Haplodiploidy, Gynandromorphs. Hormonal influence on sex determination-Freemartin and sex reversal. Role of environmental factors- Bonellia and Crocodile. Eugenics. Mutation, Chromosomal and Gene Mutation, Structural and numerical alterations of chromosomes.	11
III	**Regulation of Gene expression, regulation and mapping:** Gene Expressions and regulation: One gene-one enzyme hypothesis /one polypeptide hypothesis. Concept of operon of bacteria (Lac Operon) and bacteriophages. Bacterial transposons. Vertical and horizontal gene transfer. Transformation, transfection and transduction. Genetic mapping. RNA-inheritance, FLP-FRT. Utility of the model organisms: Escherichia coli, *Drosophila melanogaster* & *Mus musculus*	11
IV	**Population Genetics and Genetic Counselling:** Human Genetics: Pedigree analysis; Karyotype, **Genetic disorders: chromosomal aneuploidy** (Down, Edward, Patau, Turner and Klinefelter syndromes), chromosome translocation (Chronic Myeloid Leukemia) and deletion ("cry of cat" syndrome). Single Gene Disorder: gene mutation (sickle cell anemia,) and Genetic counselling, Gene isolation Manipulation and techniques. Basic concept of Polymerase Chain Reaction. DNA Sequencing; Southern, Western & Northern Blots. In situ Hybridization, FISH, RFLPs and Oligonucleotide arrays. Gene Cloning vs Animal Cloning, Nuclear transplantation,	11
Keywords	*Genetics, Mendel's law, Interaction of Gene, Sex Linkage, Sex Determination, Operon, Genetic Screening, Pedigree Analysis, Aneuploidy*	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- Arora M.P. and Sandhu G.S. Genetics, Himalayan Publishing House
- Winter P.C. Et al, Genetics Viva Publication
- Gupta P.K., Cell and Molecular Biology Rastogi Publication

Reference Books Recommended –

- Gardner, E.J. *et al.* (2006) Principles of Genetics (John Wiley).
- Russell, P.J. (2010) Genetics (Benjamin Cumm ings).
- Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). Principles of Genetics. (VIII edition) Wiley India.
- Snustad, D.P. and Simmons, M.J. (2009). Principles of Genetics. (V edition) John Wiley and Sons Inc.
- Klug, W.S., Cummings, M.R. and Spencer, C.A. (2012). Concepts of Genetics. (X edition) Benjamin Cummings.
- Carroll S.B.; Doebley J.; Griffiths, A.J.F. and Wessler, S.R. (2018) An Introduction to Genetic Analysis. W. H. Freeman and Co. Ltd.
- Campbell, N. and Reece, J. (2014) Biology (10th edition). Benjamin Cummings

Online Resources–

- National digital Library.
- http://ndl.iitkgp.ac.in/document/Rm5qb3lqRngwWDZ2Tnl6UXl4VU9YR201R0cwYXJHV25HSHFacGxtS1h3REZGd1ByL28xcmlleEFFZU5najlCZ1lHdXBBTzBleTBVRGlDSFhkMEtuUkE9PQ
- E-PG Pathshala.
- https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=2rAs1Puvga4LW93zMe83aA
- eGyankosh- Genetics and Evolutionary Biology
- eGyanKosh: BZYCT-137 Genetics and Evolutionary Biology

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Exam (ESE):	**70 Marks**

Continuous Internal Assessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **20 +20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz **+** obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF ZOOLOGY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Degree / Honors)*			**Semester - VI**	Session: **2024-2025**
1	Course Code	**ZOSC- 06P**		
2	Course Title	**Genetics**		
3	Course Type	**Discipline Specific Lab Course**		
4	**Pre-requisite** (if, any)	***As per Program***		
5	**Course Learning Outcomes (CLO)**	**After successfully completing this course, the students will be able to-** ➢ Able to understand and explain Mendel's Law of Inheritance ➢ Capable to analyze inheritance of gene by pedigree analysis. ➢ Know laboratory culture of Drosophila. ➢ Understand and configuration for animal life. ➢ Capable to understand Human keryotype and Numerical alteration in chromosomes		
6	Credit Value	**1 Credits**	***Credit =30 Hours Laboratory or Field learning/Training***	
7	Total Marks	**Max. Marks: 50**	**Min Passing Marks: 20**	

PART -B: Content of the Course

Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)

Module	Topics (Course contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course	➢ Application of probability in the law of segregation with coin tossing. ➢ Study of mode of inheritance of the following traits by pedigree charts – attached ear lobe, widow's peak. ➢ Familiarization with techniques of handling *Drosophila*, identifying males and females; observing wild type and mutant (white eye, wing less) flies, and setting up cultures. ➢ Study of human karyotypes and numerical alterations (Down syndrome, Klinefelter syndrome and Turner syndrome). ➢ Demonstration of law of segregation (monohybrid and test cross) sex-linked inheritance in Drosophila making a cross between white eye dumpy winged or sepia eyed and wild type flies (criss-cross inheritance) Explain with Model ➢ Study of structural chromosome aberrations (dicentric, ring chromosomes and inversions in polytene chromosomes) from prepared slides/photograph ➢ Extraction of Genomic DNA from bacteria. ➢ Group discussion/ Seminar/ Quiz presentation on one or two related topics	**30**
Keywords	***Mendel's Law, Human Karyotype, Drosophila Culture, Pedigree***	
Signature of Convener & Members (CBoS) :		

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- Practical Hand Book of Genetics: Vikas Pali Kalyani Publication
- Essential Practical Handbook of Cell Biology & Genetics, Biometry & Microbiology, A Laboratory Manual Debarati Das, Academic Publishers.
- Cytogenetics:Mohan P Arora, Himalayan Publishing House

Reference Books Recommended –

- Klug, W.S., Cummings, M.R. and Spencer, C.A. (2012). Concepts of Genetics. (X edition) Benjamin Cummings.
- Carroll S.B.; Doebley J.; Griffiths, A.J.F. and Wessler, S.R. (2018) An Introduction to Genetic Analysis. W. H. Freeman and Co. Ltd.

Online Resources–

- **https://jru.edu.in/studentcorner/lab-manual/agriculture/Fundamentals%20of%20Genetics.pdf**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - **05** Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **A. Performed the Task based on lab. work - 20 Marks** **B. Spotting based on tools & technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF ZOOLOGY
Course Curriculum

PART- A: Introduction				
Program: Bachelor in Life Science *(Honors / Honors With Research)*			**Semester - VII**	**Session: 2024-25**
1	**Course Code**	**ZOSC-07T**		
2	**Course Title**	**Biosystematics and Taxonomy**		
3	**Course Type**	**Discipline Specific Course**		
4	**Pre-requisite** (if, any)	*As per Program*		
5	**Course Learning. Outcomes (CLO)**	**After successfully completing this course the students will be able to -** ➢ Comprehend the basic concepts of Biosystematics and Txonomy. ➢ Understand and learn the Taxonomic Hierarchy in animal kingdom. ➢ Gain a basic knowledge and grasp the rules and philosophy of scientific nomenclature. ➢ Develop the critical understanding to identify the animals up to species level with the help of taxonomic keys. ➢ Learn the Newer trends in biosystematics and apply it in Research.		
6	**Credit Value**	**3 Credits**	***Credit = 15 Hours - learning & Observation***	
7	**Total Marks**	**Max. Marks: 100**		**Min Passing Marks: 40**

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**Introduction to systematic and classification:** Definition & basic concepts of Biosystematics and Taxonomy. Historical resume of systematic. Taxonomic Hierarchy: Definition, Linnean hierarchy and categories. Classification: Purpose, use and basis. Theories of classification: Biological, artificial and natural classification. Levels of taxonomy: alpha, beta and gamma taxonomy. Micro and macro taxonomy. Scope and applications of biosystematics in biology. The relevance of systematics in conservation programs.	11
II	**Taxonomic Characters and Scientific Nomenclature:** Different types of taxonomic characters (morphological, physiological, ecological, ethological and geographical characters). **Zoological nomenclature:** binominal and trinomial system, Principles andrules of International Code of Nomenclature (ICN), type material, author citation, criteria for publication, types of names, principle of priority and its limitations.	11
III	**Taxonomic Keys, Taxonomic treatment and Phylogenetics:** Types of taxonomic key their merits and demerits. Type concept: Process of typification and different Zoological types and their applications. Taxonomic treatment of Allopatric variation, homology and Reproductive and geographical isolating mechanisms and their role in speciation process. **Evolutionary taxonomy:** Cladistics. **Constructing trees/ dendrograms:** Phenogram, phylogram and cladogram and turning them into classifications. Mechanism of speciation in panmictic and apomictic species. **Species concept:** different species concepts, **Species category:** sub-species and other infra species categories.	12
IV	**Taxonomic procedure and Newer trends in biosystematics:** Taxonomic Collection, curetting, preservation, identification and classification. **Newer trends in biosystematics:** Morphological, Embryological, Behavioral, Ecological, Cytological and Biochemical approach. Numerical taxonomy. Differential systematic. Molecular taxonomy. DNA bar coding for identification of species.	11
Keywords	*Systematic, classification, Linnean hierarchy, dendrograms, Nomenclature, Cladistics, Species category*	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- R.C. Dalella & R.S. Sharma, (2017) Animal Taxonomy & Museology. Jai Prakashnath & Co., Meerut.
- V.C. Kapoor (2019). Theory and practice of animal taxonomy and biodiversity, 8th Edn.

Reference Books Recommended –

- E. Mayer, (1991). Principles of Systematic Zoology.
- G.G. Simpson (2012). Principles of animal taxonomy. Scientific Publisher, India
- E.O. Wilson, (1988). Biodiversity. John Wiley & Sons.
- Futuyama, D. J. (1986). Evolution, Systematics and Animal Behaviour. Evolutionary Biology. Sinauer Associates Inc.
- Mayr, E. & Ashlock, P. D. (1991) Principles of Systematic Zoology (2nd edition) McGraw Hill Int.

Online Resources–

- **http://ndl.iitkgp.ac.in/he_document/swayamprabha/swayam_prabha/qtrdnp2xfxe?e=0|species%20concept|||**
- **http://ndl.iitkgp.ac.in/he_document/swayam_ugc_moocs/214_21777_self_learning**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 100 Marks

Continuous Internal Assessment (CIA): 30 Marks

End Semester Exam (ESE): 70 Marks

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **20 +20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF ZOOLOGY
COURSE CURRICULUM

PART- A: Introduction

Program: Bachelor in Life Science *(Honors / Honors with Research)*		Semester -VII	Session: 2024-2025
1	Course Code	ZOSC- 07P	
2	Course Title	Biosystematics and Taxonomy	
3	Course Type	Discipline Specific Lab Course	
4	Pre-requisite (if, any)	*As per Program*	
5	Course Learning Outcomes (CLO)	After successfully completing this course the students will be able to ➢ Comprehend the basic concepts of Biosystematics and Txonomy. ➢ Understand and learn the Taxonomic Hierarchy in animal kingdom. ➢ Gain a basic grasp on the rules and philosophy of scientific nomenclature. ➢ Develop the critical understanding to identify the animals up to species level with the help of taxonomic keys. ➢ Learn the Newer trends in biosystematics and apply it in Research.	
6	Credit Value	1 Credits	*Credit =30 Hours Laboratory or Field learning/Training*
7	Total Marks	Max. Marks: 50	Min Passing Marks: 20

PART -B: Content of the Course

Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)

Module	Topics (Course contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course	• Study and sketch of museum specimens of Invertebrates and Vertebrates on the basis of systematic and Taxonomic Hierarchy • Preparation of identification keys for select specimens of non chordate (e.g., insects) and chordates (e.g., birds). • Make a record of biodiversity of college campus. • Construct the dendrograms, through Interactive software for exploring phylogeny and analyzing character • Use DNA bar coding for identification of species. • General discussion, distinguishing characters and classification of selected animals. • Generation of a character-state matrix by selecting and scoring diagnostic taxonomic characters. • Distance-based methods of phylogenetic reconstruction using manual and computermethods. • Group discussion/Viva or Seminar presentation on two related topics. • An "animal album or Practical Record" containing sketches, photographs, cut outs, with appropriate writes up about the above mentioned taxa. • Study of some videos to develop understanding on the animals of different taxa.	30
Keywords	*Museum specimens, dendrograms, bar coding, identification keys, phylogenetic*	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- R.C. Dalella & R.S. Sharma, (2017) Animal Taxonomy & Museology. Jai Prakashnath & Co., Meerut.
- V.C. Kapoor (2019). Theory and practice of animal taxonomy and biodiversity, 8th Edn.
- S.S. Lal, Practical Zoology, Invertebrate. 12th Edition Rastogi Publications, Meerut, New Delhi.
- A manual of practical Zoology. Dr. P.S Verma, S. Chand Publication, New Delhi

Reference Books Recommended –

- E. Mayer, (1991). Principles of Systematic Zoology.
- G.G. Simpson (2012). Principles of animal taxonomy. Scientific Publisher, India

Online Resources–

- http://ndl.iitkgp.ac.in/he_document/swayamprabha/swayam_prabha/qtrdnp2xfxe?e=0|species%20concept|||
- http://ndl.iitkgp.ac.in/he_document/swayam_ugc_moocs/214_21777_self_learning

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - **05** Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **A. Performed the Task based on lab. work - 20 Marks** **B. Spotting based on tools & technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF ZOOLOGY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Honors / Honors With Research)*			**Semester - VIII**	Session: **2024-2025**
1	**Course Code**	**ZOSC-08T**		
2	**Course Title**	**Biotechniques**		
3	**Course Type**	**Discipline Specific Course**		
4	**Pre-requisite (if, any)**	***As per program***		
5	**Course Learning Outcomes (CLO)**	***At the end of course, students will be able to -*** ➢ Have comprehensive understanding of various tools and techniques commonly employed in scientific research across disciplines ➢ Learn utilizing essential laboratory instruments such as microscopes, pH meter, spectrophotometers, chromatography systems, and centrifuges. ➢ Understand cell culture techniques ➢ Develop skills in experimental design, data acquisition, and analysis using modern software tools. ➢ Develop critical thinking on the application of various modern instruments and correlate the knowledge for better development of society.		
6	**Credit Value**	**3 Credits**	***Credit = 15 Hours - learning & Observation***	
7	**Total Marks**	**Max. Marks: 100**	**Min Passing Marks: 40**	

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**Microscopy and Microtomy: Types of Microscope:** Basic Principle, configuration and working of Light Microscope (Bright and Dark Field), Magnification & Resolution, and Numerical Aperture. Phase Contrast Microscope, Fluorescence Microscope, Confocal Microscope. Electron Microscope (SEM and TEM). **Microtomy**: Permanent slide preparation through microtome: Tissue - preparation fixation, dehydration, **block** - preparation, trimming, **cutting sections (sectioning /Ribbon) -** handling, affixing on the side, labeling and storage, **staining** the microtomy slides.	11
II	**Tools and techniques in Physiology:** Principle and applications of pH meter, Centrifugation, Colorimetry and Spectrophotometry- UV, visible spectrophotometer, Infra-red spectrophotometer, NMR and ESR.	11
III	**Chromatography and Eletrophorosis: Chromatography:** Principle and Applications of Paper chromatography, Thin layer chromatography and Gel-filtration chromatography. **Electrophoresis:** Principle and Applications of Agarose gel electrophoresis, Polyacrylamide Gel electrophoresis, PAGE, 2D PAGE.	12
IV	**Cell culture and Lab Bioethics:** Cell culture and its basic requirements. **Culture media:** Nutrient and Non-nutrient media, Types of animal cell culture: Pure Culture- Pour Plate Method, Streak Plate Method and Spread Plate Method. **Media preparation** of Animal Cell culture, viability testing, cell harvesting and storage method with special reference to Lymphocytes and stem cell culture. *In Vitro* culture of Entamoeba *histolytica, Coenorhabditis elegans*. **Sterilization technique** (Physical Method: Autoclave sterilization, Hot air Sterlization, U V sterilization, filtration and chemical Method: alcohol, Formalin and Chromic acid), sterilization of glass wares, Media and laminar flow, Flow cytometery. **Lab Bioethics:** Lab safety, disposal of bio-waste.	11
Keywords	*Cell culture, Sterilization, Cryopreservation, Media, viability testing, cell harvesting, Lymphocytes, stem cell.*	
	Signature of Convener & Members (CBoS) :	

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- Robert Braun, Introduction to instrumental analysis, McGraw Hill Publication
- Clark and Swizer, Experimental Biochemistry, Freeman, 2000
- Boyer, R. (2000) Modern Experimental Biochemistry (3rd edition) Benjamin-Cummings.
- Recommended readings.
- Pearse, A.G.E. (1980-1993) Histochemistry - Theoretical and applied, Volume I-III, Churchill-Livingstones.
- Plummer, D. (2017) An Introduction to Practical Biochemistry (3 rd edition) McGraw Hill.
- Wilson, K. and Walker, J. (2010) Experimental Biochemistry, Cambridge. Practical
- Swarup N, Arora S and Pathak SC, Laboratory Techniques in Modern Biology. Kalyani Publishers
- Sharma B.K., Principles of Instrumentation Goel Publishing House
- Upadhayay Upadhayay & Nath, Principles of Instrumentation, Himalaya Publishing House
- Chatwal G R & Anand Sharma , Principles of Instrumental method of Chemical Analysis, Himalaya Publishing House
- Arumugam N, Kumaresan V, Biotechniques Saras Publication
- Ghatak K L, Techniques and Methods in Biology PHI Learning

Online Resources–

- **https://www.youtube.com/watch?v= t9Zh3PJaF4**

Online Resources–

- **e-Resources / e-books and e-learning portals**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Exam (ESE):	**70 Marks**

Continuous Internal Assessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **20 +20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz **+** obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF ZOOLOGY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Honors/ Honors with Research)*		**Semester - VIII**	Session: **2024-2025**	
1	**Course Code**	**ZOSC-08P**		
2	**Course Title**	**Biotechniques**		
3	**Course Type**	**Discipline Specific Lab Course**		
4	**Pre-requisite** (if, any)	***As Per Program***		
5	**Course Learning. Outcomes (CLO)**	**After successfully completing this course, the students will be able to:** ➢ Understand the purpose of the technique, its proper use and possible modifications/improvement. ➢ Developed skills in handling instruments. ➢ Developed skills in the performance of experiments through scientific planning. ➢ Develop critical thinking on reviewing, discussing and reporting the results. ➢ Applied and Correlate the knowledge for better development of society.		
6	**Credit Value**	**1 Credits**	***Credit =30 Hours Laboratory or Field learning/Training***	
7	**Total Marks**	**Max. Marks: 50**	**Min Passing Marks: 20**	

PART -B: Content of the Course		
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)		
Module	**Topics (Course contents)**	**No. of Period**
Lab./Field Training/ Experiment Contents of Course	**List of labs to be conducted** • Study and handling of Compound Microscope, pH meter, Colorimeter, Centrifuge, Spectrophotometer, Chromatography Chamber, Electrophorosis Unit, Microtome. • Sterilization of Lab equipments. • Determination of pH of different soil samples & water samples. • Determination of maximum absorption. • Separation of Amino acids, plant pigment and sugar by paper and thin layer chromatography • Separation of DNA and RNA through Paper & Gel Electrophoresis • Separation of particles by Centrifuge. • Preparation of Permanent slides through Microtome. • Preparation of Temporary and Permanente slides of some microscopic organisms. • Pure culture of cell. • Cell fractionation • Contour drawing through Camera Lusida • Preparation of Practical Record. • Group discussion/Viva or Seminar presentation on above mentioned and related topics.	**30**
Keywords	*Centrifuge, Spectrophotometer, Chromatography Chamber, Electrophorosis Unit, Microtome, Cell fractionation, Camera Lusida.*	
Signature of Convener & Members (CBoS) :		

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- Sharma B.K., Principles of Instrumentation-
- Upadhayay Upadhayay & Nath, Principles of Instrumentation, Himalaya Publishing House
- Chatwal G R & Anand Sharma , Principles of Instrumental method of Chemical Analysis, Himalaya Publishing House

Reference Books Recommended –

- Boyer, R. (2000) Modern Experimental Biochemistry (3rd edition) Benjamin-Cummings.
- Recommended readings.
- Pearse, A.G.E. (1980-1993) Histochemistry - Theoretical and applied, Volume I-III, Churchill-Livingstones.
- Plummer, D. (2017) An Introduction to Practical Biochemistry (3 rd edition) McGraw Hill.
- Wilson, K. and Walker, J. (2010) Experimental Biochemistry, Cambridge. Practical
- Swarup N, Arora S and Pathak SC, Laboratory Techniques in Modern Biology. Kalyani Publishers
- Robert Braun, Introduction to Instrumental analysis

Online Resources–

- **http://ndl.iitkgp.ac.in/he_document/swayam_prabha/gb9ai2ctttc**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 50 Marks

Continuous Internal Assessment (CIA): 15 Marks

End Semester Exam (ESE): 35 Marks

Continuous Internal Assessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - **05** Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **A. Performed the Task based on lab. work - 20 Marks** **B. Spotting based on tools & technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF ZOOLOGY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Diploma / Degree/Honors)*		**Semester - III**	Session: **2024-2025**	
1	**Course Code**	**ZOSE- 01T**		
2	**Course Title**	**Parasitology**		
3	**Course Type**	**Discipline Specific Elective**		
4	**Pre-requisite** (if, any)	*As per Program*		
5	**Course Learning. Outcomes (CLO)**	➢ Students should comprehend the life cycles of various parasites, including their modes of transmission, intermediate hosts, and definitive hosts. ➢ Gain insights into the interactions between parasites and their hosts, including mechanisms of host invasion, evasion of host defenses, and pathogenesis. ➢ Develop the ability to recognize clinical manifestations associated with parasitic infections ➢ Understand the epidemiology of parasitic diseases ➢ Communicate effectively about parasitic diseases, including educating the public.		
6	**Credit Value**	**3 Credits**	***Credit = 15 Hours - learning & Observation***	
7	**Total Marks**	**Max. Marks: 100**	**Min Passing Marks: 40**	

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**Viral diseases:** General characters, Structure and Classification of virus, A brief account of pathogenic viruses. Brief history of microbiology: germ theory of disease, Host pathogen interaction: invasion, antigenic heterogeneity, toxins and enzymes secretions. Viral diseases: hepatitis, influenza, AIDS, Covid -19 with emphasis on their causative agents, pathogenesis, diagnosis, prophylaxis and chemotherapy.	12
II	**Bacterial & Fungal diseases**: General characters, Structure and Classification of bacteria. **Bacterial Diseases:** A brief account of pathogenic bacteria, discovery of penicillin, diseases caused by *Streptococcus pneumonia, Salmonella typhi, Escherichia coli, Mycobacterium tuberculosis, Rickettsia, Spirochaetes* **Fungal diseases:** Ringworm infection, *Aspergillosis, candidiasis.*	11
III	**Protozoan parasites**: An overview of protozoa & disease. Introduction to parasites and parasitic diseases. Mode of transmission, portals of entry and implications of parasitism. Parasitic adaptations. Concept of zoonotic diseases. Protozoan diseases of medical importance: Brief account of life History, pathogenicity of the following Protozoa with reference to Man, prophylaxis and treatment: *Entamoeba histolitica, Trypanosoma gambiens, Plasmodium vivex, Giardia.*	11
IV	**Helminth parasites:** An overview of Helminthic diseases. Brief account of life History, pathogenicity of the following Helminths with reference to Man, prophylaxis and treatment. *Taenia solium, Schistosoma haematobium, Ascaris lumbricoides, Wuchereria branrofti.* Vector insects.	11
Keywords	*Micrology, pathogenic bacteria, Protozoan parasites, Helminth parasites, Toxicology, toxic againts*	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- Agrawal Anju Principles of Toxicology
- Parija, S. C. (2013) Textbook of Medical Parasitology, Protozoology & Helminthology (Text and colour Atlas), IV Edition, All India Publishers & Distributers, New Delhi.
- Ichhpujani, R.L. and Bhatia, R. (2009) Medical Parasitology. III Edition, Jaypee BrothersMedical Publishers (P) Ltd., New Delhi
- Ahmed, N., Dawson, M., Smith, C. and Wood, Ed. (2007) Biology of Disease. Taylor andFrancis Group.
- Chatterjee, K. D. (2009). Parasitology: Protozoology and Helminthology. XIII Edition, CBSPublishers & Distributors (P) Ltd.
- Arora, D. R and Arora, B. (2001) Medical Parasitology. II Edition. CBS Publications andDistributors
- Chatterjee, K.D (2015) Parasitology (13th edition)

Reference Books Recommended –

- Jawetz, M. and Adelberg (2015) Medical Microbiology (27th edition)
- Noble, E.R. and Noble, G.A. (1989) Parasitology: The Biology of Animal Parasites. VIEdition, Lea and Febiger

Online Resources–

- http://ndl.iitkgp.ac.in/he_document/inflibnet_epgp/inflibnet_epgp/IN_I_e_P_P_1_Z_512_96_P_0_B_o_p_51542_M_1_M_L_c_P_D_a_P_o_E_P_1_51562_51563?e=9|*||
- http://ndl.iitkgp.ac.in/he_document/inflibnet_epgp/inflibnet_epgp/IN_I_e_P_P_1_Z_512_96_P_0_B_o_p_51542_M_2_P_d_a_p_o_w_b_51594_51595?e=3|*|||

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Exam (ESE):	**70 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **20 +20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF ZOOLOGY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Diploma / Degree/ Honors)*			**Semester - III**	Session: **2024-2025**
1	**Course Code**	**ZOSE- 01P**		
2	**Course Title**	**Parasitology**		
3	**Course Type**	**Discipline Specific Elective Lab Course**		
4	**Pre-requisite** (if, any)	***As per Program***		
5	**Course Learning. Outcomes (CLO)**	**At the end of this course, the students will be able -** ➢ Identify common parasitic Protozoa and Helminth. ➢ Learn techniques for studying growth of bacteria and its staining. ➢ Learn the techniques for examine Sputum, Blood, Urine and Stool samples for pathology		
6	**Credit Value**	**1 Credits**	***Credit =30 Hours Laboratory or Field learning/Training***	
7	**Total Marks**	**Max. Marks: 50**	**Min Passing Marks: 20**	

PART -B: Content of the Course

Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)

Module	Topics (Course contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course	➢ Study of permanent slides and specimens of parasitic Protozoans and Helminthes. ➢ Pathological examination of sputum, blood, urine and stool. ➢ Blood: Erythrocyte Sedimentation Rate (ESR), Haematocrit. ➢ Staining and identification of Gram positive and Gram negative bacteria. ➢ Preparation of thin and thick blood films to diagnose Plasmodium infections/ or permanent slides. ➢ Preparation of temporary and permanent slides of faecal matter by saline preparation and concentration techniques to identify cysts of parasitic Protozoans and Helminthes eggs /or parmanant slides studies. ➢ Study Kinetics of bacterial growth and staining techniques. ➢ Group discussion or Seminar presentation on one or two related topics ➢ Group discussion/quiz/seminar on topics related to theory. ➢ Preparation of practical record or Album of parasites.	**30**
Keywords	*Parasitic protozoa, helminth, ESR, Gram positive and Gram negative*	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- Ghosh Saugala, Panikar's Text book of Parasitology. Jaipyee Brothers
- Ananthanarayan and Paniker's Textbook of Microbiology, Twelfth Edition, Universities press

Reference Books Recommended –

- K.D. Chattargee, Parasitology . CBS Publisher

Online Resources–

- http://ndl.iitkgp.ac.in/he_document/swayam_ugc_moocs/swayam_ugc_moocs/IN_S_U_M_1_U_C_17_A_D_4127_M_L_h_o_A_L_w_P_A_o_A_L_34326_34327?e=7|*|||
- http://ndl.iitkgp.ac.in/he_document/swayam_ugc_moocs/swayam_ugc_moocs/IN_S_U_M_1_U_C_17_A_D_4127_M_L_h_o_T_s_a_F_h_10250_10251?e=8|*|||

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - **05** Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **A. Performed the Task based on lab. work - 20 Marks** **B. Spotting based on tools & technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF ZOOLOGY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Diploma / Degree/Honors)*			**Semester -IV**	Session: **2024-2025**
1	**Course Code**	**ZOSE-02T**		
2	**Course Title**	**Ecology and Wildlife Conservation & Management**		
3	**Course Type**	**Discipline Specific Elective**		
4	**Pre-requisite** (if, any)	***As per Program***		
5	**Course Learning. Outcomes (CLO)**	**After successfully completing this course, the students will be able to:** ➢ Understand the concepts of fundamental ecological principles, including energy flow, nutrient cycling, and population dynamics. ➢ Apply the knowledge of ecology to understand equilibrium of nature. ➢ Analyze the strategies of Populations to survive and sustain. ➢ Evaluate the significance of biodiversity and its conservation. ➢ Create awareness about wildlife and nature.		
6	**Credit Value**	**3 Credits**	***Credit = 15 Hours - learning & Observation***	
7	**Total Marks**	**Max. Marks: 100**		**Min Passing Marks: 40**

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**An overview of Ecology and Biomes:** Aims and scope of Ecology. Difference between Auto-ecology and Synecology. Abiotic & Biotic factors. Ecosystem and Ecological Pyramids. Bio-geo chemical cycles. Energy flow in ecosystem: Trophic levels. Food Chain, Food Web, Food chain in fresh water ecosystem. Laws of limiting factor: Leibig's Law of Minimum, Shelford Law of tolerance. Major Biomes of the world. Biogeographic zones of India.	11
II	**Population ecology:** Population characteristics: Density, Measurement of Population Density (Quadrate method and tagging method) Mortality, Natality, Age Pyramids, Migration and Dispersal. Life tables. Survivorship curves. Population Growth: Types of Population Growth, Growth Curves (S shaped & J shaped), Mathematical Expression of population growth: logistic & stochastic. R and K strategies. Carrying Capacity. Population Regulation: extrinsic & intrinsic factors.	12
III	**Biotic community and Environmental degradation:** Biotic community characteristics and attributes: Stratification; Dominance, diversity, species richness, abundance, Evenness, Similarity. Ecotone and edge effect. Ecological succession. Species interaction: Positive interactions: commensalism, proto-cooperation and mutualism. Negative interactions: parasitism. Competition: Interspecific and Intraspecifi, Lotka Volterra Model, Gause's Principle. Prey-Predatator Model. **Environmental degradation:** Air, water and noise pollution and their control. Natural resources: Mineral, water and forest, their significance and conservation.	11
IV	**Biodiversity & Wildlife management:** Biodiversity: Concept and characteristics. Levels of Biodiveristy (Genetic Diversity, Species Diversity & Ecosystem Diversity), Hotspots of Biodiversity. Major National Parks of Chhattisgarh and their biodiversity. Endemic animal species of Chhattisgarh. IUCN red list categories and criteria. Conservation of Biodiversity (In Situ, & Ex Situ Conservation). Major international & national treaties, laws and regulations for conserving biodiversity. Important conservation projects undertaken in India: Project Tiger & Project Elephant. Tiger Census and Estimation (Techniques and Findings). Cheetah re-introduction plan. Captive breeding and Propagation: Founder population, rehabilitation, education, utilization, gene banks. GIS and other technologies in Forest & Wild life conservation.	11
Keywords	*Ecology, Biome, Abiotic, Biotic factors, Nutrient Cycle, Population, Wildlife conservation, In Situ & Ex Situ*	

Signature of Convener & Members (CBoS) :

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- Sharma, P.D. Ecology and Environment, Rastogi Publication.
- Kumar Pranav, Meena Usha. Fundamentals of Ecology and Environment.
- Mathur Reena. Wildlife Conservation and Management, Rastogi Publication.
- Singh S.K., Text book of Wildlife Management, CBC Publishers and Distributors

Reference Books Recommended –

- Chapman, J.L.& M.J. Reiss. 1998. Ecology: Principles and Applications. Cambridge Univ. press. 2nd edition.
- Odum, E. P. (2004). Fundamentals of Ecology, Oxford and IBH Publishing Co. Pvt. Ltd.
- Smith, TM and Smith RL 2015. Elements of Ecology, Pearson Education, India.

Online Resources–

- **https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000035ZO/P000891/M020617/ET/1498712980Ecosystemprocesses-IPart-1Quad1.pdf**
- **https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000035ZO/P000891/M020612/ET/1498710746CommunitycharacteristicsstratificationPart4Quad1.pdf**
- **http://ndl.iitkgp.ac.in/he_document/swayam_prabha/cao2zsydjqu**

Online Resources–

- **https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1788373**
- **https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000032SW/P001702/M020403/ET/14969150701-**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Exam (ESE):	**70 Marks**

Continuous Internal Assessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **20 +20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz **+** obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM(2024 – 28)
DEPARTMENT OF ZOOLOGY
COURSE CURRICULUM

PART-A: Introduction				
Program:Bachelor in Life Science*(Diploma / Degree/ Honors)*		**Semester -IV**		Session:2024-2025
1	**CourseCode**	**ZOSE-02P**		
2	**CourseTitle**	**Ecology and Wildlife Conservation & Management**		
3	**CourseType**	**Discipline Specific Elective Lab Course**		
4	**Pre-requisite**(if, any)	***As per Program***		
5	**Course Learning. Outcomes(CLO)**	**After successfully completing this course, the students will be able to:** ➢ Understand practical fieldwork skills, including sampling techniques, data collection and methods of analysis used in ecological research. ➢ Learn to design and implement ecological experiments. ➢ Understand soil profile and characteristics. ➢ Analyse chemical parameters of various water bodies. ➢ Create awareness about local faunaand evaluate biodiversity of an area.		
6	**CreditValue**	**1 Credits**	***Credit =30 Hours Laboratory or Field learning/Training***	
7	**TotalMarks**	**Max.Marks:50**		**Min Passing Marks:20**

PART -B: Content oftheCourse

TotalNo.of learning-Training/performancePeriods:30 Periods (30 Hours)

Module	Topics(Coursecontents)	No. of Period
Lab./Field Training/ Experiment Contents of Course	• Study of biodegradable and non-biodegradable pollutants in the locality. • Study of a representative type of ecosystem. • Determination of pH of water samples from various water bodies. • To determine the transparency of water of Pond ecosystem by Secchi disc. • To study the profile of soil in the field/ Soil sampling by V- cut method. • To study the zooplankton communities in a fresh water ecosystem. • To prepare a checklist of birds/Insects in and around college campus. • Estimation of ecological density, diversity and frequency of college premises by quadrate method. • Estimation of Shannon – Weiner index of a given area. • Estimation of Simpson– biodiversity index of a given area. • Study of strategy for preventing and managing human-wildlife conflicts. • Project Work / Quiz / Poster / Model preparation/Viva. • Practical Record	**30**
Keywords	*Density, Diversity, Frequency, Biodegradable, Non- biodegradable, Pollutants, Sechhi disc,*	

SignatureofConvener&Members (CBoS):

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- Swaroop, Pathak and Arora. Laboratory technique
- Deb A.C.,Fundamentals of Biochemistry, New Central Book Agency
- Jain J.L., Jain N, Jain s., Fundamentals of Biochemistry, S.Chand Publication

Reference Books Recommended –

- Nelson, D.L. & Cox, M.M. (2017) Lehninger Principles of Biochemistry (7th edition)Worth.
- Berg, J.M.; Tymoczko, J.L. and Stryer, L. (2012) Biochemistry (7th edition) Freeman and Co.
- Zubay, G. (2017) Biochemistry (4th edition) McGraw-Hill.
- Conn, E.E.; Stumpf, P.K.; Bruening, G. and Doi, R.H. (2006) Principles of Biochemistry(5th edition) Wiley.

Online Resources–

- **http://ndl.iitkgp.ac.in/he_document/swayam_prabha/pe9ddsufpck**
- **http://ndl.iitkgp.ac.in/he_document/swayamprabha/swayam_prabha/dsajwjhnmf8?e=8|*|||**

Online Resources–

- **e-Resources / e-books and e-learning portals**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - **05** Total Marks - **15**	Better marks out of the two Test / Quiz **+** obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **A. Performed the Task based on lab. work - 20 Marks** **B. Spotting based on tools & technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF ZOOLOGY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Degree/Honors)*			**Semester - VI**	Session: **2024-2025**
1	**Course Code**	**ZOSE-04T**		
2	**Course Title**	**Evolutionary Biology**		
3	**Course Type**	**Discipline Specific Elective**		
4	**Pre-requisite** (if, any)	***As per Program***		
5	**Course Learning. Outcomes (CLO)**	**After successfully completing this course the students will be able to-** ➢ Understanding the historical concept of Evolution. ➢ Develop an understanding on the Evolutionary Concept and theories in evolution. ➢ Understanding on the different interacting evolutionary process by various examples. ➢ Learn animal phylogeny and adaptations. ➢ Develop an interest in the debates and discussion taking place in the field of evolutionary biology.		
6	**Credit Value**	**3 Credits**	***Credit = 15 Hours - learning & Observation***	
7	**Total Marks**	**Max. Marks:**	**100**	**Min Passing Marks:** **40**

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**Historical review of evolutionary concept:** Evidences in favor of Evolution: Evidences from morphology and comparative anatomy (Homology, Analogy and Vestigial organs), Evidences from Paleontology, Connecting Links, Embryology, Taxonomy, Cytology, Biochemistry & physiology and from Genetics. Theories of Evolution: Lamarckism, Neo-Lamarckism and Darwinism (Basic Postulates of Darwinism, Supplementary theories of Darwin, Support & Criticism of Darwinism) Modern Synthetic theory of Evolution: Gene and Chromosomal Mutation.	12
II	**Evolutionary forces:** Natural Selection, Genetic variation, Genetic drift (mechanism, founder's effect, bottleneck phenomenon), Gene Migration. Hardy-Weinberg Law, Molecular clock (example of globin gene family) rRNA/cyt c). Isolation: Pattern & mechanism of isolation.	11
III	**Products of evolution: speciation mechanisms:** Quantitative traits, Species Concept: Morphological, Biological, Genetical and phylogenetic species concept. Species Categories: Geographical races, Demes, Clines, Ecological races, Semi species, Speciation: Phyletic speciation, Gradual speciation: Allopatric, sympatric, peripatric, parapatric, Alloparapatric. Theories of speciation: Classical theory of Gradualism, Founder flush speciation theory. Mimicry: Protective, Aggressive, Batesian & Mullerian mimicry and significance of mimicry, Aposematic coloration, Thanatosis, Extinctions: massextinctions (causes and effects), detailed example of K-T extinction.	11
IV	**Basic patterns of Evolution:** Micro & Macro Evolution. Phylogenetic Tree: Its construction and Interpretation. Fossils and fossilization, dating and significance of fossil. Geological Time Scale, Evolution of Man and Evolution of Horse.	11
Keywords	*Homology, Analogy, Natural Selection, Genetic variation, Genetic drift, Speciation, Mimicry.*	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- Rastogi, Veerbala, Organic Evolution (2018). Third Revised Edition. MEDTECH.
- Singh, S.P., Tomar, B.S., Evolutionary Biology, Rastogi Publication
- Verma P.S., Agrawal V.K., Cell Biology, Genetics, Evolution & Ecology, S.Chand Publication

Reference Books Recommended –

- Ridley, M. (2004). *Evolution*. III Edition. Blackwell Publishing
- Barton, N. H., Briggs, D. E. G., Eisen, J. A., Goldstein, D. B. and Patel, N. H. (2007). *Evolution*. Cold Spring, Harbour Laboratory Press.
- Hall, B. K. and Hallgrimsson, B. (2008). *Evolution*. IV Edition. Jones and Bartlett
- Publishers.
- Douglas, J. Futuyma (1997). *Evolutionary Biology*. Sinauer Associates.
- Campbell, N.A. and Reece J.B (2011) Biology (9th edition) Pearson, Benjamin,Cummings
- De Robertis, E.D.P. and De Robertis, E.M.F. (2006) Cell and Molecular Biology (8thedition) Lippincott Williams andWilkins, Philadelphia.

Online Resources–

- **Egyankosh-**
- **https://egyankosh.ac.in/bitstream/123456789/16425/1/Unit-10.pdf**
- **National Digital Library**
- **http://ndl.iitkgp.ac.in/he_document/libretexts/libretexts/2f661e95fc3f32dd7204f7188addec22?e=17|EVOLUTION|||**
- **http://ndl.iitkgp.ac.in/he_document/swayamprabha/swayam_prabha/1o8mxiahue8?e=1|*|||**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Exam (ESE):	**70 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **20 +20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz **+** obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
ZOOLOGY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Degree/Honors)*			**Semester - VI**	Session: **2024-2025**
1	**Course Code**	**ZOSE-04P**		
2	**Course Title**	**Evolutionary Biology**		
3	**Course Type**	**Discipline Specific Elective Lab Course**		
4	**Pre-requisite** (if, any)	***As per Program***		
5	**Course Learning. Outcomes (CLO)**	**After successfully completing lab course the students will be able to-** ➢ Understanding on the process evolutionary biology by the study of some animals. ➢ Learn the different interacting evolutionary process by various examples. ➢ Understand evolution through fossils Acquire an in-depth knowledge on the diversity and relationships in animal world through evolutionary process.		
6	**Credit Value**	**1 Credits**	***Credit =30 Hours Laboratory or Field learning/Training***	
7	**Total Marks**	**Max. Marks: 50**	**Min Passing Marks: 20**	

PART -B: Content of the Course

Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)

Module	Topics (Course contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course	• Study of homology (forelimbs, heart, brain in vertebrates) through models and charts. • Study of Analogy (wings of insect, birds and bat) through models and charts. • Study of Serial homology in appendages of *Palaemon.* • Study of Virus, Euglena, Peripatus, Balanoglossus, Chimaera, Lung fish, Archeopteryx, and Echidna on the basis of Evolution (connecting link). • Study of adaptive radiations in vertebrates and mouth parts of insects. • Exercise based on Hardy-Weinberg Law. • Demonstration of role of natural selection and genetic drift in changing allele frequencies using simulation studies. • Construction of phylogenetic trees and its interpretation. • Phylogenetic tree of Man and Horse • Study of fossils from models/pictures • Preparation of Practical Record • Group Discussion/Quiz/Seminar/Project on related topics.	
Keywords	*Evolution, Homology, Analogy, Phylogenetic tree, Adaptive radiation*	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- Rastogi, Veerbala, Organic Evolution (2018). Third Revised Edition. MEDTECH.
- S.S. Lal, Practical Zoology, Invertebrate. 12th Edition Rastogi Publications, Meerut, New Delhi.
- A manual of practical Zoology. Dr. P.S Verma, S. Chand Publication, New Delhi

Reference Books Recommended –

- Ridley, M. (2004). Evolution. III Edition. Blackwell Publishing
- Barton, N. H., Briggs, D. E. G., Eisen, J. A., Goldstein, D. B. and Patel, N. H. (2007).
- Evolution. Cold Spring, Harbour Laboratory Press.

Online Resources–

National Digital Library

- http://ndl.iitkgp.ac.in/he_document/libretexts/3d7e9973648c332bee5336b05c6cf84f

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - **05** Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **A. Performed the Task based on lab. work - 20 Marks** **B. Spotting based on tools & technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM(2024 – 28)
DEPARTMENT OF ZOOLOGY
COURSE CURRICULUM

PART-A: Introduction				
Program: Bachelor in Life Science *(Honors/ Honors with Research)*		**Semester - VII**		**Session: 2024-25**
1	Course Code	**ZOSE- 05T**		
2	CourseTitle	**Endocrinology**		
3	CourseType	**Discipline Specific Course**		
4	Pre-requisite(if,any)	***As per Program***		
5	**Course Learning. Outcomes(CLO)**	**After successfully completing this course, the students will be able to:** ➢ Understand characters of hormones, their biochemical origin, functions and their role in physiology. ➢ Learn about the organization of endocrine glands and mechanism of hormone action. ➢ The learners will understand the hormonal disorders, and diseases. ➢ Comprehend about the role of hormone in healthy lifestyle. ➢ Develop insights on advancements in endocrinology.		
6	CreditValue	**3 Credits**	***Credit = 15 Hours - learning & Observation***	
7	TotalMarks	**Max.Marks:**	**100**	**Min Passing Marks:40**

PART -B: Content oftheCourse

Total No. of Teaching–learning Periods(01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**Chemical Regulators and Gene action:** General characters, chemical structure & properties of Hormones. Comparison between hormone and enzymes. Types of chemical regulators: Hormone, Neurotransmitters, Parahormones, Semiochemicals: Pheromones, Lumones & Chalones. Hormone Receptors: Mechanism of hormone action and cell signaling, Second messengers: types and features. Gene & Hormone Action, Hormone Responsive Element. Feedback system in Hormone action, hormone delivery. The Lesser Known Regulatory Substances (Somatomedins, Prostaglandin, Eicosanoids, Thromboxane etc.) Analytical techniques of Hormone Assay: Radioimmuno assay, Enzyme linked immune sorbent assay, Immune histochemistry. Hormone Replacement Therapy.	10
II	**Neuro-endocrine system:** Hypothalamus: Origin, Location, Gross Anatomy, and Structure. The Endocrine Hypothalamus: Hypothalamic Hormones, Hypothalamic Nuclei, General Functions of Hypothalamus, Hypothalamo-hypophysial portal system, Hypothalamo-hypophysisal-gonadal axis. Pituitary Gland: Origin, Location, Structure, Hormones, Control of secretion & disorders. Regulation of pigmentation by Pars Intermedia in vertebrate chromatophores. Pineal Gland: Origin, Location, Structure, Hormones & Control of secretion, Overview of Biological Rhythm. Role of Oxytocin, Endorphin, Serotonin and Dopamine in temperament stability (Happiness Hormones & Mental Health). Neuro-endocrine system in Insects and its physiology.	11
III	**Endocrine System & Physiology I:** Thyroid Gland: Organization of Mammalian Thyroid Gland, Biosynthesis of Thyroid Hormones, Metabolism of Thyroid Hormones, Regulation of Thyroid hormone secretion, Physiological & Metabolic Roles of Thyroxine, disorders of Thyroid Functions. Parathyroid Gland and Calcium Regulation. Calcium and Phosphate homeostasis. Adrenal Gland: Organization of Mammalian Adrenal Gland. The Adrenal Steroid Hormones (Synthesis Pathway & Physiological Roles), The Renin Angiotensin System, The Adrenal Medulla & Catecholamines (Synthesis Pathway and Mechanism of action of Catecholamines). Disorders of Adrenal Gland.	12
IV	**Endocrine System & Physiology II:** The Endocrine Pancreas: Origin, Islet Cell Structure & cell types, Hormones of the endocrine pancreas, Insulin: Biochemistry, Synthesis, Mechanism of action and physiological role, Glucose Transporters in Mammals & Diabetes mellitus. Insulin Resistance. Hormones of Gonads: Gonadal steroid hormones, Biosynthesis, transport, metabolism and physiological effects. Role of hormones in ovarian cycle & Menopause. Hormones in Birth Control. Role of hormones in sex determination. Hormones of Gastrointestinal Tract: Action of Gastrointestinal Peptides in mammals. Hormonal control of feeding behaviour. Hormones and lifestyle disorders: Chronic stress, Blood Pressure & Obesity.	12
Keywords	*Hormone, Pheromones, Biosynthesis, Thyroid Gland, Adrenal Gland, Pancreas, Catecholamines, Sex Determination, Diabetes, Obesity.*	

SignatureofConvener&Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- Chandra S. Negi: Introduction to Endocrinology, 2009, PHI
- Shastri V.K., Endocrinology and Reproductive Biology, Rastogi Publicatio

Reference Books Recommended –

- Hadley: Endocrinology (6th ed. 2009, Prentice Hall)
- Lodish et al :Molecular Cell Biology, W.H.Freeman& Co Ltd.
- Turner &Bagnara: General Endocrinology, 6th ed.1984, Saunders)
- Norris: Vertebrate Endocrinology, Fourth Edition, 2007, Academic Press

Online Resources–

- https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=2rAs1Puvga4LW93zMe83aA==
- https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=2rAs1Puvga4LW93zMe83aA==

Online Resources–

- http://ndl.iitkgp.ac.in/he_document/cec/_gFN1zyU718_PLNsppmbLKJ8KYPKIeHeF3oC4jZYt8zBe4
- https://egyankosh.ac.in/bitstream/123456789/33320/1/Unit-4.pdf
- https://www.ncbi.nlm.nih.gov/books/NBK441576/

PART -D:Assessment andEvaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment(CIA):	**30 Marks**
EndSemester Exam(ESE):	**70 Marks**

Continuous InternalAssessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **20** +**20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF ZOOLOGY
COURSE CURRICULUM

PART-A: Introduction				
Program: Bachelor in Life Science *(Honors / Honors with Research)*		**Semester - VII**		**Session: 2024-25**
1	CourseCode	**ZOSE-05P**		
2	CourseTitle	**Endocrinology**		
3	CourseType	**Discipline Specific Elective Lab Course**		
4	Pre-requisite(if,any)	***As per Program***		
5	**Course Learning. Outcomes(CLO)**	➢ Develop understanding of histological study of endocrine glands ➢ Learn the role anatomical aspects of various endocrine glands. ➢ Attain the fundamentals of applied endocrinology. ➢ Explore the operation of basic medical kits of routine usage. ➢ Create awareness towards lifestyle disorders related to hormones.		
6	CreditValue	**1 Credits**	***Credit =30 Hours Laboratory or Field learning/Training***	
7	TotalMarks	**Max.Marks:50**		**Min Passing Marks:20**

PART -B: Content oftheCourse		
TotalNo.of learning-Training/performancePeriods:30 Periods (30 Hours)		
Module	**Topics (Course contents)**	**No.ofPeriod**
Lab./Field Training/ Experiment Contents of Course	• Study of histological slides of the endocrine glands. • Demonstration of Endocrine Glands of Cockroach. (Alternative Methods) • Demonstration of Endocrine Glands in Rat (Alternative Methods) • Study of Glucose Tolerance Test. • Principle of HbA1c Test. • General procedures and demonstration of glucometer operation. • Study of working principle / demonstration of Urine Pregnancy Tests (UPT). (Principle, Procedure, Interpretation and Limitations) • General Study of Normal Blood Parameters of different hormones (From Pathological Reports) • Group discussion/ Seminar/ Quiz/ Projects on Endocrinology • Preparation of Practical Record.	**30**
Keywords	***Endocrine Glands, Glucose Tolerance Test, HbA1c, Glucometer, Pregnancy***	
Signature of Convener & Members (CBoS):		

PART–C:Learning Resources

Text Books, Reference Books and Others

Text BooksRecommended –

- Lal S.S. Practical Zoology Vertebrates; Rastogi Publications
- Islam Mofidul, DasViblab Kumar : Endocrinology with Practicals; Mahaveer Publications
- Verma P.S : A Manual of Practical Zoology Chordates; S.Chand Publications
- Arumugam N : Practical Zoology; Saras Publications.

Reference Books Recommended –

- Hadley: Endocrinology (6th ed. 2009, Prentice Hall)
- Lodish et al :Molecular Cell Biology, W.H.Freeman& Co Ltd.

Online Resources–

- **https://egyankosh.ac.in/bitstream/123456789/33320/1/Unit-4.pdf**

Online Resources–

- **https://www.ncbi.nlm.nih.gov/books/NBK532915/**
- **https://laboratorytests.org/urine-pregnancy-test/**

PART-D:Assessment andEvaluation

Suggested Continuous Evaluation Methods:
MaximumMarks: 50 Marks
ContinuousInternal Assessment(CIA):15 Marks
EndSemesterExam(ESE):35Marks

Continuous InternalAssessment(CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **10 &10** Assignment/Seminar +Attendance- **05** otal Marks -**15**	Better marks out of thetwo Test / Quiz **+**obtained marks in Assignment shall be considered against **15** Marks

End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **A. Performed the Task based on lab. work - 20 Marks** **B. Spotting based on tools& technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF ZOOLOGY
COURSE CURRICULUM

PART-A: Introduction				
Program: Bachelor in Life Sciences *(Honors / Honors with Research)*			**Semester -VII**	**Session: 2024-2025**
1	Course Code	**ZOSE – 06T**		
2	Course Title	**Immunology**		
3	Course Type	**Discipline Specific Elective**		
4	Pre-requisite(if, any)	***As per Program***		
5	Course Learning. Outcomes(CLO)	**After successfully completing this course, the students will be able to:** ➢ Understanding of fundamental concepts of immunology. ➢ Gain knowledge on various immune cells, antigens and cytokines. ➢ Understand the structure and functions of Immunoglobulins and antibodies. ➢ Students will be able to describe the processes involved in immune system. ➢ Students will analyse the pathogenesis, clinical manifestations, and therapeutic approaches of various immune disorders and diseases and experimental techniques in Immunology.		
6	Credit Value	**3 Credits**	***Credit = 15 Hours -learning & Observation***	
7	Total Marks	**Max. Marks:**	**100**	**Min Passing Marks:40**

PART -B: Content of the Course

Total No. of Teaching–learning Periods(01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**Understanding of Immunological Concepts:** Immune System: Brief history of Immunity, Concept & Types of Immunity (Innate and Acquired or Adaptive), Origin and Evolution of Immune System. Primary and Secondary lymphoid organs, lymphoid tissues. Thymic Selection: Self and non-self-recognition. Inflammation. Lymphocyte trafficking. Hematopoiesis.	10
II	**Components of Immune System- I:** Cells of Immune System: Structure and functions of macrophages, granulocytes, NK cells, T and B lymphocytes and Antigen presenting cells. T & B Cell receptors, maturation, activation and differentiation of T& B Cell. Antigen: Antigenicity v/s immunogenicity, Factors affecting Immunogenicity, immunogen, haptens, super antigen, epitope, paratope. Adjuvants: Freund's complete and incomplete. Processing and presentation of Ag. Major histocompatibility complex (MHC) and HLA. Cytokines.	12
III	**Components of Immune System- II:** Immunoglobulins: Nature, Primary structure of immunoglobulins. Enzymatic fragmentation of Ig. Domain structure of Ig and its significance. Types and subtypes of Ig and its characteristics. Membranous antibody. Antigenic determinants: isotype, allotype, idiotype. Abzymes. Theories of Antibody Formation: Instructive, selective, clonal selection theories and evidences; Immunological memory. Complement System. Hypersensitivity (Type I to IV with example) CMI & humoral immune response. Antigen-Antibody interaction: affinity & avidity.	13
IV	**Immune disorders & Immuno-techniques: Auto-immunity:** Auto-recognition, classes of auto-immuno diseases. (Hashimoto disease, Thyrotoxicosis, Systemic lupus erythematosus, Rheumatoid arthritis).Transplantation: Autograft, Isograft, Allograft, Xenograft, Immunological basis of transplantation reactions. Immune Deficiencies: Primary and secondary immune deficiencies. T-cell, B-cell and SCID, AIDS. Vaccination and types of vaccines (First, Second & Third generation vaccines). Immunological techniques: Precipitin curve, Immuno-diffusion, one and two dimensional, single radial immuno-diffusion, Double (Ouchterlony) immune-diffusion. Immuno-electrophoresis: Rocket immuno-electrophoresis; CIE, Graber and William technique.Radio-immunoassay: ELISA–Principle, Methodology and applications. Immuno-fluorescence: Direct, indirect and Sandwich, in situ localization by techniques:FISH and GISH. Hybridoma, Monoclonal antibodies.	10
Keywords	*Immunity, lymphocytes, Antigens, Immunoglobulins, Auto-immunity, Vaccination &Immuno-techniques.*	

Signature of Convener & Members (CBoS):

PART–C:Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- Pravash Sen. Gupta, Clinical Immunology. Oxford University Press. 2003.
- N Arumugam, Immunology, Saras Publication. 2014.
- Fatima D, Arumugam, Immunology, Saras Publication

Reference Books Recommended –

- Janis Kuby, Immunology, II edition. W. H. Freeman and Company, New York. 1993.
- Ivan M. Roitt, J. Brostoff and D. K. Male, Immunology, Gower Medical Publishing, London.1993.

Online Resources–

- https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=2rAs1Puvga4LW93zMe83aA==
- http://ndl.iitkgp.ac.in/he_document/swayamprabha/swayam_prabha/hdc5c5m6hkq?e=1|immunology|||
- https://xvivo.com/examples/the-innate-immune-system/
- https://xvivo.com/examples/the-adaptive-immune-system/

PART-D:Assessment andEvaluation

Suggested Continuous Evaluation Methods:
MaximumMarks: 100 Marks
ContinuousInternal Assessment(CIA):30 Marks
EndSemesterExam(ESE):70 Marks

Continuous InternalAssessment(CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **20 +20** Assignment/Seminar- **10** Total Marks -**30**	Better marks out of the two Test / Quiz+ obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40Marks**	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

DEPARTMENT OF LIFE SCIENCE

COURSE CURRICULUM

PART- A: Introduction

Program: Bachelor in Life Science *(Honors/ Honors with Research)*		**Semester - VII**	Session: **2024-2025**
1	**Course Code**	**ZOSE-06P**	
2	**Course Title**	**Immunology**	
3	**Course Type**	**Discipline Specific Elective Lab Course**	
4	**Pre-requisite** (if, any)	***As per Program***	
5	**Course Learning. Outcomes (CLO)**	**At the end of this course, the students will be able -** ➢ Gain practical knowledge on various immune cells, antigens and antibodies. ➢ Identify the major cellular and tissue components which comprise the innate and adaptive immune system. ➢ Students will experimental techniques in Immunology. ➢ Understand how does the immune system distinguish self from non-self. ➢ Gain experience at reading and evaluating the scientific literature in the area.	
6	**Credit Value**	**1 Credits**	***Credit =30 Hours Laboratory or Field learning/Training***
7	**Total Marks**	**Max. Marks: 50**	**Min Passing Marks: 20**

PART -B: Content of the Course

Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)

Module	Topics (Course contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course	• Study of permanent slides of organs of immune system • Enumeration of total leucocytes from human blood samples • Enumeration of differential leucocytes from human blood samples • Demonstration of agglutination reaction using human RBC • Demonstration of Ag-Ab precipitation by immunodiffusion technique • Antigen detection by radial immunodiffusion technique (RID) • Estimation of total serum protein • Estimation of serum gamma globulins/Separation of γ-globulin by salt precipitation. • Estimation of A/G ratio • Isolation of lymphocyte by using density gradient centrifugation • Paper and gel immuno-electrophoresis • Rocket immunoelectrophoresis • Counter current immunoelectrophoresis • ELISA • Group discussion/Quiz/ Seminar presentation on related topics. • Making of Practical record.	**30**
Keywords	*Leucocytes, Rocket immunoelectrophoresis, ELISA, A/G ratio, RID*	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- Talwar G.P. and Gupta S.K, A Handbook Of Practical And Clinical Immunology Volume 1, CBS Publication
- Zane, Immunology: Theoretical And Practical Concepts In Laboratory Medicine, ELSEVIER

Reference Books Recommended –

- Goldsby, R.A.; Kindt, T.J. and Kuby, J. (2006) Immunology (6th edition).
- Roitt, I.; Brostoff, J. and Male, D. (2012) Immunology (8th edition).

Online Resources–

- https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=2rAs1Puvga4LW93zMe83aA==
- http://ndl.iitkgp.ac.in/he_document/swayamprabha/swayam_prabha/hdc5c5m6hkq?e=1|immunology|||
- https://xvivo.com/examples/the-innate-immune-system/
- https://xvivo.com/examples/the-adaptive-immune-system/

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - **05** Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **A. Performed the Task based on lab. work - 20 Marks** **B. Spotting based on tools & technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF ZOOLOGY
COURSE CURRICULUM

PART-A: Introduction

Program: Bachelor in Life Science *(Honors/Honors with Research)*		Semester - VII	Session: 2024-2025
1	CourseCode	ZOSE- 07T	
2	CourseTitle	**Biotechnology & Genetic Engineering**	
3	CourseType	**Discipline Specific Elective**	
4	Pre-requisite(if,any)	***As per Program***	
5	Course Learning. Outcomes(CLO)	**After successfully completing this course, the students will be able to-** ➢ Define the concept of recombinant DNA and genetic engineering. ➢ Understand the molecular techniques and their proficiencies. ➢ Apply the knowledge of gene manipulation techniques. ➢ Analyze different prospects and applications of genetic engineering and bioinformatics. ➢ Develop understanding of ethical, social and legal implications of genetic engineering.	
6	CreditValue	**3 Credits**	***Credit = 15 Hours -learning & Observation***
7	TotalMarks	**Max.Marks: 100**	**Min Passing Marks:40**

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course Contents)	No. of Period
I	**Introduction to Biotechnology:** An overview of Biotechnology: History, Definition, scope, applications and ethical issues in biotechnology. Recombinant DNA, Restriction Enzymes, Application of different enzymes in Recombinant DNA technology, Restriction and modification system, Linkers & Adaptors, Restriction mapping. Vectors (Cloning and Expression Vectors). Gene Recombination and Gene transfer: Transfection, Transduction, Microinjection, Electroporation and Ultrasonication. Antibiotic Resistant Gene and their mode of action. Polymerase chain reaction (PCR): Principle and applications of different types of PCR. DNA and RNA Purification.	11
II	**Elementary Genetic Engineering:** Preparation and comparison of Genomic and cDNA library, screening of recombinants, Genome: organization, coding and non-coding sequences & genome mapping, Comparative genome hybridization. Whole genome shotgun sequencing, Chromosome Banding. Gene tagging, DNA Cloning, DNA Sequencing methods, DNA profiling. Genetic Markers, Molecular markers: Types & Features. Stem Cells: Embryonic Stem Cells, Adult Stem Cells and Induced Pluripotent Stem Cells, Formation and selection of recombinant ES cells, Role of ES cells in gene targeting in mice, Gene Probe, Colony Hybridization, Blotting Techniques (Southern, Northern, Western and Eastern Blotting), Animal Cell Culture (Primary Cultures, Cell line, Transformation characteristics, Culture Media & Growth Cycle).	11
III	**Advancements in Genetic Engineering:** Random and site-directed mutagenesis: Primer extension and PCR based methods of site directed mutagenesis, Random mutagenesis. Gene Editing, Gene shuffling, Genetic Manipulation of Animal Cells (Transgenesis and transgenic animals), Gene Knockout, Nuclear Transfer Technology and Animal Cloning, Gene Therapy, Gene Delivery System (Virus mediated transduction & non-viral transduction methods). Molecular Farming (Therapeutic products produced by genetic engineering-blood proteins, human hormones, immune modulators and vaccines), Microarraysand next generation sequencing technologies.	12
IV	**Applications of Genetic Engineering & Bioinformatics:** Cord blood banking, Genetically Modified Organism (GMO), Animals as bioreactors: Genetically engineered animals for research. Conditional knock outs using cre-loxP recombination; tissue specific promoters, CRISPR-Cas9 and its applications in treating genetic disorders. Genetic modification of livestock for improved productivity and disease resistance. Ethical, Legal, and Social Implications (ELSI) of genetic engineering. Bioinformatics: Overview and its relation with molecular biology. Biological Databases: Overview, Applications & Prospects. Examples of related tools (FASTA, BLAST, BLAT, RASMOL), databases (GENBANK, Pubmed, PDB) and software (RASMOL, Ligand Explorer), Data generation; Generation of large scale molecular biology data. (Through Genome sequencing) File Format (Genbank, DDBJ, FASTA, PDB, Swiss Prot). Sequence Alignments and Visualization, General Introduction of Biological Databases; Nucleic acid databases (NCBI, DDBJ, and EMBL). Protein databases (Primary, Composite, and Secondary). Specialized Genome databases: (SGD, TIGR, and ACeDB). Structure databases (CATH, SCOP, and PDBsum).	11
Keywords	*Recombinant DNA, Genome, Gene, Mutagenesis, Microarray, Techniques, Biological Database.*	

Signature of Convener & Members (CBoS):

PART–C:Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- Lehninger – Principles of Biochemistry, WH Freeman.
- Satyanarayan U - Biotechnology, Saras Publication
- Gupta P.K. – Elements of Biotechnology, Rastogi Publications.
- Gupta P.K. –Biotechnology and Genomics, Rastogi Publications.
- Kumar Pranav, Verma Praveen, Meena Usha – Biotechnology: A problem approach- Pathfinder Publications.
- Rastogi S.C., Rastogi P., MendirattaN :Bioinformatics: Methods and Applications: Genomics, Proteomics and Drug Discovery, PHI Learning.
- Bosu Orpita, Thukral S.K.- Bioinformatics: Experiments, Tools, Databases, and Algorithms – Oxford University Press

Reference Books Recommended –

- Lodish H et al., - Freeman
- Watson JD et al.-Macmillan - Recombinant DNA: Genes and Genomes, A Short Course.
- Alberts B et al., Molecular Biology of the Cell, - Garland
- Brown TA – Genomes, Garland

Online Resources–

- **https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=31BI+Y/JyQo+vtlwaZoj+g==**
- **http://ndl.iitkgp.ac.in/he_document/swayamprabha/swayam_prabha/ksrdg67pyn8?e=1|bioinformatics|||**
- **http://ndl.iitkgp.ac.in/he_document/nptel/nptel/courses_102_106_102106065_video_lec66?e=3|bioinformatics|||**
- **http://ndl.iitkgp.ac.in/he_document/cec/cec/0F_oDrArwTU_PLNsppmbLKJ8K5HAWhRVvEHrBSI1XVO-oE?e=0|biotechnology%20:%20genome%20editing%20tools%20-%203%20(crispr/cas9)|||**

Online Resources–

- **https://vlab.amrita.edu/?sub=3&brch=274&sim=1428&cnt=1**
- **http://ndl.iitkgp.ac.in/he_document/cec/PRwJGpzUSYM_PLNsppmbLKJ8K5HAWhRVvEHrBSI1XVO-oE**

PART-D:Assessment andEvaluation

Suggested Continuous Evaluation Methods:
MaximumMarks: 100 Marks
ContinuousInternal Assessment(CIA):30 Marks
EndSemesterExam(ESE):70 Marks

Continuous InternalAssessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **20 +20** Assignment/Seminar- **10** Total Marks -**30**	Better marks out of the two Test / Quiz**+** obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40Marks**	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM(2024 – 28)
DEPARTMENT OF ZOOLOGY
COURSE CURRICULUM

PART-A: Introduction

Program: Bachelor in Life Science *(Honors/Honors with Research)*		Semester - VII	Session: 2024-2025
1	CourseCode	ZOSE- 07P	
2	CourseTitle	Biotechnology & Genetic Engineering	
3	CourseType	Discipline Specific Elective Lab Course	
4	Pre-requisite(if,any)	*As per Program*	
5	Course Learning. Outcomes(CLO)	**After successfully completing this course, the students will be able to:** ➢ Learn to prepare aseptic techniques in laboratory for biotechnology experiments. ➢ Understand the fundamental experiments &techniques of biotechnology &genetic engineering. ➢ Develop practical skills in genetic engineering techniques and laboratory procedures. ➢ Learn characteristics of genetic material. ➢ Analyze applications of diverse genetic engineering protocols.	
6	CreditValue	1 Credits	*Credit =30 Hours Laboratory or Field learning/Training*
7	TotalMarks	Max.Marks:50	Min Passing Marks:20

PART -B: Content oftheCourse

TotalNo.oflearning-Training/performancePeriods:30 Periods (30 Hours)

Module	Topics(Coursecontents)	No. of Period
Lab./Field Training/ Experiment Contents of Course	• Sterilisation of glassware, media and laboratory. • Working principle and applications of- Hot Air Oven, Autoclave & Laminar flow hood. • Demonstration of cell culture techniques. • Demonstration of gene library and cDNA library. • Isolation of DNA from plant sample. • Isolation of plasmid DNA from E. coli cells. • Isolation of genomic DNA from whole blood. • Demonstration of Gel electrophoresis techniques. • Separation and visualization of DNA fragments using agarose gel electrophoresis. • Spectrophotometric estimation of isolated DNA. • Restriction digestion of plasmid DNA and genomic DNA. • Study related to working principle of PCR machine. • Preparation of Minimal Essential Growth medium. • Staining the cultured cells using dyes such as hematoxylin and eosin (H&E), and observe them under a light microscope to study cell morphology and structure. • Bioinformatics: Analyse DNA or protein sequences using online tools and databases. • Demonstration of online data bases for bioinformatics-based studies. • Demonstration of DNA band visualization techniques (e.g., Ethidium bromide staining, DNA intercalating dyes) • Group discussion/ Quiz/Project/Seminar presentation on related topics. • Practical Record *Note: Virtual mode of demonstration can be opted if required.*	30
Keywords	***Sterlization, Autoclave, Electrophoresis, Restriction, PCR, Plasmid, Genomic, Bioinformatics***	

SignatureofConvener&Members (CBoS):

PART–C:Learning Resources

Text Books Recommended -

- Aneja K.R.; Laboratory manual of microbiology and biotechnology; Medtech.
- Ramdass P; Practical Biotechnology; JaypeeBrothers Medical Publishers; First Edition.

Reference Books *Recommended* -

- Wilson, K., & Walker, J. Principles and Techniques of Biochemistry and MolecularBiology (8th ed.). Cambridge University Press.
- Kurian K. Noble; A complete lab manual for Biotechnology; Notion Press.
- Borah Debajit; Biotechnology Lab Practices;Global Vision Publishing House.
- Portner Ralph; Animal Cell Biotechnology: Methods and Protocols: Humana Press Springer Protocols

Online Resources–

- **https://indiabioscience.org/media/articles/DBT-Life-Science-Protocol-Manual.pdf**
- **https://webstor.srmist.edu.in/web_assets/downloads/2021/20BTC502J-lab-manual.pdf**

Online Resources–

- **https://learn.genetics.utah.edu/content/labs/**

PART-D:Assessment andEvaluation

Suggested Continuous Evaluation Methods:
MaximumMarks: 50 Marks
ContinuousInternal Assessment(CIA):15 Marks
EndSemesterExam(ESE):35Marks

Continuous InternalAssessment(CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **10 &10** Assignment/Seminar +Attendance- **05** Total Marks **-15**	Better marks out of thetwo Test / Quiz **+**obtained marks in Assignment shall be considered against **15** Marks	
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **A. Performed the Task based on lab. work - 20 Marks** **B. Spotting based on tools& technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**		**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF ZOOLOGY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Honors/ Honors with Research Degree)*		**Semester -VII**		Session: **2024-2025**
1	**Course Code**	**ZOSE- 08T**		
2	**Course Title**	**Applied Zoology**		
3	**Course Type**	**Discipline Specific Elective**		
4	**Pre-requisite** (if, any)	***As per Program***		
5	**Course Learning. Outcomes (CLO)**	**After successfully completing this course, the students will be able to:** ➢ Understand the culture techniques of prawn, pearl and fish, Lac culture. ➢ Understand silkworms rearing and their products. ➢ Understand the Bee keeping equipments and apiary management. ➢ Understand dairy animal's management. ➢ Learn thetesting of egg and milk quality. ➢ Apply this knowledge for Setting up a self-employment venture in the field.		
6	Credit Value	**3 Credits**	***Credit = 15 Hours - learning & Observation***	
7	Total Marks	**Max. Marks: 100**		**Min Passing Marks: 40**

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**Aquaculture: Prawn culture:** Culture of fresh water prawn and marine prawn. Preparation of farm for Prawn culture. Preservation and processing of prawn. Export of prawn. **Pearl Culture**: pearl formation, protocol followed, **Fresh Water Fish Culture:** Qualities or Characters of Cultivable Fishes, Construction of Fish Farm. **Fish Breeding:** bundh and induced. **Fish Seed:** Types, **Seed collection:** Benchi jal (Shooting net), hatching Hapa. **Transport of Seed:** Open and closed system, Causes of mortality in transport. **Use of chemicals in live fish transport:** Anesthetic drugs. Antiseptics and Antibiotics. Harvesting of fish: By hooks and nets (Triangular net, Dip net and Cast net). Fish preservation. Fish diseases and their control.	12
II	**Apiculture and Sericulture: Apiculture:** Species of honey bees. Morphology and life cycle of *Apis indica.* Social behaviour of honey bees: Colony organization, division of labour and communication. Methods of Bee keeping: Indigenous and Modern method, appliances used for bee keeping, management of honey bees and their hives, Extraction of honey from the comb and processing, bee Products and their economic importance. Natural enemies & diseases of Bee and their management. **Sericulture:** Types of silk, Silkworms and their host plants, Life history of *Bombyx mori* Rearing of *Bombyx mori*: Rearing racks and trays, disinfectants, rearing appliances, black boxing, Chawki rearing, bed cleaning, mountages. Harvesting of cocoons, Silkworm diseases and their control: Pebrine, Flacherie, Grasserie, Muscardine and Aspergillosis. Silkworm pests and parasites and their management: Uzi fly, Dermestid beetles. Silk reeling techniques. Quality assessment of silk fibre.	11
III	**Lac Culture and Vermiculture: Lac Culture** History of lac. Cultivation of lac: Host plants, Lac insect and its life cycle. Control of lac insect pests processing and collection of lac. Lac composition, products and uses. **Vermiculture:** Biology of *Eisenia foetida.* Rearing of earthworms. Equipments, devices used in vermiculture. Vermicompost Technology: Methods and products, Vermiwash Collection, Composition and use.	11
IV	**Dairy management and Poultry farming: Dairy:** Introduction to common dairy animals. Techniques of dairy management: System of housing. Milk and milk products. Cattle Diseases and control measures. **Poultry:** Types of breeds. Methods of brooding and Rearing. Housing and Equipment, Deep litter System, Laying cages, Debeaking, Incubation and hatching of eggs. Management of growers, Layers, Broilers. Feed formulations for chicks, Diseases and control measures. Nutritive value of egg and meet.	11
Keywords	*Aquaculture, Apiculture, Sericulture, Poultry farming, Dairy Farming, Vermiculture*	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- Srivastava, C. B. L. (1999). *Fishery Science and Indian Fisheries*. Kitab Mahal publications, India.
- Sardar Singh, *Beekeeping in India*, Indian council of Agricultural Research, New Delhi.
- Dhyan Singh Bisht, *Apiculture*, ICAR Publication.
- Shukla G.S., Upadhyay V.B. Economic Zoology, Rastogi Publication
- Ahasan J, Sinha,S.P.(2010) Handbook of Economic Zoology, S Chand Publication
- Jabde, P. Text book of Applied Zoology (2008), Discovery Publishing Pvt. Ltd

Reference Books Recommended –

- Prost, P. J. (1962). *Apiculture*. Oxford and IBH, New Delhi.
- Sericulture, *FAO Manual of Sericulture.*
- Hafez, E. S. E. (1962). *Reproduction in Farm Animals*, Lea and Fabiger Publishers.
- Knobil, E. and Neill, J. D. (2006). *The Physiology of Reproduction*, Vol. 2, Elsevier Publishers.

Online Resources–

- https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SBT1608.pdf
- https://egov.uok.edu.in/elearning/tutorials/1011020512BR15103CR15Apiculture%20Lac%20culture%20and%20%20sericultureapiculture%20lac%20culture%20and%20%20sericulture%20upload.pdf
- https://kvk.icar.gov.in/API/Content/PPupload/k0160_11.pdf
- https://dahd.nic.in/sites/default/filess/Excerpts%20of%20Poultry%20Farmn%20Manual.pdf

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Exam (ESE):	**70 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **20 +20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF ZOOLOGY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Honors/ Honors with Research)*		**Semester - VII**	Session: **2024-2025**	
1	**Course Code**	**ZOSE-08P**		
2	**Course Title**	**Applied Zoology**		
3	**Course Type**	**Discipline Specific Elective Lab Course**		
4	**Pre-requisite** (if, any)	***As per Program***		
5	**Course Learning. Outcomes (CLO)**	**After successfully completing this course, the students will be able to:** ➢ Know common species of carps, prawn, oyster. ➢ Understand and learn the culture techniques of prawn, pearl, fish, honey bee, silkworm, lac, vermicompost. ➢ Understand and Learn division of labor and identification of Honey bees ➢ Identify Lac insect, male female morphology,. ➢ Understand dairy management, breeds of Cow & diseases and learn to analyze to good quality of milk, egg and vermicompost.		
6	**Credit Value**	**1 Credits**	***Credit =30 Hours Laboratory or Field learning/Training***	
7	**Total Marks**	**Max. Marks: 50**	**Min Passing Marks: 20**	

PART -B: Content of the Course		
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)		
Module	**Topics (Course contents)**	**No. of Period**
Lab./Field Training/ Experiment Contents of Course	➢ Morphological characterization of common edible fish species. ➢ Identification of major carps. ➢ Morphology of Freshwater and Marine Prawn ➢ Pearl oyster, pearl forming species ➢ Identification of castes of Honey bee and life cycle (through charts/specimens). ➢ Mounting of the sting apparatus. ➢ Worker honey bee with emphasis on leg modifications (through specimens/charts) and whole mount preparation of the 3 pairs of legs, Mouth parts. ➢ Life cycle of mulberry silkworm, *Bombyx mori* (model/chart/specimens) and life cycle of tasar silkworm, *Antheraea mylitta*. ➢ Identification of dairy animals ((model/chart/Photographs). ➢ Milk testing: Qualitative test of milk, Determination of the specific gravity of milk by using a mercury lactometer. ➢ External morphology of poultry birds (model). ➢ Test for good quality eggs (Floating test, cracking test) and for fertilized and unfertilized eggs (Light test, Cracking test). ➢ Project report on visit to Fish farm/dairy farm/ Poultry farm/.etc ➢ Group discussion/quiz/seminar on related topics. ➢ Preparation of practical record or Album.	**30**
Keywords	*Aquaculture, Apiculture, Sericulture, Poultry farming, Dairy Farming*	
Signature of Convener & Members (CBoS) :		

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- Upadhyay, Economic Zoology
- Salvamani B R, & Mahadevan R K, Aquaculture Trends and Issues
- Jabde V, Applied Zoology Pradeep
- Shukla Prasad Economic Zoology, Biostatistics and Animal Behaviour

Online Resources–

- https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SBT1608.pdf
- https://egov.uok.edu.in/elearning/tutorials/1011020512BR15103CR15Apiculture%20Lac%20culture%20and%20%20sericultureapiculture%20lac%20culture%20and%20%20sericulture%20upload.pdf

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - **05** Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **A. Performed the Task based on lab. work - 20 Marks** **B. Spotting based on tools & technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF ZOOLOGY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Honors/ Honors with Research)*		**Semester - VIII**	Session: **2024-2025**	
1	**Course Code**	**ZOSE- 09T**		
2	**Course Title**	**Basics of Computer and Biostatistics**		
3	**Course Type**	**Discipline Specific Elective**		
4	**Pre-requisite** (if, any)	***As per Program***		
5	**Course Learning. Outcomes (CLO)**	**After successfully completing this course, the students will be able to:** ➢ Understand the computer, its applications and use in biostatistics. ➢ Understand collection of biological data and analysis of the data. ➢ Learn about how the statistical data present. ➢ Developed critical thinking to analyze and represent the significance of the statistical data. ➢ Apply the knowledge in future for Research.		
6	**Credit Value**	**3 Credits**	***Credit = 15 Hours - learning & Observation***	
7	**Total Marks**	**Max. Marks: 100**	**Min Passing Marks: 40**	

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**Unit-I: Computer structure and Applications:** History of Computers, Structure of Computers, Classification of Computers, Introduction to digital computer- basic knowledge of hardware & software, CPU, Input and Output devices, Computer Codes: Decimal System, Binary number system, hexadecimal system, octal system, conversion of numbers. Introduction to MS Office- MS Word, MS Excel, MS Power point, Introduction of Internet, web-mail, various search engine, Plagiarism, Artificial Intelligence (AI).	12
II	**Unit-II: Data collection, presentation, and Measures of central tendency:** Collection and classification of data. Presentation of data: by Tables - rules for making tables, use of tables, Types of tables, By Graphs: rules for making graph & it's uses, Pie chart, Bar diagram, Histogram, Frequency polygon, Cumulative frequency curve (Ogive and Polygon). Measures of central tendency: Arithmetic Mean, Median, Mode.	11
III	**Dispersion Correlation and Regression:** Measures of dispersion: Standard deviation and Standard error. Correlation: Types, significance and application of correlation, calculation of correlation in continuous data and ordinal data. Regression: Linear regression, regression coefficient.	11
IV	**Probability and Analysis of Significant Test:** Probability: normal, binomial distribution and Poisson distributions. Hypothesis testing, Test of significance: Paired and unpaired t-test and Chi square test. Analysis of Variance (one & two way ANOVA).	11
Keywords	*Computer, MS Word, MS Excel, MS Power point, web-mail, central tendency, ANOVA, Hypothesis testing*	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- Balagurusamy, E. (2011) Fundamentals of Computers, McGraw Hill Education, Rajaraman, V.: Fundamentals of Computers, 5th edition, PHI Learning Pvt. Ltd., 2010
- Sinha, P., Sinha, P.K. (2004), Computer Fundamentals: Concepts, Systems and Applications, 8th edition, BPB Publications.
- Khanal, A.B. (2015), Mahajan's Methods in Biostatistics, The Health Sciences Publishers,

Reference Books Recommended –

- Daniel, W.W. (2012) Biostatistics: A Foundation for Analysis in Health Sciences(10th edition) John Wiley.
- Milton, J.S. & Tsokos, J.O. (1992) Statistical Methods in the Biological and HealthSciences (2nd edition) McGraw Hill.
- Zar, JH, (2010), Biostatistical Analysis, Prentice-Hall/Pearson, 2010.

Online Resources–

National Digital Library

- **https://drive.google.com/file/d/1EaBH4SfE4AcdmoDzQ7iFwMSJkmSfIQet/view**
- **http://ndl.iitkgp.ac.in/he_document/swayam_ugc_moocs/swayam_ugc_moocs/IN_S U M 1 P C 3 B a M B 233 234?e=2|biostatistics|||**
- **http://ndl.iitkgp.ac.in/he_document/bharat_skills/bharat_skills/01_2434?e=0|basic%20computer|||**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 100 Marks

Continuous Internal Assessment (CIA): 30 Marks

End Semester Exam (ESE): 70 Marks

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **20** ÷**20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF ZOOLOGY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Honors/ Honors with Research)*			**Semester - VIII**	Session: **2024-2025**
1	**Course Code**	**ZOSE-09P**		
2	**Course Title**	**Basics of Computer and Biostatistics**		
3	**Course Type**	**Discipline Specific Elective Lab Course**		
4	**Pre-requisite** (if, any)	***As per Program***		
5	**Course Learning. Outcomes (CLO)**	**After successfully completing lab course the students will be able to** ➢ Understand the computer, its applications and use in biostatistics practically. ➢ Understand and learn collection of biological data and analyzes them. ➢ Learn to present and interpret the analyzed data. ➢ Developed critical thinking to assess the significance of the statistical data and discuss the result. ➢ Apply the knowledge in future for Research.		
6	**Credit Value**	**1 Credits**	***Credit =30 Hours Laboratory or Field learning/Training***	
7	**Total Marks**	**Max. Marks: 50**		**Min Passing Marks: 20**

PART -B: Content of the Course		
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)		
Module	**Topics (Course contents)**	**No. of Period**
Lab./Field Training/ Experiment Contents of Course	**List of labs to be conducted** ➢ Exercise based on Microsoft word. ➢ Study of hardware & software. ➢ PPT Slide preparation using Microsoft Power Point. ➢ Data collection. ➢ Analyzing Data manually and through computer: Mean, Median, Mode, SD, SE, Correlation and regression and its interpretation. ➢ Tabular & Graphical presentation of data manually and using excel. ➢ Hypothesis testing by *t*-test, Chi-square test and ANOVA. ➢ Group discussion/Quiz/Seminar presentation on related topics. ➢ Practical Record or Lab assignment.	**30**
Keywords	*Graphical presentation, hardware & software, Microsoft Power Point, Microsoft word.*	
Signature of Convener & Members (CBoS) :		

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- Balagurusamy, E. (2011) Fundamentals of Computers, McGraw Hill Education, Rajaraman, V.: Fundamentals of Computers, 5th edition, PHI Learning Pvt. Ltd., 2010
- Sinha, P., Sinha, P.K. (2004), Computer Fundamentals: Concepts, Systems and Applications, 8th edition, BPB Publications.
- Khanal, A.B. (2015), Mahajan's Methods in Biostatistics, The Health Sciences Publishers,

Reference Books Recommended –

- Daniel, W.W. (2012) Biostatistics: A Foundation for Analysis in Health Sciences(10th edition) John Wiley.
- Milton, J.S. & Tsokos, J.O. (1992) Statistical Methods in the Biological and HealthSciences (2nd edition) McGraw Hill.
- Zar, JH, (2010), Biostatistical Analysis, Prentice-Hall/Pearson, 2010.

Online Resources–

- **http://ndl.iitkgp.ac.in/he_document/libretexts/libretexts/ee0516013368a11b75812bda4e208fc6?c=0|MEAN%20MODE%20MEADIAN|||**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - **05** Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **A. Performed the Task based on lab. work - 20 Marks** **B. Spotting based on tools & technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

DEPARTMENT OF ZOOLOGY

COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Honors/ Honors with research)*		**Semester - VIII**		Session: **2024-2025**
1	**Course Code**	**ZOSE- 10T**		
2	**Course Title**	**Behaviour and Chronobiology**		
3	**Course Type**	**Discipline Specific Elective**		
4	**Pre-requisite** (if, any)	*As per Program*		
5	**Course Learning. Outcomes (CLO)**	**After successfully completing this course, the students will be able to-** ➢ Learn a wide range of theoretical knowledge about the animal behavior. ➢ Develop skills, to understand the responses of animal according to stimuli. ➢ Objectively understand and evaluate information about animal behaviour and ecology encountered in our daily lives. ➢ Understand and be able to objectively evaluate the role of behaviour in the protection and conservation of animals in the wild. ➢ Consider and evaluate behaviour of all animals, including humans, in the complex ecological world, including the urban environment.		
6	**Credit Value**	**3 Credits**	*Credit = 15 Hours - learning & Observation*	
7	**Total Marks**	**Max. Marks: 100**		**Min Passing Marks: 40**

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**Behaviour and the response invoking stimuli:** Animal behavior: Scope and importance of study. Ethology: history & branches. Ethogram: analysis of behavior. Causation of Behaviour: Proximate and ultimate causes of behavior. Stimulus: Definition, Types of stimuli invoking response: internal and external. Patterns of behaviour: Foraging behaviour, Aggressive behavior, Territorial behaviour. Allelomimetic behavior. Stereotyped Behaviors: Taxis and Reflexes: Taxis: Phototaxis, Geotaxis, Thermotaxis, Thigmotaxis, Galvanotaxis, Chemotaxis and Rheotaxis, Klinotaxis and Telotaxis. Reflexes: Definition, Kinds- Localized, Tonic & Phasic, Types of reflex action unconditioned reflexes and Conditioned reflexes	12
II	**Innate and Learning Behavior: Innate or Instinct Behaviour:** Fixed action Pattern: Definition and Characteristics: Constancy, Resistance to Phylogenetic Changes, Concept of Sign, Innate Releasing Mechanism (IRM) and Action Specific Energy (ASE). Bird migration, Navigation and Orientation. Learning Behavior: Classical conditioning (Pavlov Experiment), Types of Conditioning: Forward, Backward, Simultaneous and Temporal conditioning. Properties of Conditioning: Generalization, Discrimination, Extinction, Recovery from Extinction, Acquisition, Reinforce, Positive and Negative conditioning. Habituation. Instrumental learning / trial and error. Imprinting: types of imprinting: filial and sexual. Reasoning and Insight learning. Neural mechanism of learning.	11
III	**Social behavior and Evolutionary aspects of Behavior:** Social organization in honey bee & Primates. Elements of Socio-biology: Eusociality, Selfishness, cooperation, altruism, kinship, reciprocation and inclusive fitness. Communication: chemical, visual, light, tactile and audio. Evolutionary aspects of behavior: feeding strategies, Mimicry and Colouration, Evolution of reproductive behavior: Theory of Sexual Selection, secondary sex characteristics, Parental care in Fish and Amphibia.	11
IV	**Chronobiology:** Biological Rhythm: Types of biological rhythm: Ultradian, Circadian and Infradian. Characteristics of rhythm: mesor, amplitude, acrophase, period and phase. Patterns of biological rhythm: Exogenous and Endogenous rhythm; Entrained and Free run rhythm. Advantages of biological rhythms. Biological clock: components of clock, functions of biological clock. Applications of chronobiology.	11
Keywords	*Ethogram, Mimicry, Reflexes, biological rhythm, Parental care, Imprinting, Biological clock*	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- Reena Mathur (2021) Animal Behaviour, 6th Edition, Rastogi Publication.
- Kumar, V. (2002). Biological Rhythms: Narosa Publishing House, Delhi/ Springer -Verlag, Germany.

Reference Books Recommended –

- McFarland, D. (1999) Animal Behaviour (3rd edition) Pitman Publishing Limited,London, UK.
- Manning, A. and Dawkins, M. S. (2012) An Introduction to Animal Behaviour (6thedition) Cambridge, University Press, UK
- Alcock, J. (2005) Animal Behaviour (8th edition) Sinauer Associate Inc., USA.
- Sherman, P. W. and Alcock, J. (2013) Exploring Animal Behaviour (6th edition)Sinauer Associate Inc., Massachusetts, USA.
- Dunlap, J. C.; Loros, J.J. and DeCoursey, P. J. (2009) Chronobiology BiologicalTimekeeping (1st edition) Sinauer Associates, Inc. Publishers, Sunderland, MA, USA.

Online Resources–

- **https://g.co/kgs/TGgyveE**
- **https://www.researchgate.net/profile/Atanu-Pati/publication/278157972_Chronobiology_The_Dimension_of_Time_in_Biology_and_Medicine/links/557c8b1208aec87640db4e73/Chronobiology-The-Dimension-of-Time-in-Biology-and-Medicine.pdf**
- **https://jmpas.com/admin/assets/article_issue/1643653535JMPAS_JANUARY_-_FEBRUARY_2022.pdf**
- **https://www.amazon.in/Concise-Book-Animal-Behaviour-Chronobiology/dp/819580571X**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Exam (ESE):	**70 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **20 +20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF ZOOLOGY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Honors/ Honors with Research)*		**Semester - VIII**	Session: **2024-2025**	
1	**Course Code**	**ZOSE-10P**		
2	**Course Title**	**Behaviour and Chronobiology**		
3	**Course Type**	**Discipline Specific Elective Lab Course**		
4	**Pre-requisite** (if, any)	*As per Program*		
5	**Course Learning. Outcomes (CLO)**	**After successfully completing this course, the students will be able to-** ➢ Learn a wide range of practical knowledge about the animal behavior. ➢ Develop skills, to understand the response of animals according to stimuli in lab. ➢ Objectively understand and evaluate information about animal behaviour and learn to form the ethogram. ➢ Understand and be able to objectively evaluate the role of behaviour in the protection and conservation of animals in the surroundings. ➢ Consider and evaluate behaviour of animals, including Human in the nature.		
6	**Credit Value**	**1 Credits**	*Credit =30 Hours Laboratory or Field learning/Training*	
7	**Total Marks**	**Max. Marks: 50**	**Min Passing Marks: 20**	

PART -B: Content of the Course		
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)		
Module	**Topics (Course contents)**	**No. of Period**
Lab./Field Training/ Experiment Contents of Course	➢ Orientation of an animal in response to stimulus: To study geotaxis in earthworm and phototaxis in insect larvae. ➢ Constructing an Ethogram. ➢ Demonstration of learning behaviour in wasps to locate their burrow by using landmarks. ➢ Chemical communication in ants. ➢ Study of selective predation of coloured prey items through video/charts. ➢ Predatory behaviour of a carnivorous animal. ➢ Nests and nesting habits of the birds and social insects. ➢ Study the behavioural responses of wood lice to dry and humid conditions. ➢ Study of mimic animals in nature and take photographs. ➢ Study of circadian functions in humans (daily eating, sleep and temperature patterns). ➢ Visit to Forest/ Wild life Sanctuary/Biodiversity Park/Zoological Park to study behavioural activities of animals and prepare a short report. ➢ Group discussion or Seminar presentation on related topics. ➢ An "Animal album or Practical Record" containing sketches, photographs, cut outs, with appropriate write up about the above mentioned behavioural patterns.	**30**
Keywords	*Phototaxis, geotaxis, Predatory behavior, wood lice, circadian functions, temperature pattern, ethogram*	
Signature of Convener & Members (CBoS) :		

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- Reena Mathur (2021) Animal Behaviour, 6th Edition, Rastogi Publication.
- Kumar, V. (2002). Biological Rhythms: Narosa Publishing House, Delhi/ Springer - Verlag, Germany.

Refernce *Books Recommended –*

- McFarland, D. (1999) Animal Behaviour (3rd edition) Pitman Publishing Limited,London, UK.
- Manning, A. and Dawkins, M. S. (2012) An Introduction to Animal Behaviour (6thedition) Cambridge, University Press, UK
- Alcock, J. (2005) Animal Behaviour (8th edition) Sinauer Associate Inc., USA.
- Sherman, P. W. and Alcock, J. (2013) Exploring Animal Behaviour (6th edition)Sinauer Associate Inc., Massachusetts, USA.
- Dunlap, J. C.; Loros, J.J. and DeCoursey, P. J. (2009) Chronobiology BiologicalTimekeeping (1st edition) Sinauer Associates, Inc. Publishers, Sunderland, MA, USA.

Online Resources–

- **http://ndl.iitkgp.ac.in/he_document/swayamprabha/swayam_prabha/1fvtujeiyjw?e=0|*|||**
- **http://ndl.iitkgp.ac.in/he_document/swayamprabha/swayam_prabha/7j0mtol4jrc?e=11|*|||**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - **05** Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **A. Performed the Task based on lab. work - 20 Marks** **B. Spotting based on tools & technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF ZOOLOGY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Honors/ Honors with Research)*		**Semester - VIII**		Session: **2024-2025**
1	Course Code	**ZOSE-11T**		
2	Course Title	**Developmental Biology**		
3	Course Type	**Discipline Specific Elective**		
4	Pre-requisite (if, any)	***As per Program***		
5	**Course Learning. Outcomes (CLO)**	**After successfully completing this course, the students will be able to-** ➢ Understand of the fundamental processes involved in embryonic development, including cell differentiation, morphogenesis, and patterning ➢ Explain mechanisms underlying developmental processes, ➢ Learn reproductive techniques commonly used in developmental biology ➢ Aware of current trends and advances in developmental biology research, including emerging technologies. ➢ Understand the relevance of developmental biology in medicine or its role in development of diseases.		
6	**Credit Value**	**3 Credits**	***Credit = 15 Hours - learning & Observation***	
7	**Total Marks**	**Max. Marks: 100**		**Min Passing Marks: 40**

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**Gametes Biology:** Biology of sex determination and differentiation, Origin of primordial germ cells. Morphology of different types of gametes: Male gamete and female gamete. Formation of Gametes: Process of Spermatogenesis, Biochemical changes in spermatogenesis and control of spermatogenesis, Semination. Process of Oogenesis, Biochemical changes in Oogenesis and control of Oogenesis, Vitellogenesis: Structure and composition of yolk. Ovulation and ovum transport in mammals. Infertility in Male and female: Causes and Cure. Fertilization: external and internal fertilization, Recognition of gametes, capacitation, acrosome reaction, activation of egg metabolism, migration of pronuclei, amphimixis and post fertilization changes in the egg cytoplasm. Block to polyspermy. Parthenogenesis.	11
II	**Embryology:** Cleavage: pattern and mechanism of cleavage, physiology of cleavage. Mosaic and regulative development, Direct and indirect development, Body plan and symmetries. Germ layer differentiation. Tubulation. Morphogenesis: Epiboly, E mboly/invagination, involution and ingression. Fate maps: Methods of construction of fate map, fate map of Amphioxus, Amphibians and Chick. Formative movements, Metamorphosis: In Insect and in frog. Hormonal regulation of metamorphosis. Cell signaling, cell adhesion during tissue organization,lateral inhibition, induction, and recruitment. Organogenesis: formation of gut, heart, kidney and muscles, molecular mechanism involved. Pleuropotency.	11
III	**Developmental Biology: Organizer concept:** Types, characteristics & mechanism of organizer. Extra embryonic membranes: Development and functions in chick. Axis Formation in Drosophila, Metamorphosis in insect and in Frog. Hormonal regulation of metamorphosis. Placenta: Structure, functions and its types. Regeneration: Types- epimorphosis, morphollaxis and compensatory regeneration, mechanisms and physiological processes involved in regeneration, ability of regeneration in invertebrates and vertebrates, difference between embryogenesis and regeneration and tissue repair. Concept of competence, determination and differentiation and growth. Ageing and apoptosis.	11
IV	**Reproductive Technology and Reproductive Health: *In vitro* fertilization:** Artificial insemination (AI); Gamete intra-fallopian transfer (GIFT), Intra-cytoplasmic sperm injection (ICSI), Zygote Intra Fallopian Transfer (ZIFT), Test tube baby. Causes of Infertility. Multiple ovulation and embryo transfer technology (IVF and IVET), Pre implantation genetic diagnosis (PGD). Ethics in surrogacy. Teratology & teratogens: wound healing, birth defects, developmental brain disorders. Neuro degeneration. Endocrine Disruptors & Cancer. Causes of Sexually transmitted diseases: HIV/AIDS & Human Papilloma virus (HPV), Syphilis. Menstrual Disorders, Polycystic Ovarian Disease & Polycystic Ovarian Syndrome (PCOD & PCOS).	12
Keywords	*Spermatogenesis, Oogenesis, Gametes, Fertilization, Development, Cleavage, Fate maps, Organizers, Teratology*	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- Agrawal V K, Evolution and Developmental Biology, S Chand Publication
- Verma P S, Agrawal V K, Chordate Embryology, S Chand Publication
- Arumugam N, Embryology , Saras Publication
- Shasrti K V, Shukla Vinita, Developmental Biology, Rastogi Publication

Reference Books Recommended –

- Gerhart, J. et al. (1997) Cells, Embryos and Evolution. Blackwell Science
- Gilbert, S.F. (2010) Developmental Biology (9th edition). Sinauer
- Wolpert, L. (2007) Principles of Developmental Biology (3rd edition). Oxford University Press

Online Resources–

- https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=2rAs1Puvga4LW93zMe83aA==
- http://ndl.iitkgp.ac.in/he_document/aklectures/aklectures/4_3_2_1638?e=15|*|||
- http://ndl.iitkgp.ac.in/he_document/swayamprabha/swayam_prabha/cnqxwmzev1w?e=1|*|||

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Exam (ESE):	**70 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **20** +**20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF ZOOLOGY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Honors/ Honors with Research)*		**Semester - VIII**	Session: **2024-2025**	
1	Course Code	**ZOSE-11P**		
2	Course Title	**Developmental Biology**		
3	Course Type	**Discipline Specific Elective Lab Course**		
4	Pre-requisite (if, any)	***As per Program***		
5	**Course Learning Outcomes (CLO)**	**After successfully completing this course, the students will be able to-** ➢ Acquire knowledge of the fundamental processes involved in embryonic development, Types of eggs ➢ Explain developmental processes and identify various stages of development through study of permanent slides , ➢ Learn experimental techniques commonly used in developmental biology ➢ Aware of current trends and advances in developmental biology research, including emerging technologies.		
6	**Credit Value**	**1 Credits**	***Credit =30 Hours Laboratory or Field learning/Training***	
7	**Total Marks**	**Max. Marks: 50**	**Min Passing Marks: 20**	

PART -B: Content of the Course		
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)		
Module	**Topics (Course contents)**	**No. of Period**
Lab./Field Training/ Experiment Contents of Course	➢ Types of eggs based on quantity and distribution of yolk: sea urchin, insect frog, Chick. ➢ Comparative study of cleavage patterns in Frog and Amphioxus models. ➢ Study of cell movement, shape and size during morphogenetic movement of Blastulation, Gastrulation in Frog, Amphioxus, Chick through models and charts. ➢ Study of whole mounts and sections of developmental stages of frog through permanent slides: blastula, gastrula, neurula (Neural plate, Neural fold and Neural tube stages), tail-bud stage, tadpole (external and internal gill stages) ➢ Study of whole mounts of developmental stages of chick through permanent slides -18 hours, 24 hours, 33 hours, 48 hours, 72 hours and 96 hours of incubation ➢ Extra embryonic membranes of chick through models and charts. ➢ In vivo study of chick embryo development by windowing and candling methods. (Demonstration only) ➢ Some videos to develop understanding on the process of development. ➢ Group Discussion / Quiz /Seminar / Project related topics ➢ Prepare practical record	**30**
Keywords	*Types of eggs, Cleavage, frog, Chick Embryology, Chick Embryo Development Windowing*	
Signature of Convener & Members (CBoS) :		

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- *Lal S S, Vertebrate Practical*
- *Phukan LunaDevelopmental Biology Practical, Mahaveer Publication*

Online Resources–

- http://ndl.iitkgp.ac.in/he_document/swayamprabha/swayam_prabha/pttau909f8a?e=0|living%20chick%20embryos%20%E2%80%93%20observations|||
- https://egyankosh.ac.in/bitstream/123456789/16460/1/Unit-26.pdf

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - **05** Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **A. Performed the Task based on lab. work - 20 Marks** **B. Spotting based on tools & technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF ZOOLOGY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Honors/ Honors with Research)*		**Semester - VIII**		Session: **2024-2025**
1	**Course Code**	**ZOSE-12T**		
2	**Course Title**	**Molecular Biology**		
3	**Course Type**	**Discipline Specific Elective**		
4	**Pre-requisite** (if, any)	***As per Program***		
5	**Course Learning Outcomes (CLO)**	**After successfully completing this course, the students will be able to-** ➢ Develop an understanding of concepts, mechanisms and evolutionary significance and relevance of molecular biology in the current scenario. ➢ Get well versed in recombinant DNA technology which holds application in biomedical & genomic science, agriculture, environment management, etc. Therefore, a fundamental understanding of Molecular Biology will help in career building in all these fields. ➢ Apply their knowledge in problem solving and future course of their career development in higher education and research. ➢ Get new avenues of joining research in related areas such as therapeutic strategies or related opportunities in industry.		
6	**Credit Value**	**3 Credits**	***Credit = 15 Hours - learning & Observation***	
7	**Total Marks**	**Max. Marks: 100**	**Min Passing Marks: 40**	

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**Chromosomes and Nucleic Acids:** Chromosomes structure: Chromatin (Euchromatin and heterochromatin), Types of chromosomes. Histones, Histone-modifications. Structure of Nuclic acids: Structure and functions of DNA, DNA forms: Plasmid DNA, Genomic DNA and Repetitive DNA. DNA polymorphisms. DNA modifications. Structure and Function of RNA: Ribosomal RNA (rRNA), Transfer RNA (tRNA), Messenger RNA (mRNA), Noncoding RNA. RNA Induced Silencing Complex and CRISPR Technology. Mutation: Chromosomal and gene mutation.	11
II	**Central dogma and DNA replication:** Central dogma of Molecular Biology. DNA methylation. DNA-Protein interaction. DNA Replication, plasmid DNA replication and genomic DNA replication, Centromeric and Telomeric DNA replication, DNA replication and cell cycle regulation. DNA polymerases. DNA-damaging agents. DNA repairing.	11
III	**Transcription:** Concept of Transcription, RNA polymerase I, II, III, transcription factors. RNA processing, splicing of hnRNA into mRNA, 5'-capping and 3'-polyadenylation of mRNA, rRNA and tRNA modifications and processing. RNA editing, alternative splicing, trans- splicing, miRNA, siRNA, piRNA, lncRNA, RNA-protein complex.	11
IV	**Translation:** Structure of Ribosomes, Genetic Code, triplet codons, Wobble base, synonymous codons, degeneracy of codon. Translation in prokaryotic and Eukaryotic cells (Aminoacylation of tRNA, initiation, elongation, peptide bond formation, translocation, termination, recycling of ribosome). Post-translational modifications and processing of proteins, large protein-protein complexes and protein trafficking Reregulation of protein synthesis in prokaryotic and eukaryotic cell.	12
Keywords	*Chromosomes, Nucleic Acids, CRISPR, tRNA, Transcription, Translation, Central dogma*	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- Chaudhari K, Molecular Biology Text book IFAS Publication
- Verma P.S., Agrawal V.K., Molecular Biology S Chand

Reference Books Recommended –

- Watson, J.D. *et al.* (2013) Molecular Biology of the Gene (7th edition) CSHL Press Pearson.
- Green, M. R and Sambrook, J. (2012) Molecular Cloning: a Laboratory Protocol (4th edition) CSHL Press.
- Walter, P. (2007) Molecular Biology of the Cell (5th edition) Garland Science.
- Cell Biology by De Roberties
- Gene by Lewine 7th to 11th edition

Online Resources–

- https://tripurauniv.ac.in/Page/SubjectWiseOnline_EBooks_Cell_Molecular_Biology,
- https://www.tezu.ernet.in/Library/index.php/e-journals/55-microbiology-and-molecular-biology-education-oa

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 100 Marks

Continuous Internal Assessment (CIA): 30 Marks

End Semester Exam (ESE): 70 Marks

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **20** +**20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF ZOOLOGY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Honors/ Honors with research)*		**Semester VIII**	Session: **2024-2025**	
1	**Course Code**	**ZOSE-12P**		
2	**Course Title**	**Molecular Biology**		
3	**Course Type**	**Discipline Specific Elective Lab Course**		
4	**Pre-requisite** (if, any)	***As per Program***		
5	**Course Learning. Outcomes (CLO)**	**After successfully completing this course, the students will be able to-** ➢ Mastery of fundamental laboratory techniques used in molecular biology, such as DNA extraction, PCR (Polymerase Chain Reaction), gel electrophoresis, DNA sequencing, and cloning. ➢ Ability to design experiments, including selecting appropriate methodologies, controls, and troubleshooting potential issues that may arise during experiments. ➢ Proficiency in analyzing experimental data, including interpreting ➢ Development of critical thinking skills to evaluate experimental results.		
6	**Credit Value**	**1 Credits**	***Credit =30 Hours Laboratory or Field learning/Training***	
7	**Total Marks**	**Max. Marks: 50**	**Min Passing Marks: 20**	

PART -B: Content of the Course

Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)

Module	Topics (Course contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course	➢ Preparation of ball and stick model for B-DNA molecule (A=T and G=C base pairs). ➢ Preparation of RNA model for tRNA, mRNA and rRNA molecule (A=U and G=C base pairs) ➢ Preparation of Central dogma model with reference to Replication, Transcription and Translation i.e., Linear flow of genetic information. ➢ Isolation of genomic DNA by ethanol precipitation method. ➢ Preparation of model pBR322 ➢ Agarose gel electrophoresis of the plasmid DNA and the genomic DNA. ➢ Chromosomal staining ➢ Temporary slide preparation of Salivary gland chromosome from drosophila larva. ➢ Group discussion/Quiz/Seminar presentation on related topics. ➢ Practical Record or Lab assignment.	**30**
Keywords	*Molecular Biology, DNA model, Central Dogma, Agrose Gel electrophoresis, chromosome, salivary gland chromosomes of Drosophila*	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- Sarma. PVGK, Molecular Biology Practical Mannual, MJP Publisher
- Pranav Kumar, Fundamentals and Techniques of Biophysics and Molecular Biology, Pathfinder Publication

Reference Books Recommended

- Green, M. R and Sambrook, J. (2012) Molecular Cloning: a Laboratory Protocol (4th edition) CSHL Press.

Online Resources–

- http://ndl.iitkgp.ac.in/he_document/inflibnet_epgp/inflibnet_epgp/IN_I_e_P_P_1_Z_512_96_P_1_M_c_b_51376_51377?e=16|*|||
- http://ndl.iitkgp.ac.in/he_document/swayam_prabha/ke040dcj_84

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - **05** Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **A. Performed the Task based on lab. work - 20 Marks** **B. Spotting based on tools & technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF ZOOLOGY
Course Curriculum

PART- A: Introduction				
Program: Bachelor in Life Science *(Certificate / Diploma / Degree/ Honors)*		**Semester - I**		Session: **2024-2025**
1	**Course Code**	**ZOGE - 01T**		
2	**Course Title**	**Life on Earth and Unique Attributes of Animal Kingdom**		
3	**Course Type**	**General Elective**		
4	**Pre-requisite** (if, any)	*As per program*		
5	**Course Learning Outcomes (CLO)**	**After successfully completing this course, the students will be able to-** ➢ Develop an understanding of concepts, mechanisms, evolutionary significance and relevance of Origin of life. ➢ Understand General Idea about Invertebrate and Vertebrate animals with special reference and their specific qualities. ➢ Understand and appreciate diversity of life forms. ➢ Apply the knowledge about animals Sciences in daily life.		
6	**Credit Value**	**3 Credits**	*Credit = 15 Hours - learning & Observation*	
7	**Total Marks**	**Max. Marks: 100**		**Min Passing Marks: 40**

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**Origin of life: Theories of Origin of life:** **Ancient Theory** Theory of Special Creation (Mythological approach),Theory of Panspermia or Cosmozoic Theory, Theory of Directed Panspermia, Theory of Catastrophism, Theory of Spontaneous Generation (Abiogenesis or Autogenesis), Theory of Biogenesis: Redi's Experiment and Pasture's Experiment. **Modern Theory: Origin of Universe:** Big Bang Hypothesis in Brief, **Origin of Solar System and The Earth:** Nebular hypothesis, **Atomosphere and Eneargy Sources on Primitive Earth, Biochemical Origin of Life:** Oparin and Haldane Theory, **Chemogeny:** Formation of simple and complex organic compounds (Stanely Miller and Ure's Experiment), Formation of Coacervates, Nucleic Acids. **Biogeny:** Origin of primitive prokaryotic cell. **Evolution of modes of Nutrition:** Chemohetertrophs, Anaerobic and Aerobic Photoautotrophs. Evolution of Eukaryotes.	12
II	**Systematics & Unique attributes of Invertebrate and Vertebrate animals with special reference to Coelentrata, Mollusca and Pisces:** Definition and difference between Invertebrate and Vertebrate. **Nomenclature:** Binomial and Trinomial Nomenclature and International code of Nomenclature **Corals:** Meaning of Coral, Structure of Coral polyp, Coral Skeleton, Types of corals: Hydrozoan Coral, Example-Millipora, Octocorallian Coral, Example- Alcyonium, Hexacorallian Corals, Example-Gorgonia. **Torsion in Mollusca:** Definition, Mechanism of Torsion, Effects of Torsion, Significance of Torsion. **Pisces: Migration in fishes**: Catadromous: Eel fish and Anadromous: Salmon fish and **Parental care in fishes:** By nest formation, Coiling round eggs, Attachment to body, Integumentary cups, Shelter in mouth, Brood pouch, Mermaids purses, Viviparity.	11
III	**Unique attributes of Vertebrate animals with special reference to Amphibia & Reptilia:** **Parental care in Amphibia:** by Nest, by Nursery or Shelter and by Parents **Neoteny in Amphibia**: Definition, Partial and Total Neotony, Factors Affecting Neotony, Examples-Axolotal larva, Necturus and Siren. **Reptilia: Venomous & Non-venomous Snakes:** Identification, Poison apparatus: Poison Glands, Poison ducts and Fangs, Biting Mechanism.	11
IV	**Unique attributes of Vertebrate animals with special reference to Aves and Mammals:** **Birds:** Flight Adaptation, Migration and Perching Mechanism, Flightless Birds (Morphology and Special Characters of Emu, Ostrich and Penguins), Discuss-Birds are glorified reptiles: Archaeopteryx. **Monotremes or Egg laying mammals:** Morphology and Special Characters of Echidna and Duck bill platypus. **Aquatic Mammals:** Morphology and Special Characters of Whale and Dolphin. **Mammals: Flying Mammals:** Morphology and Special Characters of Bat.	11
Keywords	*Origin of life, Invertebrate, Vertebrate, Corals, Torsion, parental care, Neotony, Fangs, Aves, Mammals*	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books Recommended

- E. J. W. Barrington , Invertebrate structure and function, English Language Book Society UK
- Robert Barnes, Invertebrate Zoology, Robert Barnes IVth edition Holt Saunders International Edition Japan
- Park Haswell, Marshall and Williams, A textbook on Zoology Invertebrate, AITBS Publishing and Distributers, Delhi
- Park Haswell, Marshall and Williams, A textbook on Zoology Vertebrate, AITBS Publishing and Distributers, Delhi

Reference Books Recommended

- Prof R. L. Kotpal, Protozoa to Echinodermata, Rastogi Publication Meerut
- E.L. Jordan, Dr. P. S. Verma,Invertebrate Zoology , S. Chand Publications, New Delhi
- N. Arumugam, N. C. Nair S. - Invertebrate Zoology, Saras Publication.
- N. Arumugam, N. C. Nair S. - vertebrate Zoology, Saras Publication.
- Barrington E. J. W., Invertebrate Structure and Function, Nelson London
- Barnes, R. D., Invertebrate Zoology –Saunders Philadelphia
- R. L. Kotpal, Invertebrate, Rastogi Publications
- R. L. Kotpal, Vertebrate, Rastogi Publications
- H. S. Bhampah, KavitaJuneja, Recent trends in vertebrates vol 1 – 9, Anmol Publication
- S. N. Prasad, Life of invertebrates, Vikash Publication House Pvt Ltd New Delhi
- G. S. Sandhu, HarshwardhanBhagskar – Advanced invertebrate zoology –Campus books international

Online Resources–

- **https://www.coursera.org/lecture/emergence-of-life/4-5-invertebrates-successes-of-life-without-a-backbone-WQHqS**
- **https://www.shiksha.com/online-courses/introduction-to-biology-biodiversity-course-courl5385**
- **https://www.youtube.com/watch?v=k121Qv6loBA**
- **https://www.youtube.com/watch?v=uK-Xx_OCYcI**
- **https://www.youtube.com/watch?v=vybbBil5Elk**
- **https://www.youtube.com/watch?v=WxMSckEeio4**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Exam (ESE):	**70 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **20** +**20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Signature of Convener & Members (CBoS :

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DPARTMENT OF ZOOLOGY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Certificate / Diploma / Degree / Honors)*			**Semester - I**	Session: **2024-2025**
1	Course Code	**ZOGE - 01P**		
2	Course Title	**Life on Earth and Unique Attributes of Animal Kingdom**		
3	Course Type	**General Elective**		
4	Pre-requisite (if, any)	***As per Program***		
5	Course Learning Outcomes (CLO)	**After successfully completing this course, the students will be able to-** ➢ *To demonstrate comprehensive understanding of the current theories and hypotheses regarding the origin of life on Earth,* ➢ *Understand diversity of life forms* ➢ *Identify some distinctive invertebrate and vertebrate animals* ➢ *Apply this Understanding to broader context of life*		
6	Credit Value	**1 Credits**	***Credit =30 Hours Laboratory or Field learning/Training***	
7	Total Marks	**Max. Marks: 50**		**Min Passing Marks: 20**

PART -B: Content of the Course

Total No. of learning-Training / performance Periods: 30 Periods (30 Hours)

Module	Topics (Course Contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course	➢ Study of origin of life through chart and models ➢ Study of different Invertebrates and Vertebrates animals through models and museum specimens in the laboratory with details of biogeography and diagnostic features: Millipora, Alcyonium, Gorgonia, Hippocampus, Ichthyophis (Female), Alytes (Male), Axolotal larva, Necturus, Siren, Cobra, Viper (pit & Pitless), Sea Snake, Rattle Snake, Archaeopteryx, Emu, Ostrich and Penguins, Echidna and Duck bill platypus, Whale, Dolphin, Bat. ➢ Preparation and Demonstration of Key for Identification of Venomous and Non-venomous snakes. ➢ Study of Coral Reefs through Models, Photographs ➢ Study of Fossils through chart/ Models ➢ An "**Animal album or Practical Record**" containing sketches, photographs, cut outs, with appropriate write up about the above mentioned taxa. ➢ Study of some videos to develop understanding and acquired knowledge on the animals salient features as mentioned above. ➢ Group discussion/Viva or Seminar presentation on related topics mentioned in Theory paper.	**30**
Keywords	*Museum specimens, Invertebrates, Vertebrates, Venomous and Non-venomous, Seminar*	

Name and Signature of Convener & Members of CBoS:

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- S.S. Lal, Practical Zoology, Invertebrate. 12th Edition Rastogi Publications, Meerut,
  - New Delhi.
- A manual of practical Zoology. Dr. P.S Verma, S. Chand Publication, New Delhi

Reference *Books Recommended –*

- Park Haswell, Marshall and Williams, A textbook on Zoology Invertebrate, AITBS Publishing and Distributers, Delhi
- Park Haswell, Marshall and Williams, A textbook on Zoology Vertebrate, AITBS Publishing and Distributers, Delhi

Online Resources–

- http://ndl.iitkgp.ac.in/he_document/swayamprabha/swayam_prabha/gc5ua6m873i?e=3|*|||
- https://www.youtube.com/watch?v=JUdp3U6A1EA

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - **05** Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **A. Performed the Task based on lab. work - 20 Marks** **B. Spotting based on tools & technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF ZOOLOGY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Certificate / Diploma / Degree / Honors)*		**Semester - II**		Session: **2024-2025**
1	**Course Code**	**ZOGE - 02T**		
2	**Course Title**	**Cell Biology and Histology**		
3	**Course Type**	**General Elective**		
4	**Pre-requisite** (if, any)	***As per Program***		
5	**Course Learning Outcomes (CLO)**	**After successfully completing this course, the students will be able to-** ➢ Acquire knowledge of Cell membrane and function ➢ Understand the functioning of nucleus and extra nuclear organelles and understand the intricate cellular mechanisms involved. ➢ Gain Knowledge of key processes like cell division, ➢ Learn about various tissues of body their structural significance		
6	**Credit Value**	**3 Credits**	***Credit = 15 Hours - learning & Observation***	
7	**Total Marks**	**Max. Marks: 100**	**Min Passing Marks: 40**	

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**Cell Structure, Cell Membrane and Extra Nuclear Cell Organelles:** General structure of Prokaryotes and Eukaryotes. **Cell membrane organization: Origin,** structure (Lipid-Lipid Bilayer Model, Dannelli & Davson Model, Unit Membrane Model and Fluid mosaic model), chemical composition and function of cell membrane, Specialization of cell membrane: microvilli desmosomes, Hemidesmosome, Septate Desmosome, plasmodesmata, tight and gap junction. **Extra Nuclear Cell Organelles:** Ultra structure and functions of Endoplasmic reticulum and Golgi apparatus.	11
II	**Extra Nuclear Cell Organelles:** Ultra structure and functions of Ribosome, Lysosome, Peroxisomes, Mitochondria: Origin, structure and function.	11
III	**Nuclear Organization and Cell Division:** Size, shape, structure and functions of interphase nucleus. Ultra structure of nuclear membrane and pore complex. Nucleolus: general organization, chemical composition and functions, Chromosome Morphology, Cell cycle, Cell division- Mitosis and Meiosis. Cell division checks points and their regulation. Programmed cell death (Apoptosis).	12
IV	**Introduction to tissues.** Epithelial tissue: types, structure and characteristics. surface modifications. Basement membrane: structure and characteristics. Connective tissue cells. Structure and function of loose, dense and adipose tissue. Cartilage and bone: classification, and fine structure. Blood: plasma, blood cells, lymph– their structure and function. Bone marrow and haemopoesis. Structure and function of spleen. Muscular tissue: ultrastructure of smooth, skeletal and cardiac muscles. Muscle-tendon attachment. Structure and classification of neurons.	11
Keywords	*Cell Biology, Cell Membrane, Cell organelle, Nucleus, endoplasmic reticulum and Golgi apparatus, ribosome, lysosome, peroxisomes, Mitochondria, tissues.*	
Name and Signature of Convener & Members of CBoS:		

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. Gupta P.K. Cell and Molecular Biology, Himalaya Publication
2. Arumugam.N, Cell biology and Molecular Biology, Saras Publication
3. Rastogi V.B. Cell Biology, Rastogi Publication
4. Verma P.S. and Agrawal Cell Biology, S. Chand Publication

Reference Books Recommended –

5. Karp, G. (2010) Cell and Molecular Biology: Concepts and Experiments (6th edition) John Wiley & Sons. Inc.
6. De Robertis, E.D.P. and De Robertis, E.M.F. (2006) Cell and Molecular Biology (8th edition) Lippincott Williams and Wilkins, Philadelphia.
7. Cooper, G.M. and Hausman, R.E. (2009) The Cell: A Molecular Approach. (5th edition) ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
8. Becker, W.M.; Kleinsmith, L.J.; Hardin. J. and Bertoni, G. P. (2009) The World of the Cell. (7th edition) Pearson Benjamin Cummings Publishing, San Francisco. Practical

Online Resources–

1. National digital Library.- http://ndl.iitkgp.ac.in/document/Qkh4R2FGUkRNZjFicFUvWmpzQ2loY0poaUVtYlByc1BZNXk3TnZMWVFzQXpZNjhhQUplR1BTOERHelZXZUp5Nw
2. http://ndl.iitkgp.ac.in/document/Qkh4R2FGUkRNZjFicFUvWmpzQ2loZFJyVGFmaDFwbXpBS0kwNi9tbi91UGYxaFl6OC9Sb25QWUlXLzF1V3NUZw
3. https://www.youtube.com/watch?v=GYY627IeAKg
4. E-PG Pathshala. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=2rAs1Puvga4LW93zMe83aA==

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Exam (ESE):	**70 Marks**

Continuous Internal Assessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **20 +20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz **+** obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
Department of ZOOLOGY
Course Curriculum

PART- A: Introduction				
Program: Bachelor in Life Science *(Certificate / Diploma / Degree / Honors)*		**Semester - II**	Session: **2024-2025**	
1	**Course Code**	**ZOGE -02P**		
2	**Course Title**	**Cell Biology and Histology**		
3	**Course Type**	**General Elective**		
4	**Pre-requisite** (if, any)	***As per Program***		
5	**Course Learning Outcomes (CLO)**	**After successfully completing this course, the students will be able to-** ➢ Understand ultra structure of prokaryote and Eukaryote cell, undertake microscopic study to gain knowledge ➢ learn to identify cell organelles ➢ Explain and demonstrate mitosis and meiosis division in onion root tip, Grass hopper testis, etc ➢ Gain knowledge of Microtomy		
6	**Credit Value**	**1 Credits**	***Credit =30 Hours Laboratory or Field learning/Training***	
7	**Total Marks**	**Max. Marks: 50**	**Min Passing Marks: 20**	

PART -B: Content of the Course

Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)

Module	Topics (Course contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course	1. Study of prokaryotic and eukaryotic cell types with the help of chart, slide and video. 2. Separation and isolation of cells by sedimentation velocity in unit gravity. 3. Disruption of cells, isolation and identification of subcellular components, isolation of nuclei. 4. Isolation of mitochondria by differential centrifugation and identification of succinic dehydrogenase in the mitochondrial pellet. 5. Chromosome segregation in mitosis and meiosis. 6. Preparation of chromosome squashes from Onion Root tip for observation of stages of Mitosis 7. Preparation of chromosome squashes from grasshopper/cockroach testes for the observation of stages of meiosis. 8. Isolation and estimation of DNA. 9. Study of types of tissue through permanent slides: epithelial, connective, muscular, Nervous etc. 10. Preparation of Practical Record 11. Group discussion/Viva or Seminar presentation on related topics mentioned in Theory paper	**30**
Keywords	*Prokaryote, Eukaryote, cell division, Mitosis, Meiosis, DNA Separation, Histology of Tissue, Microtomy.*	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. Debarati Das Essential Practical Handbook of Cell Biology & Genetics, Biometry & Microbiology, A Laboratory Manual, Academic Publishers.
2. Mohan P Arora Cytogenetics:, Himalayan Publishing House

Reference Books Recommended –

3. Karp, G. (2010) Cell and Molecular Biology: Concepts and Experiments (6th edition) John Wiley & Sons. Inc.

Online Resources– National Digital Library

- http://ndl.iitkgp.ac.in/he_document/inflibnet_epgp/inflibnet_epgp/IN_I e P P 1 Z 51296 P 1 P o e 51600 M 0 P g 51604 51605?e=13|*|||

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 50 Marks

Continuous Internal Assessment (CIA): 15 Marks

End Semester Exam (ESE): 35 Marks

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - **05** Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **A. Performed the Task based on lab. work - 20 Marks** **B. Spotting based on tools & technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of BoS :

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF ZOOLOGY
COURSE CURRICULUM

PART-A: Introduction				
Program:Bachelor *(Certificate / Diploma / Degree)*			**Semester – I/III/V**	Session: **2024-2025**
1	**Course Code**	**ZOVAC-01**		
2	**Course Title**	**Public Health and Hygiene**		
3	**CourseType**	**Value Added Course**		
4	**Pre-requisite(if, any)**	***As per Program***		
5	**Course Learning. Outcomes(CLO)**	➢ Understand the importance of hygiene. ➢ Identify current national and global public health problems. ➢ Aware about the issues of food safety, water safety, vaccination, and obesity. ➢ Create general medical awareness in daily life. ➢ Analyze the measures to live a healthy life.		
6	**CreditValue**	**2 Credits**	***Credit = 15 Hours -learning & Observation***	
7	**TotalMarks**	**Max.Marks:50**		**Min Passing Marks:20**

PART -B: Content oftheCourse

Total No. of Teaching–learning Periods (01 Hr. per period) - 30 Periods (30 Hours)

Unit	Topics (Course Contents)	No. of Period
I	**Maintenance of personal hygiene:** Introduction to public health and hygiene: determinants and factors. Pollution and health hazards: Water and air borne diseases. Radiation hazards: Network Towers and electronic gadgets (recommended levels, effects and precaution). Personal hygiene: Oral hygiene, Menstrual Hygiene, Ideal hand washing methods, Ideal food keeping methods.	07
II	**Nutrition and Health:** Classification of food into micro and macro nutrients. Balanced diet. Importance of dietary fibres. Significance of breast feeding. Malnutrition anomalies: Anaemia (Iron and B12 deficiency), Kwashiorkar, Marasmus, Rickets, Goiter (cause, symptoms, precaution and cure).	07
III	**Communicable/Contagious and Non-Communicable Diseases: Communicable viral diseases:** measles, chicken pox, swine flu (their causal agents, symptoms and prevention). **Communicable bacterial diseases:** tuberculosis, typhoid, cholera (their causal agents, symptoms and prevention). **Sexually transmitted diseases:** AIDS, Syphilis (their causal agents, symptoms and prevention). **Non-communicable diseases:** hypertension, arthritis, Diabetes, peptic ulcer, obesity, depression and anxiety (their causal agents, symptoms and prevention).	09
IV	**Public Health Management & General Medical Awareness:** Vaccination, Benefits of institutional deliveries, Deworming drive: Use of Albendazole. First Aid: Electrocution, Road Accident, Burn, Lightning Strike, Envenomation. Importance of Cardiopulmonary resuscitation (CPR). Blood Donation: Eligibility, Health Screening. Road Safety: Good Samaritan, General safety precautions on Road and Motion Sickness. Fire Safety: Fire Control and Fire Extinguisher Categories.	07
Keywords	*Health, Hygiene, Nutrition, Disorders, Vaccination, Safety, Fire, Blood, Medication.*	

Signature of Convener & Members (CBoS):

PART–C:Learning Resources

Text Books, Reference Books and Others

Text BooksRecommended –

- Mary Jane Schneider (2011) Introduction to Public Health.
- Muthu, V.K. (2014) A Short Book of Public Health.

Reference Books Recommended

- Detels, R. (2017) Oxford Textbook of Public Health (6th edition).
- Gibney, M.J. (2013) Public Health Nutrition.
- Wong, K.V. (2017) Nutrition, Health and Disease.

Online Resources–

- **https://www.fda.gov/drugs/investigational-new-drug-ind-application/general-drug-categories**
- **https://www.nfpa.org/news-blogs-and-articles/blogs/2023/08/01/fire-extinguisher-types**
- **https://www.redcross.org/take-a-class/cpr/performing-cpr/what-is-cpr#:~:text=What%20Is%20the%20Purpose%20of,healthcare%20workers%20and%20emergency%20responders.**
- **https://unesdoc.unesco.org/ark:/48223/pf0000226792**

Online Resources–

- **https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S001827/P001833/M029447/ET/15245666876.21Q1.pdf**
- **https://www.nhm.gov.in/images/pdf/programmes/mhs/Training_Materials/PDF_English/reading_material.pdf**

PART-D:Assessment andEvaluation

Suggested Continuous Evaluation Methods:
MaximumMarks: 50 Marks
ContinuousInternal Assessment(CIA):15 Marks
EndSemesterExam(ESE):35Marks

Continuous InternalAssessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **10 &10** Assignment/Seminar +Attendance- **05** Total Marks -**15**	Better marks out of thetwo Test / Quiz+obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Two section – A & B** Section **A**: **Q1**. Objective – **05 x1= 05** Mark; **Q2**. Short answer type- **5x2 =10Marks** Section **B**: Descriptive answer type qts.,**1out of 2** from each unit-**4x05=20Marks**	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF ZOOLOGY
COURSE CURRICULUM

PART-A: Introduction

Program: Bachelor in Life Science *(Certificate / Diploma / Degree)*			**Semester – II/IV/V/VI**	**Session: 2024-2025**
1	**Course Code**	**ZOSEC-01**		
2	**Course Title**	**Vermiculture and Vermicomposting**		
3	**Course Type**	**Skill Enhancement Course**		
4	**Pre-requisite** (if, any)	***As per Program***		
5	**Course Learning Outcomes (CLO)**	**After successfully completing this course, the students will be able to:** ➢ Learn the identifiable features of earthworm species for vermiculture and vermicomposting. ➢ Cultivate the skills of vermiculture. ➢ Understand the challenges in vermiculture and vermicomposting. ➢ Analyze the features of different vermicomposting methods. ➢ Create entrepreneurial prospects in this field.		
6	**CreditValue**	**2 Credits (1C + 1C)**	***Credit = 15 Hours –Theoretical learning and = 30 Hours Laboratory or Field learning/Training***	
7	**Total Marks**	**Max.Marks:50**		**Min Passing Marks:20**

PART -B: Content of the Course

Total No. of Teaching–learning Periods:
Theory–15 Periods (15 Hrs) and Lab. or Field learning/Training 30 Periods (30 Hours)

Module	Topics (Course contents)	No. of Period
Theory Contents	**General Introduction:** Distribution and habit, habitat. Food: Phytophagous and Geophagous earthworm. Morphology of earthworm. Ecological categories: Epigeic, Endogeic and Anecic earthworms. Ecological requirements: moisture, temperature, light, pH and, organic matter. Ecosystem services: role played by earthworms in soil ecosystem. Difference between vermiculture and vermicomposting. Role of earthworm and vermicompost in growth of plants. **Vermiculture:** Definition and features. Selective features of earthworms for vermiculture. Vermiculture methods: Wormery, breeding techniques: indoor and outdoor cultures, monoculture and polyculture, merits and demerits. Obstacles in Vermiculture: Preventention and Management. **Vermicomposting:** Definition and features. Scientific names and distinguishing features of native and exotic vermicomposting earthworms (Native Indian earthworms. *Perionyx excovatus, Perionyx ceylanensis*, European earthworms. *Eisenia fetida, Eisenia andrei*, South African earthworms. *Eudriluseugeniae*), Principle of vermicomposting, Methods of vermicomposting: Low-cost Floor beds, Grow bags & Tank system. Management during vermicomposting (Physical and Biological). Products of vermicomposting, physiochemical features and their utility: earthworm biomass (vermiprotein), vermicompost and vermiwash. Harvesting the vermicompost & storage. Marketing prospects of Vermicomposting in Chhattisgarh and India.	15
Lab./Field Training Contents	➢ Key to identify different types of earthworms. ➢ Identification of materials/waste products for vermiculture and vermicomposting. ➢ Study of systematic position, habits, and habitat & External characters of *Eisenia fetida.* ➢ Study of Life stages & development of *Eisenia fetida.* ➢ Culture of earthworms in Grow Bags. ➢ Study of devices and instruments of Vermiculture and Vermicomposting. ➢ Preparation of vermibed, maintenance of vermicompost & management of climatic conditions. ➢ Study the effects of vermicompost & vermiwash on any two short duration plants. ➢ Study of different methods of vermicomposting (NADEP Composting, Bangalore Method, Coimbatore Method & Indore Method). ➢ Creation of set up for vermiwash collection. ➢ Field Visit to Vermiculture & Vermicomposting sites and interaction with self help groups/ personnel engaged in these activities. ➢ Projects/ Assignments/ Chart/ Model preparation. ➢ Practical Record	30
Keywords	***Earthworm, Vermiculture, Vermicomposting, Vermiwash, Grow Bags, NADEP.***	
Signature of Convener & Members (CBoS):		

PART–C:Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- Chauhan, A. (2012) Vermitechnology, Vermiculture, Vermicompost and Earthworms: Vermiculture, Vermicomposting, Vermitechnology and Mirobes, Lambert Academic Publishing, Germany.
- National Institute of Industrial Research, (2010): The Complete Technology Book on Vermiculture and Vermicompost, Published by National Institute of Industrial Research, Delhi-7, India.
- Kumar, A. (2005) Verms and Vermitechnology, APH Publishing.
- Bhatnagar & Patla,2007. Earthworm vermiculture and vermin-composting, Kalyani Publishers,New Delhi.
- Sultan Ahmed Ismail, 2005. The Earthworm Book, Second Revised Edition. Other India Press, Goa, India.
- Panda Himadri: The Complete Technology Book on Vermiculture and Vermicompost (Earthworm) with Manufacturing Process, Machinery Equipment Details & Plant Layout; Asia Pacific Business Press Inc.
- EIRI Board : Hand Book Of Biofertilizers & Vermiculture.

Online Resources–

- **https://agritech.tnau.ac.in/org_farm/orgfarm_composting.html#:~:text=In%20the%20Bangalore%20method%20of,laid%20over%20the%20moistened%20layer.**
- **https://www.thepharmajournal.com/archives/2021/vol10issue12/PartAR/11-5-248-926.pdf**

Online Resources–

- **https://megbrdc.nic.in/publications/fliers-Pamphlets/nadep-composting-english.pdf**

PART-D:Assessment andEvaluation

Suggested Continuous Evaluation Methods:
MaximumMarks: 50 Marks
ContinuousInternal Assessment(CIA):15 Marks
EndSemesterExam(ESE):35Marks

Continuous InternalAssessment(CIA)(By Course Coordinator)	Internal Test / Quiz-(2): **10 &10** Assignment/Seminar +Attendance- **05** Total Marks - **15**	Better marks out of thetwo Test / Quiz +obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **A. Performed the Task based on learned skill - 20 Marks** **B. Spotting based on tools (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Coordinator as per skilling**

Name and Signature of Convener & Members of CBoS:

Dr. Shubhada Rahalkar

(Dr Nazeem Ahmed Masani)

Dr Ajit Hunde

Shobha Ram Yadav

(Dr. Lata Meshram)

10.6.24

(Dr. R.K. Tambole)

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

Department of CHEMISTRY

Course Curriculum

FOUR YEAR UNDERGRADUATE PROGRAM (NEP–2020)

Program: Bachelor in Science

DISCIPLINE–CHEMISTRY

Session–2024-28

DSC- 01 to 08		DSE-01 to 12		DGE-01 to 06	
Code	Title	Code	Title	Code	Title
CHSC-01T	Fundamental Chemistry-I	CHSE-01T	Basic Analytical Chemistry	CHGE-01T	Fundamental Chemistry-I
CHSC-01P	Chemistry Lab. Course-I	CHSE-01P	Basic Analytical Chemistry Lab. Course	CHGE-01P	Chemistry Lab. Course-I
CHSC-02T	Fundamental Chemistry-II	CHSE-02T	Environmental Chemistry	CHGE-02T	Fundamental Chemistry-II
CHSC-02P	Chemistry Lab. Course-II	CHSE-02P	Environmental Chemistry Lab. Course	CHGE-02P	Chemistry Lab. Course-II
CHSC-03T	Inorganic and Physical Chemistry-I	CHSE-03T	Dyes & Polymer Chemistry		
CHSC-03P	Chemistry Lab. Course-III	CHSE-03P	Dyes & Polymer Chemistry Lab. Course		
CHSC-04T	Organic and Physical Chemistry-I	CHSE-04T	Heterocyclic Chemistry		
CHSC-04P	Chemistry Lab. Course-IV	CHSE-04P	Heterocyclic Chemistry Lab. Course		
CHSC-05T	Organic & Inorganic-I	CHSE-05T	Photochemistry & Pericyclic Reactions		
CHSC-05P	Chemistry Lab. Course-V	CHSE-05P	Photochemistry & Pericyclic Reactions Lab. Course		
CHSC-06T	Organic and Physical Chemistry-II	CHSE-06T	Spectroscopy-I		
CHSC-06P	Chemistry Lab. Course-VI	CHSE-06P	Spectroscopy-I Lab. Course		
CHSC-07T	Inorganic & Physical Chemistry-II	CHSE-07T	Chemical Kinetics & Nuclear Chemistry		
CHSC-07P	Chemistry Lab. Course-VII	CHSE-07P	Chemical Kinetics & Nuclear Chemistry Lab. Course		
CHSC-08T	Organic & Inorganic-II	CHSE-08T	Electrochemistry & Surface Chemistry		
CHSC-08P	Chemistry Lab. Course-VIII	CHSE-08P	Electrochemistry & Surface Chemistry Lab. Course		
		CHSE-09T	Spectroscopy-II		
		CHSE-09P	Spectroscopy-II Lab. Course		
		CHSE-10T	Nanotechnology & Solid State	SEC	
		CHSE-10P (VIII SEM)	Nanotechnology & Solid State Lab. Course		
		CHSE-11T	Medicinal Chemistry & Natural Products	CHSEC-01T&P	Chemical Analysis Techniques
		CHSE-11P	Medicinal Chemistry & Natural Products Lab. Course		
		CHSE-12T	Instrumental Methods of Analysis	VAC	
		CHSE-12P	Instrumental Methods of Analysis Lab. Course	CHVAC-01T	Chemistry in Daily Life

1 2 3 4 5

6 7 8 9 10

FOUR YEAR UNDERGRADUATE PROGRAM(NEP–2020)

Program: Bachelor in Science

DISCIPLINE–CHEMISTRY

Session–2024-28

PO & PSO

PROGRAMME OUTCOMES (PO)

PO-1: B.Sc. Chemistry curriculum is so designed to provide the students a comprehensive understanding about the fundamentals of chemistry covering all the principles and perspectives.

PO-2: The branches of Chemistry such as Organic Chemistry, Inorganic Chemistry, Physical Chemistry and Analytical Chemistry expose the diversified aspects of chemistry where the students experience a broader outlook of the subject.

PO-3: The syllabi of the B.Sc. Chemistry course are discretely classified to give stepwise advancement of the subject knowledge right through the four years of the term.

PO-4: The practical exercises done in the laboratories impart the students the knowledge about various chemical reagents and reactions. They are also trained about the adverse effects of the obnoxious chemicals and the first aid treatment.

PROGRAMME SPECIFIC OUTCOMES (PSO)

PSO-1: The students will understand the existence of matter in the universe as solids, liquids, and gases which are composed of molecules, atoms and sub atomic particles.

PSO-2: Students will learn to estimate inorganic salt mixtures and organic compounds both qualitatively and quantitatively using the classical methods of analysis in practical classes.

PSO-3: Students will grasp the mechanisms of different types of reactions both organic and inorganic and will try to predict the products of unknown reactions.

PSO-4: Students will learn to synthesize the chemical compounds by maneuvering the addition of reagents under optimum reaction conditions

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Science *(Certificate / Diploma / Degree/Honors)*			Semester - I	Session: 2024-2025
1	Course Code	CHSC-01T		
2	Course Title	FUNDAMENTAL CHEMISTRY-I		
3	Course Type	DSC		
4	Pre-requisite (if, any)	*As per Program*		
5	Course Learning. Outcomes (CLO)	➢ *To know the contributions of ancient Indian scientists, study atomic structure, and periodic properties.* ➢ *To explore the concept of chemical bonding, including ionic and covalent bonding, hybridization, molecular orbital theory and intermolecular interactions.* ➢ *To learn about reaction mechanisms of inorganic reactions and their stoichiometry.* ➢ *To understand basics principles of organic chemistry.*		
6	Credit Value	3 Credits	*Credit = 15 Hours - learning & Observation*	
7	Total Marks	Max. Marks: 100		Min Passing Marks: 40

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**A. Chemistry in Ancient India:** (a) Chemical techniques in ancient India: General Introduction (b) Contribution of ancient Indian scientists in chemistry, e.g., metallurgy, dyes, pigments, cosmetics, Ayurveda, Charak Sanhita. **Ancient Indian Chemist**- Their Contribution and Books- Rishi Kanad, Aacharya Nagarjuna, Vagbhatta, Govindacharya, Yashodhar, Ramchandra, Somadava, Gopalbhatta etc. Indian Chemist of 19th century- Aacharya Prafulla Chandra Ray- His Contribution and work for Indian Chemistry. **B. Atomic Structure and Periodic Properties:** (i) Review of Bohr's theory and its limitations. Dual nature of particles and waves, de Broglie's equation, Heisenberg's Uncertainty principle and its significance. (ii) Quantum numbers and their significance. Rules for filling electrons in various orbitals, Pauli's Exclusion Principle, Hund's rule of maximum multiplicity. Aufbau principle and its limitations. Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals. Anomalous electronic configurations. (iii)Effective nuclear charge (ENC), shielding or screening effect, Slater rules, Atomic and Ionic radii. Ionization energy and factors affecting ionization energy. Electron affinity, Electronegativity—Pauling's/Mulliken's electronegativity scales. Relation of electronegativity with hybridization.	11
II	**Chemical Bonding – I A) Ionic Bonding:** General characteristics of ionic bonding. **Ionic Bonding & Energy:** Lattice and solvation energies and their importance in the context of stability and solubility of ionic compounds. **Born-Haber Cycle and its Applications:** Covalent character in ionic compounds, polarizing power and polarizability. Fajan's rules. **B) Covalent Bonding:** Lewis structures, Valence Bond theory, Hybridization (concept and types with suitable examples), dipole moment and percentage ionic character. Valence shell electron pair repulsion theory (VSEPR) and structure of NH_3, H_2O, SF_4, ClF_3, PCl_5, SF_6, XeF_2, XeF_6, XeO_3, $XeOF_4$, XeF_4.	12

	Chemical Bonding - II **A) MO theory:** LCAO method-criteria of orbital overlapping, types of molecular orbitals-σ-, π- and, δ-MOs; formation of σ- and π-MOs and their, schematic illustration; qualitative MO energy level diagram of homo- (N_2 & O_2(including peroxide, superoxide)) and hetero-diatomic molecules (NO, CO), magnetic properties, bond order and stability of molecules and ions. **B)** Weak Chemical Forces: van der Waals forces, ion-dipole forces, dipole-dipole interactions, ion-induced dipole interactions, dipole-induced dipole interactions. Repulsive forces, Hydrogen bonding (theories of hydrogen bonding, valence bond treatment).	
III	**A. Chemical properties of s-block metals** Reaction with water, air, and nitrogen, Anomalous behavior of Li and Be, Compounds of s-block metals: Oxides, hydroxides, peroxides, and superoxides (preparation and properties) Complexes of s-block metals, Complexes with crown ethers **B. Chemistry of p-Block Elements** **Boron group:** Hydrides (classification of boranes), Diborane (preparation, properties, and structure elucidation), Borazine (preparation and structure) **Carbon group:** Carbides (salt-like carbides, interstitial carbides, covalent carbides), Silicates (classification, three-dimensional silicates - properties and structures) **Nitrogen group:** Hydrides of Nitrogen (hydrazine, hydroxylamine, hydrazoic acid) Structure of oxides of nitrogen (N_2O, NO, NO_2, N_2O_4, and N_2O_5), Structure of oxyacids of nitrogen (HNO_2, HNO_3, $H_2N_2O_7$,), Nitrides (classification, preparation, properties, and uses) Structure of Oxides and oxoacids of phosphorus: (P_2O_3, P_2O_5) H_3PO_2, H_3PO_3, H_3PO_4, $H_4P_2O_7$ **Halogen:** Hydrides, Oxides and oxyacids of halogens (structure only) – Inter halogen compounds and pseudo halogens	11
IV	**Electronic Effects in Organic Compounds** Bond Cleavage: Homolytic and heterolytic cleavages, bond energy, bond length, and bond angle. Electron Displacement Effects: Inductive, inductomeric, electromeric, mesomeric (resonance), hyperconjugation, and steric effects. Tautomerism (keto-enol, amido-imidol, and nitro-acinitro forms). Reaction Intermediates: Formation and stability of carbocations, carbanions, free radicals, carbenes, nitrene and benzyne. **B. Stereochemistry of Organic Compounds** **i) Optical Isomerism** Elements of symmetry, chirality, enantiomers, and optical activity, Chiral and achiral molecules with two stereogenic centers (Tartaric acid as an example),Erythro & Threo, Diastereomers and meso compounds, Inversion, retention, and racemization, Relative configuration (D/L), and absolute configuration (R/S nomenclature: sequence rules). **ii) Geometrical Isomerism** Geometric isomerism (cis-trans isomerism) in alkenes with examples (maleic acid, fumaric acid, and 2-butene), E/Z system of nomenclature.	11
Keywords	***Ancient Indian Chemistry, Atomic Structure, Periodic Properties, Chemical Bonding, s- &p-block elements, Electronic effects, Stereochemistry***	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –
Text Books

1. Puri, B. R., Sharma, L. R., & Kalia, K. C. (2018). *Principles of Inorganic Chemistry*. Nagin Chand and Co., New Delhi.
2. Satyaprakash, G., Tuli, S. K., Basu, S. K., & Madan, R. D. (2017). *Advanced Inorganic Chemistry* (Vol. 1, 5th Ed.). S. Chand & Company.
3. Lee, J. D. (2010). *Concise Inorganic Chemistry* (5th Ed.). Blackwell Science.
4. Housecroft, C. E., & Sharpe, A. G. (2012). *Inorganic Chemistry* (4th Ed.). Pearson Education Limited.
5. Ray, Acharya Prafulla Charndra, ***History of Chemistry in Ancient And Medieval India***, Chowkhamba Krishnadas Academy (Reprint 2004).

Reference Books

1. Cotton, F. A., Wilkinson, G., & Gaus, P. L. (2002). *Basic Inorganic Chemistry* (3rd Ed.). John Wiley & Sons.
2. Douglas, B. E., Mcdaniel, D. T., & Alexander, J. J. (1994). *Concepts and Models Of Inorganic Chemistry* (3rd Ed.). John Wiley & Sons.
3. Huheey, J. E., Keiter, E. A., & Keiter, R. L. (1993). *Inorganic Chemistry* (4th Ed.). Harpercollins College Publishers.
4. Shriver, D. F., Atkins, P. W., & Langford, C. H. (2010). *Inorganic Chemistry* (5th Ed.). W. H. Freeman And Company.
5. Moeller, T. (1990). *Inorganic Chemistry: A Modern Introduction*. Wiley.

Online Resources–

- https://bit.ly/3AyV3mZ
- https://nptel.ac.in/courses/104/104/104104101/
- https://nptel.ac.in/courses/104/103/104103019/
- https://nptel.ac.in/courses/104/101/104101090/
- https://nptel.ac.in/courses/104/105/104105103/

Online Resources–

- **e-Resources / e-books and e-learning portals**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Exam (ESE):	**70 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **20** ÷**20** Assignment / Seminar - 10 Total Marks - 30	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1.** Objective – **10 x1**= 10 Mark; **Q2.** Short answer type- **5x4** =**20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10**=**40 Marks**	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Science *(Certificate / Diploma / Degree/Honors)*			**Semester-I**	Session: 2024-2025
1	Course Code	CHSC-01P		
2	Course Title	CHEMISTRY LAB. COURSE-I		
3	Course Type	DSC		
4	Pre-requisite (if, any)	*As per Program*		
5	Course Learning. Outcomes (CLO)	➢ *Analyze mixtures for cations (NH_4^+, Pb^{2+}, etc.) & anions (CO_3^{2-}, S^{2-}, etc.) using H_2S or other methods.* ➢ *Perform titrimetric analysis (standardization, unknown conc. determination).* ➢ *Estimate the concentration of acetic acid in vinegar (using NaOH), alkali content in antacids (using HCl), and free alkali in soaps/detergents.* ➢ *Utilize complexometric titrations for calcium (Ca^{2+}), water hardness, Fe^{2+}/Fe^{3+}, and Cu^{2+}.*		
6	Credit Value	1 Credits	*Credit =30 Hours Laboratory or Field learning/Training*	
7	Total Marks	Max. Marks: 50		Min Passing Marks: 20

PART -B: Content of the Course

Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)

Module	Topics (Course contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course	**QUALITATIVE INORGANIC MIXTURE ANALYSIS:** Inorganic mixture analysis containing up to four ionic species (two cations and two anions) using H_2S (hydrogen sulfide) or other appropriate methods (Excluded are interfering and insoluble salts) Cations and anions that may be encountered include: **Cations:** NH_4^+, Pb^{2+}, Bi^{3+}, Cu^{2+}, Cd^{2+}, Fe^{2+}/Fe^{3+}, Al^{3+}, Co^{2+}, Ni^{2+}, Mn^{2+}, Zn^{2+}, Ba^{2+}, Sr^{2+}, Ca^{2+}, Na^+ **Anions:** CO_3^{2-}, S^{2-}, SO_4^{2-}, NO_3^-, CH_3COO^-, Cl^-, Br^-, I^-, NO_2^-, SO_3^{2-} (Spot tests may be used wherever feasible.) **TITRIMETRIC ANALYSIS** Standardize sodium hydroxide solution using a standard oxalic acid solution. Determine the concentration of hydrochloric acid (HCl) solution using standardized sodium hydroxide solution as an intermediate.	30
Keywords	*Qualitative Analysis (H_2S method, Cations (NH_4^+, Pb^{2+}, etc.), Anions (CO_3^{2-}, S^{2-}, etc.), Titrimetric Analysis, Standardization (NaOH solution), Concentration Determination (HCl solution)*	

Signature of Convener & Members (CBoS) :

PART-C: Learning Resources

Text Books, Reference Books and Others

Textbooks Recommended:

1. Gurtu, J. N., & Kapoor, R. (1987). *Experimental Chemistry*. S. Chand & Co.
2. Bajpai, D. N., Pandey, O. P., & Giri, S. (2013). *Practical Chemistry*. S. Chand & Co.
3. Ahluwalia, V. K., Dhingra, S., & Dhingram, S. (2005). *College Practical Chemistry*. Universities Press.
4. Kamboj, P. C. (2014). *Advanced University Practical Chemistry* (Part I). Vishal Publishing Co.
5. Fultariya, C., & Harsora, J. (2017). *Volumetric Analysis: Concepts and Experiments*.

Reference Books Recommended:

1. Mcpherson, P. A. (2015). *Practical Volumetric Analysis*. Royal Society Of Chemistry.
2. Shobha, R., & Banani, M. (2017). *Essentials of Analytical Chemistry*. Pearson.
3. Venkateswaran, V., Veeraswamy, R., & Kulandaivelu, A. R. (2004). *Basic Principles Of Practical Chemistry* (2nd Ed.). S. Chand Publications.
4. Sundaram, S., & Raghavan, K. (1996). *Practical Chemistry*. S. Viswanathan Co. Pvt.
5. Svehla, G. (2011). *Vogel's Textbook of Inorganic Qualitative Analysis* (7th Ed.). Pearson Education

Online Resources–

- https://bit.ly/3B7tOQV
- https://bit.ly/30V85ze
- https://bit.ly/3B5WOIQ
- https://bit.ly/3C9PXPS
- https://bit.ly/30lp9rZ
- https://bit.ly/3BPnwqc

Online Resources–

- **e-Resources / e-books and e-learning portals**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - **05** Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **A. Performed the Task based on lab. work - 20 Marks** **B. Spotting based on tools & technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**	Managed by **Course teacher** as per lab. status

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART- A: Introduction

Program: Bachelor in Science *(Certificate / Diploma / Degree/Honors)*		Semester - II	Session: 2024-2025
1	Course Code	CHSC-02T	
2	Course Title	FUNDAMENTAL CHEMISTRY-II	
3	Course Type	DSC	
4	Pre-requisite (if, any)	*As per Program*	
5	Course Learning. Outcomes (CLO)	➢ *To understand different acid-base theories and solvent system .* ➢ *To learn the preparation, bonding, and reactions of C-C σ- & π- bonded compounds* ➢ *To understand the concept and chemistry of aromatic compounds and their reactions* ➢ *To learn the basic concepts of various states of matter &understand the basic concepts of surface chemistry and chemical kinetics*	
6	Credit Value	3 Credits	*Credit = 15 Hours - learning & Observation*
7	Total Marks	Max. Marks: 100	Min Passing Marks: 40

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours).

Unit	Topics (Course contents)	No. of Period
I	**Acid, Base and Solvent System** **Theories of acids and bases**: Arrhenius, Bronsted-Lowry, conjugate acids and bases, relative strengths of acids and bases, the Lux-flood, solvent system and Lewis concepts of acids and bases. HSAB concept: Classification of Acids and Bases According to HSAB Theory (Hard, Borderline, Soft). Applications of HSAB Theory in Inorganic Reactions - Solubility, Selectivity, Redox Reactions Non-aqueous solvents: .Physical properties of a solvent, types of solvents and their general characteristics, Liquid ammonia as a solvent. Acid-base, precipitation and complex, formation reactions. Solutions of alkali and alkaline earth metals in ammonia-application)	11
II	**CHEMISTRY OF C-C σ–BONDING** Alkanes: Preparation (Wurtz reaction, reduction/hydrogenation of alkenes, Corey-House method). Reactions (mechanisms): halogenation, free radical substitution. Cycloalkanes: Preparation (Dieckmann's ring closure, reduction of aromatic hydrocarbons), Reactions (mechanisms): substitution and ring-opening reactions. Stability of cycloalkanes -Baeyer's strain theory, Sachse and Mohr predictions, Conformational structures of ethane, n-butane and cyclohexane. **CHEMISTRY OF C-C π–BONDING** Alkenes: Preparation methods (dehydration, dehydrohalogenation, dehydrogenation, Hoffmann and Saytzeff rules, cis and trans eliminations). Reactions (mechanisms): electrophilic and free radical addition (hydrogen, halogen, hydrogen halide, hydrogen bromide, water, hydroboration, ozonolysis, dihydroxylation with $KMnO_4$). Dienes: 1,2- and 1,4-additions, Diels-Alder reactions. Alkynes: Preparation (dehydrohalogenation, dehydrogenation), Reactions: Acidity, formation of acetylides, addition of water, hydrogen halides and halogens, oxidation,	12

	ozonolysis, hydroboration/oxidation. **Aromatic Hydrocarbons** Aromatic hydrocarbons: Aromaticity: Hückel's rule, aromatic character of arenes, cyclic carbocations/ carbanions and heterocyclic compounds with suitable examples. Electrophilic aromatic substitution: halogenation, nitration, sulphonation and Friedel-Craft's alkylation/acylation with their mechanism. Directive effects of the groups.	
III	**Behaviour of ideal gases:** Kinetic theory of gases – postulates and derivation of the equation, $PV = 1/3\ mnc^2$ and derivation of the gas laws- Maxwell's distribution of molecular velocities-effect of temperature-types of molecular velocities-degrees of freedom-Principle of equipartition of energy. **Behaviour of Real gases:** Deviation from ideal behaviour, derivation of van der Waals, equation of state and critical constants. **Liquid state chemistry:** structure of liquids(Eyring Theory), Properties of liquids, viscosity and surface tension. **Solid state chemistry:** Nature of the solid state, law of constancy of interfacial angles, law of rational indices, Miller indices, elementary ideas of symmetry, symmetry elements and symmetry operations, seven crystal systems and fourteen Bravais lattices; X-ray diffraction, Bragg's law, Crystal defects.	11
IV	**A. Colloids and surface chemistry:** Classification, Optical, Kinetic and Electrical Properties of colloids, Coagulation, Hardy Schulze law, flocculation value, Protection, Gold number, Emulsion, micelles and types, Gel, Syneresis and thixotropy, Physical adsorption, chemisorption, **B. Chemical kinetics:** Rate of reaction, Factors influencing rate of reaction, rate law, rate constant, Order and molecularity of reactions, rate determining step, Zero, First and Second order reactions, Rate and Rate Law, methods of determining order of reaction, Chain reactions. Temperature dependence of reaction rate, Arrhenius theory, Physical significance of Activation energy, collision theory, demerits of collision theory, non-mathematical concept of transition state theory. **C. Catalysis:** Homogeneous and Heterogeneous Catalysis, types of catalyst, characteristics of catalyst, Enzyme catalyzed reactions, Industrial applications of catalysis.	11
Keywords	***Acid & Bases, Alkanes, Cycloalkanes, Alkenes, Dienes, Alkynes, Aromatic Hydrocarbons, Kinetic theory of gases, Real gases, Intermolecular forces, Crystal structure, Chemical kinetics***	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Textbooks Recommended:

1. *Bahl, A., & Bahl, B. S. (2014). Organic Chemistry (22nd Ed.). S. Chand & Sons.*
2. *Ahluwalia, V. K., & Goyal, M. (2001). A Textbook of Organic Chemistry. Narosa Publishing House.*
3. *Jain, M. K., & Sharma, S. C. (2017). Modern Organic Chemistry. Vishal Publishing Company.*
4. *Puri, B. R., Sharma, L. R., & Pathania, M. S. (2013). Principles of Physical Chemistry (46th Ed.). Shoban Lal Nagin Chand And Co.*
5. *Bahl, B. S. A., & Tuli, G. D. (2009). Essentials of Physical Chemistry (Multicolour Ed.). S. Chand & Company Pvt Ltd.*
6. *Puri, B. R., Sharma, L. R., & Kalia, K. C. (2018). Principles of Inorganic Chemistry. Nagin Chand and Co., New Delhi.*

Reference Books Recommended:

1. *Paula, B. Y. (2014). Organic Chemistry (7th Ed.). Pearson Education, Inc. (Singapore).*
2. *Solomons, T. W. G. (2017). Organic Chemistry (Global Ed.). John Wiley & Sons.*
3. *Morrison, R. T., & Boyd, R. N. (2010). Organic Chemistry (7th Ed.). Prentice-Hall Of India Limited.*
4. *Laidler, K. J., & Meiser, J. H. (2006). Physical Chemistry (2nd Indian Ed.). CBS Publishers.*
5. *Atkins, P. W., & De Paula, J. (2006). Physical Chemistry (8th Ed.). Oxford University Press.*
6. *Dogra, S., & Dogra, S. (2006). Physical Chemistry through Problems (2nd Ed.). New Age International.*
7. *Sangaranarayanan, M. V., & Mahadevan, V. (2011). Textbook of Physical Chemistry. University Press.*

Online Resources–

- https://bit.ly/3Gb99iy
- https://www.organic-chemistry.org/
- https://bit.ly/3GduvMi
- https://bit.ly/30TXm8d
- https://application.wiley-vch.de/books/sample/3527316728_c01.pdf
- https://www.ncbi.nlm.nih.gov/books/NBK547716/

Online Resources–

- **e-Resources / e-books and e-learning portals**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Exam (ESE):	**70 Marks**

Continuous Internal Assessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **20 / 20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks

End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1.** Objective – **10 x1= 10** Mark; **Q2.** Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

DEPARTMENT OF CHEMISTRY

COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Science *(Certificate / Diploma / Degree/Honors)*			**Semester- II**	Session: 2024-2025
1	Course Code	CHSC-02P		
2	Course Title	CHEMISTRY LAB. COURSE-II		
3	Course Type	DSC		
4	Pre-requisite (if, any)	*As per Program*		
5	Course Learning. Outcomes (CLO)	➢ *Demonstrating and using common glassware for accurate measurements* ➢ *Studying the functional group analysis organic compounds* ➢ *Determining melting points to assess compound purity and employing distillation and sublimation techniques to establish boiling points* ➢ *Equipping with essential skills in measuring liquid surface tension and solution viscosity*		
6	Credit Value	1 Credits	*Credit =30 Hours Laboratory or Field learning/Training*	
7	Total Marks	Max. Marks: 50		Min Passing Marks: 20

PART -B: Content of the Course

Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)

Module	Topics (Course contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course	**Basic Laboratory Techniques** Demonstration of Laboratory Glassware and Equipment, Calibration of Thermometer : 80-82°C (Naphthalene), 113.5°-114°C (Acetanilide), 132.5°C - 133°C (Urea), 100°C (Distilled Water) **Functional group Analysis of Organic Compounds,** Detection of elements (N, S, and halogens) and functional groups **Physical chemistry** Surface tension measurements: Determine the surface tension by (i) drop number (ii) drop weight method. Surface tension composition curve for a binary liquid mixture. Viscosity measurement using Ostwald's viscometer, Determination of viscosity of aqueous solutions of (i) sugar (ii) ethanol at room temperature. Study of the variation of viscosity of sucrose solution with the concentration of solute. Viscosity Composition curve for a binary liquid mixture	30
Keywords	*Basic laboratory techniques, Equipments, Calibration, Melting points, Qualitative analysis, Physical chemistry, Surface tension, Viscosity*	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Textbooks Recommended:

1. *Ahluwalia, V. K., Dhingra, S., & Gulati, A. (N.D.). College Practical Chemistry. University Press.*
2. *Khosla, B. D., Garg, V. C., & Gulati, A. (2011). Senior Practical Physical Chemistry. S. Chand & Co.*

Reference Books Recommended:

3. *Garland, C. W., Nibler, J. W., & Shoemaker, D. P. (2003). Experiments in Physical Chemistry (8th Ed.). Mcgraw-Hill.*
4. *Mendham, J. (2009). Vogel's Quantitative Chemical Analysis (6th Ed.). Pearson Education.*
5. *Mann, F. G., & Saunders, B. C. (2009). Practical Organic Chemistry. Pearson Education.*
6. *Furniss, B. S., Hannaford, A. J., Smith, P. W. G., & Tatchell, A. R. (2012). Practical Organic Chemistry (5th Ed.). Pearson Education.*

Online Resources–

- http://heecontent.upsdc.gov.in/Home.aspx
- https://nptel.ac.in/courses/104/106/104106096/
- http://heecontent.upsdc.gov.in/Home.aspx
- https://nptel.ac.in/courses/104/106/104106096/
- https://www2.chemistry.msu.edu/faculty/reusch/VirtTxtml/introl.htm
- https://nptel.ac.in/courses/104/103/104103071/W

Online Resources–

- **e-Resources / e-books and e-learning portals**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): 10 & 10 Assignment/Seminar +Attendance - 05 Total Marks - 15	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 15 Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **D. Performed the Task based on lab. work - 20 Marks** **E. Spotting based on tools & technology (written) – 10 Marks** **F. Viva-voce (based on principle/technology) - 05 Marks**	Managed by Course teacher as per lab. status

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART-A: Introduction				
Program: Bachelor in Science *(Diploma/Degree/Honors)*			**Semester - III**	Session: 2024-2025
1	Course Code	CHSC-03T		
2	Course Title	INORGANIC AND PHYSICAL CHEMISTRY-I		
3	Course Type	DSC		
4	Pre-requisite(if,any)	*As per Program*		
5	Course Learning. Outcomes(CLO)	➢ *Understand fundamental chemical concepts of transition elements and their applications.* ➢ *Master the principles of coordination chemistry.* ➢ *Grasp the core principles of thermodynamics and apply them to various phenomena.* ➢ *Explore the world of electrochemistry and its applications.*		
6	Credit Value	3 Credits	*Credit = 15 Hours -learning & Observation*	
7	Total Marks	Max.Marks: 100		Min Passing Marks:40

PART -B: Content of the Course

Total No.of Teaching–learning Periods(01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics(Course contents)	No. of Periods
I	**Chemistry of d & f-block elements** **A. d-block elements (5 hrs.)** **(i) Chemistry of elements of first transition series:** Characteristic properties of the elements of first transition series with reference to their: Electronic configuration, Atomic and ionic radii, Ionization potential, Variable oxidation states, Magnetic properties, Color, Complex formation tendency and catalytic activity. **(ii) Chemistry of elements of second and third transition series:** Electronic configuration of 4d and 5d transition series. Comparative treatment with their 3d-analogous (Group Cr- Mo-W, Co-Rh-Ir) in respect of oxidation states and magnetic behavior. **B. f-block elements (6 hrs.)** **Chemistry of Lanthanide & Actinides:** Electronic structure, oxidation states, ionic radii, magnetic, and spectral properties. Lanthanide contraction and its consequences, complex formation, occurrence and isolation, Separation of lanthanides: solvent extraction and ion exchange method. General features and chemistry of actinides, Transuranic elements, chemistry of separation of Np, Pu and Am from uranium, similarities between the later actinides and the later lanthanides.	12
II	**Oxidation and reduction (5 hrs)** Various definitions of oxidation and reduction, Balancing of redox reaction by ion-electron method, Latimer diagram of Chlorine and Oxygen, Frost diagram of Nitrogen and Oxygen, and Pourbaix diagrams of Iron. Predicting disproportionation and comproportionation phenomena. **Coordination Chemistry (6 hrs)** **A. Coordination compounds:**Distinction among simple salts, double salts, and coordination compounds. Terminology and nomenclature of Coordination	11

	compounds. Types of ligands based on denticity. Werner's Coordination theory and its experimental verification. Sidgwicks electronic interpretation, EAN rule with examples. Electroneutrality principle, Valence Bond Theory of transition metal complexes. Determination of structures and magnetic properties of complexes based on VBT. Chelates: Classification and their application. **B) Isomerism in coordination compounds:** Structural isomerism and Stereoisomerism (Geometrical and optical) in coordination compounds with four and six coordination numbers.	
III	**Thermodynamics-I: (5 hrs)** **A. Basic concept of thermodynamics:** System, surrounding, types of system (closed, open & isolated). Intensive & extensive properties. Thermodynamic processes: isothermal, adiabatic, isobaric, isochoric, cyclic, reversible & irreversible. State function & path functions and their differentiation, concept of heat & work. Zeroth law of thermodynamics, First law of thermodynamics. Definition of internal energy & enthalpy. Concept of heat capacity, heat capacity at constant volume & at constant pressure, and their relationship. Joule-Thomson experiment, Joule-Thomson coefficient (no derivation) & inversion temperature. Calculations of w, q, E & H for expansion of gases for isothermal & adiabatic conditions for reversible process. **B. Thermochemistry(2 hrs.)** Standard states, Heat of reaction, enthalpy of formation, enthalpy of combustion, enthalpy of solution, enthalpy of neutralization, Hess's law of constant heat of summation & its applications. Variation of enthalpy change of reaction with temperature (Kirchoff's equation). **C. Thermodynamics II (4 hrs.)** **Second law of thermodynamics:** Limitations of first law and need for the second law. Statements of second law. Carnot cycle & Efficiency of heat engine. Thermodynamic principle of working of a refrigerator (Carnot theorem). Concept of entropy: entropy change in a reversible and irreversible process; entropy change in isothermal reversible expansion of an ideal gas. Physical significance of entropy. Gibbs free energy, Gibbs -Helmholtz equation. **D.Third law of thermodynamics (1 hr)** Statement of third law, Nernst heat theorem, Absolute entropy of solids, liquids, and gases.	11
IV	**Electrochemistry-1** Electrolyte conductance: specific and equivalent conductance, measurement of equivalent conductance, effect of dilution on conductance, Kohlrausch law, application of Kohlrausch law in determination of dissociation constant of weak electrolyte, solubility of sparingly soluble electrolyte, absolute velocity of ions, ionic product of water, conductometric titrations. Single electrode potential, standard electrode potential, electrochemical series and its applications. Concept of overvoltage. Theory of strong electrolyte: limitation of Ostwald's dilution law weak and strong electrolyte, Debye-Huckel-Onsager's (DHO) equation for strong electrolytes, relaxation, and electrophoretic effect. Migration of ions: Transport number-definition and determination by Hittorf method and moving boundary method. Electrochemical cells or Galvanic cells: reversible and irreversible cells, conventional Representation of electrochemical cells. EMF of a cell, effect of temperature on EMF of cell, Nernst equation calculation of ΔG, ΔH and ΔS for cell reaction, polarization, Over potential and hydrogen overvoltage.	11
Keywords	***D & f-block elements, Coordination compounds, Werner's theory, VBT, Isomerism, Thermodynamics, Thermochemistry, Electrical/electrolytical conductance, Transport number.***	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. *Jauhar, S. P. (2010). Modern Approach to Inorganic Chemistry: A Textbook for B. Sc. I Students. Modern publishers*
2. *Bajpai, D. N. (1992). Advanced book of physical chemistry. S Chand publishing.*
3. *Sharma, k. K. & Sharma, L. K. (2016). A textbook of physical chemistry. Vikas publishing.*
4. *Bhasin, K. K. (2018). Pradeep's Inorganic Chemistry Vol.III. Pradeep publications.*
5. *Puri, S., & Sharma, L. R. (2008). Kalia "Principles of Inorganic Chemistry".*

Reference Books recommended-

Inorganic Chemistry

1. *Lee, J. D. (2008). Concise inorganic chemistry. John Wiley & Sons.*
2. *Cotton, F. A., Wilkinson, G., &Gaus, P. L. (1995). Basic inorganic chemistry. John Wiley & Sons.*
3. *Huheey, J. E., Keiter, E. A., Keiter, R. L., & Medhi, O. K. (2006). Inorganic chemistry: principles of structure and reactivity. Pearson Education India.*
4. *Douglas, B. E., McDaniel, D. H., & Alexander, J. J. (1994). Concepts and models of inorganic chemistry, John Wiley & Sons*

Physical Chemistry

1. *Puri, L. B., Sharma, L. R., & Pathania, M. S. (2013). Principles of physical chemistry. Vishal Publishing Co.*
2. *Atkins, P. W., De Paula, J., & Keeler, J. (2023). Atkins' physical chemistry. Oxford university press.*
3. *McQuarrie, D. A., & Simon, J. D. (2004). Molecular Thermodynamics Viva Books Pvt. Ltd.: New Delhi.*

Online Resources–

- **e-Resources / e-books and e-learning portals**
- **https://www.geeksforgeeks.org/d-block-elements/**
- **https://www.vedantu.com/evs/lanthanides-vs-actinides**
- **https://www.livescience.com/50776-thermodynamics.html**
- **https://byjus.com/jee/electrochemistry/**

Online Resources–

- **e-Resources / e-books and e-learning portals**

PART -D:Assessment andEvaluation

Suggested Continuous Evaluation Methods:
Maximum Marks: 100 Marks
Continuous Internal Assessment(CIA):30 Marks
EndSemester Exam(ESE): 70 Marks

Continuous InternalAssessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): 20 ~~/~~20 Assignment / Seminar - 10 Total Marks - 30	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1.** Objective – **10 x1= 10** Mark; **Q2.** Short answer type- **5x4 =20**Marks Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40** Marks	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART-A: Introduction

Program: Bachelor in Science *(Diploma / Degree/Honors)*		Semester - III	Session: 2024-2025
1	CourseCode	CHSC-03P	
2	CourseTitle	CHEMISTRY LAB. COURSE-III	
3	CourseType	DSC	
4	Pre-requisite(if,any)	-	
5	Course Learning. Outcomes(CLO)	➢ *Understand the principle of determining transition temperature of hydrated or other allotropic salts.* ➢ *Employ the principle of determination of solubility of a given salt at different temperatures.* ➢ *Apply Born-Haber cycle to determine enthalpy and lattice energy.* ➢ *Determine strength of an acid, ionization constant of weak acid and solubility product by conductometric or potentiometric titrations.*	
6	CreditValue	1 Credits	*Credit =30 Hours Laboratory or Field learning/Training*
7	TotalMarks	Max.Marks:50	Min Passing Marks:20

PART -B: Content of the Course

Total No. of learning-Training/performancePeriods:30 Periods (30 Hours)

Module	Topics(Course contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course	**Transition Temperature** 1) Transition temperature of a salt hydrate – determination of molecular weight. 2) Determination of the transition temperature of the given substance by thermometric /dialometric method (e.g. $SrBr_2.2H_2O$ or $MnCl_2.4H_2O$). **Thermochemistry** **A. Determination of solubility:** 1) To determine the solubility of benzoic acid at different temperatures and to determine ΔH of the dissolution processes. **B. Calorimetry:** 1) To determine the enthalpy of neutralization of hydrochloric acid (strong acid) by sodium hydroxide (strong base) solution. 2) (a) To determine the enthalpy of neutralization of a weak acid (acetic acid) versus strong base (sodium hydroxide) and determine enthalpy of ionization of weak acid. (b) To determine the enthalpy of neutralization of a weak base (ammonium hydroxide) versus strong acid (hydrochloric acid) and determine enthalpy of ionization of weak base. 3) To determine the enthalpy of solution of solid calcium chloride and calculate the lattice energy. **Conductometry** 1) Conductometry – Determination of limiting molar conductance of a strong Electrolyte (KCl). 2) To determine the strength of the given acid (HCl or CH3COOH)conductometrically	30

	using standard alkali (NaOH) solution. 3) To determine the strength of strong acid and a week acid in the given mixture conductometrically against a standard alkali solution. 4) To determine the ionization constant of weak acid conductometrically. **Solubility Product** 1) To determine the solubility and solubility product of a sparingly soluble salt conductometrically. 2) Potentiometry – Determination of solubility product of a sparingly soluble substance.	
Keywords	*Solution, Acid, Alkali. Transition temperature, Thermochemistry, Temperature, Enthalpy, Conductometric titrations, Potentiometric titrations, Solubility product.*	

SignatureofConvener&Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. *Vishwanathan, B. & Raghavan, P. S. (2017). Practical Physical Chemistry. Viva books originals publishing.*
2. *Yadav, J. B. (2006). Advanced Practical Physical Chemisty. Krishna Prakashan Media.*
3. *Sahu, D. P.& Bapat, K. N. (2022) Unified practical chemistry, Navbodh Prakashan.*

Reference Books recommended:

1. *Moudgil, H. K. (2010). Textbook of physical chemistry. PHI Learning Pvt. Ltd.*
2. *Adamson, A. (2012). A textbook of physical chemistry. Elsevier.*
3. *Findlay, A. (1923). Practical physical chemistry. Longmans, Green.*

Online Resources–

- **e-Resources / e-books and e-learning portals**
- **https://tech.chemistrydocs.com/Books/Physical/Advanced-Physical-Chemistry-Experiments-by-J-N-Gurtu-&-Amit-Gurtu.pdf**
- **https://byjus.com/chemistry/conductometric-titration/**
- **https://chem.libretexts.org/Courses/University_of_California_Davis/Chem_4B_Lab%3A_General_Chemistry_for_Majors_II/1%3A_Thermochemistry_(Experiment)**
- **https://www.ulm.edu/chemistry/courses/manuals/chem1010/experiment_10.pdf**

Online Resources–

- **e-Resources / e-books and e-learning portals**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 50 Marks
Continuous Internal Assessment(CIA): 15 Marks
End Semester Exam(ESE): 35 Marks

Continuous Internal Assessment(CIA): (By Course Teacher)	Internal Test / Quiz-(2): 10 & 10 Assignment/Seminar +Attendance - 05 Total Marks - 15	Better marks out of the two Test / Quiz +obtained marks in Assignment shall be considered against 15 Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** G. Performed the Task based on lab. work - 20 Marks H. Spotting based on tools & technology (written) – 10 Marks I. Viva-voce (based on principle/technology) - 05 Marks	Managed by Course teacher as per lab. status

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART-A: Introduction				
Program: Bachelor in Science *(Diploma/Degree/Honors)*			**Semester - IV**	Session: 2024-2025
1	Course Code	CHSC-04T		
2	Course Title	ORGANIC AND PHYSICAL CHEMISTRY-I		
3	Course Type	DSC		
4	Pre-requisite(if,any)	-		
5	Course Learning. Outcomes(CLO)	➢ *Master the synthesis, properties, and reactivity of various functional groups and apply this knowledge to understand their significance in organic chemistry.* ➢ *Employ the principles of chemical/ionic equilibria, their influencing factors and applications* ➢ *Interpret phase diagrams for one and two-component systems, determine degrees of freedom, and identify the triple point.* ➢ *Master the principles and applications of liquid-liquid mixtures using Raoult's law, Henry's law, and Nernst distribution law.*		
6	Credit Value	3 Credits	*Credit = 15 Hours -learning & Observation*	
7	Total Marks	Max.Marks: 100		Min Passing Marks:40

PART -B: Content of the Course

Total No.of Teaching–learning Periods(01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics(Course contents)	No.of Period
I	**A. Halides (5 hrs)** **(i) Alkyl Halides:** Preparation: from alkenes and alcohols. Reactions: Nucleophilic substitution reactions of alkyl halides (alcohol, ester, nitrile & isonitrile formation, Williamson's ether synthesis), mechanism and stereochemistry of nucleophilic substitution reactions (SN1 and SN2), factors affecting SN1 and SN2 reactions. **(ii) Aryl Halides:** Chlorobenzene: Preparation by aromatic halogenation and Sandmeyer reaction. Aromatic nucleophilic substitution involving Benzyne Mechanism: KNH_2/NH_3 (or $NaNH_2/NH_3$). Reactivity and Relative strength of C-Halogen bond in alkyl and aryl/ Vinyl halides. **B. Alcohols & Phenols (7hrs)** **(i)Alcohols** **(a)Monohydric**-nomenclature, methods of formation, Properties & chemical reactions distinction between primary, secondary & tertiary alcohols. **(b)Dihydric alcohols:** Nomenclature, methods of formation of ethylene glycol (from ethylene, epoxide, ethylene dibromide and ethylene diamine). Chemical reactions of vicinal glycols: with carbonyl compounds, dehydration, oxidative cleavage with Pb(OAc)4 and HIO4 and Pinacol–Pinacolone rearrangement (with mechanism). **(c) Trihydric alcohols:** Nomenclature and methods of formation (from hydrolysis of fats and oils, propene and acrolein), chemical reactions of glycerol (with PCl5, HI, oxidation, and dehydration) and uses/applications. **(ii)Phenols** Nomenclature and methods of formation, physical properties, and acidic character. Resonance stabilization of phenoxide ion. Comparative acidic strength of alcohols and phenols. Electrophilic aromatic substitution, acetylation, and carboxylation. Mechanism of Fries rearrangement, Claisen rearrangement, and Reimer-Tiemann reaction.	12

II	**Aldehydes/Ketones and acid/its derivatives** **A. Aldehydes and Ketones (6 hrs)** Nomenclature and structure of the carbonyl group, synthesis of aldehydes and ketones. Acidity of alpha hydrogens and formation of enolate, Concept of reactive methylene group, Keto-enol tautomerism in Acetoacetic ester. Oxidation of aldehydes by $KMnO_4$, and Tollen's reagent, Reduction of aldehydes by $LiAlH_4$ and $NaBH_4$. Mechanism of nucleophilic additions to carbonyl group with particular emphasis on aldol, Perkin, and Knoevenagel reactions. Wittig and Mannich reaction (without mechanism), Baeyer-Villiger oxidation of Ketones (without mechanism), Cannizaro reaction (with mechanism), MPV, Clemmensen, and Wolf-Kishner reaction. **B. Acid & its derivatives (5 hrs)** **(i) Carboxylic Acids** Nomenclature, structure, physical properties, acidity of carboxylic acids, effect of substituent on acid strength, method of preparation and chemical reaction. Hell-Volhard –Zeilinsky (HVZ) reaction, Reduction of carboxylic acids, Mechanism of decarboxylation. Di carboxylic acids: - Methods of formation and chemical reactions, effect of heat and Dehydrating agents. **(ii) Carboxylic Acid Derivatives** Structure, method of preparation & physical properties of acid chlorides, esters, amides (Urea) and acid anhydrides. Relative stability of acyl derivatives.	11
III	**Equilibrium** **A. Chemical equilibria (3 hrs)** Equilibrium in physical and chemical processes, dynamic nature of equilibrium, law of mass action, equilibrium constants and their quantitative dependence on temperature, pressure, and concentration, factors affecting equilibrium – Le Chatelier's principle. **B. Ionic Equilibria (5 Hrs)** Ionization of acids and bases, Strong and weak electrolytes, degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect and solubility product (with illustrative examples), Salt hydrolysis - calculation of hydrolysis constant and degree of hydrolysis for salt of strong acid and weak base, Buffer solutions – Introduction, Henderson-Hasselbalch equations for acidic and basic buffer. **(C). Phase Equilibrium (3 hrs)** (A)Gibbs phase (no derivation), phase, component and degree of freedom, Application of phase rule to one component system (water system and Sulphur systems), Reduced phase rule. Application of phase rule to two component systems: Pb-Ag system. Congruent-Ferric chloride system.	11
IV	**Photochemistry and liquid-liquid mixtures** **A) Photochemistry (8 hrs)** Interaction of radiation with matter, difference between thermal and photochemical reactions, Laws governing absorption of light, laws of photochemistry, Jablonski diagram depicting various processes, quantum yield, determination of quantum yield of reactions, reasons for low and high quantum yields. Some examples of photochemical reactions (e.g. Photochemical decomposition of Hydrogen iodide, Photosynthesis of HBr from H_2 and Br_2 and photosynthesis of HCI from H_2 and Cl_2). Photosensitization and Quenching, Photosensitized reactions. **B)Liquid-Liquid mixtures(3 hrs)** Ideal liquid mixtures, Raoult's law of ideal solutions, Henry's law and its applications, Nernst distribution law, limitations, and applications (association and dissociation - No derivation).	11
Keywords	***Halides (alkyl & aryl halides), Alcohols, Phenols, Aldehydes & Ketones, Carboxylic acids & their derivatives, Equilibrium (Chemical, Ionic, and Phase equilibria), Photochemistry, Liquid-liquid mixtures.***	

Signature of Convener &Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. *Bahl, A. (2010). Advanced organic chemistry. S. Chand publishing.*
2. *Singh, J & Yadav, L. D. S. (2016) Advanced organic chemistry. Pragati Prakashan Meerut.*
3. *Puri, L. B., Sharma, L. R., & Pathania, M. S. (2013). Principles of physical chemistry. Vishal Publishing Co.*
4. *Kapoor, K. L. (2019). A Textbook of Physical Chemistry, Thermodynamics and Chemical Equilibrium (SI Units) - Vol. 2, 6th Edition.*

Reference Books recommended-

1. *Boyd, R. N., & Morrison, R. T. (1983). Organic Chemistry:(uden title). Allyn and Bacon.*
2. *Physical Chemistry*
3. *Atkins, P. W., De Paula, J., & Keeler, J. (2023). Atkins' physical chemistry. Oxford university press.*
4. *McQuarrie, D. A., & Simon, J. D. (2004). Molecular Thermodynamics Viva Books Pvt. Ltd.: New Delhi.*

Online Resources–

- **e-Resources / e-books and e-learning portals**
- **https://ncert.nic.in/ncerts/l/lech202.pdf**
- **https://unacademy.com/content/wp-content/uploads/sites/2/2022/10/30.-Aldehydes-Ketones-and-Carboxylic-Acid.pdf**
- **https://egyankosh.ac.in/bitstream/123456789/68232/3/Unit-3.pdf**
- **https://magadhmahilacollege.org/wp-content/uploads/2020/04/photochemistry_and_jablonski_diagram_M.sc_II_Sem.pdf**

Online Resources–

- **e-Resources / e-books and e-learning portals**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:
Maximum Marks: 100 Marks
Continuous Internal Assessment(CIA):30 Marks
End Semester Exam(ESE): 70 Marks

Continuous Internal Assessment(CIA): (By Course Teacher)	Internal Test / Quiz-(2): 20+20 Assignment / Seminar - 10 Total Marks - 30	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1.** Objective – **10** x1= 10 Mark; **Q2.** Short answer type- **5x4** =20Marks Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART-A: Introduction

Program: Bachelor in Science *(Diploma / Degree/Honors)*		Semester - IV	Session: 2024-2025
1	Course Code	CHSC-04P	
2	Course Title	CHEMISTRY LAB. COURSE-IV	
3	Course Type	DSC	
4	Pre-requisite(if, any)	*As per Program*	
5	Course Learning. Outcomes(CLO)	➢ *Understand the fundamentals of organic compounds analysis including preparation of sodium extract and detection of elements.* ➢ *Identify functional groups and prepare derivatives.* ➢ *Determine the pH of various samples like water/acid/base/soil etc.* ➢ *Apply the concepts of phase equilibria to determine critical solution temperature and study concepts of Nernst distribution law and determine equilibrium constant of various reactions.*	
6	Credit Value	1 Credits	*Credit =30 Hours Laboratory or Field learning/Training*
7	Total Marks	Max.Marks:50	Min Passing Marks:20

PART -B: Content of the Course

Total No. of learning-Training/performancePeriods:30 Periods (30 Hours)

Module	Topics (Course contents)	No. of Periods
Lab./Field Training/ Experiment Contents of Course	**Organic Analysis** *Systematic identification of organic compounds:* a. Test for aliphatic and aromatic nature of substances. b. Test for saturation and unsaturation. c. Detection of elements (N, S, and halogens) in organic compounds. d. Identification of functional groups: i) Carboxylic acids ii) Phenols iii) Aldehydes iv) Ketones, v) Esters vi) Carbohydrates vii) Amines viii) Amides, ix) Halogen compounds e. Determination of melting and boiling points. f. Preparation of solid derivatives. **pH determination** Determination of pH of soil, water. To measure the pH of various solutions using pH indicators and pH meter. To determine the value of Ka for an unknown acid. To prepare and study the properties of buffer solutions. **Phase Equilibrium:** 1) To determine the critical solution temperature of two partially miscible liquids (phenol-water systems). 2) To study the effect of solute such as (i) sodium chloride (NaCl), (ii) succinic acid ($HOOC-CH_2-CH_2-COOH$) on the critical solution temperature of two partially miscible liquids (e.g. phenol – water system). 3) To construct the phase diagram of two components (e. g. diphenylamine-benzophenone system) by cooling curve method. **Nernst Distribution Law** 1) To determine the partition coefficient of Iodine between water and carbon tetrachloride/Kerosene. 2) To determine the partition coefficient of benzoic acid between water and benzene.	30

	3) To determine the equilibrium constant of the reaction, $KI + I_2 = KI_3$ by distribution method.	
Keywords	*Organic analysis, Aromatic/Aliphatic compounds, Saturated/unsaturated compounds, Element detection, Functional groups, Derivatives for functional groups, pH, Phase equilibria, Nernst distribution law.*	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. *Sahu, D. P.& Bapat, K. N. (2022) Unified Practical Chemistry, Navbodh Prakashan.*
2. *Yadav, J. B. (2006). Advanced Practical Physical Chemistry. Krishna Prakashan Media.*
3. *Pandey, O. P., Bajpai, D. N., Giri, S. (2010). Practical Chemistry. S. Chand Publisher.*

Reference Books Recommended:

1. *Moudgil, H. K. (2010). Textbook of Physical Chemistry. PHI Learning Pvt. Ltd.*
2. *Adamson, A. (2012). A Textbook Of Physical Chemistry. Elsevier.*
3. *Findlay, A. (1923). Practical Physical Chemistry. Longmans, Green.*
4. *Leonard. J, Lygo. B & Procter, G. (2013). Advanced Organic Practical Chemistry, CRC Press.*

Online Resources–

- **e-Resources / e-books and e-learning portals**
- **https://faculty.ksu.edu.sa/sites/default/files/vogel_-_practical_organic_chemistry_5th_edition.pdf**
- **https://tech.chemistrydocs.com/Books/Physical/Advanced-Physical-Chemistry-Experiments-by-J-N-Gurtu-&-Amit-Gurtu.pdf**
- **https://byjus.com/chemistry/conductometric-titration/**
- **https://chem.libretexts.org/Courses/University_of_California_Davis/Chem_4B_Lab%3A_General_Chemistry_for_Majors_II/1%3A_Thermochemistry_(Experiment)**
- **https://www.ulm.edu/chemistry/courses/manuals/chem1010/experiment_10.pdf**
- **https://www.masterjeeclasses.com/wp-content/uploads/2019/02/11.Practical-Organic-ChemistryTheory.pdf**

Online Resources–

- **e-Resources / e-books and e-learning portals**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 50 Marks
Continuous Internal Assessment(CIA): 15 Marks
End Semester Exam(ESE): 35 Marks

Continuous Internal Assessment(CIA): (By Course Teacher)	Internal Test / Quiz-(2): 10 & 10 Assignment/Seminar +Attendance - 05 Total Marks - 15	Better marks out of the two Test / Quiz +obtained marks in Assignment shall be considered against 15 Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** J. Performed the Task based on lab. work - 20 Marks K. Spotting based on tools & technology (written) – 10 Marks L. Viva-voce (based on principle/technology) - 05 Marks	Managed by Course teacher as per lab. status

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART-A: Introduction

Program: Bachelor in Science *(Degree/Honors)*		Semester -V	Session: 2024-2025
1	Course Code	CHSC-05T	
2	Course Title	ORGANIC AND INORGANIC CHEMISTRY - I	
3	Course Type	DSC	
4	Pre-requisite(if,any)	*As per Program*	
5	Course Learning. Outcomes(CLO)	➢ *Explore role of nitrogen in organic chemistry by studying N-containing compounds and heterocycles.* ➢ *Unravel molecular structures using techniques like rotational, vibrational, and Raman spectroscopy.* ➢ *Demystify bonding in transition metal complexes, including stability, lability, and magnetic properties.* ➢ *Understand the importance of organometallic and inorganic compounds in biological systems.*	
6	Credit Value	3 Credits	*Credit = 15 Hours -learning & Observation*
7	Total Marks	Max. Marks: 100	Min Passing Marks:40

PART -B: Content oftheCourse

TotalNo.of Teaching–learning Periods(01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics(Course contents)	No. of Periods
I	**(A)Organic Compound of Nitrogen** Preparation of Nitroalkanes and Nitroarenes, Chemical properties of nitroalkanes, Mechanism of nucleophilic substitutions in nitroarenes, Reduction of nitroalkane in acidic, neutral, and alkaline medium.Picric acid Amines:- Nomenclature, Structure and stereochemistry. Basicity, Structural feature effecting basicity of amines. separation of primary, secondary and tertiary ammines. Amine salt as phase transfer catalyst. Preparation of alkyl and aryl amines:- reduction of nitro compound, reductive amination of aldehydic and ketonic compounds. Gabriel Phthalimide reaction, Hoffmann Bromamide reaction. Physical and chemical properties of amine: electrophilic aromatic substitution in aryl amines, reaction of amines with nitrous acid, synthetic transformation of aryl diazonium salts, Azo-coupling reaction.	12
II	**Spectroscopy:** General introduction, electromagnetic radiation, region of spectrum, representation of spectral width and intensity of spectral transition. (A)Rotational spectra of diatomic molecule as rigid rotor, selection rule, energy level, transition, spectra. Determination of bond length, Isotope effect, Qualitative description of non-rigid rotor. (B)Vibrational Spectra: Fundamental vibrational bands and their symmetry. Diatomic molecule as harmonic oscillator. Selection rule, pure vibrational spectrum, Determination of force constant Anharmonic oscillator. (C)Raman Spectra: introduction, concept of polarization, quantum theory, stoke and antistoke line, pure rotational and vibrational Raman spectra. Applications of Raman spectra.	11
III	**(A)Metal Ligand Bonding in Transition Metal Complex:** postulate of CFT. Splitting of d orbitals in octahedral, tetrahedral complex, Spectro-chemical series, Calculation of CFSE, Factors affecting CFSE, Applications of CFSE, Jahn-Teller Distortion, Limitations of CFT. **(B) Thermodynamic and Kinetic aspects of Metal Complexes:** A brief introduction of	11

	thermodynamic and kinetic stability of complex, Stepwise and overall stability constant. (C) Magnetic properties: Types of magnetic behavior, Methods of determining magnetic susceptibility, Spin Only formula, L-S Coupling, Calculation of effective magnetic moment, Orbital contribution to magnetic moment.	
IV	**(A)Organometallic Chemistry:** Definition, nomenclature, and Classification of organometallic compounds. Preparation, properties, bonding and application of alkyls and aryls of Li, Al. A brief account of metal ethylenic metal complexes special reference to Zeisse's salt. Mononuclear carbonyls and nature of bonding in metal carbonyls. 18 electron rules(Effective Atomic Number Rule). Ziegler-Nata Catalyst for polymerization of alkene, Wilkinson Catalyst and Hydrogenation , Hydroformylation. **(B)Bioinorganic Chemistry:** Essentials and trace elements in biological system, metalloporphyrins, with special reference to hemoglobin and myoglobin. Biological role of alkali and alkaline earth metals with special reference to Na^+ K^+ Ca^{2+} and Mg^{+2}, Nitrogen fixation.	11
Keywords	***Amines, Nitro compounds, Zeigler-Nata Catalyst, Wilkinson Catalyst, rigid rotor, harmonic oscillator, Hemoglobin, myoglobin.***	

SignatureofConvener&Members:

PART–C:Learning Resources

Text Books, Reference Books and Others

Text Books Recommended:

1. *Bahl, A., & Bahl, B. S. (2020). Organic chemistry (5th ed.). S. Chand & Company.*
2. *Madan, R. D. (2018). Advanced organic chemistry. S. Chand & Company.*
3. *Soni, P. L. (2019). A textbook of organic chemistry. S. Chand & Company.*
4. *Sharma, B. K. (2015). Spectroscopy. GOEL Publishing House.*
5. *Kaur, H. (2018). Spectroscopy. Pragati Prakashan.*
6. *Das, A. K. (2012). Bioinorganic Chemistry. Publisher.*

Reference Books Recommended:

1. *Skoog, D. A., Holler, F. J., & Crouch, S. R. (2017). Principles of Instrumental Analysis. Cengage Learning.*
2. *Mehrotra, R. C. (2010). Organometallic Chemistry. New Age International.*
3. *Carbtree, R. H. (2014). Organometallic Chemistry of the Transition Metal. University Science Books.*
4. *Housecroft, C. E., & Sharpe, A. G. (2012). Inorganic Chemistry. Pearson.*
5. *Miessler, G. L., Fischer, P. J., & Tarr, D. A. (2010). Inorganic Chemistry. Pearson.*

Online Resource:

- **e-Resources / e-books and e-learning portals**
- **https://onlinecourses.nptel.ac.in/noc23_cy01/preview**
- **https://pubs.rsc.org/en/content/articlelanding/1978/f2/f29787401203**
- **https://onlinecourses.swayam2.ac.in/cec23_cy03/preview**
- **https://onlinecourses.nptel.ac.in/noc22_cy12/preview**

PART-D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:
Maximum Marks: 100 Marks
Continuous Internal Assessment(CIA):30 Marks
End Semester Exam(ESE):70 Marks

Continuous Internal Assessment(CIA): (By Course Teacher)	Internal Test / Quiz-(2): 20 #20 Assignment/Seminar- 10 Total Marks -30	Better marks out of the two Test / Quiz+ obtained marks in Assignment shall be considered against 30 Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1.** Objective – **10 x1**= 10 Mark; **Q2.** Short answer type- 5x4 =20Marks Section B: Descriptive answer type qts.,**1out of 2** from each unit-4x10=40Marks	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART-A: Introduction				
Program: Bachelor in Science *(Degree/Honors)*			**Semester -V**	Session: 2024-2025
1	CourseCode	CHSC-05P		
2	CourseTitle	CHEMISTRY LAB COURSE -V		
3	CourseType	DSC		
4	Pre-requisite(if,any)	*As per Program*		
5	Course Learning. Outcomes(CLO)	➢ *To apply the knowledge of qualitative and quantitative estimations in real sample analysis.* ➢ *To get 'Hands on Training' and develop skill for synthesis of various inorganic compounds.* ➢ *To learn the concept of gravimetric estimation.* ➢ *To learn use of conductometer and spectrophotometer for titration.*		
6	CreditValue	1 Credits	*Credit =30 Hours Laboratory or Field learning/Training*	
7	Total Marks	Max.Marks:50		Min Passing Marks:20

PART -B: Content oftheCourse

TotalNo.of learning-Training/performancePeriods:30 Periods (30 Hours)

Module	Topics(Coursecontents)	No.ofPeriod
Lab./Field Training/ Experiment Contents of Course	1)To verify Beer-Lambert Law for $KMnO_4$/ $K_2Cr_2O_7$ and determine the concentration of the given solution of the substrate from absorbance measurement. 2)To Determine the strength of the given acid conductometrically using standard alkali solution. 3)Gravimetric estimation of Ba as $BaSO_4$ from given solution of $BaCl_2$. 4)Inorganic compound synthesis: (i) Synthesis of sodium trioalato ferrate(III) $Na_2[Fe(C_2O_4)_3]$ and determination of its composition by permangnometry. (ii) Synthesis of Ni-dimethylglyoxime complex $[Ni(dmg)_2]$ (iii) Synthesis of Tetraaminecopper(II) sulphate $[Cu(NH_3)_4]SO_4$ (iv) Synthesis of Cis- and Trans-bisoxalateochromate(III)ion.	30
Keywords	*Spectrophotometer, Lambert beers law, Gravimetric estimation, synthesis of inorganic complexes*	

Signature of Convener &Members (CBoS):

PART–C:Learning Resources

Text Books, Reference Books and Others

Text Books:

1. Chatwal, G. R., & Sharma, A. (n.d.). *Instrumental methods of chemical analysis*. Himalaya Publishing House.
2. Raj, G. (2009). *Advanced Practical Inorganic Chemistry*. Krishna Prakashan.

Reference Books:

1. Svehla, G. (Ed.). (1978). *A textbook of quantitative inorganic analysis* (by A. I. Vogel). ELBS Publishers and Distributors. (Original work published 1968)
2. Henderson, W. A. (n.d.). *Inorganic synthesis*. Benjamin-Cummings Publishing Company.
3. Fernelius, W. G. (2009). *Experimental inorganic chemistry* (Adapted by R. K. Sharma & G. Panda). New Age International Publishers. (Original work published 1972)
4. Mendham, J., Denney, R. C., Barnes, J. D., & Thomas, M. (Eds.). (2000). *Vogels textbook of quantitative chemical analysis* (6th ed.). Pearson Education India. (Original work by A. I. Vogel)
5. Furniss, B. S., Hannaford, A. J., Smith, P. W. G., & Tatchell, A. R. (Eds.). (1989). *Vogel's textbook of practical organic chemistry* (5th ed.). Longman Scientific & Technical. (Original work by A. I. Vogel)

Online Resources:

- **e-Resources / e-books and e-learning portals**
- **https://www.youtube.com/watch?v=s7pXbV9dumI**
- **https://onlinelibrary.wiley.com/series/2146**
- **https://chem.libretexts.org/Ancillary_Materials/Laboratory_Experiments/Wet_Lab_Experiments/General_Chemistry_Labs/Online_Chemistry_Lab_Manual/Chem_11_Experiments/07%3A_Gravimetric_Analysis_(Experiment)**
- **https://mas-iiith.vlabs.ac.in/exp/beer-lambert-law/**

PART-D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:
Maximum Marks: 50 Marks
Continuous Internal Assessment(CIA):15 Marks
End Semester Exam(ESE):35Marks

Continuous Internal Assessment(CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **10** Assignment/Seminar +Attendance- 05 otal Marks -**15**	Better marks out of thetwo Test / Quiz +obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **M. Performed the Task based on lab. work - 20 Marks** **N. Spotting based on tools& technology (written) – 10 Marks** **O. Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM(2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART-A: Introduction				
Program: Bachelor in Science *(Degree/Honors)*			**Semester -VI**	Session: 2024-2025
1	Course Code	DSC-06T		
2	Course Title	ORGANIC AND PHYSICAL CHEMISTRY- II		
3	Course Type	DSC		
4	Pre-requisite(if,any)	*As per Program*		
5	Course Learning. Outcomes(CLO)	➢ *To understand role of quantum mechanics in chemistry.* ➢ *To know the organic compound in biological system* ➢ *To know the polymers in chemistry their preparation and application of polymer.* ➢ *To learn the techniques for studying the structure of chemical molecule.*		
6	Credit Value	3 Credits	*Credit = 15 Hours -learning & Observation*	
7	Total Marks	Max.Marks: 100		Min Passing Marks:40

PART -B: Content of the Course

Total No.of Teaching–learning Periods(01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics(Course contents)	No. of Periods
I	**Quantum Chemistry I:**-Black body radiation ,plank's radiation law, photoelectric effect, Compton effect, de-Broglie's idea of matter and waves and its experimental verification. Heisenberg's uncertainty principle, operators: Hamiltonian operator, angular momentum operator, Laplacian operator, postulates of quantum mechanics, Eigen values, Eigen function, Schrodinger time independent wave equation, physical significance of Ψ and Ψ^2. Application of Schrodinger wave equation to Particle in one dimensional box. **Quantum Chemistry II:**-Quantum mechanical approach of molecular orbital theory basic idea, criteria of forming Molecular orbitals, LCAO(Linear combination of atomic orbital) approximation, formation of H_2^+ ion, calculation of energy of energy levels from wave functions, bonding and antibonding wave functions, concept of sigma bonding sigma antibonding, pi bonding and pi anti bonding M.Os. and their characteristics Comparison of M.O. theory and V.B. Model.	12
II	**(A)Carbohydrate:** Introduction and classification of carbohydrate, monosaccharide: open chain and cyclic structure of glucose and fructose, epimer and anomers of glucose. Relative and absolute configuration of carbohydrates, Specific rotation and mutarotation of glucose. Determination of ring size in glucose. Chemical properties of gluose: Osazone formation, oxidation, reduction, Reaction with HIO_4, Interconversion of Glucose and fructose, Chain lengthening and chain shortening. Structure of Disaccharide Sucrose, Lactose and Maltose. Structure of polysaccharide: Starch, Cellulose. (B) **Amino Acid & Protein**: amino acid types of amino acid, isoelectric point, structure of protein primary, secondary and tertiary structure. (C) **Nucleic Acid:** components of nucleic acid, types of nucleic acid, nucleoside, nucleotide, structure of nucleic acid.	11
III	**(A)Organometallic compound:** Preparation, Structure, and chemical reactions of organomagnesium(Grignard Reagent), Organozinc compound, Organolithium compound, Organosulphur compound **(B) Synthesis of organic compound via enolates** : Active methylene compound, Keto-enol tautomerism, Alkylation of diethyl malonate and acetoacetic ester. Claisen ester	11

	condensation and Robinson anealation. Synthesis of monoalkyl and dialkyl derivative, fatty acids, dibasic acid, α, β unsaturated acid, valeric acid, monoketone, diketone, heterocyclic compounds etc.	
IV	Spectroscopy II(Organic) (A) Infra red Spectroscopy: Basic principle and instrumentation, introduction, Modes of vibrations, fundamental band of different bond and functional groups, identification of band for compound and IR spectra of different compounds. Applications of IR spectroscopy. (B)Principle and instrumentation of UV-visible spectroscopy, Introduction, wavelength maxima, Beer Lambert's Law, Shifts in UV-visible spectra, Chromophore –Auxochrome theory, Effect of conjugation on wavelength maxima. Types of electronic transitions. Applications of UV-visible spectroscopy. Woodward Fischer rule for polyene wavelength maxima calculation. (C) NMR (Nuclear Magnetic Resonance): Introduction to NMR, Basic principle and instrumentation, No. of signal in PMR(proton Magnetic Resonance),Chemical shift, Sheilding and deshielding effect, Splitting of signal or spin-spin interaction, Intensity of Signal and peak height and peak ratio. Coupling Constant J. Proton NMR of some compound like ethanol, propanol, toluene, acetaldehyde, ketone,1,2-dibromoethylene etc.	11
Keywords	***Particle in one Dimensional Box, Hydrogen atom, Proton NMR, UV Visible, Vibrational Spectra. Woodward Fischer Rule.***	

SignatureofConvener&Members (CBoS):

PART-C:Learning Resources

Text Books, Reference Books and Others

Text Books Recommended:

1. *Tandon, M. M. N., & Agarwal, S. C. (2022). Unified chemistry. Shivalal and Company.*
2. *Sharma, B. K. (2010). Spectroscopy comprehension. Goel Publishing House.*
3. *Puri, B. R., Sharma, L. R., & Pathania, M. S. (2021). Principles of physical chemistry. Vishal Publications.*
4. *Gurtu, J. N., & Gurtu, R. (2015). Advanced physical chemistry. Pragati Prakashan.*

Reference Books Recommended:

5. *Atkins, P. W., de Paula, J., & Keeler, J. A. (2005). Atkins' physical chemistry Oxford University Press.*
6. *Pandya, A. J. (2010). A textbook of biochemistry: Nucleic acids, proteins and carbohydrates.*
7. *Korte, F., & Goto, M. (2009) Nucleic acids, proteins and carbohydrates, John Willy & Sons*

Online Resources:

- https://onlinecourses.nptel.ac.in/noc23_cy09/preview
- https://www.udemy.com/course/ochemnmr/?couponCode=LEADERSALE24A
- https://en.wikipedia.org/wiki/Bioorganic_chemistry#:~:text=Biophysical%20organic%20chemistry%20is%20a,nature%20to%20determine%20their%20properties.
- https://onlinecourses.nptel.ac.in/noc21_cy38/preview

PART-D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:
Maximum Marks: 100 Marks
Continuous Internal Assessment(CIA):30 Marks
End Semester Exam(ESE):70 Marks

Continuous Internal Assessment(CIA): (By Course Teacher)	Internal Test / Quiz-(2): 20 ~~40~~ 20 Assignment/Seminar- 10 Total Marks -30	Better marks out of the two Test / Quiz+ obtained marks in Assignment shall be considered against 30 Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1.** Objective – **10 x1= 10** Mark; **Q2.** Short answer type- **5x4 =20**Marks Section B: Descriptive answer type qts., **1out of 2** from each unit-**4x10=40**Marks	

Name and Signature of Convener & Members ofCBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART-A: Introduction				
Program:Bachelor in Science *(Diploma / Degree)*			**Semester VI**	Session: 2024-2025
1	CourseCode	CHSC-06P		
2	CourseTitle	CHEMISTRY LAB COURSE-VI		
3	CourseType	DSC		
4	Pre-requisite(if,any)	*As per Program*		
5	Course Learning. Outcomes(CLO)	➢ *To understand the basic principles involved in separation and identification of organic compound.* ➢ *To apply the knowledge of qualitative and quantitative estimations in real sample analysis.* ➢ *To learn the synthesis of organic compounds* ➢ *To learn the use of conductometer and spectrophotometer in analysis.*		
6	CreditValue	1 Credits	*Credit =30 Hours Laboratory or Field learning/Training*	
7	TotalMarks	Max.Marks:50		Min Passing Marks:20

PART -B: Content oftheCourse

TotalNo.of learning-Training/performancePeriods:30 Periods (30 Hours)

Module	Topics(Coursecontents)	No.ofPeriod
Lab./Field Training/ Experiment Contents of Course	1)To determine the solubility and solubility product of Sparingly soluble salt using conductometer. 2)To titrate potentiometrically the given ferrous sulphate solution using KMnO4 / $K_2Cr_2O_7$ as titrant and calculate redox potential of Fe^{2+} /Fe^{3+} system on the hydrogen scale. **Organic mixture analysis** Separation and Identification of two solid organic compounds from given binary organic mixture by H_2O,$NaHCO_3$, NaOH for separation and preparation of suitable derivative. **Synthesis of one organic compound** :- (a)synthesis of m-dinitrobenzene from nitrobenzene. (b) synthesis of acetanilide from aniline (c)Preparation of iodoform from ethanol and acetone (d)Preparation of p-bromoacetanilide (e)Preparation of 2,4,6-tribromophenol. (f)Preparation of methyl orange and methyl red. (g)Preparation of benzoic acid from toluene. (h)Preparation of aniline from nitrobenzene.	30
Keywords	*Organic mixture analysis, synthesis of organic compound, solubility product, conductometer.*	

Signature of Convener & Members (CBoS):

PART–C:Learning Resources

Text Books, Reference Books and Others

Text Books Recommended:

1. *Tandon, M. M. N., & Shiva Lal Agarwal & Company. (2012). BSc. Practical Chemistry.*
2. *Pandey, O. P., BajPai, D. N., Giri, S., & S. Chand. (2013). Practical Chemistry.*

Reference Books Recommended:

1. *Bassett, J., Denney, R. C., Jeffery, G. H., & Mendham, J. (2000). Vogel's Text Book of Qualitative Analysis (revised). ELBS.*
2. *Das, R. C., & Behra, B. (2002). Experimental Physical Chemistry. Tata McGrawHill.*

Online Resources:

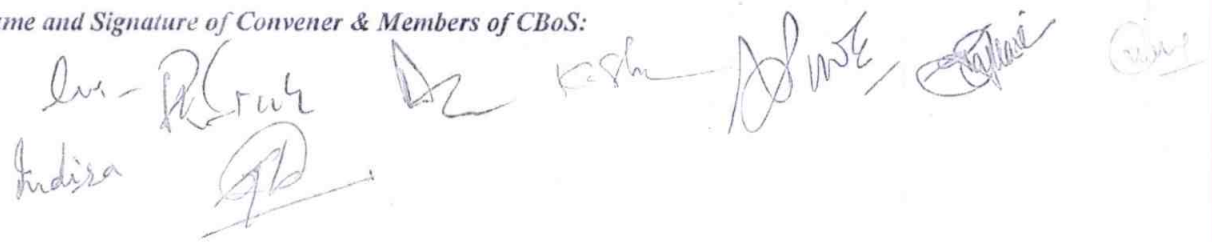
- e-Resources / e-books and e-learning portals
- https://chem.libretexts.org/Courses/University_of_California_Davis/Chem_4C_Lab%3A_General_Chemistry_for_Majors/Chem_4C%3A_Laboratory_Manual/05%3A_Potentiometric_Titrations_(Experiment)
- https://vlab.amrita.edu/?sub=2&brch=191
- https://www.orgsyn.org/

PART-D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:
Maximum Marks: 50 Marks
Continuous Internal Assessment(CIA):15 Marks
End Semester Exam(ESE):35Marks

Continuous Internal Assessment(CIA): (By Course Teacher)	Internal Test / Quiz-(2): 10 & 10 Assignment/Seminar +Attendance- 05 otal Marks -15	Better marks out of thetwo Test / Quiz +obtained marks in Assignment shall be considered against 15 Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** P. Performed the Task based on lab. work - 20 Marks Q. Spotting based on tools& technology (written) – 10 Marks R. Viva-voce (based on principle/technology) - 05 Marks	Managed by Course teacher as per lab. status

Name and Signature of Convener & Members of CBoS:



DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Science *(Honors/Honors with research)*			**Semester - VII**	Session: 2024-25
1	Course Code	**CHSC-07T**		
2	Course Title	**INORGANIC & PHYSICAL CHEMISTRY-II**		
3	Course Type	**DSC**		
4	Pre-requisite (if, any)	*As per Program*		
5	Course Learning. Outcomes (CLO)	➢ *Study the formation, stability and electronic spectra of complexes* ➢ *Analyze the chemistry of metal carbonyls and metal nitrosyls.* ➢ *Solve the Schrodinger equation for the hydrogen atom and utilize Huckel theory for conjugated systems.* ➢ *Analyze collision theory and transition state theory to understand chemical reactions.*		
6	Credit Value	**3 Credits**	*Credit = 15 Hours - learning & Observation*	
7	Total Marks	**Max. Marks:** 100	**Min Passing Marks:** 40	

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**MOT & Electronic Spectra of Complexes** Electronic spectra and MO theory of Transition Metal complexes , M.O. Theory for octahedral, tetrahedral and square planar complexes with and without π-bonding Determining the Energy terms, Spin-orbit (L-S) coupling scheme, Hund's rule for term symbol, Hole formalism, Determination of the term symbol (ground and excited states) for d 1 to d 9 configurations, Electronic spectra of transition metal complexes, Types of transitions, Laporte 'orbital' selection rule, spin selection rule. Orgel diagrams for octahedral metal complexes. Charge transfer spectra, Racah parameters, calculations of 10Dq, B, β parameters. Tanabe- Sugano Diagrams of octahedral complexes with d 2 and d8 configuration.	12
II	**Metal – Ligand Equilibria** A) Metal – Ligand Equilibria in Solution: Stepwise and overall formation constants; trends in stepwise formation constants; factors affecting stability of metal complexes with reference to nature of metal ion, ligand, chelate effect and thermodynamic origin. Determination of formation constant by: (1) spectrophotometric method (Job's and Mole ratio method) (2) Potentiometric method (Irving-Rossotti Method) B) **Reaction Mechanism of Transition metal complexes-**: Energy Profile of a reaction, reactivity of metal complexes, Inert and Labile complexes, Kinetics of Octahedral substitution C) **Metal carbonyls**: vibrational spectra of metal carbonyls for bonding and structure elucidation, important reaction of metal carbonyls. Metal carbonyl clusters with reference to classification, synthesis and structures. D) **Metal nitrosyls**: Nitrosylating agents for synthesis of metal nitrosyls, vibrational spectra and X-ray diffraction studies of transition metal nitrosyls for bonding and structure elucidation.	11
III	**Advanced Quantum Mechanics** Discussion of solutions of the Schrodinger equation to three - dimensional box, concept of degeneracy, the harmonic oscillator, the rigid rotor, the hydrogen atom. **Approximate Methods**	11

	The variation theorem and perturbation theory (first order and non-degenerate). Applications of variation method and perturbation theory to hydrogen and helium atom. **Angular Momentum** Ordinary angular momentum, eigen functions and eigen values of angular momentum, ladder operator, concept of spin, antisymmetry and Pauli's exclusion principle. **Molecular Orbital Theory** Huckel theory of conjugated systems, Applications to ethylene, butadiene and cyclobutadiene.	
IV	**Advanced Chemical Dynamics** A) Methods of determining rate laws, Temperature dependence of chemical reaction rates, Arrhenius equation, Energy of activation, pre-exponential factor and its limitations. Collision theory and its limitations, steric factors, Transition State theory of gas and liquid phase bimolecular reactions, comparison of three theories of reaction rates, kinetic salt effects. Kinetics of Photochemical reactions (Hydrogen-bromine and hydrogen - chlorine reactions). B) Bodeinstein steady state approximation and its application in consecutive reactions, Dynamics of unimolecular reactions :Lindeman-Hinshelwood mechanism, RRKM theory, Thermodynamic formulation of transition state theory, Enthalpy, Gibbs free energy and enthalpy of activation.	11
Keywords	***Electronic spectra, MO theory, Complex stability, Spectrophotometry, Vibrational spectra, Bonding, Metal nitrosyls, Schrodinger equation, Huckel theory , Collision theory, Transition state theory***	

Signature of Convener & Members (CBoS) :

PART-C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended:

1. *Bali, R. (2014). Principles of inorganic chemistry (5th ed.). New Age International.*
2. *Prasad, R. K. (2012). Quantum mechanics (3rd ed.). New Age International.*
3. *Puri, B. R., Sharma, L. R., & Rastogi, V. D. (2012). A textbook of physical chemistry. Vishwa Prakashan.*
4. *Rakshit, P. C. (2014). Elements of physical chemistry. S. Chand & Company.*

Reference Books Recommended:-

1. *Lee, J. D. (2008). Inorganic chemistry (4th ed.). Wiley India.*
2. *Greenwood, N. N., & Earnshaw, A. (2012). Chemistry of the elements (2nd ed.). Elsevier.*
3. *Laidler, K. J. (1987). Chemical kinetics (3rd ed.). Pearson Education.*
4. *Cotton, F. A., Wilkinson, G., Boch, P. L., & Bailar, M. Bailar Jr. (2018). Inorganic chemistry (6th ed.). John Wiley & Sons.*
5. *Mathews, P. M., & McFarlane, F. W. (2014). A textbook of quantum mechanics (2nd ed.). Mc Graw Hill Education.*
6. *Houston, P. L. (2001). Chemical kinetics and reaction dynamics. Dover Publications.*

Online Resources–

- https://nptel.ac.in/courses/115106066
- https://nptel.ac.in/
- https://onlinecourses.nptel.ac.in/noc23_cy02/preview
- https://swayam.gov.in/

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Exam (ESE):	**70 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): 20 +20 Assignment / Seminar - 10 Total Marks - 30	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1.** Objective – **10 x1= 10** Mark; **Q2.** Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Science *(Honor/Honors with Research)*			**Semester - VII**	Session: 2024-2025
1	Course Code	CHSC-07P		
2	Course Title	CHEMISTRY LAB. COURSE-VII		
3	Course Type	DSC		
4	Pre-requisite (if, any)	*As per Program*		
5	Course Learning. Outcomes (CLO)	➢ *Master separating and estimating acidic and basic radicals in inorganic mixtures.* ➢ *Apply qualitative and quantitative analysis skills to real samples. • Inorganic Synthesis & Characterization* ➢ *Gain hands-on experience synthesizing inorganic compounds and identify them using spectral analysis.* ➢ *Grasp basic physical chemistry concepts through practical experiments and learn to operate basic equipment.*		
6	Credit Value	1 Credits	*Credit =30 Hours Laboratory or Field learning/Training*	
7	Total Marks	Max. Marks: 50		Min Passing Marks: 20

PART -B: Content of the Course

Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)

Module	Topics (Course contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course	**Qualitative analysis of mixture containing eight radicals including two less common metals from among the following by semi micro method.** **Basic Radicals:** Ag, Pb, Hg Bi, Cu, Cd, As, Sb, Sn, Fe, Al, Cr, Zn, Mn, Co, Ni, Ba, Sr, Ca, Mg, Na, K, Ce, Th, Zr, W, Te, Ti, Mo, U, V, Be, Li, Au, Pt. **Acidic Radicals:** Carbonate, Sulphite, Sulphide, Nitrite, Nitrate, Acetate, Fluoride, Chloride, Bromide, Iodide, Sulphate, Borate, Oxalate, Phosphate, Silicate, Thiosulphate, Ferricyanide, Sulphocyanide, Chromate, Arsinate and Permanganate. **Separation and determination of two metal ions in ores, alloys, or mixtures in solution, one by volumetric and the other by gravimetric methods.** **Estimations** (a) Phosphoric acid in commercial orthophosphoric acid. (b) Boric acid in borax. (c) Ammonia in an ammonium salt. (d) Manganese dioxide in pyrolusite. (e) Available chlorine in bleaching powder. (f) Hydrogen peroxide in a commercial sample. **Preparations** Preparation of selected inorganic compounds and their study by I.R. Electronic spectra, Mossbauer, E.S.R. and magnetic susceptibility measurements. Handling of air and moisture sensitive compounds. Theoretical study of structure and their identification of some preparations by spectral analysis	30

1.	$VO(acac)_2$	2. $TiO(C_9H_8NO)_2 2H_2O$
3.	Cis-K $[Cr(C_2O_4)_2(H_2O)_2]$	4. $Na[Cr(NH_3)_2(SCN)_4]$
5.	$Mn(acac)_3$	6. $K_3[Fe(C_2O_4)_3]$
7.	Prussian Blue, Turnbull's Blue.	8. $[Co(NH_3)_6][Co(NO_2)_6]$
9.	Cis-$[Co(trien)(NO_2)_2]Cl.H_2O$	10. $Hg[Co(SCN)_4]$
11.	$[Co(Py)_2Cl_2]$	12. $[Ni(NH_3)_6]Cl_2$
13.	$Ni(DMG)_2$	14. $[Cu(NH_3)_4]SO_4.H_2O$

Adsorption

1. To study surface tension – concentration relationship for solution (Gibb's equation).
2. To study the adsorption of oxalic acid on charcoal and to verify Freundlich adsorption isotherm.

Chemical Kinetics

1. Determination of the effect of (a) Change of temperature (b) Change of concentration of reactants and catalyst and (c) ionic strength of the media on the velocity constant of hydrolysis of an ester/ionic reactions.
2. Determination of the rate constant for the oxidation of iodide ions by hydrogen peroxide studying the kinetics as an iodine clock reaction.

Polarimetry

1. Determine the specific and molecular rotation of optically active substance.
2. To determine the concentration of a solution of an optically active substance.

Solutions

1. Determination of molecular weight of non-electrolyte/electrolyte by cryoscopic method and to determine the activity coefficient of an electrolyte.
2. Determination of molecular weight of non-volatile substances by Landsberger's method.

Spectrophotometry

1. Verification of Beer-Lambert law and determination of concentration of unknown solution.
2. Effect of pH in aqueous coloured system.

Potentiometry/pH metry

1. Determination of temperature dependence of EMF of a cell.
2. To determine pKa of the given monobasic acid by pHmetric titration.
3. Determination of the dissociation constant of monobasic/dibasic acid by Albert- Serjeant method.

Keywords	***Qualitative Analysis, Separation and Determination, Estimations, Preparations, Spectroscopic Techniques, Adsorption, Chemical Kinetics, Polarimetry, Solutions, Instrumental Methods***

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended

1. *Das, R. C., & Behra, B. (2009). Experimental Physical Chemistry (1st Ed.). Tata Mcgraw-Hill Education.*
2. *Chatwal, G. R., & Sharma, A. (2019). Instrumental Methods of Chemical Analysis. Himalaya Publishing House.*

Reference Books Recommended

1. *Bassett, J., Denney, R. C., Jeffery, G. H., & Mendham, J. (1974). Vogel's Textbook of Qualitative Chemical Analysis (5th Ed.). ELBS.*
2. *Jolly, W. L. (1970). Synthesis and Characterization of Inorganic Compounds. Prentice Hall.*
3. *James, A. M., & Prichard, F. E. (1981). Practical Physical Chemistry (4th Ed.). Longman.*
4. *Plevitt, B. (1974). Findlay's Practical Physical Chemistry (9th Ed.). Longman.*

Online Resources–

- (https://www.wiley.com/en-us/Microscale+Inorganic+Chemistry%3A+A+Comprehensive+Laboratory+Experience-p-9780471619963)
- (https://onlinelibrary.wiley.com/doi/book/10.1002/9780470405840)
- (https://www.amazon.com/Physical-Chemistry-Molecular-Donald-McQuarrie/dp/0935702997)
- (https://www.amazon.com/Laboratory-Manual-Physical-Chemistry-Davison/dp/1297998979)

Online Resources–

- **e-Resources / e-books and e-learning portals**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - **05** Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **S. Performed the Task based on lab. work - 20 Marks** **T. Spotting based on tools & technology (written) – 10 Marks** **U. Viva-voce (based on principle/technology) - 05 Marks**	Managed by Course teacher as per lab. status

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Science *(Honors/Honors with Research)*			**Semester - VIII**	Session: 2024-2025
1	Course Code	CHSC-08T		
2	Course Title	ORGANIC & INORGANIC CHEMISTRY-II		
3	Course Type	DSC		
4	Pre-requisite (if, any)	*As per Program*		
5	Course Learning. Outcomes (CLO)	➢ *Master mechanisms, kinetics, mechanism and reactivity factors in organic chemistry.* ➢ *Understand and predict regioselectivity in aromatic electrophilic substitution reactions.* ➢ *Utilize symmetry and group theory to analyze molecules and predict spectroscopic features.* ➢ *Understand and classify supramolecular chemistry*		
6	Credit Value	3 Credits	*Credit = 15 Hours - learning & Observation*	
7	Total Marks	Max. Marks: 100		Min Passing Marks: 40

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**MECHANISTIC ORGANIC CHEMISTRY** Unit I: A) Reaction mechanism: Types of reaction, Types of mechanism, kinetic and thermodynamic control, Hammond's postulate, Curtin-Hammett principle, Potential energy diagrams, transition states and intermediates, methods of determining mechanisms, trapping of intermediates, checking for common intermediate, competition and cross-over experiments, isotope effects, Hard and soft acids and bases. B) Reaction Kinetics: Reaction co-ordinate diagrams, rate laws and methods of determining concentration. C) Effect of Structure on reactivity: Resonance and field effects, Steric effect, quantitative treatment. The Hammett equation and linear free energy relationship, substituent and reaction constants, Taft Equation. D) Aromatic electrophilic substitution: The arenium ion mechanism, orientation and reactivity, energy profile diagrams. The o/p ratio, ipso attack, orientation in benzene ring with more than one substituent, orientation in another ring system. Friedel-Crafts reaction, Vilsmeir-Hack reaction, Gatterman-Koch reaction, Pechman reaction, Diazonium coupling, Blanc chloromethylation, Kolbe– Schmitt reaction	12
II	**SUBSTITUTION REACTIONS** A) Aliphatic nucleophilic substitution: The SN1, SN2, mixed SN1, SN2 and SET and SNi mechanisms. Nucleophilicity, effect of leaving group, ambient nucleophiles and ambient substrates regiospecificity, substitution at allylic and vinylic carbon atoms, Mitsunobu reaction B) Concept of neighbouring group participation: Anchimeric assistance with mechanism, neighboring group participation by π and σ bonds, classical and non-classical carbocations, Intramolecular displacement by hydrogen, oxygen, nitrogen, sulphur and halogen. Alkyl, cycloalkyl, aryl participation, participation in bicyclic system, migratory aptitude. C) Aromatic Nucleophilic Substitution: A general introduction to different mechanisms of aromatic nucleophilic substitution SNAr, SN1, benzyne and SRN1 mechanisms,	11

	arynes as reaction intermediate, Reactivity - effect of substrate structure leaving group and attacking nucleophile. The Von Richter and Smiles rearrangements, Chichibabin amination reaction. Benzyne: Structure, methods of generations and reactions	
III	**Symmetry and Group Theory in Chemistry** Symmetry elements and symmetry operation, definition of group, subgroup, relation between order of a finite group and its subgroup. Conjugacy relation and classes. point symmetry group. Schonflies symbols, representations of groups by matrices (representation for the C_n, C_{nv}, C_{nh}, D_{nh} etc. groups to be worked out explicitly). Character of a representation. The great orthogonality theorem (without proof) and its importance. Character tables and their uses in spectroscopy.	11
IV	**Supramolecular Chemistry:** Concepts and language, Molecular recognition Molecular receptors for different types of molecules including arisonic substrates, design and synthesis of coreceptor molecules and multiple recognition. Supramolecular reactivity and catalysis. **Transport processes and carrier design.** Supramolecular devices. Supramolecular photochemistry, Supramolecular electronic, ionic and switching devices. Some examples of self-assembly in supramolecular chemistry. **Metal Clusters:** Higher boranes, carboranes, metalloboranes and metallocarboranes, compounds with metal-metal multiple bonds. **Isopoly and Heteropoly Acids and Salts.**	11
Keywords	***Reaction mechanisms, kinetics, regioselectivity, electrophilic substitution, substitution mechanisms, neighboring group participation, symmetry, group theory, supramolecular chemistry***	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended -

Textbooks Recommended

1. *Soni, P. L., Bahl, B. S., & Bahl, A. (2019). Organic Chemistry.S. Chand & Company Ltd.*
2. *Morrison, R. T. & Boyd, R. N. (2012). Organic Chemistry. Pearson Education.*
3. *Kumar, A. (2004). Elements of Group Theory for Chemists. New Delhi, India: Affiliated East-West Press.*
4. *Mukherji, S. M. & Chakrabarti, S. P. (2007). Reaction Mechanisms in Organic Chemistry. Macmillan India Ltd.*

Reference Books Recommended

1. *Carey, F. A. & Sundberg, R. J. (2007). Advanced Organic Chemistry. Springer.*
2. *Ahluwalia, V. K. & Aggarwal, R. (2010). A Textbook of Organic Chemistry. Narosa Publishing House.*
3. *Carruthers, W. (1987). Modern Organic Synthesis. Springer.*
4. *Smith, M. B. & March, J. (2006). March's Advanced Organic Chemistry: Reactions, Mechanisms, and Structure. John Wiley & Sons.*
5. *Grossman, R. B. (2004). The Art of Writing Reasonable Organic Reaction Mechanisms. Oxford University*

Online Resources–

- https://onlinecourses.nptel.ac.in/noc20_cy30/preview
- https://swayam.gov.in/
- https://www.coursera.org/
- https://www.edx.org/
- https://onlinecourses.nptel.ac.in/noc20_cy30/preview

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:		
Maximum Marks:	**100 Marks**	
Continuous Internal Assessment (CIA):	**30 Marks**	
End Semester Exam (ESE):	**70 Marks**	
Continuous Internal Assessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **20** +20 Assignment / Seminar - 10 Total Marks - 30	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts., **1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART- A: Introduction

Program: Bachelor in Science *(Honors/Honors with Research)*	Semester - VIII	Session: 2024-2025

1	Course Code	CHSC-08P		
2	Course Title	CHEMISTRY LAB. COURSE-VIII		
3	Course Type	DSC		
4	Pre-requisite (if, any)	*As per Program*		
5	Course Learning. Outcomes (CLO)	➢ *To understand the basic principles involved in separation of organic binary mixture and identify the components by qualitative analysis.* ➢ *To get trained in one step/two-step synthesis of commercially important organic compounds based on different chemical processes.* ➢ *To learn about separation and purification of organic mixtures by chromatography* ➢ *To identify and characterize prepared and separated compounds by IR spectral analysis.*		
6	Credit Value	1 Credits	*Credit =30 Hours Laboratory or Field learning/Training*	
7	Total Marks	Max. Marks: 50		Min Passing Marks: 20

PART -B: Content of the Course

Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)

Module	Topics (Course contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course	**Organic Synthesis** (i) Acetylation: Acetylation of cholesterol and separation of cholesteryl acetate by column chromatography. (ii) Synthesis of β-Naphthyl acetate / Hydroquinone diacetate. (iii) Oxidation: Adipic acid by chromic acid oxidation of cyclohexanol (iv) Grignard reaction: Synthesis of triphenylmethanol from benzoic acid (v) Aldol condensation: Dibenzalacetone from benzyldehyde (vi) Sandmeyer reaction: p-chlorotoluene from p-toluidine / o-chlorobenzoic acid from anthranilic acid. (vii) Acetoacetic ester Condensation: Synthesis of ethyl-n-butylacetoacetate by A.E.E. condensation. (viii) Cannizzaro reaction: 4- chlorobenzaldehyde as substrate / Benzoic acid and benzyl alcohol. (ix) Friedel Crafts Reaction: β-Benzoyl propionic acid from succinic anhydride and benzene. (x) Aromatic electrophilic substitutions: Synthesis of p-nitroaniline and bromoaniline. (xi) Clemmenson reduction: Hydrocarbons from ketones. (xii) Nitration: Picric acid from phenol (xiii) Reduction: Acetic acid from ethanol. (xiv) Esterification: Oil of Wintergreen from salicylic acid. (xv) Sulphonation: Sulphanilic acid from aniline. **Separation, purification and identification of compounds of binary mixtures (solid-solid, liquid-solid) using chemical tests.** Identification of functional group of organic compounds by FTIR Separation, purification and identification of compounds of binary mixtures TLC	30

	and column chromatography.	
Keywords	*Organic Synthesis, Separation techniques (column chromatography, TLC), Identification techniques (FTIR), Volumetric analysis, Chromatography (paper, column), Flame photometry, Spectrophotometry (UV-Vis), Conductometry, pH-metry.*	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Textbooks Recommended:

1. Basavarajaiah, S. M., Nagesh, G. Y., & Ramakrishna Reddy, K. (2016). *Compendious Practical Organic Chemistry: Preparations, Isolation, and Chromatography*. New Age International.
2. Manna, A. K. (2011). *Practical Organic Chemistry*. Books & Allied (Publishers) Pvt. Ltd.
3. Peesapati, V. (2017). *Practical Organic Chemistry – A Primer*. BSP Books.

Reference Books Recommended:

1. Vogel, A. I. (**1957**). *Practical Organic Chemistry*. Longman Scientific & Technical.
2. Mann, F. G., & Saunders, B. C. (**2004**). *Practical Organic Chemistry* (4th Ed.). Longman.
3. Jeffery, G. H., Mendham, J., Denney, R. C., & Barnes, J. (**2000**). *Vogel's Textbook Of Quantitative Chemical Analysis* (6th Ed.). Longman.
4. Harris, D. C. (**1998**). Quantitative Chemical Analysis (5th Edition). W H Freeman & Co

Online Resources–

- **e-Resources / e-books and e-learning portals**
- **(https://www.wiley.com/en-us/Microscale+Inorganic+Chemistry%3A+A+Comprehensive+Laboratory+Experience-p-9780471619963)**
- **(https://onlinelibrary.wiley.com/doi/book/10.1002/9780470405840)**
- **(https://www.amazon.com/Physical-Chemistry-Molecular-Donald-McQuarrie/dp/0935702997)**
- **(https://www.amazon.com/Laboratory-Manual-Physical-Chemistry-Davison/dp/1297998979)**

Online Resources–

- **e-Resources / e-books and e-learning portals**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): 10 & 10 Assignment/Seminar +Attendance - 05 Total Marks - 15	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 15 Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **V. Performed the Task based on lab. work - 20 Marks** **W. Spotting based on tools & technology (written) – 10 Marks** **X. Viva-voce (based on principle/technology) - 05 Marks**	Managed by Course teacher as per lab. status

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM(2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART-A: Introduction				
Program: Bachelor in Science *(Diploma / Degree/Honors)*			Semester - III	Session: 2024-2025
1	Course Code	CHSE-01T		
2	Course Title	BASIC ANALYTICAL CHEMISTRY		
3	Course Type	DSE		
4	Pre-requisite(if,any)	*As per Program*		
5	Course Learning Outcomes(CLO)	➢ *To understand the sampling, procedure and treatment of sample.* ➢ *To understand the analytical techniques for analysis in different types of chemical reactions.* ➢ *To understand the volumetric analysis technique.* ➢ *To understand the gravimetric analysis technique.*		
6	Credit Value	3 Credits	*Credit = 15 Hours -learning & Observation*	
7	Total Marks	Max.Marks: 100		Min Passing Marks:40

PART -B: Content of the Course

Total No. of Teaching–learning Periods(01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics(Course contents)	No. of Period
I	**Qualitative and quantitative aspects of analysis** Classification of analytical Techniques, Qualitative and quantitative analysis. Classical and instrumental methods. Factors affecting choice of analytical method. Errors in chemical analysis. Types of errors: Systematic and random, Absolute and relative, Additive and proportional. Normal distribution of indeterminate errors. Statistical parameters for data evaluation: Mean, median, average deviation, standard deviation, coefficient of variation, relative standard deviation. Accuracy and precision of results. Comparison of data using F and t-test, rejection of data using Q test. Numerical problems.	12
II	**Sampling and sample treatment** Criteria for representative sample. Bulk, gross, incremental and analysis sample. Sampling statistics. Techniques of sampling of ambient air, water and soil samples. Methods of sample size reduction: Coning and quartering, rolling and quartering. Hazards in sampling. Sample dissolution methods for elemental analysis: Dry and wet ashing, acid digestion, fusion processes and dissolution of organic samples. Types of analysis: Macro, semi-micro, micro, sub-micro and ultramicro. Major, minor and trace constituents of a sample.	11
III	**Volumetric analysis** General principle. Criteria for reactions used in titrimetric analysis. Primary standards and secondary standards. Concepts of equivalent weight and molecular weight, normality, molarity and various methods of expressing concentrations. Internal and external indicators. Theories of indicators in acid-base, precipitation, redox and complexometric titrations. Calculations involving preparation of standard solutions. Stoichiometric calculations in various types of titrations.	11
IV	**Gravimetric analysis** General principles and conditions of precipitation. Concepts of solubility, solubility product and precipitation equilibrium. Numerical problems based on solubility and solubility product. Purity of precipitate: Co-precipitation and post-precipitation. Super saturation and peptization. Criteria of selection of wash liquids. Steps involved in gravimetric analysis of barium as barium sulphate.	11

Keywords	*Qualitative and quantitative analysis;errors;Accuracy;Sampling;titrimetric analysis;indicators;Gravimetric analysis*

Signature of Convener & Members (CBoS):

PART–C:Learning Resources

Text Books, Reference Books and Others

Text Books Recommended:

1. *Pandey, O. P., Bajpai, D. N., Giri, S., Shrivastava, B. B. L., & Mishra, A. (2010). Practical chemistry (1st ed.). S. Chand & Company.*
2. *Shrivastava, B. B. L., & Mishra, A. ([Year]). Fundamentals of analytical chemistry.*

Reference books Recommended:

1. *Harris, D. C. (2000). Quantitative chemical analysis W. H. Freeman and Company.*
2. *Mikes, O., & Chalmers, R. A. (2007). Laboratory handbook of chromatographic methods Elsevier.*
3. *Christian, G. D., Dasgupta, P. K., & Snyder, S. (2001). Concepts of instrumental analysis , Oxford University Press.*

Online Resources:

- https://edu.rsc.org/resources/analysis
- https://guides.loc.gov/chemistry-resources/print-materials/analytical
- https://www.classcentral.com/course/swayam-analytical-techniques-13896
- https://www.technic.com/analytical-controls/capabilities/volumetric-analysis
- https://chem.libretexts.org/Ancillary_Materials/Laboratory_Experiments/Wet_Lab_Experiments/General_Chemistry_Labs/Online_Chemistry_Lab_Manual/Chem_11_Experiments/07%3A_Gravimetric_Analysis_(Experiment)

PART-D:Assessment andEvaluation

Suggested Continuous Evaluation Methods:

MaximumMarks: 100 Marks

ContinuousInternal Assessment(CIA):30 Marks

EndSemesterExam(ESE): 70 Marks

Continuous InternalAssessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): 20 +20 Assignment/Seminar- 10 Total Marks -30	Better marks out of the two Test / Quiz+ obtained marks in Assignment shall be considered against 30 Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – 10 x1= 10 Mark; **Q2**. Short answer type- 5x4 =**20Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit- **4x10=40Marks**	

Name and Signature/of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART-A: Introduction				
Program:Bachelor in Science *(Diploma / Degree/Honors)*			Semester- III	Session: 2024-2025
1	Course Code	CHSE-01P		
2	Course Title	BASIC ANALYTICAL CHEMISTRY LAB. COURSE		
3	Course Type	DSE		
4	Pre-requisite(if,any)	*As per Program*		
5	Course Learning. Outcomes(CLO)	➢ *To make the student aware of Common analytical method.* ➢ *To demonstrate the volumetric titration.* ➢ *To demonstrate the students about gravimetric analysis.* ➢ *To learn the testing of solubility, pH of soil and water.*		
6	Credit Value	1 Credits	*Credit =30 Hours Laboratory or Field learning/Training*	
7	TotalMarks	Max.Marks:50		Min Passing Marks:20

PART -B: Content of the Course

Total No. of learning-Training/performance Periods:30 Periods (30 Hours)

Module	Topics (Course contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course	1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture by volumetric titration. 2. Estimation of oxalic acid by titrating it with $KMnO_4$ (potassium permanganate) by volumetric titration. 3. Estimation of water of crystallization in Mohr's salt by titrating with $KMnO_4$ (potassium permanganate). 4. Estimation of Fe(II) ions by titrating it with $K_2Cr_2O_7$ (potassium dichromate) using an internal indicator. 5. Estimation of Cu(II) ions iodometrically using $Na_2S_2O_3$ (sodium thiosulfate). 6. Determination of heat capacity of a calorimeter for different volumes. 7. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide. 8. Determination of ionization of acetic acid. 9. Determination of solubility of benzoic acid in water and determination of enthalpy of solubilization. 10. Analysis of soil: (a) Determination of pH of soil. (b) Determination of total soluble salts. (c) Determination of carbonate and bicarbonate. (d) Determination of calcium, magnesium, and iron.	30
Keywords	***Volumetric analysis, gravimetric analysis, water testing, soil testing.***	

Signature of Convener & Members (CBoS):

PART–C:Learning Resources

Text Books, Reference Books and Others

Text Books Recommended:

1. *Chatwal, G. R., & Sharma, A. (2017). Instrumental methods of chemical analysis. Himalaya Publishing House.*
2. *Sharma, L. R. (2021). Practical inorganic chemistry.*
3. *Fernelius, W. G. (2009). Experimental inorganic chemistry (Adapted by R. K. Sharma & G. Panda). New Age International Publishers.*
4. *Yadava, T. F. (2010). A textbook of soil chemistry. Kalyani Publishers.*

Reference Books Recommended:

1. *James, A. M., & Prichard, F. E. (1981). Practical physical chemistry (3rd ed, repr). Longman. Bassett, J., Denney, R. C., Jeffery, G. H., & Mendham, J. (Eds.). (2000). Vogel's textbook of quantitative chemical analysis (6th ed.). Pearson Education India. (Original work by A. I. Vogel)*
2. *Svehla, G. (Ed.). (1978). A textbook of quantitative inorganic analysis (by A. I. Vogel). ELBS Publishers and Distributors.*

Online Resources:

- **https://swayam.gov.in/explorer**
- **https://in.indeed.com/career-advice/career-development/analytical-skills**
- **https://chemcollective.org/labtech**

PART-D:Assessment andEvaluation

Suggested Continuous Evaluation Methods:
MaximumMarks: 50 Marks
ContinuousInternal Assessment(CIA):15 Marks
EndSemesterExam(ESE):35Marks

Continuous InternalAssessment(CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **10 &10** Assignment/Seminar +Attendance- 05 Total Marks -**15**	Better marks out of thetwo Test / Quiz +obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **A. Performed the Task based on lab. work - 20 Marks** **B. Spotting based on tools& technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**	Managed by Course teacher as per lab. status .

Name and Signature of Convener& Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART-A: Introduction				
Program: Bachelors in Science *(Diploma /Degree/Honors)*			Semester–IV	Session: 2024-2025
1	Course Code	CHSE-02T		
2	Course Title	ENVIRONMENTAL CHEMISTRY		
3	Course Type	DSE		
4	Pre-requisite(if, any)	*As per Program*		
5	Course Learning Outcomes(CLO)	➢ *To explore the environment through the lens of chemistry, examining interactions between the biosphere, lithosphere, hydrosphere, and atmosphere.* ➢ *To delve into ecological principles, biogeochemical cycles, and the challenges of thermal and noise pollution.* ➢ *To develop concept of water quality, water management, and the multifaceted issue of water pollution take center stage.* ➢ *To investigate air pollution, soil composition, radiation chemistry, and potential solutions for environmental challenges.*		
6	Credit Value	03 Credits	*Credit = 15 Hours - learning & Observation*	
7	Total Marks	Max.Marks:100		Min. PassingMarks:40

PART-B: Content of the Course

Total No.of Teaching–learning Periods(01 Hr. per period) - 45 Periods (45 Hours)

Module /Unit	Topics(Course contents)	No.of Period
I	**Introduction to Environmental Chemistry** Biosphere, Lithosphere, Hydrosphere and Atmosphere, Ecological principles- aspects of ecology, classification, types of ecosystems. Biogeochemical cycles- carbon, nitrogen, phosphorous, oxygen, hydrogen. Thermal pollution: sources, harmful effects, and prevention of thermal pollution. Noise pollution: sources, effects, and control of noise pollution.	12
II	**Water** Origin, physico-chemical properties of water, sources of water, hydrological cycle, criteria of water quality, Water management- water shed management, rainwater harvesting, water pollution- sources, consequences and harmful effects of water pollution, strategies for water pollution control.	11
III	**Air** Major regions of the atmosphere, composition of the atmosphere, temperature inversion and air pollution episodes, photochemistry of the atmosphere, depletion of the stratospheric ozone, greenhouse effect, greenhouse gases, remedial measures for reversion of greenhouse effect, acid rain, photochemical smog, particulate matter.	11
IV	**Soil and radiation pollution** Chemical and mineralogical composition of soil, classification of soil, types of soil-saline and alkaline, physical properties – texture, bulk density, permeability, chemical properties—Ion exchange capacity, soil pH and micro and macro nutrient availability. Introduction to radiation chemistry, sources of radioactive pollution, effects of radioactive pollution, protection from radiation, control of radiation.	11
Keywords	*Environment, Chemistry, Atmosphere, Hydrosphere/Biosphere/lithosphere, Biogeochemical cycles, water, water management, Air, Acid rain, Photochemical smog, Greenhouse gases,*	

	Particulate matter, Soil and radiation pollution, Radiation Chemistry.

Signature of Convener & Members (CBoS) :

PART–C

Learning Resources: Text books, Reference Books and Others

Textbooks Recommended–

1. *Dara, S. S. (2002). Environmental chemistry. New Delhi: S Chand & Company Ltd.*
2. *De, A. K. (2003). Environmental chemistry. New Delhi: New Age International.*
3. *Mahajan, (2010). Environmental chemistry. New Delhi: S Chand & Company Ltd.*
4. *Kudesia, V. P. (1985). Water pollution. Pragati Prakashan.*

Reference Books Recommended–

1. *Chiras, D. D. (1994). Environmental science (4th ed.). Jones & Bartlett Learning.*
2. *Bockris, J. O. M. (1977). Environmental chemistry. Academic Press.*
3. *Lodge, J. P. (1994). Methods of air sampling and analysis. Publications, Jaipur.*
4. *Moore, W., & Moore, J. (2010). Environmental chemistry. CRC Press.*

OnlineResources–e-Resources/e-booksande-learningportals

- https://ncert.nic.in/textbook/pdf/kech207.pdf
- https://archive.nptel.ac.in/courses/122/106/122106030/
- https://scienceinfo.com/environmental-chemistry-definition-importance-application-and-careers/
- https://www.ncbi.nlm.nih.gov/books/NBK83730/
- https://ebooks.inflibnet.ac.in/esp16/chapter/water-pollution/#:~:text=The%20amount%20of%20dissolved%20oxygen,dissolved%20oxygen%20than%20saline%20water.
- https://chem.libretexts.org/Bookshelves/General_Chemistry/Map%3A_Chemistry_-_The_Central_Science_(Brown_et_al.)/18%3A_Chemistry_of_the_Environment
- https://byjus.com/chemistry/environmental-chemistry/
- https://www.nrdc.org/stories/water-pollution-everything-you-need-know#whatis

Part-D:AssessmentandEvaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment(CIA):	**30 Marks**
EndSemester Exam(ESE):	**70 Marks**

Continuous InternalAssessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **20 &20** Assignment / Seminar - **10** Total Marks - 30	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam(ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks.**	

Name and Signature of Convener and Members of CBoS

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FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Science *(Diploma / Degree/Honors)*			**Semester - IV**	Session: 2024-2025
1	Course Code	CHSE-02P		
2	Course Title	ENVIRONMENTAL CHEMISTRY LAB. COURSE		
3	Course Type	DSE		
4	Pre-requisite (if, any)	-		
5	Course Learning Outcomes (CLO)	➢ *To know the basic idea on techniques of water analysis and acidity alkalinity* ➢ *To get experience with the calculations of BOD and COD* ➢ *To understand the basics of soil analysis viz. pH, Conductivity.* ➢ *To have an experience on the determination of heavy metals in soil and Colorimetric estimation of iron and manganese.* ➢ *To familiarize with interpretation of data*		
6	Credit Value	01Credit	*Credit =30 Hours Laboratory or Field learning/Training*	
7	Total Marks	Max.Marks:50	Min. Passing Marks:20	

PART-B: Content of the Course

Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)

Module	Topics(Course contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course.	**Water Analysis** a. Alkalinity b. Acidity c. Temporary, Permanent and total hardness d. Sulphate e. Phosphorus	30
	Water analysis e. Nitrites f. Chlorides g. D.O, BOD and COD h. Insecticides i. Pesticides Analysis of chemicals used in water and waste water treatment-Alum, bleaching powder, activated carbon. Determination and comparison of chlorine content in tap water, storage tank and swimming pool.	
	Soil Analysis Determination of: a. pH b. Conductivity c. Ca d. Mg e. Heavy metals like Cr, Pb, Cd, Zn.	
	Miscellaneous Analysis of nutrients – Nitrogen (total, ammonia,nitrite, and nitrate), Phosphate Determination of N,P,K of soil	

	Determination of macro and micro nutrients in soil. Sampling of water- tap water, well water, overhead storage tank water pond water and lake water. Physicochemical and organoleptic characteristics of the above water samples. Statistical evaluation of the data obtained for optimization of results. Determination of Total solids, Total dissolved solids and total suspended solids and its significance. Determination of noise pollution in a particular area with noise dosimeter. Study of particulate matter. Study of atmospheric chemistry. Air Monitoring Gas detection.
Keywords	***Sampling, Water, soil, N/P/K, pH, Conductivity, acidity & alkalinity, Heavy metals.***

Signature of Convener & Members (CBoS) :

PART–C

Learning Resources: Text Books, Reference Books andOthers

Textbooks Recommended–

1. *Dara, S. S., & Asole, B. G. (2017). Environmental chemistry: Practical approach (2nd ed.). New Age International (India) Publishers.*
2. *Trivedi, R. K., Goyal, P., & Trisal, B. S. (2018). Manual of water and wastewater analysis (2nd ed.). ABD Publishers & Distributors.*
3. *Sehgal, H. S. (2010). A textbook of soil chemical analysis (2nd ed.). Kalyani*

Reference Books Recommended–

1. *Vogel, A. I. (1955). A text-book of quantitative inorganic analysis: theory and practice. Longmans,*
2. *Green and Company.*
3. *Sandell, E. B. (1945). Colorimetric determination of traces of metals (Vol. 59, No. 6, p. 481). LWW.*
4. *Boubel, R. W., Vallero, D., Fox, D. L., Turner, B., & Stern, A. C. (2013). Fundamentals of air*
5. *pollution. Elsevier.*
6. *Clesceri, L. S. (1998). Standard methods for examination of water and wastewater. American public*
7. *health association, 9.*
8. *Rump, H. H. (1999). Laboratory manual for the examination of water, waste water and soil (No. Ed. 3). Wiley-VCH Verlag GmbH.*

OnlineResources– e-Resources/e-booksande-learningportals

- https://ncert.nic.in/textbook/pdf/kech207.pdf
- https://archive.nptel.ac.in/courses/122/106/122106030/
- https://scienceinfo.com/environmental-chemistry-definition-importance-application-and-careers/
- https://www.ncbi.nlm.nih.gov/books/NBK83730/
- https://ebooks.inflibnet.ac.in/esp16/chapter/water-pollution/#:~:text=The%20amount%20of%20dissolved%20oxygen,dissolved%20oxygen%20than%20saline%20water.
- https://chem.libretexts.org/Bookshelves/General_Chemistry/Map%3A_Chemistry_-_The_Central_Science_(Brown_et_al.)/18%3A_Chemistry_of_the_Environment
- https://byjus.com/chemistry/environmental-chemistry/
- https://www.nrdc.org/stories/water-pollution-everything-you-need-know#whatis
- https://www.envirotech-online.com/news/gas-analyser/157/envea/portable-multi-gas-analyser-gains-qal1-certification-for-so2/60799.

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - 05 Total Marks - 15	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 15 Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **D. Performed the Task based on lab. work - 20 Marks** **E. Spotting based on tools & technology (written) – 10 Marks** **F. Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener and Members of CBoS

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART-A: Introduction				
Program:Bachelor in Science *(Degree/Honors)*			**Semester- V**	Session: 2024-2025
1	CourseCode	CHSE-03T		
2	CourseTitle	DYES & POLYMER CHEMISTRY		
3	CourseType	DSE		
4	Pre-requisite(if,any)	*As per Program*		
5	Course Learning. Outcomes(CLO)	➢ *To know about various synthetic dyes and their structures.* ➢ *To understand classification, colour and chemical constitution of dyes.* ➢ *To know about various types of polymeric materials.* ➢ *To understand preparation, structure, properties and application of polymers.*		
6	Credit Value	3 Credits	*Credit = 15 Hours -learning & Observation*	
7	TotalMarks	Max.Marks: 100		Min Passing Marks:40

PART -B: Content of the Course

TotalNo.of Teaching–learning Periods(01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics(Course contents)	No.ofPeriod
I	**Introduction to dyes:** Requirements of a good dye Solubility, Linearity, Co-planarity, Fastness, Substantivity, Economic viability. Definition of fastness and its properties and Mordants with examples Explanation of nomenclature or abbreviations of commercial dyes with at least one example suffixes – G, O, R. Naming of dyes by colour index (two examples) used in dye industries. **Colour and chemical constitution of dyes:** Absorption of visible light, colour o wavelength absorbed and complementary colour, chromogen, chromophore, auxochrome bathochromic and hypsochromic shifts. Relation of colour to resonance in the followin classes of dyes: Azo, Triphenylmethane, Anthraquinone.	12
II	**Classification of dyes based on application:** Definition, fastness properties and applicability on substrates, examples with structures. (a) Acid dyes – Orange II, Alizarin Cyanine Green G. (b) Basic dyes – Crystal Violet, Bismark Brown. (c) Direct Cotton Dyes – Chrysophenine G. (d) Azoic dyes – Diazo components: Fast Red B Base, Fast Blue B Base; Coupling components: Naphthol AS, Naphthol AS-G. (e) Mordant dyes – Eriochrome Black T, Alizarin. (f) Vat dyes – Indigo, Indanthrene (g) Disperse dyes– Celliton Scarlet B, Disperse Yellow 6G	11
III	**Introduction and history of polymeric materials:** Different schemes of classification of polymers, Polymer nomenclature, Molecular forces and chemical bonding in polymers, Texture of Polymers. **Functionality and its importance:** Criteria for synthetic polymer formation, classification of polymerization processes, Relationships between functionality, extent of reaction and degree of polymerization. Bifunctional systems, Poly-functional systems.	11
IV	**Determination of molecular weight of polymers** (*Mn,Mw*, etc) by end group analysis, viscometry, light scattering and osmotic pressure methods. Molecular weight distribution and its significance. Polydispersity index **Brief introduction to preparation, structure, properties and application**: polyolefins, polystyrene and styrene copolymers, poly(vinyl chloride), polyamides and related polymers, Phenol formaldehyde resins (Bakelite, Novalac), Conducting Polymers,	11

	[polyacetylene, polyaniline, poly(p-phenylene sulphide polypyrrole, polythiophene)].	
Keywords	***Average molecular mass, PDI, Dyes, Polymer, diazodyes, bismarkbrown,Vat dyes,indigo dyes.***	

SignatureofConvener&Members (CBoS):

PART–C:Learning Resources

Text Books, Reference Books and Others

Text Books Recommended:

1. *Bhatnagar, M. S. (2010). A textbook of polymer chemistry. S. Chand & Company.*
2. *Misra, G. S. (2004). Introductory polymer chemistry. New Age International Publishers & Distributors.*
3. *Gowariker, V. R., Vishvanathan, N. V., & Sreedhar, J. (2008). Polymer science. New Age International Publication.*

Reference Books Recommended:

1. *Braun, D., Cherdron, H., Rehahm, M., Ritter, H., & Voit, B. (Year). Polymer synthesis: Theory and practice: fundamental method experiments (5th ed.). Springer.*
2. *Vogel, A. I. (Year). A textbook of Organic Chemistry including Qualitative Organic Analysis. Longman Publication.*
3. *Mann, F. G., & Saunders, B. C. (Year). Organic Chemistry. Pearson Publications.*

Online Resources–

- **e-Resources / e-books and e-learning portals**

- **https://onlinecourses.nptel.ac.in/noc22_cy53/preview**
- **https://nptel.ac.in/courses/116104044**
- **http://ndl.iitkgp.ac.in/he_document/swayam_prabha/1tcmcnbo3sk**
- **http://www.ndl.gov.in/he_document/swayam_prabha/cyvucrniwcq**

PART-D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:
MaximumMarks: 100 Marks
Continuous Internal Assessment(CIA):30 Marks
End Semester Exam(ESE):70 Marks

Continuous InternalAssessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **20** Assignment/Seminar- **10** Total Marks -**30**	Better marks out of the two Test / Quiz+ obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1.** Objective – **10 x1= 10** Mark; **Q2.** Short answer type- **5x4 =20Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit- **4x10=40Marks**	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART-A: Introduction				
Program:Bachelor in Science *(Degree/Honors)*			**Semester-V**	Session: 2024-2025
1	**Course Code**	**CHSE-03P**		
2	**Course Title**	**DYES AND POLYMER CHEMISTRY LAB. COURSE**		
3	**Course Type**	**DSE**		
4	**Pre-requisite(if,any)**	*As per Program*		
5	**Course Learning Outcomes(CLO)**	➢ To learn the synthesis of organic dyes in laboratory. ➢ To learn the synthesis of common drugs. ➢ To learn the synthesis of polymer. ➢ To make aware the student about polymer in our day to day life.		
6	**CreditValue**	**1 Credits**	*Credit =30 Hours Laboratory or Field learning/Training*	
7	**TotalMarks**	**Max.Marks:50**		**Min Passing Marks:20**

PART -B: Content of the Course

Total No.of learning-Training/performance Periods:30 Periods (30 Hours)

Module	Topics (Course contents)	No.of Period
Lab./Field Training/ Experiment Contents of Course	1. Synthesis of organic compound or dyes:- Methyl orange(azo coupling) phenolphthalein, Methyl red, Cango red, Fluorecein, Alizarin 2. Synthesis of drugs: Paracetamol, aspirin, sulphanilamide, Chlorobutanol, Tolbutamide, hexamine, 3. Synthesis of Some polymer or project work on some polymer: polyvinyl alcohol, Rayon,PVC,Nylon6, silicon based inorganic polymer, silicone, zeolite 4. Project work of identification of polymer around us in day to day life	30
Keywords	***Synthesis of organic compound, Crude test, Limit test, Pharmaceutical Packaging.***	

PART-C:Learning Resources

Text Books, Reference Books and Others

Text Books:

1. *Gupta, V. R., Kumar, R., & Gupta, A. (Year). Organic Chemistry. I. K. International Publishing House.*
2. *Bansal, R. K. (Year). Industrial Organic Chemistry. New Age International Publishers.*
3. *Kar, A. (Year). Medicinal Chemistry. New Age International Publishers.*
4. *Jain, A. K. (Year). Introduction to Pharmaceutical Chemistry. Pharma Book Publications.*
5. *Ghosh, B. (Year). Polymer Chemistry. New Age International Publishers.*
6. *Sinha, U. C., & Sinha, N. K. (Year). Polymer Science. Oxford University Press.*

Reference Books:

1. Braun, D., Cherdron, H., Rehahm, M., Ritter, H., & Voit, B. (Year). Polymer synthesis: Theory and practice: fundamental method experiments (5th ed.). Springer.
2. Vogel, A. I. (Year). A text book of Practical Organic Chemistry including Qualitative Organic Analysis. Longman Publication London.
3. Mann, F. G., & Saunders, B. C. (Year). Practical Organic Chemistry. Pearson Publications.
4. Burrell, H. (Year). Polymer Analysis. John Wiley & Sons.
5. Griffiths, R. F. (Year). Identification of Polymers. John Wiley & Sons.

Online Resources:

- **https://chem.libretexts.org/Ancillary_Materials/Laboratory_Experiments/Wet_Lab_Experiments/Organic_Chemistry_Labs/Experiments/1%3A_Synthesis_of_Aspirin_(Experiment)**
- **https://edu.rsc.org/experiments/the-microscale-synthesis-of-azo-dyes/559.article#:~:text=In%20this%20experiment%2C%20students%20prepare,practical%20should%20take%2020%20minutes.**
- **https://www.scribd.com/doc/36584645/Polymers-Chemistry-Project**

PART-D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:
MaximumMarks: 50 Marks
ContinuousInternal Assessment(CIA):15 Marks
EndSemesterExam(ESE):35Marks

Continuous InternalAssessment(CIA): (By Course Teacher)	Internal Test / Quiz-(2): 10 &10 Assignment/Seminar +Attendance- 05 Total Marks -15	Better marks out of thetwo Test / Quiz +obtained marks in Assignment shall be considered against 15 Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **G. Performed the Task based on lab. work - 20 Marks** **H. Spotting based on tools& technology (written) – 10 Marks** **I. Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Science *(/ Degree/Honors)*			**Semester - VI**	Session: 2024-2025
1	Course Code	CHSE-04T		
2	Course Title	HETEROCYCLIC CHEMISTRY		
3	Course Type	DSE		
4	Pre-requisite (if, any)	*- As per Program*		
5	Course Learning. Outcomes (CLO)	➢ *To apply Hantzsch-Widman and IUPAC nomenclature for heterocyclic compounds.* ➢ *To understand the concept of tautomerism in aromatic heterocycles and to analyze the influence of strain on small ring heterocycles.* ➢ *To learn the synthesis and reactions of three-, four-, five- and six-membered heterocycles with one heteroatom.* ➢ *To learn the synthesis of important bicyclic heterocycles (indole, quinoline, and isoquinoline) and learn the mechanisms of reactions.*		
6	Credit Value	3 Credits	*Credit = 15 Hours - learning & Observation*	
7	Total Marks	Max. Marks: 100		Min Passing Marks: 40

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**Nomenclature and Stereochemistry** Introduction to heterocyclic compounds, Trivial names of common ring systems Hantzsch-Widman nomenclature for: Monocyclic heterocycles, Fused heterocycles Bridged heterocycles Replacement of Hantzsch-Widman nomenclature by IUPAC nomenclature	11
II	**Tautomerism and Strain in Heterocycles** Tautomerism in aromatic heterocycles The effect of strain: Bond angle strain Torsional strain Consequences of strain in small ring heterocycles **Three- and Four-Membered Heterocycles** Synthesis and reactions of: Aziridines, Oxiranes (epoxides), Thiiranes, Azetidines Oxetanes, Thietanes	11
III	**Five- and Six-Membered Heterocycles with One Heteroatom** Preparation and properties (chemical and physical) of: Pyrroles (including Paal-Knorr synthesis, Knorr pyrrole synthesis, and Hantzsch synthesis), Furan, Thiophene Pyridine (including Hantzsch synthesis) **V. Five-Membered Heterocycles with Two Heteroatoms** Preparation, properties, and Substitution reactions of: Pyrazoles, Imidazoles, Oxazoles	11
IV	**Bicyclic Heterocycles: Reactions and Synthesis** Indole (including Fischer indole synthesis and Madelung synthesis) Quinoline and isoquinoline (including Skraup synthesis, Friedlander's synthesis, Knorr quinoline synthesis, Doebner-Miller synthesis, Bischler-Napieralski reaction, Pictet-Spengler reaction, and Pomeranz-Fritsch reaction) Reactions of bicyclic heterocycles: Mechanisms of electrophilic and nucleophilic substitutions, Oxidation and reduction reactions	12
Keywords	*Heterocyclic Chemistry, Nomenclature, Tautomerism, Strain, Rings, Synthesis, Reactions, Bicyclic heterocycles,*	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books Recommended

1. *Gupta, R.R., Kumar, M., & Gupta, V. (Eds.) (1984). Heterocyclic Chemistry (Vol. 1-3). Springer Verlag.*
2. *Arora, M. K. (2009). Heterocyclic chemistry. New Age International Publishers.*

Reference Books Recommended

1. *Acheson, R.M. (1961). An Introduction to the Heterocyclic Compounds. John Wiley.*
2. *Katritzky, A.R., & Rees, C.W. (Eds.) (1984). Comprehensive Heterocyclic Chemistry. Pergamon Press.*
3. *Joule, J.A., Mills, K., & Smith, G.F. (2010). Heterocyclic Chemistry. Wiley-Blackwell.*
4. *Gilchrist, T.L. (1992). Heterocyclic Chemistry. Pearson Education Limited.*

Text Books Recommended -

Online Resources–

- **e-Resources / e-books and e-learning portals**

- https://www.masterorganicchemistry.com/
- https://docs.chemaxon.com/display/lts-helium/functions-by-categories.md
- https://archive.catalog.arizona.edu/faculty/courses/001/chem.html
- https://www.organic-chemistry.org/
- https://www.sciencedirect.com/org/journal/journal-of-heterocyclic-chemistry
- https://www.wiley.com/en-us/Heterocyclic+Chemistry%2C+5th+Edition-p-9781405133005
- https://www.amazon.com/Chemistry-Heterocycles-Structures-Reactions-Applications/dp/3527327479
- https://www.wiley.com/en-us/Name+Reactions+in+Heterocyclic+Chemistry-p-9780471302155

Online Resources–

- **e-Resources / e-books and e-learning portals**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: **100 Marks**
Continuous Internal Assessment (CIA): **30 Marks**
End Semester Exam (ESE): **70 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **20** +20 Assignment / Seminar - 10 Total Marks - 30	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1.** Objective – 10 x1= 10 Mark; **Q2.** Short answer type- 5x4 =20 **Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-4x10=40 **Marks**	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Science *(Degree/Honors)*			**Semester - VI**	Session: 2024-2025
1	Course Code	CHSE-04P		
2	Course Title	HETEROCYCLIC CHEMISTRY LAB. COURSE I		
3	Course Type	DSE		
4	Pre-requisite (if, any)	*As per Program*		
5	Course Learning. Outcomes (CLO)	➢ *Proficient in basic laboratory techniques like distillation, extraction, crystallization, and chromatography.* ➢ *Skilled in the synthesis and purification of heterocyclic compounds.* ➢ *Adept at using various spectroscopic techniques (IR, NMR, MS) to characterize heterocyclic structures.* ➢ *Able to analyze reaction mechanisms and predict product formation in heterocyclic reactions.*		
6	Credit Value	1 Credits	*Credit =30 Hours Laboratory or Field learning/Training*	
7	Total Marks	Max. Marks: 50		Min Passing Marks: 20

PART -B: Content of the Course

Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)

Module	Topics (Course contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course	**Synthesis and Characterization of a Simple Pyridine Derivative:** This experiment will involve the synthesis of a pyridine derivative (e.g., 2-aminopyridine, 2,6-dimethylpyridine(Hantzsch-syntheis) or nicotinamide) followed by purification (recrystallization/distillation) and characterization using melting point, thin-layer chromatography (TLC). **Synthesis and Characterization of a Five-Membered Heterocycle (e.g., Imidazole, Pyrazole, Furan):** Students will synthesize an 2,5 dimethyl pyrrole(Paal-Knorr synthesis) imidazole, pyrazole derivative using a condensation reaction. Purification (distillation/recrystallization) and characterization using techniques like melting point , TLC. **Synthesis and Characterization of a Benzofused Heterocycle** This experiment experiment will involve the synthesis of Coumarins, Coumarone, 2-Phenylindole, Indigo(Dye) **Isolation of Caffeine from Tea Leaves:** This practical involves the extraction and purification of caffeine (a purine derivative) from tea leaves. Techniques like solvent extraction, filtration, and sublimation might be employed. **Identification of Unknown Heterocycle:** Students will be presented with an unknown heterocyclic compound and utilize various spectroscopic techniques (IR, NMR, mass spectrometry) to identify the functional groups and propose the structure of the unknown molecule.	30
Keywords	*Synthesis, Characterization, Heterocycles, Techniques, TLC, IR, Extraction, Isolation*	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. *Ahluwalia, V. K., & Aggarwal, R. (2000). Comprehensive practical organic chemistry: Preparations and quantitative analysis, Universities Press*

Reference Books Recommended –

1. *Miller, J. R., & Friswell, M. D. (2000). Organic Chemistry Laboratory Techniques. Pearson Education Limited.*
2. *Mohrig, J., Garland, T. L., & Hammond, P. C. (2022). Techniques and Experiments in Organic Chemistry. W. H. Freeman and Company*

Online Resources–

- **e-Resources / e-books and e-learning portals**
- (https://www.cas.org/)
- (https://www.youtube.com/channel/UCEWpbFLzoYGPfuWUMFPSaoA)
- (https://ocw.mit.edu/courses/chemistry/)

Online Resources–

- **e-Resources / e-books and e-learning portals**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - **05** Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **J. Performed the Task based on lab. work - 20 Marks** **K. Spotting based on tools & technology (written) – 10 Marks** **L. Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM(2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART-A: Introduction				
Program:Bachelor in Science *(Honors/Honors with Research)*		Semester VII	Session: 2024-2025	
1	CourseCode	CHSE-05T		
2	CourseTitle	PHOTOCHEMISTRY AND PERICYCLIC REACTION		
3	CourseType	DSE		
4	Pre-requisite(if,any)	*As per Program*		
5	Course Learning. Outcomes(CLO)	➢ *To study the photochemical reaction and pericyclic reaction* ➢ *To gain knowledge about mechanism of light induced reaction.* ➢ *To learn the mechanism of thermal reaction* ➢ *To understand the difference between light and thermal reaction.*		
6	CreditValue	3 Credits	*Credit = 15 Hours -learning & Observation*	
7	TotalMarks	Max.Marks: 100	Min Passing Marks:40	

PART -B: Content of the Course

TotalNo.of Teaching–learning Periods(01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics(Coursecontents)	No.ofPeriod
I	**Photochemical reactions and Reaction Mechanism** Interaction of electromagnetic radiation with matter, types of excitations, fate of excited molecules, quantum yield, transfer of excitation energy, actinometry. Classification, rate constants and life times of reactive energy states - determination of rate constants of reactions. Effect of light intensity on the rate of photochemical reactions. Types of photochemical reactions – Photo-oxidation, photo-reduction, photo-dissociation, gas phasephotolysis.	12
II	**Photochemistry of Alkenes** Intramolecular reactions of the olefinic bond - geometrical isomerism, cyclisation reactions, photochemical rearrangement of alkenes,rearrangement 1, 4- and 1,5-dienes. **Photochemistry of Aromatic Compounds:** Photochemical isomerization of aromatic compounds, Photochemical addition and substitutions reactions shown by aromatic compounds.	11
III	**Photochemistry of Carbonyl Compounds** Photochemical reactions of carbonyl compounds: Norrish type I and II reactions Intramolecular reactions of carbonyl compounds - saturated cyclic and acyclic, β, γ - unsaturated and α, β - unsaturated compounds. Cyclohexadienones. Intermolecular cycloaddition reactions –photo-dimerisation reaction and oxetane formation. **Miscellaneous Photochemical Reactions** Photo-Fries reactions of anilides. Photo-Fries rearrangment. Barton reaction. Singlet molecular oxygen reactions. Photochemical formation of smog. Photodegradation of polymers. Photochemistry of vision.	11
IV	**Pericyclic Reactions** Molecular orbital symmetry, Frontier orbitals of ethylene, 1,3- butadiene, 1,3,5-hexatriene and allyl system. Classification of pericyclic reactions. Woodward-Hoffman correlation diagrams. FMO and PMO approach. Electrocyclic reactions- conrotarory and	11

	disrotatory motions, 4n, 4n+2 and allyl systems. Cycloadditions- antarafacialand suprafacial additions, 4n and 4n+2 systems, 2+2 addition of ketenes.Sigmatropic rearrangements, suprafacial and antarafacial shifts of H, sigmatropic shifts involving carbon moieties, 3, 3-and 5,5- sigmatropic rearrangements. Claisen, Cope and aza-Cope rearrangements.	
Keywords	*Photochemical reaction, thermal reaction,*	

SignatureofConvener&Members (CBoS):

PART–C:Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. *Singh, J., & Singh, J. (n.d.).* ***Photochemistry and pericyclic reactions****. [Publisher not provided].*
2. *Gupta, A. L. (2024).* ***Photochemistry****. Pragati Prakashan (7th Edition).*

Reference books Recommended:

1. *Ramamurthy, V., & Schanze, K. S. (1999).* ***Organic photochemistry****. Taylor & Francis.*
2. *Wardle, B. (2000).* ***Principles and applications of photochemistry****. John Wiley & Sons.*

Online Resources–

- https://nptel.ac.in/courses/104105038
- https://archive.nptel.ac.in/courses/104/106/104106077/
- https://www.scribd.com/document/512848351/Photochemistry-and-Pericyclic-Reactions-by-J-Singh

PART-D:Assessment andEvaluation

Suggested Continuous Evaluation Methods:
MaximumMarks: 100 Marks
ContinuousInternal Assessment(CIA):30 Marks
EndSemesterExam(ESE):70 Marks

Continuous InternalAssessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): 20 +20 Assignment/Seminar- 10 Total Marks -30	Better marks out of the two Test / Quiz+ obtained marks in Assignment shall be considered against 30 Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1.** Objective – 10 x1= 10 Mark; **Q2.** Short answer type- 5x4 =**20Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit- **4x10=40Marks**	

NameandSignatureofConvener&MembersofCBoS:

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FOUR YEAR UNDERGRADUATE PROGRAM(2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART-A: Introduction				
Program: Bachelor in Science *(Honors/Honors with Research)*		**Semester VII**		Session: 2024-2025
1	CourseCode	CHSE-05P		
2	CourseTitle	PHOTOCHEMISTRY& PERICYCLIC REACTION LAB. COURSE		
3	CourseType	DSE		
4	Pre-requisite(if,any)	-		
5	Course Learning. Outcomes(CLO)	➢ *To learn the advanced organic chemistry concept that will applied in solving their future chemistry problems.* ➢ *To learn about arenium ion ,classical versus non classical carbonium ion ,different rearrangement reactions* ➢ *To make student aware the level of basic organic chemistry to apply in different reaction mechanisms and organic transformations.*		
6	CreditValue	1 Credits	*Credit =30 Hours Laboratory or Field learning/Training*	
7	TotalMarks	Max.Marks:50		Min Passing Marks:20

PART -B: Content oftheCourse		
TotalNo.of learning-Training/performancePeriods:30 Periods (30 Hours)		
Module	Topics(Coursecontents)	No.ofPeriod
Lab./Field Training/ Experiment Contents of Course	1. Synthesis of organic compound involving important chemical reaction:- (a)Acetylations salicylic acid, aniline, glucose and hydroquinone, (b) Benzoylation of aniline and phenol. (c) Aliphatic electrophilic substitution: preparation of iodoform from ethanol and acetone (d) Arromatic electrophilic substitution: nitration-preparation of meta dinitrobenzene, p-nitroacetinalide, halogenation: preparation of p-bromoaetanilaide,2,4,6-tribromophenol. (e) Diazotisation/ coupling :- Preparation of methyl orange and methyl red, (f)Oxidation: Preaparation of benzoic acid from toluene (g) Reduction: Preparation of aniline from nitrobenzene, m-nitroanilene from m-dinitrobenzene. 2. Isolation of some natural products(casein from milk, lycopene from tomato, nicotine from tobacco leaves etc.) 3. Detection of element, functional group and organic compound.	30
Keywords	*Synthesis of organic compound, functional group test. Lassagne test.*	

Signature of Convener& Members (CBoS):

PART–C:Learning Resources

Text Books, Reference Books and Others

Text books Recommended:

1. *Bansal, R. K. (1994). **Laboratory manual of organic chemistry**. New Age International Publishers.*
2. *Vogel Textbook of Practical Organic Chemistry 5th edition, Pearson Publication.*

Reference books Recommended:.

1. *Vishnoi, N. K. (2010). **Advanced practical organic chemistry (3rd ed.)**. Vikas Publishing House.*
2. *Saikia, B. (Year). **Organic chemistry-I with practical**..*
3. *Agrawal, O. P. (Year). **Advanced practical organic chemistry**. Krishna Publication.*

Online Resources:

https://www.organic-chemistry.org/synthesis/

https://www.orgsyn.org/

https://vlab.amrita.edu/?sub=2&brch=191&sim=344&cnt=1#:~:text=In%20order%20to%20detect%20them,detected%20by%20simple%20chemical%20tests.

PART-D:Assessment andEvaluation

Suggested Continuous Evaluation Methods:
MaximumMarks: 50 Marks
ContinuousInternal Assessment(CIA):15 Marks
EndSemesterExam(ESE):35Marks

Continuous InternalAssessment(CIA): (By Course Teacher)	Internal Test / Quiz-(2): 10 &10 Assignment/Seminar +Attendance- 05 Total Marks -15	Better marks out of thetwo Test / Quiz +obtained marks in Assignment shall be considered against 15 Marks

End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **M. Performed the Task based on lab. work - 20 Marks** **N. Spotting based on tools& technology (written) – 10 Marks** **O. Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS:

Indira

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Science *(Degree/Honors)*			**Semester - VII**	Session: 2024-2025
1	Course Code	CHSE-06T		
2	Course Title	SPECTROSCOPY-I		
3	Course Type	DSE		
4	Pre-requisite (if, any)	*As per Program*		
5	Course Learning. Outcomes (CLO)	➢ *To equips students with advanced spectroscopic techniques for in-depth molecular analysis.* ➢ *To enable classification, isotope effect analysis, and vibrational energy calculations of techniques like microwave and infrared spectroscopy* ➢ *To provide detailed information on structure, environment, and electronic configuration on advanced methods like NMR, NQR, and PES.* ➢ *To allows students to probe chemical and surface properties of materials using Photoacoustic spectroscopy.* ➢		
6	Credit Value	3 Credits	*Credit = 15 Hours - learning & Observation*	
7	Total Marks	Max. Marks: 100		Min Passing Marks: 40

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**Molecular Spectroscopy** Energy levels, molecular orbital, vibronic transitions, vibration progressions and geometry of the excited states, Franck - Condon principle, electronic spectra of polyatomic molecules. Emission spectra: radiative and non-radiative decay, internal conversion, spectra of transition metal complex, charge transfer spectra. **Microwave Spectroscopy** Classification of molecules, rigid rotor model, effect of isotopic substitution on the transition frequencies, intensities, non-rigid rotor. Stark effect, nuclear and electron spin interaction and effect of external field. Applications.	12
II	**Infrared spectroscopy** Review of linear harmonic oscillator, vibrational energy of diatomic molecules, zero point energy, force constant and bond strengths, anharmonicity. Morse potential energy diagram, vibration – rotation Spectroscopy, P, Q, R branches. Breakdown of Oppenheimer approximation, vibration of polyatomic molecules. Selection rules, normal modes of vibration, group frequencies, overtones, hot bands, factors affecting the band positions and intensities, far IR region, metal ligand vibrations, normal co-ordinate analysis. **Raman Spectroscopy** Classical and quantum theories of Raman effect – Pure rotational, vibrational and vibrational–rotational Raman spectra, selection rules, mutual exclusion principle. Resonance Raman Spectroscopy, coherent anti stokes Raman Spectroscopy (CARS)	11
III	**Nuclear Magnetic Resonance Spectroscopy** Nuclear spin, nuclear resonance, saturation, shielding of magnetic nuclei, chemical shift and its measurements, factors influencing chemical shift,	11

	deshielding, spin- spin interactions, factors including coupling constant 'J'. Classification (ABX, AMX, ABC, AB etc), spin decoupling. Basic ideas about instruments, FT NMR, advantages of FT NMR, use of NMR in medical diagnostics. **Nuclear Quadruple Resonance Spectroscopy** Quadruple nuclei, Quadruple moments, electric field gradient, coupling constant, splitting, applications.	
IV	**Photoelectron Spectroscopy** Basic principle: photo-electric effect, ionization process, Koopmans theorem, photoelectron spectra of simple molecules, ESCA, chemical information from ESCA. **Photo acoustic Spectroscopy** Basic principles of photo acoustic spectroscopy (PAS), PAS gases and condensed systems, chemical and surface applications. **Electron Spin Resonance Spectroscopy** Basic principles, zero field splitting and Kramer's degeneracy, factors affecting the 'g' value. Isotropic and anisotropic hyperfine coupling constants, spin Hamiltonian, spin densities and McConnell relationship, measurement techniques, applications.	11
Keywords	*Electronic Transitions, Emission Spectra, Isotope Effect, Vibrational Energies, Raman Spectroscopy, Nuclear Magnetic Resonance (NMR), Nuclear Quadrupole Resonance (NQR), Photoelectron Spectroscopy (PES), Photoacoustic Spectroscopy (PAS), Molecular Structure*	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. *Muthu, K. S. (2010). Applications of spectroscopy. Medtech Publications.*
2. *Ambika, Dr., & Singh, P. P. (2017). Organic spectroscopy. Viva Books.*

References Books Recommended –

1. *Hollas, J. M. (2019). Modern Spectroscopy (John Wiley & Sons).*
2. *Applied Electron Spectroscopy For Chemical Analysis (Wiley-Interscience).*
3. *Parish, R. V. (1983). NMR, NQR, EPR and Mossbauer Spectroscopy in Inorganic Chemistry (Ellis Horwood).*
4. *Drago, R. S. (1977). Physical Methods in Chemistry (Saunders Company).*
5. *Nakamoto, K. (2009). Infrared and Raman Spectra: Inorganic and Coordination Compounds (Wiley).*
6. *Williams, D. H., & Fleming, I. (2010). Spectroscopic Methods in Organic Chemistry (Tata - Mcgraw-Hill).*
7. *Dyer, J. R. (1975). Application of Spectroscopy of Organic Compounds (Prentice Hall).*

Online Resources–

- **e-Resources / e-books and e-learning portals**

Online Resources–

- **(https://archive.nptel.ac.in/courses/104/106/104106122/**
- **(https://m.youtube.com/watch?v=o8zELwp358A**
- **https://archive.nptel.ac.in/courses/103/108/103108139/)**
- **(https://nptel.ac.in/courses/104108078)**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Exam (ESE):	**70 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **20** +20 Assignment / Seminar - 10 Total Marks - 30	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- 5x4 =20 **Marks** Section B: Descriptive answer type qts.,**1 out of 2** from each unit-4x10=40 **Marks**	

Name and Signature of Convener & Members of CBoS:

Indira

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Science *(Certificate / Diploma / Degree/Honors)*			**Semester - VII**	Session: 2027-2028
1	Course Code	CHSE-06P		
2	Course Title	SPECTROSCOPY-I LAB. COURSE		
3	Course Type	DSE		
4	Pre-requisite (if, any)	*As per Program*		
5	Course Learning. Outcomes (CLO)	➢ *Understand the fundamental principles of different spectroscopic techniques (Microwave, Infrared, Raman, NMR, UV-Vis (optional) and interpret the data obtained from various spectroscopic experiments.* ➢ *Relate the observed spectroscopic features to the structure, bonding, and dynamics of molecules.* ➢ *Develop practical skills in operating spectroscopic instrumentation and analyzing data.* ➢ *Enhance critical thinking and problem-solving skills in a laboratory setting.*		
6	Credit Value	1 Credits	*Credit =30 Hours Laboratory or Field learning/Training*	
7	Total Marks	**Max. Marks:** 50		**Min Passing Marks:** 20

PART -B: Content of the Course		
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)		
Module	**Topics (Course contents)**	**No. of Period**
Lab./Field Training/ Experiment Contents of Course	**Rotational Spectroscopy of a Diatomic Molecule (Microwave Spectroscopy):** Analyze the rotational spectrum of simple molecules and calculate its moment of inertia. **Infrared (IR) Spectroscopy of a Simple Molecule:** Record and interpret the IR spectrum of a molecule, identifying functional groups based on characteristic frequencies. **Raman Spectroscopy of a Liquid Sample:** Compare the Raman spectrum of a liquid to its IR spectrum and explore the concept of mutual exclusion principle. **Nuclear Magnetic Resonance (NMR) Spectroscopy of Simple Molecules:** Analyze the ^1H NMR spectrum of simple organic molecule, understanding the effects of chemical environment and spin-spin coupling. **(Ultraviolet-Visible (UV-Vis) Spectroscopy of a Conjugated System: Concentration Determination of Using Lambert Beer's Law,** measurement of the UV-Vis spectrum of a chromophore-containing molecule (e.g., conjugated diene, transition metal complex) and analyze the observed absorption bands based on their λ_{max} (wavelength of maximum absorption) values, Investigate the electronic transitions of a conjugated molecules (polyenes and conjugated carbonyls) using UV-Vis spectroscopy, study the formation of a colored complex in a complexation reaction, Calculation of the equilibrium constant using Beer's Law and relevant equations. **ESR:** Common examples include studying free radicals generated during chemical reactions or analyzing organic radicals in biological systems.	30

Keywords	*Electronic Transitions, Emission Spectra, Raman Spectroscopy, Nuclear Magnetic Resonance (NMR), Electron Spin Spectroscopy (ESR), UV-Visible Spectroscopy*

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. Mukherjee, P. S. (2009). *Electronic Absorption Spectroscopy and Related Techniques* (1st Ed.). New Age International (Publishers).
2. Sharma, Y. R. (2007). *Elementary organic spectroscopy* (Reprint). S. Chand Publishing.
3. Yadav, D. S. (2004). *Organic spectroscopy*. [Kindle Edition]. doi: 10.1007/978-1-4020-2575-4

Reference Books:

1. Smith, R. A. (1974). *Infrared and Raman Spectra of Inorganic Compounds*. CRC Press.
1. Abraham, R. J., & Settle, F. A. (2011). *Interpreting NMR Spectra*. Wiley-Blackwell.
2. Jaffe, H. H., & Orchin, M. (1962). *UV-Vis Spectral Library of Common Organic Molecules*. Prentice-Hall.
3. Carnevale, A., & Piacenti, P. (2017). *Experimental Techniques in Nuclear Magnetic Resonance Spectroscopy*. Royal Society of Chemistry.
4. Chalmers, J. M., & Griffiths, P. R. (2002). *Handbook of Vibrational Spectroscopy*. John Wiley & Sons, Ltd.

Online Resources–

- **e-Resources / e-books and e-learning portals**

- (https://www.nist.gov/)
- (https://edu.rsc.org/resources/spectroscopy-videos/1041.article)
- (https://acsanalytical.org/)
- (https://nscl.msu.edu/)
- (https://new.nsf.gov/funding/opportunities/nsf-national-quantum-virtual-laboratory-nqvl)
- (https://www.chemtube3d.com/sym-operationsrotations/)

Online Resources–

- **e-Resources / e-books and e-learning portals**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - **05** Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **P. Performed the Task based on lab. work - 20 Marks** **Q. Spotting based on tools & technology (written) – 10 Marks** **R. Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART-A: Introduction				
Program: Bachelors in Science *(Honors/Honors with Research)*		Semester–VII		Session:2024-25
1	CourseCode	CHSE-07T		
2	CourseTitle	CHEMICAL KINETICS AND NUCLEAR CHEMISTRY		
3	CourseType	DSE		
4	Pre-requisite(if,any)	*As per Program*		
5	CourseLearning. Outcomes(CLO)	➢ *To understand types/kinetics of composite reactions and elucidate mechanism and derive rate laws, calculate various activation parameters and predict feasibility of reaction of its basis.* ➢ *To explain the concept of acidity functions and illustrate the various rate correlations, isotopic effect and solvent effect.* ➢ *To discuss various aspects of nuclear models, nuclear reactions and nuclear reactors.* ➢ *To understand the principles of radioactivity, its measurements, counters, apply in determining reaction mechanism, structures, physicochemical properties and in chemical analysis.*		
6	CreditValue	03Credits	*Credit = 15 Hours - learning & Observation*	
7	TotalMarks	Max.Marks:100		MinPassingMarks:40

PART-B: Content of the Course

TotalNo.of Teaching–learning Periods(01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics(Coursecontents)	No.of Period
I	**Kinetics of CompositeReactions** Types of composite mechanism, rate equation for composite mechanisms- simultaneous and consecutive reactions, microscopic reversibility, some inorganic mechanisms- formation and decomposition of phosgene, decomposition of nitrogen pentoxide and ozone and thermal para-ortho hydrogen conversion. **Kinetics of Catalytic Reactions** Kinetics of acid-base catalysis: general and specific, hydrolysis of ester and amide; Enzyme catalysis, Micellar catalysis. **Activation Parameters** Activation parameters from experimental results- Arrhenius factor, standard free energy of activation, standard enthalpy of activation, entropy of activation and their physical significance.	12
II	**Acidity function and various rate correlations** Hammett acidity function, various treatments of rate correlation, Linear Free Energy Relationship (LFER), The Hammett equation, Zucker-Hammett hypothesis, Bunnett-Olsen parameter. **Isotopic Effect** Theory of isotopic effects; Primary and secondary kinetic isotope effects. Heavy atom isotope effects, Tunneling effect. Kinetic solventeffects. **Solvent Effect** Qualitative theory of influence of solvent on reaction rate; Solvent effect in terms of dielectric constant, Grunwald - Weinstein parameter, Z and E values. Application of solvent polarity, Koppel - Palmtreatment.	11

III	**Nuclear Models** Shell model – magic numbers, salient features and merits; liquid drop model – analogy with liquid drop, merits, semi-empirical equation; Fermi gas model; collective model and opticalmodel. **Nuclear Reactions** Nuclear fusion and fission; Nuclear fission – mass, energy and charge distribution of fission products; fission neutrons; liquid drop model. **Nuclear Reactors** Natural uranium reactors, classification of reactors – typical reactors, Breeder reactor.	11
IV	**Radioactivity** General characteristics of radioactive decay and decay kinetics, measurement of radioactivity: Ionization chamber, electron pulse counters – variation of pulse size with voltage, Geiger-Muller counter, proportional counter and scintillation counters. **Applications of Radioactivity** Typical applications of radioisotopes as tracers; chemical investigation – reaction mechanism and structure determination; physicochemical applications – solubility of sparingly soluble and surface area of a powder; analytical applications – isotope dilutionanalysisand neutron activation analysis; age determination and medical applications.	11
Keywords	***Kinetics, composite reactions, catalytic reactions, activation parameters, acidity function, isotopic effect, nuclear models, radioactivity.***	

Signature of Convener & Members (CBoS):

PART–C

LearningResources:Textbooks,ReferenceBooksandOthers

Textbooks Recommended–

1. Arnikar, H. J. (1995). *Essentials of nuclear chemistry* (No. 1653). New Age International.

Reference Books Recommended–

1. Laidler, K. J., & Keith, J. (1965). *Chemical kinetics* (Vol. 2). New York: McGraw-Hill.
2. Chorkendorff, I., & Niemantsverdriet, J. W. (2017). *Concepts of modern catalysis and kinetics*. John Wiley & Sons.
3. Vannice, M. A., & Joyce, W. H. (2005). *Kinetics of catalytic reactions* (Vol. 134). New York: Springer.Investigation of Reduction Rates and Mechanism of Reactions. Edward Lewis.

OnlineResources–e-Resources/e-booksande-learningportals

- **https://chem.libretexts.org/Bookshelves/General_Chemistry/Map%3A_Chemistry_-_The_Central_Science_(Brown_et_al.)/14%3A_Chemical_Kinetics/14.S%3A_Chemical_Kinetics_(Summary)**
- **https://www.vssut.ac.in/lecture_notes/lecture1425072667.pdf**
- **https://www.khanacademy.org/science/chemistry/chem-kinetics/arrhenius-equation/a/types-of-catalysts**
- **https://wou.edu/chemistry/courses/online-chemistry-textbooks/ch103-allied-health-chemistry/ch103-chapter-3-radioactivity/**
- **https://www.orano.group/en/unpacking-nuclear/all-about-radioactivity**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Exam (ESE):	**70 Marks**

Continuous InternalAssessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **20 &20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz **+** obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1**= 10 Mark; **Q2.** Short answer type- 5x4 =20 **Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener and Members of CBoS

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Science *(Honors/ Honors with Research)*		**Semester - VII**		Session: 2024-2025
1	CourseCode	CHSE-07P		
2	CourseTitle	CHEMICAL KINETICS AND NUCLEAR CHEMISTRY LAB. COURSE		
3	CourseType	DSE		
4	Pre-requisite(if,any)	*As per Program*		
5	Course Learning Outcomes(CLO)	➢ *To understand basic concepts in Physical Chemistry through experiential learning.* ➢ *To acquaint with the basic principles of equipment/instruments and its applications.* ➢ *To determine the order of reaction with respect to various reactants and overall order and activation parameters using experimental data.* ➢ *To acquire the knowledge of radioactive decay and GM counter.*		
6	Credit Value	01Credit	*(Credit = 30 Hrs laboratory or Field learning / training)*	
7	Total Marks	Max.Marks:50		MinPassingMarks:20

PART -B: Content of the Course

Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)

Module	Topics(Course contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course	**Chemical Kinetics** 1. Determination of the effect of (a) Change of temperature (b) Change of concentration of reactants and catalyst and (c) ionic strength of the media on the velocity constant of hydrolysis of an ester/ionic reactions. 2. Determination of the rate constant for the oxidation of iodide ions by hydrogen peroxide studying the kinetics as an iodine clock reaction. **Polarimetry** 1. Determine the specific and molecular rotation of optically active substance. 2. To determine the concentration of a solution of an optically active substance. **Viscosity** 1. To determine viscosity of an organic liquid using Ostwald viscometer. 2. To verify Kendall's equation. 3. To study the variation of viscosity with temperature. 1. To study the effect of concentration of the reactant and catalysts on the rate of hydrolysis of ester. 2. To study the effect of temperature, concentration of the reactant and catalysts on the rate of hydrolysis of ester and to calculate energy of activation, frequency factor, enthalpy of activation, entropy of activation and free energy of activation.	30

	3. To study the kinetics of saponification of ethyl acetate by (a)Volumetric method (b) Conductometric method 4. To study the influence of ionic strength on the reaction between potassium persulphate and iodide. 5. To study the Kinetics of reaction between H_2O_2 and KI. 6. To study the kinetics of reaction between sodium formate and iodine. 7. To study the kinetics of reaction between acetone and iodine. 8. To determine the rate constant of hydrolysis / inversion of sugar using polarimeter and factors effecting. 9. To study some simple enzyme catalysed reaction. 10. To determine plateau and optimal operating voltage of Geiger-Muller counter. 1. To determine the dead time or resolving time of GM counter. 2. Simulation of Radioactive decay using rolling of dice.	
Keywords	***Chemical Kinetics, nuclear chemistry, Activation energy, GM counter, Decay kinetics***	

Signature of Convener &Members (CBoS):

PART–C

LearningResources:TextBooks,ReferenceBooksandOthers

Textbook Recommended-

1. *Athawale, V. D., & Oza, N. R. (2001). Experimental physical chemistry. New Age International Publishers.*
2. *Bahl, B. S., Bahl, A., & Tuli, G. D. (2018). Essentials of physical chemistry (Vol. 2: Practical physical chemistry). S. Chand Publishing.*

Reference Books Recommended

1. *Friedlander, G., Kennedy, J. W., Miller, J. M., Seaborg, G. T., & Nuclear Regulatory Commission. (2014). **Radiochemistry and nuclear chemistry** (Vol. 2: Practical radiochemistry).*

OnlineResources–

https://www.mdpi.com/books/reprint/4856-synthesis-and-characterization-of-nanomaterials
https://swayam.gov.in
https://epathshala.nic.in
http://as.wiley.com/WileyCDA/WileyTitle/productCd-EHEP000803.html

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	50 Marks
Continuous Internal Assessment (CIA):	15 Marks
End Semester Exam (ESE):	35 Marks

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - **05** Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam(ESE):	**Laboratory/Field Skill Performance : on spot Assessment** **A: Perform task Based on the lab work- 20 Mark** **B: Spotting Based on tools and techniques- 10 marks** **C: Viva-voce (Based on principle/technology)-05 Marks**	**Managed by Course teacher as per Lab. Status.**

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART-A: Introduction

Program: Bachelors in Science *(Certificate/Diploma /Degree/Honors)*	Semester–VII	Session:2024-2025

1	CourseCode	CHSE-08T	
2	CourseTitle	ELECTRO CHEMISTRY & SURFACE CHEMISTRY	
3	CourseType	DSE	
4	Pre-requisite(if,any)	*As per Program*	
5	CourseLearning. Outcomes(CLO)	➢ *Understand electrochemistry fundamentals, explain laws and industrial applications* ➢ *To explain and derive equations related to the theory of strong electrolytes – Debye-Huckel law and its extensions, structure/models and thermodynamics of electrified interfaces, polarography and its applications.* ➢ *To describe and interpret various adsorption isotherms and its applications, concept and various aspects of micelles.* ➢ *To understand the fundamentals, types, and applications of surfactants and micelles.*	
6	CreditValue	03Credits	*Credit = 15 Hours - learning & Observation*
7	TotalMarks	Max.Marks:100	MinPassingMarks:40

PART-B: Content of the Course

TotalNo.of Teaching–learning Periods(01 Hr. per period) - 45 Periods (45 Hours)

Module /Unit	Topics(Coursecontents)	No.of Period
I	**Electrochemistry-1** Electrolyte conductance: specific and equivalent conductance, measurement of equivalent conductance, effect of dilution on conductance, Kohlrausch law, application of Kohlrausch law indetermination of dissociation constant of weak electrolyte, solubility of sparingly soluble electrolyte, absolute velocity of ions, ionic product of water, conductometric titrations. Single electrode potential, standard electrode potential, electrochemical series and its applications. Concept of overvoltage.	12
II	Theory of strong electrolyte: limitation of Ostwald's dilution law weak and strong electrolyte, Debye-Huckel-Onsager's(DHO) equation for strong electrolytes, relaxation, and electrophoretic effect. Migration of ions: Transport number-definition and determination by Hittorf method and movingboundary method. Electrochemical cells or Galvanic cells: reversible and irreversible cells, conventional representation of electrochemical cells. EMF of a cell, effect of temperature on EMF of cell, Nernst equation calculation of ΔG, ΔH and ΔS for cell reaction.	11
III	**Electrochemistry-2** Electrochemistry of solutions: Ion- solvent interactions, Debye-Huckel theory for activity coefficient of electrolyte solutions, ionic strength, Debye-Huckel limiting law, Debye- Huckel- Onsager treatment and its extension. Thermodynamics of electrified interface equations: Derivation of electro-capillarity, Lippmann equations, determination of surface excess. Structure of electrified interfaces: Guoy-Chapman and Stern models. Over	11

	potentials, exchange current density, derivation of Butler-Volmer equation. Tafel plot. Polarography theory - Ilkovic equation, half wave potential and its significance.	
IV	**Surface Chemistry** Adsorption Surface tension, capillary action, pressure difference across curved surface (Laplace equation), Gibbs adsorption isotherm, BET equation and estimation of surface area using BETequation. **Micelles** Surface active agents, classification of surface active agents, micellization, critical micellar concentration (CMC), factors affecting the CMC of surfactants, counter ion binding to micelles, thermodynamics of micellization, reverse micelles.	11
Keywords	***Electrochemistry, Kohlrausch law, electrode potential, standard electrode potential, electrochemical series, Debye-Huckel limiting law, surface chemistry, micelles, adsorption.***	

Signature of Convener & Members (CBoS):

PART–C

LearningResources:Textbooks,ReferenceBooksandOthers

Textbooks Recommended–

1. Soni, P. L., & Mahajan, S. N. (2013). **A textbook of physical chemistry** (Vol. 3: Electrochemistry and surface chemistry). Sultan Chand & Sons.
2. Rakshit, P. C. (2009). **A textbook of physical chemistry** (Vol. 2: States of matter). Tata McGraw-Hill Education.

Reference Books Recommended–

1. Moroi, Y. (2013). *Micelles: theoretical and applied aspects*. Springer Science & Business Media.
2. Glasstone, S. (2011). *An introduction to electrochemistry*. Read Books Ltd.
3. Plieth, W. (2008). *Electrochemistry for materials science*. Elsevier.
4. Bikerman, J. J. (2013). *Surface chemistry: theory and applications*. Elsevier.
5. Somorjai, G. A., & Li, Y. (2010). *Introduction to surface chemistry and catalysis*. John Wiley & Sons.

OnlineResources–e-Resources/e-booksande-learningportals

- https://ceramrtr.ceramika.agh.edu.pl/~szyszkin/eis/Modern%20Electrochemistry%20Vol%202B%20Electrodics%20in%20Chemistry,%20Engineering.pdf
- https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SCYA5303.pdf
- https://www.genesis-tutorials.com/wp-content/uploads/2018/04/Surface-chemistry.pdf
- https://study.com/academy/lesson/micelles-biology-structure-function.html

Part-D:Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 100 Marks
Continuous Internal Assessment(CIA): 30 Marks
EndSemester Exam(ESE): 70 Marks

Continuous InternalAssessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): 20 &20 Assignment / Seminar - 10 Total Marks - 30	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
End Semester Exam(ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2.** Short answer type- **5x4 =20Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks.**	

Name and Signature of Convener and Members of CBoS

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Science *(Honors/Honors with Research)*		**Semester - VIII**		Session: **2024-2025**
1	CourseCode	CHSE-08P		
2	CourseTitle	ELECTROCHEMISTRY AND SURFACE CHEMISTRY LAB. COURSE		
3	CourseType	DSE		
4	Pre-requisite(if,any)	*As per Program*		
5	CourseLearning.Outcomes(CLO)	➢ *To acquire the knowledge of surface tension* ➢ *To apply the principle of conductance in studying different applications.* ➢ *To apply various concepts of Physical Chemistry and use instruments in studying various applications.* ➢ *To acquire the surface tension – concentration relationship for solution*		
6	CreditValue	01Credit (Practical)	*(Credit = 30Hrs laboratory or Field learning / training)*	
7	TotalMarks	Max.Marks:50		MinPassingMarks:20

PART -B: Content of the Course

Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)

Module	Topics(Coursecontents)	No.of Period
Lab./Field Training/ Experiment Contents of Course	**Conductometry** Estimation of aspirin from tablet. Determination of relative strengths of different acids. Determination of the strength of strong and weak acids in a given mixture conductometrically. **Potentiometry/pH metry** Determination of temperature dependence of EMF of a cell. To determine pK_a of the given monobasic acid by pH metric titration. Determination of the dissociation constant of monobasic/dibasic acid by Albert-Serjeant method. **Surface Tension:** Determination of CMC of Surfactants by (1) Surface Tension method (2) Conductometric method To study surface tension – concentration relationship for solution (Gibb's equation). To study the adsorption of oxalic acid on charcoal and to verify Freundlich adsorption isotherm. To determine the parachor of the given liquid. Compare CMC of different surfactants by surface tension method.	30
Keywords	Conductometry, potentiometry, pH-metry,CMC	

SignatureofConvener&Members (CBoS):

PART–C
LearningResources:TextBooks,ReferenceBooksandOthers
Textbook Recommended 1. *Athawale, V. D., & Oza, N. R. (2001). Experimental physical chemistry. New Age International Publishers.*
OnlineResources– ➢ **SWAYAM https://swayam.gov.in** ➢ **e-Pathshala https://epathshala.nic.in**

Part-D:AssessmentandEvaluation		
Suggested Continuous Evaluation Methods: **Maximum Marks:** 50 Marks **Continuous Internal Assessment (CIA):** 15 Marks **End Semester Exam (ESE):** 35 Marks		
Continuous Internal Assessment (CIA): (By Course Teacher)	**Continuous Internal Assessment (CIA):** (By Course Teacher)	Better marks out of two Test/Quiz + obtained marks in assessment shallbe consideredagainst 15Marks
End Semester Exam(ESE):	**Laboratory/Field Skill Performance : on spot Assessment** **A: Perform task Based on the lab work- 20 Mark** **B: Spotting Based on tools and techniques- 10 marks** **C: Viva-voce (Based on principle/technology)-05 Marks**	**Managed by Course teacher as per Lab. Status.**

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART-A: Introduction

Program: Bachelor in Science *(Honors/Honors with Research)*	Semester–VIII	Session: 2024-25

1	Course Code	CHSE-09T	
2	Course Title	APPLICATION OF SPECTROSCOPY -II	
3	Course Type	DSE	
4	Pre-requisite(if,any)	*As per Program*	
5	Course Learning. Outcomes(CLO)	➢ *To interpret the vibrational spectra of molecules to identify functional groups and understand their bonding modes.* ➢ *To gain proficiency in analyzing NMR and ESR spectra to determine the structure and electronic environment of atoms within a molecule.* ➢ *To equip students with the ability to utilize Mössbauer spectroscopy for the characterization of iron-containing materials, analyzing their oxidation state and local environment.* ➢ *To develop the skills to interpret mass spectra, including fragmentation patterns, to determine the molecular weight and structure of unknown compounds.*	
6	Credit Value	03Credit	*Credit = 15 Hours - learning & Observation*
7	TotalMarks	Max.Marks:100	MinPassingMarks:40

PART-B: Content of the Course

Total No.ofTeaching–learningPeriods (01Hr.perperiod)

Module /Unit	Topics(Coursecontents)	No.of Period
I	**Vibrational Spectroscopy** Instrumentation and sample handling in IR Spectroscopy, Characteristic vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, ethers, phenols and amines. Detailed study of vibrational frequencies of carbonyl compounds (Ketones, aldehydes, esters, amides, acids, anhydrides, lactones, lactams and conjugated carbonyl compounds). Effect of hydrogen bonding and solvent effect on vibrational frequencies, overtones, combination bands and fermi resonance. FTIR. **Optical Rotatory Dispersion (ORD)and Circular Dichroism (CD)** Definition, deduction of absolute configuration, Octant rule for Ketone	12
II	**Nuclear Magnetic Resonance Spectroscopy** General introduction and definition, chemical shift, spin-spin interaction, shielding mechanism of measurement, chemical shift values and correlation for protons bonded to carbon (aliphatic, olefinic, aldehydic and aromatic) and other nuclei (alcohols, phenols, enols, carboxylic acids, amines, amides and mercapto), chemical exchange, effect of deuteration, complex spin-spin interaction between two, three, four and five nuclei (first order spectra), virtual coupling. Stereochemistry hindered rotation. **Carbon-13 NMR Spectroscopy** General consideration, chemical shift (aliphatic, olefinic alkyne, aromatic,	11

	heteroaromatic and carbonyl carbon), coupling constants. **Two-dimension NMR Spectroscopy:** COSY, NOESY, DEPT, INEPT, APT and INADEQUATE Techniques.	
III	**Electron Spin Resonance Spectroscopy** Hyperfine coupling, spin polarization for atoms and transition metal ions, spin-orbit coupling and significance of g-tensors, application to transition metal complexes (having one unpaired electron). **Mossbauer Spectroscopy** Basic principles, spectral parameters and spectrum display. Application of the technique to the studies of (1) bonding and structures of Fe^{+2} and Fe^{+3} compounds including those of intermediate spin, (2) Sn^{+2} and Sn^{+4} compounds - nature of M - L bond coordination number, structure and(3) Detection of oxidation state and inequivalent MBatoms.	11
IV	**Mass Spectrometry** Introduction, ion production - EI, CI, FD and FAB, factors affecting fragmentation, ion analysis, ion abundance. Mass spectral fragmentation of organic compounds, common functional groups, molecular ion peak, metastable peak, Mc Lafferty rearrangement.Nitrogenrule.High-resolution mass spectrometry.Examples of mass spectral fragmentation of organic compounds with respect to their structure determination.	11
Keywords	***Vibrational Spectroscopy, Infrared Spectroscopy (IR), Nuclear Magnetic Resonance (NMR), Carbon-13 NMR, Two-Dimensional NMR (COSY, NOESY, DEPT, etc.), Electron Spin Resonance (ESR), Mössbauer Spectroscopy, Mass Spectrometry, Functional Group Identification, Organic Structure Determination***	

Signature of Convener & Members (CBoS):

PART–C

LearningResources: Textbooks, Reference Books andOthers

Textbooks Recommended

1. *Chatwal, G. R., & Sharma, A. (2017). Instrumental Methods of Chemical Analysis. Himalaya Publishing House.*
2. *Sharma, Y. R. (2000). Infrared Spectroscopy: Fundamentals and Applications. Alpha Science Agency.*
3. *Aruldhas, B. R. (2007). Nuclear Magnetic Resonance Spectroscopy. Springer.*

Reference Books Recoomended

1. *Nakamoto, K. (2009). Infrared and Raman Spectra: Inorg. and coordination compounds. Wiley.*
2. *Parish, R. V., & Ellis, H. A. (1978). NMR, NQR, EPR and Mossbauer Spectroscopy. in Inorg. Chem. Ellis Horwood.*
3. *Martin, M. L., Delpeuch, J. J., & Martin, G. J. (1982). Practical NMR Spectroscopy. Heyden.*
4. *Silverstein, R. M., Bassler, G. C., & Morrill, T. C. (1991). Spec. Identification of Org. Compd. John Wiley.*
5. *Abraham, R. J., Fisher, J., & Loftus, P. (2011). Introduction to NMR Spectroscopy. Wiley.*
6. *Dyer, J. R. (1978). Application of Spectroscopy of Organic compounds. Prentice Hall.*
7. *Williams, D. H., & Fleming, I. (1990). Spectroscopic Methods in Org. Chem. Tata McGraw Hill.*

OnlineResources–e-Resources/e-booksande-learningportals

- https://swayam.gov.in/nd1_noc19_ch08/preview
- https://www.coursera.org/learn/spectroscopy-chemistry
- https://nptel.ac.in/courses/104/106/104106050/
- https://epathshala.nic.in/e-textbook/Class%20XI/Chemistry/ChemistryIEng.pdf

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Exam (ESE):	**70 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): 20 ~~+20~~ Assignment / Seminar - 10 Total Marks - 30	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10** x1= 10 Mark; **Q2**. Short answer type- 5x4 =20 **Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener and Members of CBoS

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART-A: Introduction				
Program: Bachelors in Science *(Honors/Honors with Research)*			Semester-VIII	Session:2024-25
1	Course Code	CHSE-09P		
2	Course Title	SPECTROSCOPY-II LAB. COURSE		
3	Course Type	DSE		
4	Pre-requisite(if,any)	*As per Program*		
5	Course Learning Outcomes(CLO)	➢ *Understand working principle of FTIR instrument and interpret FTIR spectrum.* ➢ *Interpretation of H- NMR spectra, Carbon-13 NMR and ESR spectra and identifying molecules based on chemical shifts and coupling constants.* ➢ *Interpretation of Mossbauer spectra and understanding its working principle.* ➢ *Understanding working principle of mass spectrometry and interpret mass spectrum.*		
6	Credit Value	01Credit	*Credit =30 Hours Laboratory or Field learning/Training*	
7	Total Marks	Max.Marks:50		MinPassingMarks:20

PART-B: Content of the Course

Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)

Module	Topics(Course contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course.	**FTIR** • To prepare the KBr pellet of an organic compound (such as benzoic acid). • To carry out a qualitative analysis of an organic compound (such as benzoic acid) using FTIR. • To identify IR absorption peaks and the corresponding functional groups of an unknown solid/liquid/powder. • To study the Optical Rotatory Dispersion (ORD) of some chiral substances.	30
	NMR and 13CNMR • To interpret the peaks and identify molecules/structures of NMR spectrums. • To interpret the peaks and identify molecule(s)/structures of ^{13}CNMR spectrums. • To interpret the peaks and identify molecules/structures based on both NMR and ^{13}CNMR spectrums.	
	ESR and Mossbauer • To interpret the peaks and identify the magnetic character of metal/ion based on ESR spectroscopy. • To determine the resonance magnetic field B_0 as function of the selected resonance frequency (v) and the g-factor of DPPH. • To determine the line width δB_0 of the resonance signal. • To interpret and understand the Mössbauer spectra of iron Fe and Sn complexes. • To interpret the peaks (signals) and identify metal/ions based on ESR and	

	Mössbauer spectroscopy.
	Mass Spectrometry • To interpret the mass spectrum and distinguish between different molecules (e.g., alcohols/ethers, aldehydes/ketones, acids, and other aromatic molecules). • To identify the unknown molecule(s) based on combined UV-visible, FTIR, NMR and mass spectrum data.
Keywords	***Vibrational spectroscopy, FTIR, Nuclear Magnetic Resonance (NMR), ^{13}CNMR, Electron spin Resonance (ESR Spectroscopy), Mössbauer spectroscopy, Mass Spectrometry, peaks, signals.***

Signature of Convener & Members (CBoS) :

PART–C

Learning Resources: Text Books, Reference Books and Others

Textbooks Recommended–

1. *Chatwal, G. R., & Sharma, A. (2017). Instrumental Methods of Chemical Analysis. Himalaya Publishing House. Sharma,*
2. *Y. R. (2000). Infrared Spectroscopy: Fundamentals and Applications. Alpha Science Agency.*
3. *Aruldhas, B. R. (2007). Nuclear Magnetic Resonance Spectroscopy. Springer.*

Reference Books Recommended

1. *Vij, D. R. (Ed.). (2007). Handbook of applied solid state spectroscopy. Springer Science & Business Media.*
2. *Guthrie, R. D. (1979). Introduction to Spectroscopy (Pavia, Donald; Lampman, Gary M.; Kriz, George S., Jr.).*
3. *Silverstein, R. M., Bassler, G. C., & Morrill, T. C. (1991). Spec. Identification of Org. Compd. John Wiley.*
4. *Parish, R. V., & Ellis, H. A. (1978). NMR, NQR, EPR and Mossbauer Spectros. in Inorg. Chem. Ellis Horwood.*

OnlineResources– e-Resources/e-booksande-learningportals

- https://www.scribd.com/document/431879132/Lab-Report-3-CHM-260
- https://www.scribd.com/document/68027365/Electron-Spin-Resonance-Experiment
- https://www.intechopen.com/chapters/76771
- https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/Supplemental_Modules_(Physical_and_Theoretical_Chemistry)/Spectroscopy/Magnetic_Resonance_Spectroscopies/Nuclear_Magnetic_Resonance/NMR%3A_Experimental/NMR_-_Interpretation

Part-D:AssessmentandEvaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 50 Marks
Continuous Internal Assessment(CIA): 15 Marks
EndSemester Exam(ESE): 35 Marks

Continuous InternalAssessment(CIA): (By Course Teacher)	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance -05 Total Marks - 15	Better marks out of the two Test / Quiz +obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam(ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **A. Performed the Task based on lab. work - 20 Marks** **B.Spotting based on tools & technology (written) – 10 Marks** **C.Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. Status**

Signature of Convener & Members CBoS :

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART-A: Introduction				
Program: Bachelors in Science *(Certificate/Diploma /Degree/Honors)*			Semester–VIII	Session:2024-25
1	CourseCode	CHSE-10T		
2	CourseTitle	SOLID STATE & NANOMATERIALS CHEMISTRY		
3	CourseType	DSE		
4	Pre-requisite(if,any)	*As per Program*		
5	CourseLearning. Outcomes(CLO)	➢ *Understand the origin and nature of defects and crystals, electrically conducting solids and superconductors.* ➢ *Apply the concept of band theory to explain the behavior of conductors.* ➢ *To compare bulk and nanomaterials, explain the role of size, shape, properties and uses of nanomaterials, describe various methods for synthesis of nanoparticles* ➢ *To describe the instrumentation/principle of various characterization techniques like EDAX, FTIR, SEM, TEM, etc and its application.*		
6	CreditValue	03Credits	*Credit = 15 Hours - learning & Observation*	
7	TotalMarks	Max.Marks:100		MinPassingMarks:40

PART-B: Content of the Course

TotalNo.of Teaching–learning Periods(01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics(Course contents)	No.of Period
I	**Crystal Defects and Non-Stoichiometry** Perfect and imperfect crystals, intrinsic and extrinsic defects-point defects, line and plane defects, vacancies - Schottky defects and Frenkel defects. Thermodynamics of Schottky and Frenkel defect formation, colourcentres, non-stoichiometry defects. **Organic Solids** Electrically conducting solids, organic charge transfer complex, organic metals, new superconductors.	12
II	**Electronic Properties and Band theory** Metals, insulators and semiconductors, electronic structure of solids – band theory, band structure of metals, insulators, and semiconductors. Intrinsic and extrinsic semiconductors, doping semiconductors, p-n junctions, super conductors. Optical properties- Optical reflectance, photoconduction - photoelectric effects. Magnetic properties-Classification of materials: Quantum theory of paramagnetism- cooperative phenomena - magnetic domains, hysteresis.	11
III	**Introduction to Nano-materials** Properties and uses of bulk and nano-materials; Optical, electrical and magnetic properties of nano-materials; quantum confinement, role of size and shape in nano-materials. Synthesis of nano-materials Synthesis of nano-crystals by reduction, solvo-thermal synthesis, photochemical synthesis, electrochemical synthesis, semiconductor nano-particles by arrested precipitation. Synthesis of nano-particles by green routes, thermolysis routes and sono-chemical routes, sol-gel, micelle and micro-	11

	emulsion methods.	
IV	**Characterization of nano-materials** Instrumentation, operating principle, and application of Energy dispersive X-ray spectroscopy (EDAX); FTIR; X-ray diffraction; Atomic Force Microscope (AFM); Scanning Electron Microscope(SEM); Transmission Electron Microscope (TEM); UV-VIS-IR spectroscopy, Thermogravimetric/Diffferential Thermal Analyzer (TG/DTA) **Applications of Nanomaterials:** Applications of nano in biology, nanoprobes for analytical applications, status of nanobiotechnology, future perspectives of nanobiology; nanosensors.	11
Keywords	***Nanomaterials, synthesis, characterization, applications, SEM, TEM, IR, UV-visible, TGA, DTA,nanosensors, nanotechnology.***	

Signature of Convener & Members (CBoS):

PART–C

Learning Resources: Text books, Reference Books and Others

Textbooks Recommended–

1. *Keer, H. V. (1993). Principles Of The Solid State. New Age International.*
2. *Rao, C. N. R., Müller, A., & Cheetham, A. K. (Eds.). (2006). The Chemistry Of Nanomaterials: Synthesis, Properties and Applications. John Wiley & Sons.*
3. *Kulkarni, S. K., & Kulkarni, S. K. (2015). Synthesis Of Nanomaterials—II (Chemical Methods). Nanotechnology: Principles And Practices, 77-109.*

Reeference Books Recommended–

1. *Hannay, N. B. (1973). Solid state chemistry. In Electronic Materials (pp. 505-534). Boston, MA: Springer US.*

OnlineResources–e-Resources/e-booksande-learningportals

- https://web.mit.edu/robertsilbey/research/papers/1981-1990/rsilbey_structure_properties_organic_solid_state.pdf
- https://chem.libretexts.org/Courses/Howard_University/General_Chemistry%3A_An_Atoms_First_Approach/Unit_5%3A_States_of_Matter/Chapter_12%3A_Solids/Chapter_12.04%3A_Crystal_Defects
- https://jiwaji.edu/pdf/ecourse/chemistry/Electronic%20Properties%20and%20Band%20%20Theory.pdf
- https://www.researchgate.net/publication/259118068_Chapter_-_INTRODUCTION_TO_NANOMATER

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 100 Marks

Continuous Internal Assessment (CIA): 30 Marks

End Semester Exam (ESE): 70 Marks

Continuous Internal Assessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): 20 /~~40~~ Assignment / Seminar - 10 Total Marks - 30	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1.** Objective – **10 x1= 10** Mark; **Q2.** Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener and Members of CBoS

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Science *(Honors/Honors with Research)*		**Semester - VII**		Session: 2024-2025
1	CourseCode	**CHSE-10P**		
2	CourseTitle	**NANOTECHNOLOGY AND SOLID STATE LAB. COURSE**		
3	CourseType	**DSE**		
4	Pre-requisite(if,any)	*As per Program*		
5	CourseLearning.Outcomes(CLO)	➢ *The consolidation of knowledge about the structure-property relationship of solids through the self-directed synthesis, structure and property determination* ➢ *To apply the knowledge gained on the synthesis, structure and function of solid-state compounds.* ➢ *To acquire knowledge to synthesize nanomaterials and interpret its characteristics.* ➢ *To acquire the knowledge of basic sciences required to understand the fundamentals of nanomaterials*		
6	CreditValue	**01Credit (Practical)**	*(Credit = 30Hrs laboratory or Field learning / training)*	
7	TotalMarks	**Max.Marks:50**		**MinPassingMarks:20**

PART-B: Content oftheCourse

TotalNo.ofTraining/performancePeriods (01Hr.perperiod)(30 Period 30hours)

Module	Topics(Coursecontents)	No.of Period
Lab./Field Training/ Experiment Contents of Course	Preparation of several solid-state compounds using different synthesis methods Characterization of the compounds by FTIR and X-ray diffraction Analysis of the crystal structures and the properties of the prepared solids Synthesis and characterization of nanoparticle of Fe_3O_4 by chemical method. Synthesis of graphene oxide from graphene by chemical methods. Synthesis of graphene oxide from graphene by green methods. Synthesis and characterization of Ag nano-particles by green method. Synthesis and characterization of Ag nano-particles by chemical method. Synthesis and characterization of Cu nano-particles by green method. Synthesis and characterization of Cu nano-particles by chemical method. Synthesis and characterization of Ni nano-particles by chemical method. Synthesis and characterization of Ni nano-particles by green method Microwave synthesis of materials. organic compounds. The Nano World. Nanomaterials and Their Synthesis. Characterization Methods for Studying Nanomaterials. Laboratory Safety and Scientific Report Writing.	30
Keywords	*X-ray Diffraction;Microwave Synthesis,Nanomaterails, Charecterization, Green Methods.*	

Signature of Convener & Members (CBoS):

PART–C

Learning Resources: Text Books, Reference Books and Others

TextBooks Recommended-

1. *Venkatraman, D., Mukhopadhyay, C., & Das, K. (2018).* ***Introduction to nanoscience and nanomaterials****. McGraw-Hill Education.*
2. *Byrappa, K., & Yoshimura, M. (2010).* ***Functional nanomaterials and devices****. Elsevier.*
3. *Kumar, S. (2018).* ***Green chemistry for sustainable development****. Springer Nature Singapore Pte Ltd.*

Reference Books Recommended-

1. Rao, C. N. R., Müller, A., & Cheetham, A. K. (2007). Nanomaterials chemistry. Wiley-VCH.
2. Chakravarty, A., & Singh, P. (2024). Green synthesis of nanomaterials: Biological and environmental applications. Wiley.
3. Sharon, M. (2018). **Green processes and sustainable chemistry**. Springer Nature Singapore Pte Ltd.
4. Anastas, P. T., & Warner, J. C. (1998). **Green chemistry: Theory and applications**. Oxford University Press.

OnlineResources–

- https://www.mdpi.com/books/reprint/4856-synthesis-and-characterization-of-nanomaterials
- https://swayam.gov.in
- https://epathshala.nic.in
- http://as.wiley.com/WileyCDA/WileyTitle/productCd-EHEP000803.html

Web Resources :-

Not Voodoo
The Safety Net
Comp Chem Website

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Exam (ESE):	**70 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): 20 ~~/20~~ Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of** 2 from each unit- **4x10=40 Marks**	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Science *(Honors/Honors with Research)*			**Semester - VIII**	Session: 2024-25
1	Course Code	CHSE-11T		
2	Course Title	NATURAL PRODUCTS & MEDICINAL CHEMISTRY		
3	Course Type	DSE		
4	Pre-requisite (if, any)	*As per Program*		
5	Course Learning. Outcomes (CLO)	➢ *To study the occurrence, types, structure, and analysis methods of terpenes and alkaloids and their biosynthesis* ➢ *To grasp key concepts in medicinal chemistry and drug terminology and learn importance of drug structure for activity.* ➢ *To explore specific drug classes and study the medicinal value of natural products*		
6	Credit Value	3 Credits	*Credit = 15 Hours - learning & Observation*	
7	Total Marks	Max. Marks: 100	Min Passing Marks: 40	

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**Natural Products- Class, Structure and biological importance** Introduction, Natural occurrence, Classification, Uses, general structural features, general methods for structure elucidation including Hoffmann's exhaustive methylation and Emde's method. Terpenes: Isoprene rule Classification of mono- sesqui-, di- and triterpenoids, extraction and biological importance (structure and functions of camphor, citral and α-pinene).	12
II	**Alkaloids and Biosynthesis** Alkaloids: Classification, isolation and biological importance (structure and functions of papaverine, nicotine, coniine). Introduction to biosynthesis: Principles and underlying concepts Building blocks and precursors in biosynthesis (acetate, mevalonate, shikimate, etc.), Enzymatic reactions and their roles in biosynthetic pathways (polyketide synthases, terpene synthases). Biosynthesis of flavonoids and related polyphenols.	11
III	**Introduction to Medicines** Definition of a Medicinal drug, Requirements of an ideal drug, Nomenclature of drugs: Generic name, Brand name, Systematic name Definition of the following medicinal terms: Pharmacon, Pharmacophore, Prodrug, Half-life efficiency, LD50, ED50, Therapeutic Index. (Explanation without including chemistry or structures) Brief idea of the following terms: Receptors, Drug-receptor interaction, Drug Potency, Bioavailability Structure-activity relationships of drug molecules, Quantiative-structure activity relationships (QSAR), binding role of –OH group,-NH_2 group, double bond, and aromatic ring.	11
IV	**Pharmaceutical Compounds** Classification, structure and therapeutic uses of antipyretics - Paracetamol (with	11

	synthesis); Analgesics-Ibuprofen (with synthesis); Antimalarials - Chloroquine (with synthesis); Antitubercular drugs - Isoniazid. An elementary treatment of Antibiotics and detailed study of chloramphenicol, Concept of sedation, hypnotics, and anesthesia Medicinal values of curcumin (haldi), azadirachtin (neem).	
Keywords	***Natural Products, Structure Elucidation, Terpenes & Alkaloids, Medicinal Chemistry, Drug Discovery, Structure-Activity Relationships (SAR), Pharmacokinetics & Pharmacodynamics, Drug Targets, Pharmaceutical Compounds***	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. *Singh, H., & Kapoor, V. K. (1996). Medicinal and Pharmaceutical Chemistry. Vallabh Prakashan.*
2. *Singh, J., Ali, S. M., & Singh, J. (2010). Natural Product Chemistry. Pragati Prakashan.*

Reference Books Recommended –

1. *Finar, I. L., & Finar, A. L. (1998). Organic Chemistry (Vol. 2). Addison-Wesley.*
2. *Foye, W. O., Lemke, T. L., & William, D. A. (1995). Principles of Medicinal Chemistry. B.I. Waverly Pvt. Ltd.*
3. *Hertweck, C. (2012). Natural Product Biosynthesis. Springer-Verlag Berlin Heidelberg.*
4. *Patrick, G. (2017). Introduction to Medicinal Chemistry. Oxford University Press.*

Online Resources–

- https://m.youtube.com/watch?v=H2b-2msgjEE)
- (https://www.genome.jp/kegg/)
- (https://pubchem.ncbi.nlm.nih.gov/)
- (https://onlinecourses.nptel.ac.in/noc23_cy58/preview)
- (https://archive.nptel.ac.in/courses/104/106/104106106/)
- (https://nptel.ac.in/courses/104105076)

Online Resources–

- **e-Resources / e-books and e-learning portals**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 100 Marks
Continuous Internal Assessment (CIA): 30 Marks
End Semester Exam (ESE): 70 Marks

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): 20 ~~/ 20~~ Assignment / Seminar - 10 Total Marks - 30	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Science *(Honors/ Honors with Research)*			**Semester - VIII**	Session: 2024-2025
1	Course Code	**CHSE-11P**		
2	Course Title	NATURAL PRODUCTS AAND MEDICINAL CHEMISTRY LAB. COURSE		
3	Course Type	**DSE**		
4	Pre-requisite (if, any)	*As per Program*		
5	Course Learning. Outcomes (CLO)	➢ *Demonstrate competence in determining the physicochemical properties of drugs relevant to their biological activity.* ➢ *Gain practical experience in the synthesis and characterization of common drugs.* ➢ *Develop skills in isolating natural products from plant sources and analyzing their purity.* ➢ *Evaluate the antimicrobial potential of natural product extracts or synthetic drugs.* ➢ *Integrate theoretical concepts of medicinal chemistry with laboratory techniques.*		
6	Credit Value	**1 Credits**	*Credit =30 Hours Laboratory or Field learning/Training*	
7	Total Marks	**Max. Marks: 50**		**Min Passing Marks: 20**

PART -B: Content of the Course		
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)		
Module	Topics (Course contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course	Determination the solubility of drug at room temperature Determination of pK_a of drug value by Half Neutralization/ Henderson Hassel Balch equation Determination of Partition of co- efficient of a drug in octanol(other solvent) and water Synthesis and Characterization of some common drugs: paracetamol, Aspirin (Acetylsalicylic Acid) etc Isolation & Characterization: Isolation of the product, determine the yield, and perform characterization using melting point and infrared (IR) spectroscopy. **Antimicrobial Activity Assay:** This practical could involve testing the inhibitory effect of a common antiseptic or a natural product extract on bacterial growth using an agar diffusion assay. Isolation of natural products: Caffeine from Tea Leaves, Pigments from Flowers, Essential Oils from Leaves, Curcumin from Turmeric	**30**
Keywords	***Physicochemical properties, Drug synthesis, Drug characterization, Natural product isolation, Spectroscopy, Antimicrobial activity, Solubility, Partition coefficient***	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. *Iyengar, M. S. (2009). Pharmacognosy and Phytomedicinal Plants. CRC Press. Organic Chemistry Laboratory Techniques. Pearson Education Limited.*
2. Gupta, Y. K. (2009). **Practical pharmaceutical chemistry - I.** CBS Publishers & Distributors Pvt. Ltd.

Reference Books Recommended –

1. *Stovall, J. C. (2010). Experimental Organic Chemistry: A Miniscale and Microscale Approach. Cengage Learning.*
2. *Martin, A. (2010). Physical Pharmacy (6th ed.). Lippincott Williams & Wilkins.*
3. *Parrott, E. L. (2009). Experimental Pharmaceutics. CRC Press.*

Online Resources–

- **e-Resources / e-books and e-learning portals**
- https://www.ncbi.nlm.nih.gov/books/NBK548557/
- https://www.sigmaaldrich.com/technical-documents/protocols/chemistry/drug-discovery-and-development/partition-coefficient-(log-p)-determination.html
- https://www.sciencedirect.com/science/article/pii/S0022354915332010
- https://www.chm.bris.ac.uk/webprojects2002/sleath/Synthesis.htm
- https://www.michiganstateuniversityonline.com/resources/chemistry/synthesis-and-characterization-of-aspirin/
- https://chem.libretexts.org/Courses/University_of_California_Davis/UCD_Chem_124A%3A_Kauzlarich/Text/04._Infrared_Spectroscopy/4.2%3A_IR_Spectroscopy_Analysis
- https://journals.asm.org/doi/pdf/10.1128/9781555818722.ch15
- https://www.michiganstateuniversityonline.com/resources/chemistry/isolation-of-caffeine-from-tea/
- https://www.life.illinois.edu/mcb/150/SP04/LabManual/natural_products.pdf

Online Resources–

- **e-Resources / e-books and e-learning portals**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): 10 & 10 Assignment/Seminar +Attendance - 05 Total Marks - 15	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 15 Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **S. Performed the Task based on lab. work - 20 Marks** **T. Spotting based on tools & technology (written) – 10 Marks** **U. Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART-A: Introduction				
Program: Bachelors in Science *(Honors/Honors with Research)*			Semester–VIII	Session:2024-2025
1	Course Code	CHSE-12T		
2	Course Title	INSTRUMENTAL METHODS OF ANALYSIS		
3	Course Type	DSE		
4	Pre-requisite (if, any)	*As per Program*		
5	CourseLearning. Outcomes(CLO)	➢ *Understand the importance of sampling and sample treatment.* ➢ *Select appropriate sampling technique based on sample and target analyte.* ➢ *Explain principle and instrumentation involved in AAS.* ➢ *Deduce the necessity to remove interferences in AAS and methods involved.* ➢ *Select proper technique among the available techniques.* ➢ *Formulate experiments based on optical and electroanalytical techniques.*		
6	Credit Value	03Credits	*Credit = 15 Hours - learning & Observation*	
7	Total Marks	Max.Marks:100		MinPassingMarks:40

PART-B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Module /Unit	Topics(Coursecontents)	No.of Period
I	**Sampling and sample treatment:** Criteria for representative sample. Techniques of sampling of gases (ambient air and exhaust gases), liquids (water and milk samples), solids (soil and coal samples) and particulates. Hazards in sampling. Safety aspects in handling hazardous chemicals. Sample dissolution methods for elemental analysis: Dry and wet ashing, acid digestion, fusion processes and dissolution of organic samples. Detection and quantification: Concepts and difference between sensitivity, limit of detection and limit of quantification, role of noise in determination of detection limit of analytical techniques. Methods of quantification: Absolute method, comparison method, calibration curve method, standard addition method and internal standard method.	11
II	**Polarography and amperometry** Polarography: Principle of DC polarography. Instrumentation in polarography. Advantages and limitations of DME. Types of currents- residual current, migration current, diffusion current, limiting current, adsorption current, kinetic current and catalytic current. Ilkovic equation-diffusion current constant and capillary characteristics. Derivation of equation of polarographic wave and half wave potential. Experimental determination of half wave potential. Reversible, quasi reversible and irreversible electrode reactions. Polarographic maxima and maximum suppressor. Oxygen interference and deaeration. Introduction to pulse, a.c. and oscillographic techniques and their advantages. Applications of polarography in determination of dissolved oxygen, metal ion quantification and speciation, simultaneous determination of metal ions, analysis of organic compounds. Limitations of polarography.	12

	Amperometric titrations: Principle, types and applications in analytical chemistry.	
III	**Atomic absorption spectroscopy**: Principle. Atomic energy levels. Grotrian diagrams. Population of energy levels. Instrumentation. Sources: Hollow cathode lamp and electrodeless discharge lamp, factors affecting spectral width. Atomizers: Flame atomizers, graphite rod and graphite furnace. Cold vapors and hydride generation techniques. Factors affecting atomization efficiency, flame profile. Monochromators and detectors. Beam modulation. Detection limit and sensitivity. Interferences and their removal. Comparison of AAS and flame emission spectrometry. Applications of AAS.	11
IV	**Miscellaneous techniques** **Fluorometry and phosphorimetry:** Principles of fluorescence and phosphorescence. Jablonski diagram. Concentration dependence of fluorescence intensity. Fluorescence quenching. Instrumentation. Applications. **Nephelometry and turbidimetry:** Principle, instrumentation, and applications. **Photoacoustic spectroscopy:** Theory. Instrumentation. Advantages over absorption spectroscopy. Chemical and surface applications of PAS	11
Keywords	***Sample, sample treatment, Polarography, Amperometry, Atomic absorption spectroscopy, Instrumentation, fluorometry, Phoshorimetry, Nephelometry, turbidimetry,Photoacoustic spectroscopy.***	

SignatureofConvener & Members (CBoS):

PART–C

LearningResources:Textbooks,ReferenceBooksandOthers

Textbooks Recommended–

1. *Bhatt, B. I., & Vora, S. M. (2008). Stoichiometry (2nd ed.). Tata McGraw-Hill Publishing Company Ltd.*
2. *Chatwal, G., & Anand, S. (2013). Instrumental methods of analysis. Himalaya Publishing House.*
3. *Khopkar, S. M. (2003). Basic concepts in analytical chemistry. New Age International Publishers*

Reference Books Recommended–

1. *Anderson, R. (1986). Sample pre-treatment and separation. John Wiley and Sons.*
2. *Bassett, J., Denney, R. C., Jeffery, G. H., & Mendham, J. (1986). Vogel's textbook of quantitative inorganic analysis. ELBS.*
3. *Braun, R. D. (2004). Instrumental methods of chemical analysis. Tata McGraw-Hill Education.*
4. *Christian, G. D. (2013). Analytical chemistry. Wiley India.*
5. *Day, R. A., & Underwood, A. L. (1986). Quantitative analysis. Prentice-Hall of India.*
6. *Ewing, G. W. (1975). Instrumental methods of chemical analysis. G. W. Ewing.*
7. *Meites, L., & Thomas, H. C. (1977). Advanced analytical chemistry. McGraw-Hill.*
8. *Meites, L., & Thomas, H. C. (1990). Advance analytical chemistry: Meites and Thomas. McGraw-Hill.*
9. *Skoog, D. A., & West, D. M. (1976). Fundamentals of analytical chemistry.*
10. *Shyder, L. R., & Harvath, C. H. (1983). An introduction to separation science. Wiley Interscience.*
11. *Sane, S. S., & Joshi, M. V. (2011). Electroanalytical chemistry. Quest Publications.*
12. *Kolthoff, I. M., & Lingane, J. J. (1952). Polarography.*

OnlineResources–e-Resources/e-booksande-learningportals

- https://people.umass.edu/~mcclemen/581Sampling.html
- https://nptel.ac.in/courses/104105084
- https://egyankosh.ac.in/bitstream/123456789/43329/1/Unit-8.pdf

- https://mvpsvktcollege.ac.in/wp-content/uploads/2022/11/1-TYAAS.pdf
- https://webstor.srmist.edu.in/web_assets/srm_mainsite/files/downloads/FLUORIMETRY.pdf
- https://courseware.cutm.ac.in/wp-content/uploads/2020/06/nephelometry-and-turbidimetry.pdf
- https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/Supplemental_Modules_(Physical_and_Theoretical_Chemistry)/Spectroscopy/Photoacoustic_Spectroscopy

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 100 Marks
Continuous Internal Assessment (CIA): 30 Marks
End Semester Exam (ESE): 70 Marks

Continuous Internal Assessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **20 ~~20~~** Assignment / Seminar - **10** Total Marks - 30	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts., **1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener and Members of CBoS

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART-A: Introduction				
Program: Bachelors in Science *(Honors/Honors with Research)*			Semester-VIII	Session:2024-2025
1	Course Code	CHSE-12P		
2	Course Title	INSTRUMENTAL METHOD OF ANALYSIS LAB. COURSE-		
3	Course Type	DSE		
4	Pre-requisite (if, any)	*As per Program*		
5	Course Learning Outcomes (CLO)	➢ *Understanding fundamental principles of polarography and amperometry.* ➢ *Understand the working principle of UV-visible and Atomic absorption spectroscopy.* ➢ *Handling and working with Fluorometer, understanding fluorescence quenching.* ➢ *Handling of flame photometer instrument.* ➢ *To determine concentration of ions in different samples by Nephelo-Turbidometry.*		
6	Credit Value	01Credit	*Credit =30 Hours Laboratory or Field learning/Training*	
7	Total Marks	Max.Marks:50		MinPassingMarks:20

PART-B: Content oftheCourse

Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)

Module	Topics(Course contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course.	**Polarography and Amperometry:** • Determination of half wave potential E1/2 and unknown concentration of Cu or Pb or Zn ion. • Amperometric titration of $Pb(NO_3)_2$ with $K_2Cr_2O_7$.	30
	Absorption spectroscopy: Experiment 7: Atomic Absorption Spectroscopy – Determination of the Amount of Copper and Zinc in a Brass Alloy Experiment 7: Atomic Absorption Spectroscopy – Determination of the Amount of Copper and Zinc in a Brass Alloy • Determination of absorption maxima and effect of solvents on absorption maxima of organic compounds. • To determine lambda max (λ_{max}) of phenol and effects of solvents on absorption spectra of phenol. • Assay of paracetamol by UV- Spectrophotometry • To determine the amount of Ca in a sample using the standard calibration curve- Atomic Absorption Spectroscopy (AAS).	
	Fluorimetry and Flame Photometry: • To perform the assay of Riboflavin tablets by fluorimetry • Estimation of quinine sulfate by fluorimetry • Study of quenching of fluorescence • To study the effect of concentration in fluorescence intensity of quinine	

	sulphate solution. • To determination concentration of sodium in given unknown sample by Flame photometry • To determination concentration of potassium in given unknown sample by Flame photometry
	Nephelometry and turbidimetry: • To determine phosphate ion concentration in water sample by Nephelo-Turbidometry. • To determine sulphate and/or chloride ion concentration in water sample by Nephelo-Turbidometry.
Keywords	***Polarography, Amperometry, Absorption Spectroscopy, Fluorimetry, Flame Photometry, Nephelometry, Turbidimetry, Fluorescence, Lambda Max, Absorbance, concentration.***

Signature of Convener & Members (CBoS) :

PART–C,

Learning Resources: TextBooks, Reference Books and Others

Textbooks Recommended–

1. *Sharma, B. K. (1981). Instrumental methods of chemical analysis. Krishna Prakashan Media.*
2. *Badwaik, H. R., Thote L.K.; Giri, T.K. (2022). Practical Handbook: Instrumental methods of analysis. Vallabh Prakashan. Delhi, India.*
3. *Sethi, P. D. (1985). Quantitative analysis of drugs in pharmaceutical formulations. Unique Publishers.*

Reference Books Recommended–

1. *Vogel, A. I., & Jeffery, G. H. (1989). Vogel's textbook of quantitative chemical analysis. (No Title).*
2. *Stenlake, J. B. (1976). Practical pharmaceutical chemistry. Athlone Press.*

OnlineResources– e-Resources/e-booksande-learningportals

- https://egyankosh.ac.in/bitstream/123456789/43329/1/Unit-8.pdf
- https://mlrip.ac.in/wp-content/uploads/2022/03/INSTRUMENTAL-METHODS-OF-ANALYSIS-LAB-MANUAL.pdf
- https://www.studyandscore.com/studymaterial-detail/flame-photometer-principle-components-working-procedure-applications-advantages-and-disadvantages
- https://www.youtube.com/watch?v=DFQd0Ncj76w
- https://www.studocu.com/en-ie/document/national-university-of-ireland-maynooth/analytical-chemistry/ch202-experiment-7-atomic-absorption-spectroscopy-determination-of-the-amount-of-copper-and-zinc/7019987
- https://www.scribd.com/document/434710621/EXP-4-AAS

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Exam (ESE):	**70 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1.** Objective – **10 x1**= 10 Mark; **Q2.** Short answer type- **5x4** =20 **Marks** Section B: Descriptive answer type qts., **1out of 2** from each unit-**4x10**=40 **Marks**	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Science *(Certificate / Diploma / Degree/Honors)*			Semester - I	Session: 2024-2025
1	Course Code	CHGE-01T		
2	Course Title	FUNDAMENTAL CHEMISTRY-I		
3	Course Type	GE		
4	Pre-requisite (if, any)	*As per Program*		
5	Course Learning. Outcomes (CLO)	➢ *To know the contributions of ancient Indian scientists, study atomic structure, and periodic properties.* ➢ *To explore the concept of chemical bonding, including ionic and covalent bonding, hybridization, molecular orbital theory and intermolecular interactions.* ➢ *To learn about reaction mechanisms of inorganic reactions and their stoichiometry.* ➢ *To understand different acid-base theories and solvent system.*		
6	Credit Value	3 Credits	*Credit = 15 Hours - learning & Observation*	
7	Total Marks	Max. Marks: 100		Min Passing Marks: 40

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**A. Chemistry in Ancient India:** (a) Chemical techniques in ancient India: General Introduction (b) Contribution of ancient Indian scientists in chemistry, e.g., metallurgy, dyes, pigments, cosmetics, Ayurveda, Charak Sanhita. **Ancient Indian Chemist-** Their Contribution and Books- Rishi Kanad, Aacharya Nagarjuna, Vagbhatta, Govindacharya, Yashodhar, Ramchandra, Somadava, Gopalbhatta etc. Indian Chemist of 19th century- Aacharya Prafulla Chandra Ray- His Contribution and work for Indian Chemistry. **B. Atomic Structure and Periodic Properties:** (i) Review of Bohr's theory and its limitations. Dual nature of particles and waves, de Broglie's equation, Heisenberg's Uncertainty principle and its significance. (ii) Quantum numbers and their significance. Rules for filling electrons in various orbitals, Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau principle and its limitations. Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals. Anomalous electronic configurations. (iii)Effective nuclear charge (ENC), shielding or screening effect, Slater rules, Atomic and Ionic radii. Ionization energy and factors affecting ionization energy. Electron affinity. Electronegativity- –Pauling's/Mulliken's electronegativity scales. Relation of electronegativity with hybridization.	11
II	**Chemical Bonding – I A) Ionic Bonding:** General characteristics of ionic bonding. **Ionic Bonding & Energy:** Lattice and solvation energies and their importance in the context of stability and solubility of ionic compounds. **Born-Haber Cycle and its Applications:** Covalent character in ionic compounds, polarizing power and polarizability. Fajan's rules. **B) Covalent Bonding:** Lewis structures, Valence Bond theory, Hybridization (concept and types with suitable examples), dipole moment and percentage ionic character. Valence shell electron pair repulsion theory (VSEPR) and structure of NH_3, H_2O, SF_4, ClF_3, PCl_5, SF_6, XeF_2, XeF_6, XeO_3, $XeOF_4$, XeF_4.	12

	Chemical Bonding - II **A) MO theory:** LCAO method-criteria of orbital, overlap, types of molecular orbitals-σ-, π- and, δ-MOs; formation of σ- and π-MOs and their, schematic illustration; qualitative MO energy, level diagram of homo- (N_2 & O_2(including peroxide, superoxide)) and hetero-diatomic molecules (NO, CO), magnetic properties, bond order and stability of molecules and ions. **B)** Weak Chemical Forces: van der Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interactions, Instantaneous dipole-induced dipole interactions. Repulsive forces, Hydrogen bonding (theories of hydrogen bonding, valence bond treatment).	
III	**A. Chemical properties of s-block metals** Reaction with water, air, and nitrogen, Anomalous behavior of Li and Be, Compounds of s-block metals: Oxides, hydroxides, peroxides, and superoxides (preparation and properties) Complexes of s-block metals, Complexes with crown ethers **B. Chemistry of p-Block Elements** **Boron group:** Hydrides (classification of boranes), Diborane (preparation, properties, and structure elucidation), Borazine (preparation and structure) **Carbon group:** Carbides (salt-like carbides, interstitial carbides, covalent carbides), Silicates (classification, three-dimensional silicates - properties and structures) **Nitrogen group:** Hydrides of Nitrogen (hydrazine, hydroxylamine, hydrazoic acid) Structure of oxides of nitrogen (N_2O, NO, NO_2, N_2O_4, and N_2O_5), Structure of oxyacids of nitrogen (HNO_2, HNO_3, $H_2N_2O_7$,), Nitrides (classification, preparation, properties, and uses) Structure of Oxides and oxoacids of phosphorus: (P_2O_3, P_2O_5) H_3PO_2, H_3PO_3, H_3PO_4, $H_4P_2O_7$ **Halogen:** Hydrides, Oxides and oxyacids of halogens (structure only) – Inter halogen compounds and pseudo halogens	11
IV	**Electronic Effects in Organic Compounds** Bond Cleavage: Homolytic and heterolytic cleavages, bond energy, bond length, and bond angle. Electron Displacement Effects: Inductive, inductomeric, electromeric, mesomeric (resonance), hyperconjugation, and steric effects. Tautomerism (keto-enol, amido-imidol, and nitro-acinitro forms). Reaction Intermediates: Formation and stability of carbocations, carbanions, free radicals, carbenes, nitrene and benzyne. **B. Stereochemistry of Organic Compounds** **i) Optical Isomerism** Elements of symmetry, chirality, enantiomers, and optical activity, Chiral and achiral molecules with two stereogenic centers (Tartaric acid as an example),Erythreo & Threo, Diastereomers and meso compounds, Inversion, retention, and racemization, Relative configuration (D/L), and absolute configuration (R/S nomenclature: sequence rules). **ii) Geometrical Isomerism** Geometric isomerism (cis-trans isomerism) in alkenes with examples (maleic acid, fumaric acid, and 2-butene), E/Z system of nomenclature.	11
Keywords	***Ancient Indian Chemistry, Atomic Structure, Periodic Properties, Chemical Bonding, s- &p-block elements, Electronic effects, Stereochemistry***	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –
Text Books

1. Puri, B. R., Sharma, L. R., & Kalia, K. C. (2018). *Principles of Inorganic Chemistry*. Nagin Chand and Co., New Delhi.
2. Satyaprakash, G., Tuli, S. K., Basu, S. K., & Madan, R. D. (2017). *Advanced Inorganic Chemistry* (Vol. 1, 5th Ed.). S. Chand & Company.
3. Lee, J. D. (2010). *Concise Inorganic Chemistry* (5th Ed.). Blackwell Science.
4. Housecroft, C. E., & Sharpe, A. G. (2012). *Inorganic Chemistry* (4th Ed.). Pearson Education Limited.

Reference Books

1. Cotton, F. A., Wilkinson, G., & Gaus, P. L. (2002). *Basic Inorganic Chemistry* (3rd Ed.). John Wiley & Sons.
2. Douglas, B. E., Mcdaniel, D. T., & Alexander, J. J. (1994). *Concepts and Models Of Inorganic Chemistry* (3rd Ed.). John Wiley & Sons.
3. Huheey, J. E., Keiter, E. A., & Keiter, R. L. (1993). *Inorganic Chemistry* (4th Ed.). Harpercollins College Publishers.
4. Shriver, D. F., Atkins, P. W., & Langford, C. H. (2010). *Inorganic Chemistry* (5th Ed.). W. H. Freeman And Company.
5. Moeller, T. (1990). *Inorganic Chemistry: A Modern Introduction*. Wiley.

Online Resources–

- https://bit.ly/3AyV3mZ
- https://nptel.ac.in/courses/104/104/104104101/
- https://nptel.ac.in/courses/104/103/104103019/
- https://nptel.ac.in/courses/104/101/104101090/
- https://nptel.ac.in/courses/104/105/104105103/

Online Resources–

- **e-Resources / e-books and e-learning portals**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Exam (ESE):	**70 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): 20 ~~+20~~ Assignment / Seminar - 10 Total Marks - 30	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1**= 10 Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Science *(Certificate / Diploma / Degree/Honors)*			**Semester - I**	Session: 2024-2025
1	**Course Code**	**CHGE-01P**		
2	**Course Title**	**Chemistry Lab. Course-I**		
3	**Course Type**	**GE**		
4	**Pre-requisite** (if, any)	*As per Program*		
5	**Course Learning. Outcomes (CLO)**	➢ *Analyze mixtures for cations (NH_4^+, Pb^{2+}, etc.) & anions (CO_3^{2-}, S^{2-}, etc.) using H_2S or other methods.* ➢ *Perform titrimetric analysis (standardization, unknown conc. determination).* ➢ *Estimate the concentration of acetic acid in vinegar (using NaOH), alkali content in antacids (using HCl), and free alkali in soaps/detergents.* ➢ *Utilize complexometric titrations for calcium (Ca^{2+}), water hardness, Fe^{2+}/Fe^{3+}, and Cu^{2+}.*		
6	**Credit Value**	**1 Credits**	*Credit =30 Hours Laboratory or Field learning/Training*	
7	**Total Marks**	**Max. Marks: 50**		**Min Passing Marks: 20**

PART -B: Content of the Course

Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)

Module	Topics (Course contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course	**QUALITATIVE INORGANIC MIXTURE ANALYSIS:** Inorganic mixture analysis containing up to four ionic species (two cations and two anions) using H_2S (hydrogen sulfide) or other appropriate methods (Excluded are interfering and insoluble salts) Cations and anions that may be encountered include: **Cations:** NH_4^+, Pb^{2+}, Bi^{3+}, Cu^{2+}, Cd^{2+}, Fe^{2+}/Fe^{3+}, Al^{3+}, Co^{2+}, Ni^{2+}, Mn^{2+}, Zn^{2+}, Ba^{2+}, Sr^{2+}, Ca^{2+}, Na^+ **Anions:** CO_3^{2-}, S^{2-}, SO_4^{2-}, NO_3^-, CH_3COO^-, Cl^-, Br^-, I^-, NO_2^-, SO_3^{2-} (Spot tests may be used wherever feasible.) **TITRIMETRIC ANALYSIS** Standardize sodium hydroxide solution using a standard oxalic acid solution. Determine the concentration of hydrochloric acid (HCl) solution using standardized sodium hydroxide solution as an intermediate.	30
Keywords	*Qualitative Analysis (H_2S method, Cations (NH_4^+, Pb^{2+}, etc.), Anions (CO_3^{2-}, S^{2-}, etc.), Titrimetric Analysis, Standardization (NaOH solution), Concentration Determination (HCl solution)*	

Signature of Convenor & Members (CBoS) :

Indira

PART–C: Learning Resources

Text Books, Reference Books and Others

Textbooks Recommended:

1. Gurtu, J. N., & Kapoor, R. (1987). *Experimental Chemistry*. S. Chand & Co.
2. Bajpai, D. N., Pandey, O. P., & Giri, S. (2013). *Practical Chemistry*. S. Chand & Co.
3. Ahluwalia, V. K., Dhingra, S., & Dhingram, S. (2005). *College Practical Chemistry*. Universities Press.
4. Kamboj, P. C. (2014). *Advanced University Practical Chemistry* (Part I). Vishal Publishing Co.
5. Fultariya, C., & Harsora, J. (2017). *Volumetric Analysis: Concepts and Experiments*.

Reference Books Recommended:

1. Mcpherson, P. A. (2015). *Practical Volumetric Analysis*. Royal Society Of Chemistry.
2. Shobha, R., & Banani, M. (2017). *Essentials of Analytical Chemistry*. Pearson.
3. Venkateswaran, V., Veeraswamy, R., & Kulandaivelu, A. R. (2004). *Basic Principles Of Practical Chemistry* (2nd Ed.). S. Chand Publications.
4. Sundaram, S., & Raghavan, K. (1996). *Practical Chemistry*. S. Viswanathan Co. Pvt.
5. Svehla, G. (2011). *Vogel's Textbook of Inorganic Qualitative Analysis* (7th Ed.). Pearson Education

Online Resources–

- https://bit.ly/3B7tOQV
- https://bit.ly/30V85ze
- https://bit.ly/3B5WQIQ
- https://bit.ly/3C9PXPS
- https://bit.ly/30Ip9rZ
- https://bit.ly/3BPnwqc

Online Resources–

- **e-Resources / e-books and e-learning portals**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - **05** Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** A. Performed the Task based on lab. work - **20 Marks** B. Spotting based on tools & technology (written) – **10 Marks** C. Viva-voce (based on principle/technology) - **05 Marks**	Managed by Course teacher as per lab. status

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Science *(Certificate / Diploma / Degree/Honors)*			**Semester - II**	Session: 2024-2025.
1	**Course Code**	**CHGE-02T**		
2	**Course Title**	**FUNDAMENTAL CHEMISTRY-II**		
3	**Course Type**	**GE**		
4	**Pre-requisite** (if, any)	*As per Program*		
5	**Course Learning. Outcomes (CLO)**	➢ *To understand different acid-base theories and solvent system .* ➢ *To learn the preparation, bonding, and reactions of C-C σ- & π-bonded compounds* ➢ *To understand the concept and chemistry of aromatic compounds and their reactions* ➢ *To learn the basic concepts of various states of matter &understand the basic concepts of surface chemistry and chemical kinetics*		
6	**Credit Value**	**3 Credits**	*Credit = 15 Hours - learning & Observation*	
7	**Total Marks**	**Max. Marks: 100**	**Min Passing Marks: 40**	

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**Acid, Base and Solvent System** **Theories of acids and bases**: Arrhenius, Bronsted-Lowry, conjugate acids and bases, relative strengths of acids and bases, the Lux-flood, solvent system and Lewis concepts of acids and bases. **HSAB concept**: Classification of Acids and Bases According to HSAB Theory (Hard, Borderline, Soft). Applications of HSAB Theory in Inorganic Reactions - Solubility, Selectivity, Redox Reactions Non-aqueous solvents: .Physical properties of a solvent, types of solvents and their general characteristics, Liquid ammonia as a solvent. Acid-base, precipitation and complex, formation reactions. Solutions of alkali and alkaline earth metals in ammonia-application)	11
II	**CHEMISTRY OF C-C σ–BONDING** Alkanes: Preparation (Wurtz reaction, reduction/hydrogenation of alkenes, Corey-House method). Reactions (mechanisms): halogenation, free radical substitution. Cycloalkanes: Preparation (Dieckmann's ring closure, reduction of aromatic hydrocarbons), Reactions (mechanisms): substitution and ring-opening reactions. Stability of cycloalkanes -Baeyer's strain theory, Sachse and Mohr predictions, Conformational structures of ethane, n-butane and cyclohexane. **CHEMISTRY OF C-C π–BONDING** Alkenes: Preparation methods (dehydration, dehydrohalogenation, dehydrogenation, Hoffmann and Saytzeff rules, cis and trans eliminations). Reactions (mechanisms): electrophilic and free radical addition (hydrogen, halogen, hydrogen halide, hydrogen bromide, water, hydroboration, ozonolysis, dihydroxylation with $KMnO_4$). Dienes: 1,2- and 1,4-additions, Diels-Alder reactions. Alkynes: Preparation (dehydrohalogenation, dehydrogenation), Reactions: Acidity, formation of acetylides, addition of water, hydrogen halides and halogens, oxidation, ozonolysis, hydroboration/oxidation.	12

	Aromatic Hydrocarbons Aromatic hydrocarbons: Aromaticity: Hückel's rule, aromatic character of arenes, cyclic carbocations/ carbanions and heterocyclic compounds with suitable examples. Electrophilic aromatic substitution: halogenation, nitration, sulphonation and Friedel-Crafi's alkylation/acylation with their mechanism. Directive effects of the groups.	
III	**Behaviour of ideal gases:** Kinetic theory of gases – postulates and derivation of the equation, $PV = 1/3\ mnc^2$ and derivation of the gas laws- Maxwell's distribution of molecular velocities-effect of temperature-types of molecular velocities-degrees of freedom-Principle of equipartition of energy. **Behaviour of Real gases:** Deviation from ideal behaviour, derivation of van der Waals, equation of state and critical constants. **Liquid state chemistry:** structure of liquids(Eyring Theory), Properties of liquids, viscosity and surface tension. **Solid state chemistry:** Nature of the solid state, law of constancy of interfacial angles, law of rational indices, Miller indices, elementary ideas of symmetry, symmetry elements and symmetry operations, seven crystal systems and fourteen Bravais lattices; X-ray diffraction, Bragg's law, Crystal defects.	11
IV	**A. Colloids and surface chemistry:** Classification, Optical, Kinetic and Electrical Properties of colloids, Coagulation, Hardy Schulze law, flocculation value, Protection, Gold number, Emulsion, micelles and types, Gel, Syneresis and thixotropy, Physical adsorption, chemisorption, **B. Chemical kinetics:** Rate of reaction, Factors influencing rate of reaction, rate law, rate constant, Order and molecularity of reactions, rate determining step, Zero, First and Second order reactions, Rate and Rate Law, methods of determining order of reaction, Chain reactions. Temperature dependence of reaction rate, Arrhenius theory, Physical significance of Activation energy, collision theory, demerits of collision theory, non-mathematical concept of transition state theory. **C. Catalysis:** Homogeneous and Heterogeneous Catalysis, types of catalyst, characteristics of catalyst, Enzyme catalyzed reactions, Industrial applications of catalysis.	11
Keywords	***Acid & Bases, Alkanes, Cycloalkanes, Alkenes, Dienes, Alkynes, Aromatic Hydrocarbons, Kinetic theory of gases, Real gases, Intermolecular forces, Crystal structure, Chemical kinetics***	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Textbooks Recommended:

1. Bahl, A., & Bahl, B. S. (2014). *Organic Chemistry* (22nd Ed.). S. Chand & Sons.
2. Ahluwalia, V. K., & Goyal, M. (2001). *A Textbook of Organic Chemistry*. Narosa Publishing House.
3. Jain, M. K., & Sharma, S. C. (2017). *Modern Organic Chemistry*. Vishal Publishing Company.
4. Puri, B. R., Sharma, L. R., & Pathania, M. S. (2013). *Principles of Physical Chemistry* (46th Ed.). Shoban Lal Nagin Chand And Co.
5. Bahl, B. S. A., & Tuli, G. D. (2009). *Essentials of Physical Chemistry* (Multicolour Ed.). S. Chand & Company Pvt Ltd.
6. Puri, B. R., Sharma, L. R., & Kalia, K. C. (2018). *Principles of Inorganic Chemistry*. Nagin Chand and Co., New Delhi.

Reference Books Recommended:

1. Paula, B. Y. (2014). *Organic Chemistry* (7th Ed.). Pearson Education, Inc. (Singapore).
2. Solomons, T. W. G. (2017). *Organic Chemistry* (Global Ed.). John Wiley & Sons.

3. Morrison, R. T., & Boyd, R. N. (2010). *Organic Chemistry* (7th Ed.). Prentice-Hall Of India Limited.
4. Laidler, K. J., & Meiser, J. H. (2006). *Physical Chemistry* (2nd Indian Ed.). CBS Publishers.
5. Atkins, P. W., & De Paula, J. (2006). *Physical Chemistry* (8th Ed.). Oxford University Press.
6. Dogra, S., & Dogra, S. (2006). *Physical Chemistry through Problems* (2nd Ed.). New Age International.
7. Sangaranarayanan, M. V., & Mahadevan, V. (2011). *Textbook of Physical Chemistry*. University Press.

Online Resources–

- **Online Resources–**
- **https://bit.ly/3Gb99iy**
- **https://www.organic-chemistry.org/**
- **https://bit.ly/3GduvMi**
- **https://bit.ly/30TXm8d**
- **Web Resources**
- **https://application.wiley-vch.de/books/sample/3527316728_c01.pdf**
- **https://www.ncbi.nlm.nih.gov/books/NBK547716/**

Online Resources–

- **e-Resources / e-books and e-learning portals**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Exam (ESE):	**70 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **20 ≠20** Assignment / Seminar - 10 Total Marks - 30	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts., **1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Science *(Certificate / Diploma / Degree)*			**Semester - II**	Session: 2024-2025
1	**Course Code**	**CHGE-02P**		
2	**Course Title**	Chemistry Lab. Course-II		
3	**Course Type**	GE		
4	**Pre-requisite** (if, any)	*As per Program*		
5	**Course Learning. Outcomes (CLO)**	➢ *Demonstrating and using common glassware for accurate measurements* ➢ *Studying the functional group analysis organic compounds* ➢ *Determining melting points to assess compound purity and employing distillation and sublimation techniques to establish boiling points* ➢ *Equipping with essential skills in measuring liquid surface tension and solution viscosity*		
6	**Credit Value**	**1 Credits**	*Credit =30 Hours Laboratory or Field learning/Training*	
7	**Total Marks**	**Max. Marks: 50**	**Min Passing Marks: 20**	

PART -B: Content of the Course

Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)

Module	Topics (Course contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course	**Basic Laboratory Techniques** Demonstration of Laboratory Glassware and Equipment, Calibration of Thermometer : 80-82°C (Naphthalene), 113.5°-114°C (Acetanilide), 132.5°C - 133°C (Urea), 100°C (Distilled Water) **Functional group Analysis of Organic Compounds,** Detection of elements (N, S, and halogens) and functional groups **Physical chemistry** Surface tension measurements: Determine the surface tension by (i) drop number (ii) drop weight method. Surface tension composition curve for a binary liquid mixture. Viscosity measurement using Ostwald's viscometer, Determination of viscosity of aqueous solutions of (i) sugar (ii) ethanol at room temperature. Study of the variation of viscosity of sucrose solution with the concentration of solute. Viscosity Composition curve for a binary liquid mixture	30
Keywords	*Basic laboratory techniques, Equipments, Calibration, Melting points, Qualitative analysis, Physical chemistry, Surface tension, Viscosity*	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Textbooks Recommended:

1. Ahluwalia, V. K., Dhingra, S., & Gulati, A. (N.D.). *College Practical Chemistry*. University Press.
2. Khosla, B. D., Garg, V. C., & Gulati, A. (2011). *Senior Practical Physical Chemistry*. R. Chand & Co.

Reference Books Recommended:

1. Garland, C. W., Nibler, J. W., & Shoemaker, D. P. (2003). *Experiments in Physical Chemistry* (8th Ed.). Mcgraw-Hill.
2. Mendham, J. (2009). *Vogel's Quantitative Chemical Analysis* (6th Ed.). Pearson Education.
3. Mann, F. G., & Saunders, B. C. (2009). *Practical Organic Chemistry*. Pearson Education.
4. Furniss, B. S., Hannaford, A. J., Smith, P. W. G., & Tatchell, A. R. (2012). *Practical Organic Chemistry* (5th Ed.). Pearson Education.

Online Resources–

- http://heecontent.upsdc.gov.in/Home.aspx
- https://nptel.ac.in/courses/104/106/104106096/
- http://heecontent.upsdc.gov.in/Home.aspx
- https://nptel.ac.in/courses/104/106/104106096/
- https://www2.chemistry.msu.edu/faculty/reusch/VirtTxtml/introl.htm
- https://nptel.ac.in/courses/104/103/104103071/W

Online Resources–

- **e-Resources / e-books and e-learning portals**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - **05** Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **D. Performed the Task based on lab. work - 20 Marks** **E. Spotting based on tools & technology (written) – 10 Marks** **F. Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM(2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART-A: Introduction				
Program: Bachelor in Science *(Certificate / Diploma / Degree/Honors)*			Semester-I/III/V	Session: 2024-2025
1	Course Code	CHVAC		
2	Course Title	Chemistry in Daily Life		
3	Course Type	Value Added Course(VAC)		
4	Pre-requisite(if,any)	*As per Program*		
5	Course Learning Outcomes(CLO)	➢ *To introduce the student about dairy product,beverages,food additives, artificial sweeteners, flavors, food colorants, paints, pigments, dyes etc.* ➢ *To make aware the students about air pollution, hydrological cycle, composition of soil, fertilizers etc.* ➢ *To introduce the students about carbohydrate, vitamins,drugs.* ➢ *To introduce students about concept of thermodynamics used in day to day life.*		
6	Credit Value	2 Credits	*Credit = 15 Hours -learning & Observation*	
7	Total Marks	Max.Marks:50		Min Passing Marks:20

PART -B: Content of the Course

TotalNo.of Teaching–learning Periods(01 Hr. per period) - 30 Periods (30 Hours)

Unit	Topics(Course contents)	No. of Period
I	**Dairy Products:** Composition of milk and milk products. Analysis of fat content, minerals in milk and butter. Estimation of added water in milk. **Beverages:** Analysis of caffeine in coffee and tea, detection of chicory in coffee, chloral hydrate in toddy, estimation of methyl alcohol in alcoholic beverages. **Food additives, adulterants and contaminants:** Food preservatives like benzoates, propionates, sorbates, disulphites. **Artificial sweeteners:** spartame, saccharin, dulcin, sucralose and sodium cyclamate. **Flavors:** Vanillin, alkyl esters (fruit flavours) and monosodium glutamate. Artificial food colorants: Coal tar dyes and non-permitted colours and metallic salts. Analysis of pesticide residues in food. **Paints & Pigments:** White pigments (white lead, ZnO, lithopone, TiO_2). Blue, red, yellow and green pigments. Paints and distempers: Requirement of a good paint. Emulsion, latex; luminescent paints. Fire retardant paints and enamels, lacquers. Solvents and thinners for paints. **Dyes:** Colour and constitution (electronic concept). Classification of dyes. Methods of applying dyes to the fabrics. A general study of azo dyes, Mordant brown, Congo red and methyl orange.	08
II	**Air Pollution:** Air pollutants, prevention and control, Greenhouse gases and acid rain. Ozone hole and CFC's. Photochemical smog and PAN. Catalytic converters for mobile sources. Bhopal gas tragedy. Hydrologic cycle, sources, criteria and standards of water quality - safe drinking water. Public health significance and measurement of water quality parameters - (Colour, turbidity, total solids, acidity, alkalinity, hardness, sulphate, fluoride, phosphate, nitrite, nitrate, BOD and COD). Water purification for drinking and industrial purposes. Toxic chemicals in the environment. Detergents - pollution aspects, eutrophication. Pesticides and insecticides - pollution aspects. Heavy metal pollution. Solid pollutants - treatment and disposal. Treatment of industrial liquid wastes. Sewage and industrial effluent treatment.	07

	Composition of soil – inorganic and organic components in soil - micro and macronutrients. **Fertilizers:** Classification of fertilizers - Straight Fertilizers, Compound/Complex Fertilizers, Fertilizer Mixtures. Manufacture and general properties of fertilizer products - Urea and DAP.	
III	**Carbohydrates**: Structure, function and Chemistry of some important mono and disaccharides. **Vitamins:** Classification and Nomenclature.Sources, deficiency diseases and structures of Vitamin A_1, Vitamin B_1,VitaminC, Vitamin D, Vitamin E &Vitamin K_1. **Drugs:** Classification and nomenclature. Structure and function of: *Analgesics* –aspirin, paracetamol. *Anthelmentic drug*:mebendazole. *Antiallergic drug:* Chloropheneramine maleate. *Antibiotics:*PenicillinV,Chloromycetin,Streptomycin. *Anti-infalmmatory agent:* Oxypheno-butazone. *Antimalarials:* Primazuine phosphate & Chloroquine. **Oils and fats:** Composition of edible oils, detection of purity, rancidity of fats and oil. Tests for adulterants like aregemone oil and mineral oils. **Soaps & Detergents:** Structures and methods of use of soaps and detergents.	08
IV	**Chemical Thermodynamics**: Concept of fugacity and free energy, Activity and activity coefficient, spontaneity of processes-entropy and free energy changes. Partial molar quantities, colligative properties, Le-Chatelier principle, phase equilibrium. Enzyme catalyzed reactions. **Principles of Reactivity**: Basis kinetic concepts, rates of simple and complex chemical reactions, empirical rate equations.Temperature dependence of rates and activation parameters. Branched chain reactions – explosion limits. Oscillatory reactions. **Chemical energy system** and limitations, principles and applications of primary & secondary batteries and fuel cell. Basics of solar energy, future energy storer. aerospace materials. Problems of plastic waste management.Strategies for the development of environment friendly polymers.	08
Keywords	***Air pollution, carbohydrate,vitamins, LeChatteliar's law, Dairy product, artificial sweeteners. fertilizers,Paint,pigment ,dyes.***	

SignatureofConvener&Members (CBoS):

PART–C:Learning Resources

Text Books, Reference Books and Others

Text Books Recommended:

1. Sharma, B. K. (1998). Introduction to Industrial Chemistry. Meerut: Goel Publishing.

2. Many, N. S., & Swamy, S. (1998). Foods: Facts and Principles (4th ed.). New Age International.

3. Kar, A. (2022). Medicinal Chemistry. NEW AGE International Pvt Ltd

Reference books Recommended:

1. Drugs and Pharmaceutical Sciences Series. (Year). Marcel Dekker, Vol. II. New York: INC.

2. Atkins, P., & de Paula, J. (2002). Physical Chemistry (7th ed.). Oxford University Press.

3. Swaminathan, & Goswamy. (2001). Handbook on Fertilizer Technology (6th ed.). FAI.

4. Finar, I. L. (Year). Organic Chemistry (Vol. 1&2).

5. Fired, J. R. (Year). Polymer Science and Technology. Prentice Hall.

Online Resources:

https://onlinecourses.swayam2.ac.in/nos22_sc23/preview

https://www.researchgate.net/publication/343585969_Chemistry_in_Everyday_Life

https://www.youtube.com/watch?v=P3p1C87gc0U

https://www.slideshare.net/sanjaijosephManesh/food-chemistry-51688453

PART-D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 50 Marks

Continuous Internal Assessment(CIA):15 Marks

End Semester Exam(ESE):35Marks

Continuous InternalAssessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **10 &10** Assignment/Seminar +Attendance- **05** Total Marks -**15**	Better marks out of thetwo Test / Quiz+obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1.** Objective – **05 x1= 05** Mark; **Q2.** Short answer type- **5x2 =10Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x05=20Marks**	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART-A: Introduction				
Program: Bachelor in Science *(Certificate / Diploma / Degree)*			**Semester - II/IV/V/VI**	Session: 2024-2025
1	Course Code	CHSEC		
2	Course Title	GREEN CHEMISTRY		
3	Course Type	SEC		
4	Pre-requisite(if, any)	*As per Program*		
5	Course Learning. Outcomes(CLO)	➢ *Understand needs, goals, and obstacles in green chemistry.* ➢ *Understand and application of twelve principles of chemistry.* ➢ *Design green solvents and green reactions.* ➢ *To interpret and execute case study, survey, and projects on Green Chemistry.*		
6	Credit Value	2 Credits (1C + 1C)	*Credit = 15 Hours –Theoretical learning and = 30 Hours Laboratory or Field learning/Training.*	
7	Total Marks	Max.Marks:50		Min Passing Marks:20

PART -B: Content of the Course

Total No.of Teaching–learning Periods:
Theory–15 Periods (15 Hrs.) and Lab. or Field learning/Training 30Periods (30 Hours)

Module	Topics (Course contents)	No. of Period
Theory Contents	**Introduction to Green Chemistry:** What is Green Chemistry? Need for Green Chemistry. Goals of Green Chemistry. Limitations/ Obstacles in the pursuit of the goals of Green Chemistry. **Principles of Green Chemistry and Designing a Chemical synthesis:** Twelve principles of Green Chemistry with their explanations and examples and special emphasis on the following: • Designing a Green Synthesis using these principles; Prevention of Waste/ by products; maximum incorporation of the materials used in the process into the final products, Atom Economy, addition, substitution, and elimination reactions. • Prevention/ minimization of hazardous/ toxic products reducing toxicity, and risks (hazard × exposure); waste or pollution prevention hierarchy. • Green solvents– supercritical fluids, water as a solvent for organic reactions, ionic liquids, fluorous biphasic solvent, PEG, solventless processes, immobilized solvents and how to compare greenness of solvents. **Future Trends in Green Chemistry:** Oxidation reagents and catalysts; Biomimetic, multifunctional reagents; Combinatorial green chemistry; Proliferation of solventless reactions; Green chemistry in sustainable development.	15
Lab./Field Training Contents	• Green Synthesis of the following compounds: adipic acid, catechol, disodium iminodiacetate (alternative to Strecker synthesis). • Microwave assisted reactions in water: Hofmann elimination, methyl benzoate to benzoic acid, oxidation of toluene and alcohols; microwave assisted reactions in organic solvents Diels-Alder reaction and Decarboxylation reaction. • Right fit pigment: synthetic azo pigments to replace toxic organic and inorganic pigments. • An efficient, green synthesis of a compostable and widely applicable plastic (poly lactic acid) made from corn.	30

	Case study/Project Case study/Project on Green chemistry, Role of green chemistry in lab safety, and implications of green chemistry.	
Keywords	***Green chemistry, Green synthesis, Green solvents, Green reactions, principles of Green chemistry, Hofmann elimination, Diels-Alder reaction, oxidation, and reduction.***	

Signature of Convener &Members (CBoS):

PART–C:Learning Resources

Text Books, Reference Books and Others

Textbooks Recommended–

1. *Ahluwalia, V.K. (2013). Green chemistry: A textbook.Alpha Science International.*
2. *Shukla, S., Gulati, S., & Batra, S.K. (2020). A textbook of green chemistry: benign by design. Shree kala Prakashan.*
3. *Kumar, V. (2013). An introduction to green chemistry. Vishal publishing Co.*
4. *Lancaster, M. (2020). Green chemistry: an introductory text. Royal society of chemistry.*

Reference books Recommended:

1. *Perosa, A., & Zecchini, F. (2007). Methods and reagents for green chemistry: an introduction. John Wiley & Sons.*
2. *Clark, J. H., & Macquarrie, D. J. (Eds.). (2008). Handbook of green chemistry and technology. John Wiley & Sons.*
3. *Ameta, S. C., & Ameta, R. (Eds.). (2023). Green Chemistry: Fundamentals and Applications. CRC press.*
4. *Anastas, P. T. (Ed.). (2013). Handbook of green chemistry (Vol. 1). Wiley-VCH.*

Online Resources- e-Resources / e-books and e-learning portals

- https://www.mygreenlab.org/uploads/2/1/9/4/21945752/gc_-_green_chem_guide-_beyond_benign___my_green_lab.pdf
- https://www.organic-chemistry.org/topics/green-chemistry.shtm
- https://royalsocietypublishing.org/doi/10.1098/rsos.191378
- https://www.gvsu.edu/labsafety/green-chemistry-99.htm

PART-D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:
Maximum Marks: 50 Marks
Continuous Internal Assessment(CIA):15 Marks
End Semester Exam(ESE): 35Marks

Continuous Internal Assessment(CIA): (By Course Coordinator)	Internal Test / Quiz-(2): **10 &10** Assignment/Seminar +Attendance- 05 Total Marks -**15**	Better marks out of the two Test / Quiz +obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **A. Performed the Task based on learned skill - 20 Marks** **B. Spotting based on tools (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Coordinator as per skilling**

Name and Signature of Convener & Members of CBoS:

FOURTH YEAR UNDER GRADUATE PROGRAM(NEP–2020)

Program: Bachelor of Science (2024-28)

DISCIPLINE– MATHEMATICS

Session–2024- 25

DSC -01 to08		DSE-01to12		DGE-01&02	
Code	**Title**	**Code**	**Title**	**Code**	**Title**
MASC-01	Elementary Calculus	MASE-01	Advanced Calculus	MAGE-01	Elementary Calculus
MASC-02	Algebra	MASE-02	Mechanics	MAGE-02	Algebra
MASC-03	Differential Equations	MASE-03	Numerical Methods		
MASC-04	Abstract Algebra	MASE-04	Number Theory	SEC	
MASC-05	Real Analysis	MASE-05	Integral Transforms	MASEC-01	Introduction to Latex
MASC-06	Metric Spaces	MASE-06	Topology	MASEC-02	Python
MASC-07	Advanced Real Analysis	MASE-07	Complex Analysis - I		
MASC-08	Advanced Abstract Algebra	MASE-08	Discrete Mathematics	VAC	
		MASE-09	Measure Theory	MAVAC-01	Basic Mathematics and Logic
		MASE-10	General and Algebraic Topology		
		MASE-11	Complex Analysis - II		
		MASE-12	Graph Theory		

Program Outcomes(PO):

PO1: Ability to develop scientific temper and acquire in-depth knowledge of algebra, calculus, real analysis, complex analysis, topology and several other branches of mathematics. This program helps learners in building a solid foundation for higher studies in mathematics.

PO2: Utilize mathematics to solve theoretical and applied problems by critical thinking, understanding, analysis and synthesis.

PO3. The skills and knowledge gained has intrinsic beauty, which also leads to proficiency in analytical reasoning. This can be utilized in modeling and solving real life problems.

PO4. Ability to apply mathematical tools in Physics, Economics, Optimization and other subjects it will also develop understanding the architecture of curves and surfaces in plane and spaces etc.

PO5. This program will also enable the learners to join teaching profession in schools and this will help the students to enhance their employability for government jobs, jobs in banking insurance and investment sectors, data analyst jobs and jobs in various other public and private enterprises.

FOUR YEAR UNDER GRADUATE PROGRAM (2024-28)
DEPARTMENT OF MATHEMATICS
COURSE CURRICULUM

Part A: Introduction			
Program: Bachelor in Science (Certificate/Diploma/Degree/Honors)		**Semester - I**	**Session:2024-2025**
1	Course Code	**MASC-01**	
2	Course Title	**Elementary Calculus**	
3	Course Type	DSC	
4	Pre-requisite(if any)	Knowledge of basic Differential and Integral calculus	
5	Course Learning Outcome (CLO)	**This Course will enable the students to:** ➢ Know about ancient Indian Mathematicians and their contribution ➢ Calculate the limit and examine the continuity and understand the geometrical interpretation of differentiability. Apply various tests to determine convergence. ➢ Understand the consequences of various mean value theorems. ➢ Understand concepts of Curvature and Asymptotes . ➢ Draw curves in Cartesian and polar coordinate systems ➢ Understand the elementary integration of transcendental function and understand applications of reduction formulae.	
6	Credit Value	**4 C**	1Credit = 15 hours- Learning and observation
7	Total Marks	Maximum Marks : 100	Minimum Passing Marks:40

Part B: Content of the Course		
Total no of teaching – learning period =60 Periods (60 Hours)		
UNIT	**Topics**	**No of Periods**
I	**Contributions and Biography of Indian Mathematicians:** Bodhayan, Apasthamb, Katyayan, Mahaveeracharya, Brahmagupta and Bhaskarachaya in special context of Leelavati. **Sequences, Continuity and Differentiability** : Notion of convergence of sequences and series of real numbers, Definition of limit and continuity of a real valued function; Differentiability and its geometrical interpretation. Elementary Differentiation.	**15**
II	**Expansion of Functions:** Rolle's Theorem, Lagrange's mean value theorem, Cauchy's mean value theorem and their geometrical interpretations, Successive differentiation and Leibnitz theorem, Maclaurin's and Taylor's theorems for expansion of a function.	**15**
III	**Curvature, Asymptotes , Curve Tracing:** Curvature; Asymptotes of general algebraic curves, Parallel asymptotes, Asymptotes parallel to axes; Symmetry, Concavity and convexity, Points of inflection, Tangents at origin, Multiple points, Position and nature of double points; Tracing of Cartesian, polar and parametric curves.	**15**

IV	**Integration:** Elementary integration, Integration of Transcendental function, Reduction formulae, Definite integral.	**15**

Part C - Learning Resource

Text Books, Reference Books, Other Resources

Text Books Recommended-

1. Howard Anton, I. Bivens& Stephan Davis (2016). Calculus (10th edition). Wiley India.
2. Gabriel Klambauer (1986). Aspects of Calculus. Springer-Verlag.
3. Wieslaw Krawcewicz & BindhyachalRai (2003). Calculus with Maple Labs. Narosa.
4. Gorakh Prasad (2016). Differential Calculus (19th edition). Pothishala Pvt. Ltd.

Reference Books Recommended-

5. George B. Thomas Jr., Joel Hass, Christopher Heil& Maurice D. Weir (2018). Thomas' Calculus (14th edition). Pearson Education.
6. Jerrold Marsden, Anthony J. Tromba& Alan Weinstein (2009). Basic Multivariable Calculus, Springer India Pvt. Limited.
7. James Stewart (2012). Multivariable Calculus (7th edition). Brooks/Cole. Cengage.
8. Monty J. Strauss, Gerald L. Bradley & Karl J. Smith (2011). Calculus (3rd edition). Pearson Education. Dorling Kindersley (India) Pvt. Ltd.

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https://epgp.inflibnet.aci.in
https://swayam.gov.in
https://www.mooc.org

Part D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: **100 Marks**

Continuous Internal Assessment (CIA): **30 Marks**

End Semester Examination (ESE): **70 Marks**

Continuous Internal Assessment (CIA) (Conducted by course teacher)	Test /Quiz – 20+20 Marks Assignment/Seminar- 10 Marks	Better marks out of two test/quiz + obtained marks in Assignment shall be considered against 30 marks
End Semester Examination (ESE)	**Two Section-A&B** Section-A: Q1.Objective- 10x1=10 marks Q2. Short answer type question-5x4=20marks Section-B: Descriptive answer type question, 1 out of 2 from each unit- 10x4= 40 Marks	

Name and signature of convener & members of CBOS-

(Dr. S. Dashpute)

(Dr. P. K. Sahu)

Dr. Omkar Nath Shivastava

Dr. S. Khan

FOUR YEAR UNDER GRADUATE PROGRAM(2024-28)

DEPARTMENT OF MATHEMATICS

COURSE CURRICULUM

Part A: Introduction			
Program: Bachelor in Science (Certificate/Diploma/Degree/Honors)		**Semester - II**	**Session:2024-2025**
1	Course Code	**MASC-02**	
2	Course Title	**Algebra**	
3	Course Type	**Discipline Specific Course (DSC)**	
4	Pre requisite	Knowledge of basic algebra , determinants and matrices.	
5	Course Learning Outcome (CLO)	**This Course will enable the students to:** ➢ Learn about the Matrix algebra. ➢ Understand Set theory, Function and Relation ➢ Learn about the theory of equations. ➢ Learn about the fundamental concepts of groups, Subgroups. ➢ Understand cosets and normal subgroups	
6	Credit Value	**4 C**	1Credit = 15 hours- Learning and Observation
7	Total Marks	Maximum Marks : 100	Minimum Passing Marks:40

Part B: Content of the Course		
Total no of teaching – learning period =60 Periods (60 Hours)		
UNIT	**Topics**	**No of Periods**
I	**Matrix Algebra :** Introduction, elementary operations of matrices, Inverse of a matrix. Special types of matrices: Transpose of a matrix, Symmetric and Skew symmetric matrices, Hermitian and Skew Hermitian matrix, Rank of a matrix, Echelon form of a matrix, Normal form, Application of matrices to a system of linear (both homogeneous and non-homogeneous) equations , Theorems on consistency of a system of linear equations.Eigen values and Eigen vectors, relation between Eigen values and Eigen vectors. Process of finding Eigen values and Eigen vectors, Cayley Hamilton theorem, and its use in finding inverse of a matrix.	**15**
II	**Sets Theory & Functions:**Sets, subsets Set operations and the laws of set theory and Venn diagrams. Examples of finite and infinite sets. Finite sets and counting principle. Empty set, properties of empty set. Standard set operations. Classes of a set. Power set of a set. Difference and symmetric difference of two sets. Set identities, Generalized union and intersection. **Relations and Functions:** Product set, Composition of relations, Types of relations, Partitions, Equivalence Relations with example of congruence modulo relation, Partial ordering relations. Function, Types of Function, Inverse Function, Composite of functions, Modular arithmetic and basic properties of congruences	**15**

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III	**Theory of equations:**Symmetric functions of the roots of an equation Root of a multiplicity, Synthetic division, Greatest common Divisors, Relation between the roots and coefficients of general polynomial equations in one variable. Transformation of equations. Descarte's rule of signs. Solutions of cubic equations (Cardon method) , Biquadrate equation.	**15**
IV	**Group Theory:**Definition and properties of a group, Abelian groups, Examples of groups, Subgroups and examples, Cosets and their properties, Lagrange's theorem and its applications, Normal subgroups and their properties, Simple groups, Factors groups .	**15**

Part C - Learning Resource

Text Books, Reference Books, Other Resources

Text Books Recommended-

1. RamjiLal (2017). *Algebra 1: Groups, Rings, Fields and Arithmetic*. Springer.
2. Nathan Jacobson (2009). *Basic Algebra* I (2nd edition). Dover Publications
3. John B. Fraleigh (2007). *A First Course in Abstract Algebra* (7th edition). Pearson

Reference Books Recommended-

4. Michael Artin (2014). *Algebra* (2nd edition). Pearson.
5. Stephen H. Friedberg, Arnold J.Insel& Lawrence E. Spence (2003). *Linear Algebra* (4thedition). Prentice-Hall of India Pvt. Lt
6. Joseph A. Gallian (2017). *Contemporary Abstract Algebra* (9th edition). Cengage.
7. Kenneth Hoffman & Ray Kunze (2015). *Linear Algebra* (2nd edition). Prentice-Hall.
8. I. N. Herstein (2006). *Topics in Algebra* (2nd edition). Wiley India.

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Part D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Examination (ESE):	**70 Marks**

Continuous Internal Assessment (CIA) (Conducted by course teacher)	Test /Quiz – 20+20 Marks Assignment/Seminar- 10 Marks	Better marks out of two test/quiz + obtained marks in Assignment shall be considered against 30 marks
End Semester Examination (ESE)	**Two Section-A&B** Section-A: Q1.Objective- 10x1=10 marks Q2. Short answer type question-5x4=20marks Section-B: Descriptive answer type question, 1 out of 2 from each unit- 10x4= 40 Marks	

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FOUR YEAR UNDER GRADUATE PROGRAM (2024-28)

DEPARTMENT OF MATHEMATICS

COURSE CURRICULUM

Part A: Introduction			
Program: Bachelor in Science (Diploma/Degree/Honors)		**Semester - III**	**Session:2024-2025**
1	Course Code	**MASC-03**	
2	Course Title	**Differential Equations**	
3	Course Type	**Discipline Specific Course (DSC)**	
4	Pre-requisite(if any)	Knowledge of basic Differential and Integral calculus and differential equation.	
5	Course Learning Outcome (CLO)	**This Course will enable the students to:** ➢ Learn various techniques of getting exact solutions of certain solvable first order differential equations and linear differential equations of second order. ➢ Understand the genesis of ordinary as well as partial differential equations. ➢ Learn about solution of first order linear partial differential equations using Lagrange's method. ➢ Know how to solve second order linear partial differential equations with constant coefficients.	
6	Credit Value	**4 C**	1Credit = 15 hours- Learning and Observation
7	Total Marks	Maximum Marks : 100	Minimum Passing Marks:40

Part B: Content of the Course		
Total no of teaching – learning period =60 Periods (60 Hours)		
UNIT	**Topics**	**No of Periods**
I	**Contributions and Biography of Indian Mathematicians:** Aryabhatta, Varahmihir, Bhaskar-I, Shreedharacharya, Shreepati and Parmeshwar. **First Order and higher degree Differential Equations** : Differential equations of first order and first degree, Equations in which variables are separable, Homogeneous equations, Linear differential equations and equations reducible to linear form, Exact differential equations, Integrating factor, First order higher degree equations solvable for x, y and p, Clairaut's form and singular solutions, orthogonal trajectories.	15
II	**Linear and Ordinary simultaneous differential equations:** Linear differential equations with constant coefficients, Homogeneous linear ordinary differential equations. Linear differential equations of second order.Transformation of the equation by changing the dependent variable/the independent variable.Method of variation of parameters. Ordinary simultaneous differential equations.	15
III	**First order Partial differential equations:** Lagrange's solution, Some special types of equation which can be solved by methods other than general method, Charpit's general method of solution.	15

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IV	**Second and higher order Partial differential equations:** Classification of Linear partial differential equation of second order, Homogeneous and non- homogeneous equation with constant coefficients, Partial differential equation reducible to equation with constant coefficients. Monge's Method.	15

Part C - Learning Resource

Text Books, Reference Books, Other Resources

Text Books Recommended-

1. Dr. M. D. Rajsinghania, Ordinary and partial Differential Equation ,S. Chand and company Pvt.Ltd.
2. A.H. Siddiqi and P. Manchanda , A first course in Differential Equations with Applications, Macmillan India Ltd.

Reference Books Recommended-

3. Erwin Kreyszig (2011). *Advanced Engineering Mathematics* (10th edition). J. Wiley & Sons
4. B. Rai& D. P. Choudhury (2006). *Ordinary Differential Equations - An Introduction*. Narosa Publishing House Pvt. Ltd. New Delhi.
5. Shepley L. Ross (2007). *Differential Equations* (3rd edition). Wiley.
6. George F. Simmons (2017). *Differential Equations with Applications and Historical Notes* (3rd edition). CRC Press. Taylor & Francis.
7. Ian N. Sneddon (2006). *Elements of Partial Differential Equations*. Dover Publications.

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https://swayam.gov.in
https://www.mooc.org

Part D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Examination (ESE):	**70 Marks**

Continuous Internal Assessment (CIA) (Conducted by course teacher)	Test /Quiz – 20+20 Marks Assignment/Seminar- 10 Marks	Better marks out of two test/quiz + obtained marks in Assignment shall be considered against 30 marks
End Semester Examination (ESE)	**Two Section**-A&B Section-A: Q1.Objective- 10x1=10 marks Q2. Short answer type question-5x4=20marks Section-B: Descriptive answer type question, 1 out of 2 from each unit- 10x4= 40 Marks	

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FOUR YEAR UNDER GRADUATE PROGRAM(2024-25)

DEPARTMENT OF MATHEMATICS

COURSE CURRICULUM

Part A: Introduction			
Program: Bachelor in Science (Diploma/Degree/Honors)		**Semester - IV**	**Session:2024-2025**
1	Course Code	**MASC-04**	
2	Course Title	**Abstract Algebra**	
3	Course Type	**Discipline Specific Course (DSC)**	
4	Pre-requisite(if any)	Knowledge of algebra, vector space and inner product space.	
5	Course Learning Outcome (CLO)	➢ Understand of Homomorphism, Isomorphism of Group ➢ Understand Cyclic and Permutation Groups. ➢ Understand vector spaces, subspaces, basis, dimension and their properties. ➢ Learn about properties of linear transformation and isomorphism theorems. ➢ Understand the concept of linear transformations.	
6	Credit Value	**4 C**	1Credit = 15 hours- Learning and Observation
7	Total Marks	Maximum Marks : 100	Minimum Passing Marks:40

Part B: Content of the Course		
Total no of teaching – learning period =60 Periods (60 Hours)		
UNIT	**Topics**	**No of Periods**
I	**Isomorphism Theorems , Cyclic and Permutation Groups :** Group homomorphism and isomorphism with properties; First, second and third isomorphism theorems for groups, Cyclic groups and properties, Classifications of subgroup of cyclic groups, Permutation group and properties, Even and odd permutations, Cayley's theorem.	15
II	**Ring, Field and Integral Domain, Ideals:** Definition and properties of a ring, example of rings, Subrings, Integral domain and fields, characteristic of ring and field. Ring Homomorphism, Ideals and Quotient Rings. Field of Quotients of an Integral Domain, Euclidean Rings, Polynomial Rings, Polynomials over the Rational Field. The Eisenstein Criterion, Polynomial Rings over Commutative Rings, Unique factorization domain. R unique factorization domain implies so is R [x1, x2 ….. xn].	15
III	**Vector Spaces:** Definition and examples of vector spaces. Subspaces. Sum and direct sum of subspaces, Linear span. Linear dependence, independence and their basic properties. Basis. Finite dimensional vector spaces. Existence theorem for bases. Invariance of the number of elements of a basis set. Dimension. Existence of complementary subspace of a subspace of a finite dimensional vector space. Dimension of sums of subspaces. Quotient space and its dimension.	15

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IV	**Linear Transformation**: Linear transformations and their representation as matrices. The Algebra of linear transformations. The rank nullity theorem. Change of basis. Dual space. Bi-dual space and natural isomorphism. Adjoint of a linear transformation.	15

Part C - Learning Resource

Text Books, Reference Books, Other Resources

Text Books Recommended-

1. Nathan Jacobson (2009). *Basic Algebra* I (2nd edition). Dover Publications.
2. Nathan Jacobson (2009). *Basic Algebra* II (2nd edition). Dover Publications.

Reference Books Recommended-

3. I. M. Gel'fand (1989). *Lectures on Linear Algebra*. Dover Publications.
4. Kenneth Hoffman & Ray Kunze (2015). *Linear Algebra* (2nd edition). Prentice-Hall.
5. Serge Lang (2005). *Introduction to Linear Algebra* (2nd edition). Springer India.
6. Gilbert Strang (2014). *Linear Algebra and its Applications* (2nd edition). Elsevier

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Part D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Examination (ESE):	**70 Marks**

Continuous Internal Assessment (CIA) (Conducted by course teacher)	Test /Quiz – 20+20 Marks Assignment/Seminar- 10 Marks	Better marks out of two test/quiz + obtained marks in Assignment shall be considered against 30 marks
End Semester Examination (ESE)	**Two Section-A&B** Section-A: Q1.Objective- 10x1=10 marks Q2. Short answer type question-5x4=20marks Section-B: Descriptive answer type question, 1 out of 2 from each unit- 10x4= 40 Marks	

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FOUR YEAR UNDER GRADUATE PROGRAM (2024-28)

DEPARTMENT OF MATHEMATICS

COURSE CURRICULUM

Part A: Introduction			
Program: Bachelor in Science (Degree/Honors)		**Semester - V**	**Session:2024-2025**
1	Course Code	**MASC-05**	
2	Course Title	Real Analysis	
3	Course Type	**Discipline Specific Course (DSC)**	
4	Pre-requisite(if any)	Knowledge of algebra, real numbers, set theory, functions and elementary calculus.	
5	Course Learning Outcome (CLO)	**This Course will enable the students to:** ➢ Understand basic properties of real number system such as least upper bound property and Order property. ➢ Realize importance of bounded,convergent,Cauchy and monotonic sequences of real numbers,find their limit superior and limit inferior. ➢ Learn about Riemann integrability of bounded functions and algebra of R-integrable functions. ➢ Determine various applications of the fundamental theorem of integral calculus. ➢ Relate concepts of uniform continuity,differentiation,integration and uniform convergence..	
6	Credit Value	**4 C**	1Credit = 15 hours- Learning and Observation
7	Total Marks	Maximum Marks : 100	Minimum Passing Marks:40

Part B: Content of the Course		
Total no of teaching – learning period =60 Periods (60 Hours)		
UNIT	**Topics**	**No of Periods**
I	**Contributions and Biography of Indian Mathematicians** Swami Bharati Krishna Tirth, Madhav, NeelkanthSomayaji and ShrinivaasAayangarRamanujan **Real Numbers :** The set of real numbers R as an ordered field, Least upper bound properties of R, Metric property and completeness of R, Archimedean property of R, Dense subsets of R, Nested intervals property; Neighborhood of a point in R, Open sets, limit point of a set, closed and perfect sets in R.	15
II	**Convergence of sequences in R:** Bounded and monotonic sequences, Convergent sequence and its limit, Limit theorems, Monotone convergence theorem, Subsequences, Bolzano-Weierstrass theorem, Limit superior and limit inferior, Cauchy sequence, Cauchy's convergence criterion.	15
III	**Infinite Series:** Convergence and divergence of infinite series of positive real numbers, Necessary condition for convergence, Cauchy criterion for convergence;Test for	15

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	convergence of positive term series; Basic comparison test, Comparison test,D'Alembert's Ratio test, Cauchy root test,Raabe's test, Logarithmic test, Cauchy Integral test, Alternating series, Leibnitz's test, Series of arbitrary terms,Absolute and conditional convergence,Rearrangement of series and Riemann's theorem.	
IV	**Riemann Integration and Improper Integrals:** Riemann integrability of bounded functions, Examples of R- integrable and non-integrable functions, Algebra of Riemann integrable functions, Integrability of continuous and monotonic functions, Darboux theorems, Fundamental theorem of integral calculus, Improper Integral.	15

Part C - Learning Resource

Text Books, Reference Books, Other Resources

Text Books Recommended-

1. T.M.Apostol(2008).*MathematicalAnalysis:AModernApproachtoAdvancedCalculus*.Pearson Education.
2. Charalambos D.Aliprantis&)OwenBurkinshaw1998).*PrinciplesofReal Analysis*.AcademicPress

Reference Books Recommended-

3. RobertG.Bartle&DonaldR.Sherbert(2015).*IntroductiontoRealAnalysis*(4th edition).WileyIna.
4. GeraldG.Bilodeau,PaulR.Thie&G.E.Keough(2015).*AnIntroductiontoAnalysis* (2nd edition),JonesandBartlettIndiaPvt.Ltd.
5. E.Hewitt&K.Stromberg(2013).*RealandAbstractAnalysis*.Springer-Verlag.
6. K.A.Ross(2013).*ElementaryAnalysis*:*TheTheoryofCalculus*(2nd edition).Springer.
7. WalterRudin.*PrinciplesofMathematicalAnalysis*(3rd edition),TataMcGrawHill.

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Part D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Examination (ESE):	**70 Marks**

Continuous Internal Assessment (CIA) (Conducted by course teacher)	Test /Quiz – 20+20 Marks Assignment/Seminar- 10 Marks	Better marks out of two test/quiz + obtained marks in Assignment shall be considered against 30 marks
End Semester Examination (ESE)	**Two Section-A&B** Section-A: Q1.Objective- 10x1=10 marks Q2. Short answer type question-5x4=20marks Section-B: Descriptive answer type question, 1 out of 2 from each unit- 10x4= 40 Marks	

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FOUR YEAR UNDER GRADUATE PROGRAM(2024-28)

DEPARTMENT OF MATHEMATICS

COURSE CURRICULUM

Part A: Introduction			
Program: Bachelor in Science (Degree/Honors)		**Semester - VI**	**Session:2024-2025**
1	Course Code	**MASC-06**	
2	Course Title	Metric Spaces	
3	Course Type	**Discipline Specific Course (DSC)**	
4	Pre-requisite(if any)	Knowledge of basic real analysis	
5	Course Learning Outcome (CLO)	**This Course will enable the students to-** ➢ Understand concepts of metric, distance, convergence, completeness, compactness, connectedness, Bolzano-Weierstrass property. ➢ Apply these concepts to key classes of spaces. ➢ Learn to analyze mapping between spaces. ➢ Identify the continuity of a function defined on metric spaces homeomorphism. ➢ Attain background for advanced courses in real analysis, functional analysis and topology.	
6	Credit Value	**4 C**	1Credit = 15 hours- Learning and Observation
7	Total Marks	Maximum Marks : 100	Minimum Passing Marks:40

Part B: Content of the Course		
Total no of teaching – learning period =60 Periods (60 Hours)		
UNIT	**Topics**	**No of Periods**
I	**Concepts in metric spaces:** Definition and examples of metric spaces, Open spheres and closed spheres, Neighborhoods, Open sets, Interior, exterior and boundary points, Closed sets, Limit points and isolated points, Interior and closure of a set, Boundary of a set, Bounded sets, Distance between two sets, Diameter of a set, Subspace of a metric space	15
II	**Complete Metric Spaces and Continuous Functions:** Cauchy and Convergent sequences, Completeness of metric spaces, Cantor's intersection theorem, Dense sets and separable spaces, Nowhere dense sets and Baire's category theorem, Continuous and uniformly continuous functions, Homeomorphism, Banach contraction principle.	15
III	**Compactness:** Compact spaces, Sequential compactness, Bolzano-Weierstrass property, Compactness and finite intersection property, Heine-Borel theorem, Totally bounded sets, Equivalence of compactness and sequential compactness, Continuous functions on compact spaces.	15
IV	**Connectedness:** Separated sets, Disconnected and connected sets, Components, Connected subsets of R, Continuous functions on connected sets.	15

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Part C - Learning Resource		
Text Books, Reference Books, Other Resources		
Text Books Recommended- . 1. Mathematical Analysis II- Metric Spaces, J N Sharma, Krishna Prakashan Mandir, Meerut		
Reference Books Recommended- 2. Metric Spaces, P K Jain and Khalil Ahmad, New Age International, NewDelhi. 3. An Introduction to Metric Spaces, D Gopal, A Deshmukh, A S Randive and S Yadav, CRC Press, London.		
E-resources: https://onlinecourses.nptel.ac.in https://epgp.inflibnet.aci.in https://swayam.gov.in https://www.mooc.org		
Part D: Assessment and Evaluation		
Suggested Continuous Evaluation Methods: **Maximum Marks:** **100 Marks** **Continuous Internal Assessment (CIA):** **30 Marks** **End Semester Examination (ESE):** **70 Marks**		
Continuous Internal Assessment (CIA) (Conducted by course teacher)	Test /Quiz – 20+20 Marks Assignment/Seminar- 10 Marks	Better marks out of two test/quiz + obtained marks in Assignment shall be considered against 30 marks
End Semester Examination (ESE)	**Two Section-A&B** Section-A: Q1.Objective- 10x1=10 marks Q2. Short answer type question-5x4=20marks Section-B: Descriptive answer type question, 1 out of 2 from each unit- 10x4= 40 Marks	

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IV	**Modules** Modules. Submodules Quotient Modules. Homomorphism Isomorphism theorems.Cyclic modules; simple modules; Semi-simple modules; Schuler's lemma; free modules; Noetherian and Artinian modules and rings; Hilbert basis theorem; WedderburnArtin theorem; Uniform modules; primary modules; Noether-Laskar theorem.	15

Part C - Learning Resource

Text Books, Reference Books, Other Resources

Text Books Recommended:

1. P.B. Bhattacharya, S. K. Jain, S.R. Nagpaul : Basic Abstract Algebra, Cambridge University press
2. I.N. Herstein : Topics in Albegra, Wiley Eastern Ltd.
3. VivekSahai and VikasBist, Algebra, Narosa Publishing House, 1999.

References Books Recommended:

1. M.Artin, Algeabra, Prentice -Hall of India, 1991.
2. P.M. Cohn, Algebra,Vols. I,II&III, John Wiley & Sons, 1982,1989,1991.
3. N.Jacobson, Basic Algebra, Vols. I , W.H. Freeman, 1980 (also published by Hindustan Publishing Company).
4. S.Lang, Algebra, 3rd edition, Addison-Wesley, 1993.
5. I.S. Luther and I.B.S. Passi, Algebra, Vol. I-Groups, Vol.II-Rings, Narosa Publishing House (Vol.I-1996,Vol. II-1999)
6. D.S.Malik, J.N.Mordeson, and M.K.Sen, Fundamentals of Abstract Algebra, McGraw-Hill, International Edition,1997.
7. QuaziZameeruddin and SurjeetSingh : Modern Algebra
8. I. Stewart, Galois theory, 2nd edition, chapman and Hall, 1989.
9. J.P. Escofier, Galois theory, GTM Vol.204, Springer, 2001..
10. Fraleigh , A first course in Algebra Algebra, Narosa,1982.
11. K.B. Datta, Matrix and Linear Algebra, Prentice Hall of India Pvt. Ltd., New Delhi,2000.
12. S.K.jain,A. Gunawardena and P.B Bhattacharya, Basic Linear Algebra with MATLAB, Key College Publishing (Springer-Verlag),2001.
13. S.Kumaresan, Linear Algebra, A Geometric Approach, Prentice-Hall of India, 2000.
14. T.Y. Lam, lectures on Modules and Rings, GTM Vol. 189, SpringerVerlag,1999.

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Part D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Examination (ESE):	**70 Marks**

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FOUR YEAR UNDER GRADUATE PROGRAM(2024-28)

DEPARTMENT OF MATHEMATICS

COURSE CURRICULUM

Part A: Introduction			
Program: Bachelor in Science (Honors/Honors with Research)		**Semester - VII**	**Session:2024-2025**
1	Course Code	**MASC-07**	
2	Course Title	Advanced Real Analysis	
3	Course Type	**Discipline Specific Course (DSC)**	
4	Pre-requisite(if any)	Knowledge of basic real analysis, sequence, series	
5	Course Learning Outcome (CLO)	**At the end of the course, the students will be able to :** ➢ Understand the concept of sequences and series of functions, power series apply the test for their convergence, divergence and apply Abel's and Tauber's theorems. ➢ Understand the concept of functions of several variables and properties of sets of vectors in R^n, maxima and minima of real valued functions from R to R and from R^n to R, concept of Integration theory that is closely related to the theory of Euclidean spaces and derivatives of functions of several variables. ➢ Understand the concept of Riemann-Stieltjes integral and apply it to evaluate definite integrals arising in different fields of science and engineering.	
6	Credit Value	**4 C**	1Credit = 15 hours- Learning and Observation
7	Total Marks	Maximum Marks : 100	Minimum Passing Marks:40

Part B: Content of the Course		
Total no of teaching – learning period =60 Periods (60 Hours)		
UNIT	**Topics**	**No of Periods**
I	**The Riemann –Stieltjes Integral:** Definition and existence of Riemann-Stieltjes integral, Properties of the Integral, integration and differentiation, the fundamental theorem of Calculus, integration of vector-valued functions, Uniform convergence and Riemann-Stieltjes integration, Rectifiable curves.	15
II	**Sequence and Series of Functions:** Sequences and series of functions, pointwise and uniform convergence, Cauchy criterion for uniform convergence, Weierstrass M-test, Abel's and Dirichlet's tests for uniform convergence, uniform convergence and continuity, uniform convergence and differentiation, uniform convergence and integration, Weierstrass approximation theorem.	15
III	**Functions of Several Variables:** Linear transformations, Derivatives in an open subset of R^n, Chain rule, Partial derivatives, interchange of the order of differentiation, Derivatives of higher orders, Taylor's theorem, Inverse function theorem, Implicit function theorem.	15

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IV	**Jacobians, extremum problems and Power Series:** Jacobians, extremum problems with constraints, Lagrange's multiplier method, Differentiation of integrals. Uniqueness theorem for power series, Abel's theorem, Taylor's theorem Tauber's theorems	15

Part C - Learning Resource
Text Books, Reference Books, Other Resources
Text Books Recommended- 1. Principle of Mathematical Analysis By Walter Rudin(3rd edition) McGrawHill, 1976, International student edition. 2. Real Analysis By H.L.Roydon, Macmillan Pub.Co.Inc.4th Edition, New York .1962.
References Books Recommended- 1. T.M. Apostol, Mathematical Analysis, Narosa Publishing House, New Delhi,1985. 2. Gabriel Klambauer, Mathematical Analysis, Marcel Dekkar,Inc. New York,1975. 3. A.J. White, Real Analysis; an introduction, Addison-Wesley Publishing Co.,Inc.,1968. 4. E. Hewitt and K. Stromberg. Real and Abstract Analysis, Berlin, Springer, 1969. 5. I.P. Natanson, Theory of Functions of a Real Variable. Vol. I, Frederick Ungar Publishing Co., 1961. 6.A. Friedman, Foundations of Modern Analysis, Holt, Rinehart and Winston, Inc., New York, 1970. 7. Serge Lang, Analysis I & II, Addison-Wesley Publishing Company, Inc. 1969. 8..Walter Rudin, Real & Complex Analysis, Tata McGraw-Hill Publishing Co.Ltd. NewDelhi,1966.
E-resources: https://onlinecourses.nptel.ac.in https://epgp.inflibnet.aci.in https://swayam.gov.in https://www.mooc.org

Part D: Assessment and Evaluation		
Suggested Continuous Evaluation Methods: **Maximum Marks:** **100 Marks** **Continuous Internal Assessment (CIA):** **30 Marks** **End Semester Examination (ESE):** **70 Marks**		
Continuous Internal Assessment (CIA) (Conducted by course teacher)	Test /Quiz – 20+20 Marks Assignment/Seminar- 10 Marks	Better marks out of two test/quiz + obtained marks in Assignment shall be considered against 30 marks
End Semester Examination (ESE)	**Two Section-A&B** Section-A: Q1.Objective- 10x1=10 marks Q2. Short answer type question-5x4=20marks Section-B: Descriptive answer type question, 1 out of 2 from each unit- 10x4= 40 Marks	

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FOUR YEAR UNDER GRADUATE PROGRAM(2024-25)

DEPARTMENT OF MATHEMATICS

COURSE CURRICULUM

Part A: Introduction			
Program: Bachelor in Science (Honors/Honors with Research)		**Semester - VIII**	**Session:2024-2025**
1	Course Code	**MASC-08**	
2	Course Title	**Advanced Abstract Algebra**	
3	Course Type	**Discipline Specific Course (DSC)**	
4	Pre-requisite(if any)	Knowledge of Abstract Algebra	
5	Course Learning Outcome (CLO)	**At the end of the course, the students will be able to :** ➢ Demonstrate capacity for mathematical reasoning through analyzing, Proving and explaining concepts from advanced algebra. ➢ Understand the concept of Normal and subnormal series, solvable group, state and prove Jordan-Holder theorem. ➢ Understand the concepts of fields, extension of fields and splitting fields of polynomials ➢ . Create, select and apply appropriate algebraic structures such as Galois extensions, Automorphisms of groups and fixed fields, Fundamental theorem of Galois theory to understand and use the Fundamental theorem of Algebra, solvability of polynomials. ➢ Understand the concepts of modules, Noetherian and artinian modules. Prove Wedderburns theorem on finite division rings.	
6	Credit Value	**4 C**	1Credit = 15 hours- Learning and Observation
7	Total Marks	Maximum Marks : 100	Minimum Passing Marks:40

Part B: Content of the Course		
Unit	Topics	No. of Hours
I	**Counting Principle and Sylow's Theorem** Group-Automorphism, inner automorphism, Automorphism groups and their computations. Conjugacy relation; Normalizer; Counting principle and the class equation of a finite group. Center for Group of prime order. Abelianizing of a group and its universal property ;Sylow's theorems. Sylow's subgroup; Structure theorem for finite Abelian groups.	15
II	**Field Theory** Extension fields; algebraic and transcendental extensions; Separable and inseparable extensions; Perfect fields; Finite fields; Algebraically closed fields.	15
III	**Group Series and Galois Theory** Normal and subnormal series; composition series; Jordan-Holder theorem. Automorphism of extensions; Galois extensions; Fundamental theorem of Galois Theory	15

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Continuous Internal Assessment (CIA) (Conducted by course teacher)	Test /Quiz – 20+20 Marks Assignment/Seminar- 10 Marks	Better marks out of two test/quiz + obtained marks in Assignment shall be considered against 30 marks
End Semester Examination (ESE)	**Two Section-A&B** Section-A: Q1.Objective- 10x1=10 marks Q2. Short answer type question-5x4=20marks Section-B: Descriptive answer type question, 1 out of 2 from each unit- 10x4= 40 Marks	

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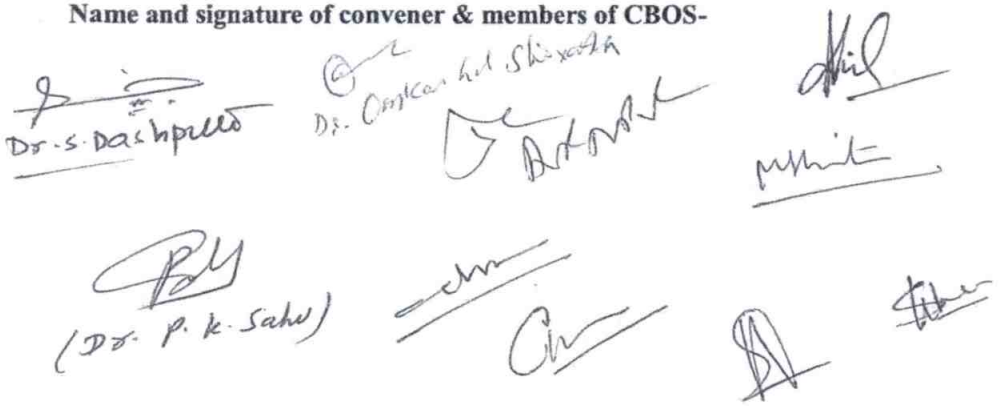

FOUR YEAR UNDER GRADUATE PROGRAM (2024-28)
DEPARTMENT OF MATHEMATICS
COURSE CURRICULUM

Part A: Introduction				
Program: Bachelor in Science (Certificate/Diploma/Degree/Honors)		**Semester - I**	**Session:2024-2025**	
1	Course Code	**MAGE-01**		
2	Course Title	**Elementary Calculus**		
3	Course Type	**Generic Elective (GE)**		
4	Pre-requisite(if any)	Knowledge of basic Differential and Integral calculus		
5	Course Learning Outcome (CLO)	**This Course will enable the students to:** ➢ Know about ancient Indian Mathematicians and their contribution ➢ Calculate the limit and examine the continuity and understand the geometrical interpretation of differentiability. Apply various tests to determine convergence. ➢ Understand the consequences of various mean value theorems. ➢ Understand concepts of Curvature and Asymptotes . ➢ Draw curves in Cartesian and polar coordinate systems ➢ Understand the elementary integration of transcendental function and understand applications of reduction formulae.		
6	Credit Value	**4 C**	1Credit = 15 hours- Learning and observation	
7	Total Marks	Maximum Marks : 100		Minimum Passing Marks:40

Part B: Content of the Course		
Total no of teaching – learning period =60 Periods (60 Hours)		
UNIT	**Topics**	**No of Periods**
I	**Contributions and Biography of Indian Mathematicians:** Bodhayan, Apasthamb, Katyayan, Mahaveeracharya, Brahmagupta and Bhaskarachaya in special context of Leelavati. **Sequences, Continuity and Differentiability** : Notion of convergence of sequences and series of real numbers, Definition of limit and continuity of a real valued function; Differentiability and its geometrical interpretation. Elementary Differentiation.	15
II	**Expansion of Functions:** Rolle's Theorem, Lagrange's mean value theorem, Cauchy's mean value theorem and their geometrical interpretations, Successive differentiation and Leibnitz theorem, Maclaurin's and Taylor's theorems for expansion of a function.	15
III	**Curvature, Asymptotes , Curve Tracing:** Curvature; Asymptotes of general algebraic curves, Parallel asymptotes, Asymptotes parallel to axes; Symmetry, Concavity and convexity, Points of inflection, Tangents at origin, Multiple points, Position and nature of double points; Tracing of Cartesian, polar and parametric curves.	15
IV	**Integration:** Elementary integration, Integration of Transcendental function, Reduction formulae, Definite integral.	15

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Part C - Learning Resource

Text Books, Reference Books, Other Resources

Text Books Recommended-

1. Howard Anton, I. Bivens& Stephan Davis (2016). Calculus (10th edition). Wiley India.
2. Gabriel Klambauer (1986). Aspects of Calculus. Springer-Verlag.
3. Wieslaw Krawcewicz & BindhyachalRai (2003). Calculus with Maple Labs. Narosa.
4. Gorakh Prasad (2016). Differential Calculus (19th edition). Pothishala Pvt. Ltd.

Reference Books Recommended-

5. George B. Thomas Jr., Joel Hass, Christopher Heil& Maurice D. Weir (2018). Thomas' Calculus (14th edition). Pearson Education.
6. Jerrold Marsden, Anthony J. Tromba& Alan Weinstein (2009). Basic Multivariable Calculus, Springer India Pvt. Limited.
7. James Stewart (2012). Multivariable Calculus (7th edition). Brooks/Cole. Cengage.
8. Monty J. Strauss, Gerald L. Bradley & Karl J. Smith (2011). Calculus (3rd edition). Pearson Education. Dorling Kindersley (India) Pvt. Ltd.

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Part D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Examination (ESE):	**70 Marks**

Continuous Internal Assessment (CIA) (Conducted by course teacher)	Test /Quiz – 20+20 Marks Assignment/Seminar- 10 Marks	Better marks out of two test/quiz + obtained marks in Assignment shall be considered against 30 marks
End Semester Examination (ESE)	**Two Section**-A&B Section-A: Q1.Objective- 10x1=10 marks Q2. Short answer type question-5x4=20marks Section-B: Descriptive answer type question, 1 out of 2 from each unit- 10x4= 40 Marks	

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FOUR YEAR UNDER GRADUATE PROGRAM(2024-28)

DEPARTMENT OF MATHEMATICS

COURSE CURRICULUM

Part A: Introduction			
Program: Bachelor in Science (Certificate/Diploma/Degree/Honors)		**Semester - II**	**Session:2024-2025**
1	Course Code	**MAGE-02**	
2	Course Title	**Algebra**	
3	Course Type	Generic Elective (GE)	
4	Pre requisite	Knowledge of basic algebra , determinants and matrices.	
5	Course Learning Outcome (CLO)	**This Course will enable the students to:** ➢ Learn about the Matrix algebra. ➢ Understand Set theory, Function and Relation ➢ Learn about the theory of equations. ➢ Learn about the fundamental concepts of groups, Subgroups. ➢ Understand cosets and normal subgroups	
6	Credit Value	**4 C**	1Credit = 15 hours- Learning and Observation
7	Total Marks	Maximum Marks : 100	Minimum Passing Marks:40

Part B: Content of the Course		
Total no of teaching – learning period =60 Periods (60 Hours)		
UNIT	**Topics**	**No of Periods**
I	**Matrix Algebra :** Introduction, elementary operations of matrices, Inverse of a matrix. Special types of matrices: Transpose of a matrix, Symmetric and Skew symmetric matrices, Hermitian and Skew Hermitian matrix, Rank of a matrix, Echelon form of a matrix, Normal form, Application of matrices to a system of linear (both homogeneous and non-homogeneous) equations , Theorems on consistency of a system of linear equations.Eigen values and Eigen vectors, relation between Eigen values and Eigen vectors. Process of finding Eigen values and Eigen vectors, Cayley Hamilton theorem, and its use to finding inverse of a matrix.	**15**
II	**Sets Theory & Functions:**Sets, subsets Set operations and the laws of set theory and Venn diagrams. Examples of finite and infinite sets. Finite sets and counting principle. Empty set, properties of empty set. Standard set operations. Classes of a set. Power set of a set. Difference and symmetric difference of two sets. Set identities, Generalized union and intersection. **Relations and Functions:** Product set, Composition of relations, Types of relations, Partitions, Equivalence Relations with example of congruence modulo relation, Partial ordering relations. Function, Types of Function, Inverse Function, Composite of functions, Modular arithmetic and basic properties of congruences	**15**

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III	**Theory of equations:**Symmetric functions of the roots of an equation Root of a multiplicity, Synthetic division, Greatest common Divisors, Relation between the roots and coefficients of general polynomial equations in one variable. Transformation of equations. Descarte's rule of signs. Solutions of cubic equations (Cardon method) , Biquadrate equation.	**15**
IV	**Group Theory:**Definition and properties of a group, Abelian groups, Examples of groups, Subgroups and examples, Cosets and their properties, Lagrange's theorem and its applications, Normal subgroups and their properties, Simple groups, Factors groups .	**15**

Part C - Learning Resource

Text Books, Reference Books, Other Resources

Text Books Recommended-

1. RamjiLal (2017). *Algebra 1: Groups, Rings, Fields and Arithmetic*. Springer.
2. Nathan Jacobson (2009). *Basic Algebra* I (2nd edition). Dover Publications
3. John B. Fraleigh (2007). *A First Course in Abstract Algebra* (7th edition). Pearson

Reference Books Recommended-

4. Michael Artin (2014). *Algebra* (2nd edition). Pearson.
5. Stephen H. Friedberg, Arnold J.Insel& Lawrence E. Spence (2003). *Linear Algebra* (4thedition). Prentice-Hall of India Pvt. Lt
6. Joseph A. Gallian (2017). *Contemporary Abstract Algebra* (9th edition). Cengage.
7. Kenneth Hoffman & Ray Kunze (2015). *Linear Algebra* (2nd edition). Prentice-Hall.
8. I. N. Herstein (2006). *Topics in Algebra* (2nd edition). Wiley India.

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Part D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: **100 Marks**
Continuous Internal Assessment (CIA): **30 Marks**
End Semester Examination (ESE): **70 Marks**

Continuous Internal Assessment (CIA) (Conducted by course teacher)	Test /Quiz – 20+20 Marks Assignment/Seminar- 10 Marks	Better marks out of two test/quiz + obtained marks in Assignment shall be considered against 30 marks
End Semester Examination (ESE)	**Two Section-A&B** Section-A: Q1.Objective- 10x1=10 marks Q2. Short answer type question-5x4=20marks Section-B: Descriptive answer type question, 1 out of 2 from each unit- 10x4= 40 Marks	

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FOUR YEAR UNDER GRADUATE PROGRAM(2024-28)
DEPARTMENT OF MATHEMATICS
COURSE CURRICULUM

Part A: Introduction			
Program: Bachelor in Science (Diploma/Degree/Honors)		**Semester - III**	**Session:2024-2025**
1	Course Code	**MASE-01**	
2	Course Title	Advanced Calculus	
3	Course Type	Discipline Specific Elective (DSE)	
4	Pre-requisite (if any)	Basic idea of elementary differential and integral calculus	
5	Course Learning Outcome (CLO)	**This Course will enable the students to:** ➢ Calculate the limit and examine the continuity and understand the concepts of limit , continuity and differentiability of functions of more than one variable with geometrical interpretation. ➢ To Understand the concepts of mean value theorems with their applications . ➢ To understand the concept of maxima and minima for functions of two and three variables with their uses and techniques ➢ Understand conceptual variations while advancing from one variable to severalvariables in calculus. ➢ Understand the concept of integration of functions of two and three variables and their evaluation technique with emphasis on beta and gamma functions .	
6	Credit Value	**4 C**	1Credit = 15 hours- Learning and observation
7	Total Marks	Maximum Marks : 100	Minimum Passing Marks:40

Part B: Content of the Course		
Total no of teaching – learning period =60 Periods (60 Hours)		
UNIT	**Topics**	**No of Periods**
I	Limit and continuity of function of two and three variables. Mean value theorems of function of two variables- First mean value theorem and taylor's theorem. Partial Differentiation and Euler's theorem on homogeneous functions, Change of variables.	**15**
II	Partial Derivation and differentiability of function of two variables. Schwartz's theorem, Young's theorem, Implicit function theorem. Fourier series, Fourier expansion of piece wise monotonic function.	**15**
III	Jacobians , Maxima, Minima and saddle points of function of two variables. Lagrange's multipliers method. Envelopes, Evolutes	**15**
IV	Beta and Gamma function. Double and triple integrals .Dirichelet's integrals. Change of order of integration.	**15**

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Part C - Learning Resource		
Text Books, Reference Books, Other Resources		
Text Books Recommended- 1. Gorakh Prasad (2016). Differential Calculus (19th edition). Pothishala Pvt. Ltd. 2. Mathematical Analysis, S.C. malik and S. Arora, New age international,Delhi		
3. Howard Anton, I. Bivens & Stephan Davis (2016). Calculus (10th edition).Wiley India. 4.Gabriel Klambauer (1986). Aspects of Calculus. Springer-Verlag. 5.Wieslaw Krawcewicz & Bindhyachal Rai (2003). Calculus with Maple Labs. 6.Principles of Mathematical analysis, W.Rudin,McGraw Hill Publication 7.Jerrold Marsden, Anthony J. Tromba & Alan Weinstein (2009). Basic 8. James Stewart (2012). Multivariable Calculus (7th edition). Brooks/Cole. Cengage.		
E-resources: https://onlinecourses.nptel.ac.in https://epgp.inflibnet.aci.in https://swayam.gov.inhttps://www.mooc.org		
Part D: Assessment and Evaluation		
Suggested Continuous Evaluation Methods: **Maximum Marks:** **100 Marks** **Continuous Internal Assessment (CIA):** **30 Marks** **End Semester Examination (ESE):** **70 Marks**		
Continuous Internal Assessment (CIA) (Conducted by course teacher)	Test /Quiz – 20+20 Marks Assignment/Seminar- 10 Marks	Better marks out of two test/quiz + obtained marks in Assignment shall be considered against 30 marks
End Semester Examination (ESE)	**Two Section**-A&B Section-A: Q1.Objective- 10x1=10 marks Q2. Short answer type question-5x4=20marks Section-B: Descriptive answer type question, 1 out of 2 from each unit- 10x4= 40 Marks	

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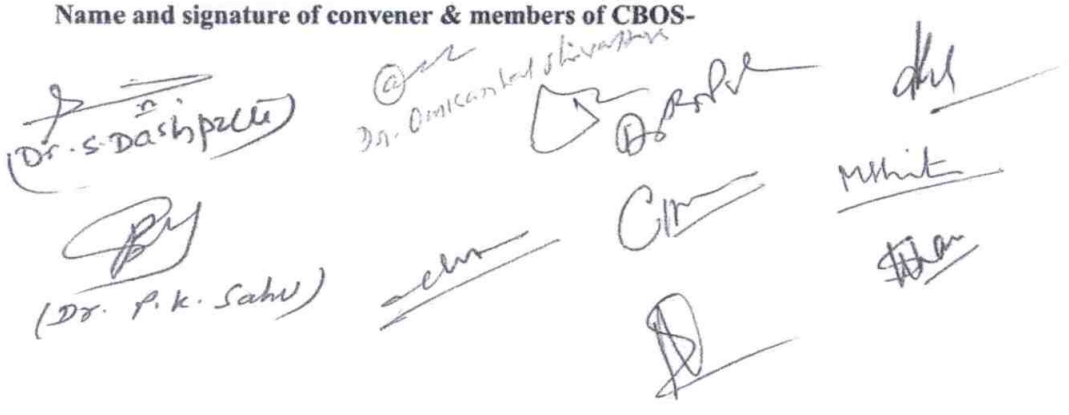

FOUR YEAR UNDER GRADUATE PROGRAM (2024-28)

DEPARTMENT OF MATHEMATICS

COURSE CURRICULUM

Part A: Introduction			
Program: Bachelor in Science (Diploma/Degree/Honors)		**Semester - IV**	**Session:2024-2025**
1	Course Code	**MASE-02**	
2	Course Title	**MECHANICS**	
3	Course Type	**Discipline Specific Elective (DSE)**	
4	Pre-requisite(if any)	Basic idea of Statics and Dynamics	
5	Course Learning Outcome (CLO)	**This Course will enable the students to:** ➢ The object of the paper is to give students knowledge of basic mechanics such as simple harmonic motion, motion under other laws and forces. ➢ Learn about a nul point, a nul line, and a nul plane with respect to a system of forces acting on a rigid body together with the idea of central axis. ➢ Understand necessary conditions for the equilibrium of particles acted upon by various forces and learn the principle of virtual work for a system of coplanar forces acting on a rigid body. Determine the centre of gravity of some materialistic systems and discuss the equilibrium of a uniform cable hanging freely under its own weight. ➢ Deal with the kinematics and kinetics of the rectilinear and planar motions of a particle including the constrained oscillatory motions of particles. Learn that a particle moving under a central force describes a plane curve and know the Kepler's laws of the planetary motions, which were deduced by him long before the mathematical theory given by Newton. ➢ Understand the reduction of force system in three dimensions to a resultant force acting at a base point and a resultant couple, which is independent of the choice of base of reduction.	
6	Credit Value	**4 C**	1Credit =15 hours-Learning and Observation
7	Total Marks	Maximum Marks : 100	Minimum Passing Marks:40

Part B: Content of the Course		
Total no of teaching – learning period =60 Periods (60 Hours)		
UNIT	**Topics**	**No of Periods**
I	Analytical conditions of equilibrium of Coplanar Forces. Forces in three dimensions, Poinsot's central axis, Wrenches, Null lines and planes.	**15**
II	Virtual work, Stable and Unstable equilibrium, Catenary.	**15**
III	Velocities and accelerations along and transverse directions, and along tangential and normal directions, Simple harmonic motion, Motion under other law of forces. Elastic strings.	**15**

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IV	Motion in resisting medium, Constrained motion, Motion on smooth and rough plane curves. Motion of particles of varying mass, Central orbit, Keplers laws of motion, Rocket motion, Motion of particle in three dimensions.	15

Part C - Learning Resource

Text Books, Reference Books, Other Resources

Text Books Recommended-

1.R.S. Verma (1962). a text books of statics Pothishala Pvt. Ltd.

2. P.L. Shrivastava (1964). Elementary dynamics. Ram Narayan Lal, Beni Prasad Publishers Allahabad

Reference Books Recommended-

3. A.S. Ramsey (2009), Statics, Cambridge University Press

4. A.S. Ramsey (2009), Dynamics, Cambridge University Press

5. S.L. Loney (2006) , An Elementary Treatise on the dynamics of a partical and of rigid bodies. .

6. J.L. Synge an Griffith (1949). Principal of Mechanics, McGraw-Hill.

E-Recourses:

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Part D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
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Continuous Internal Assessment (CIA) (Conducted by course teacher)	Test /Quiz – 20+20 Marks Assignment/Seminar- 10 Marks	Better marks out of two test/quiz + obtained marks in Assignment shall be considered against 30 marks
End Semester Examination (ESE)	**Two Section-A&B** Section-A: Q1.Objective- 10x1=10 marks Q2. Short answer type question-5x4=20marks Section-B: Descriptive answer type question, 1 out of 2 from each unit- 10x4= 40 Marks	

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FOUR YEAR UNDERGRADUATE PROGRAM(2024-28)

DEPARTMENT OF MATHEMATICS

COURSE CURRICULUM

Part A: Introduction			
Program: Bachelor in Science (Degree/Honors)		**Semester - V**	**Session:2024-2025**
1	Course Code	**MASE-03**	
2	Course Title	**Numerical Methods**	
3	Course Type	**Discipline Specific Elective (DSE)**	
4	Pre-requisite (if any)	Basic idea of Numerical solutions, Differential equation and theory of eqution.	
5	Course Learning Outcome (CLO)	**This Course will enable the students to:** ➢ The aim of this course is to teach the student the application of various numerical techniques for variety of problems occurring in the daily life. ➢ The main outcome will be that student will be able to handle problems and finding approximated solution. ➢ Obtain numerical solutions of algebraic and transcendental equations. ➢ Find numerical solutions of system of linear equations and to check the accuracy of the solutions. ➢ Learn about various interpolating and extrapolating methods to find numerical solutions.	
6	Credit Value	**4 C**	1Credit =15 hours-Learning and Observation
7	Total Marks	Maximum Marks : 100	Minimum Passing Marks:40

Part B: Content of the Course		
Total no of teaching – learning period =60 Periods (60 Hours)		
UNIT	**Topics**	**No of Periods**
I	Numerical Methods for Solving Algebraic and Transcendental Equations Round-off error and computer arithmetic, Local and global truncation errors, Algorithms and convergence; Bisection method, false position method, fixed point iteration method, Newton's method and secant method for solving equations.	**15**
II	Lagrange and Newton interpolations, Piecewise linear interpolation, Cubic spline interpolation, Finite difference operators, Gregory Newton forward and backward difference interpolations.	**15**
III	First order and higher order approximation for first derivative, Approximation for second derivative; Numerical integration: Trapezoidal rule, Simpson's rule and its error analysis, BulirschStoer extrapolation methods, Richardson extrapolation.	**15**
IV	Euler's method, RungeKutta methods, Higher order one step method, Multi-step methods; Finite difference method, Shooting method, Real life examples: Google search engine, 1D and 2D simulations, Weather forecasting.	**15**

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Part C - Learning Resource		
Text Books, Reference Books, Other Resources		
Text Books Recommended- 1. M.K. Jain, S. R. K. Iyengar& R. K. Jain (2012). Numerical Methods for Scientific and Engineering Computation (6th edition). New Age International Publishers. 2. C. F. Gerald & P. O. Wheatley (2008). Applied Numerical Analysis (7th edition), Pearson Education, India.		
Reference Books Recommended- 3. Brian Bradie (2006), A Friendly Introduction to Numerical Analysis. Pearson. 4. Robert J. Schilling & Sandra L. Harris (1999). Applied Numerical Methods for Engineers Using MATLAB and C. Thomson-Brooks/Cole.		
E-Recourses: https://onlinecourses.nptel.ac.in https://epgp.inflibnet.aci.in https://swayam.gov.in https://www.mooc.org		
Part D: Assessment and Evaluation		
Suggested Continuous Evaluation Methods: **Maximum Marks:** **100 Marks** **Continuous Internal Assessment (CIA):** **30 Marks** **End Semester Examination (ESE):** **70 Marks**		
Continuous Internal Assessment (CIA) (Conducted by course teacher)	Test /Quiz – 20+20 Marks Assignment/Seminar- 10 Marks	Better marks out of two test/quiz + obtained marks in Assignment shall be considered against 30 marks
End Semester Examination (ESE)	**Two Section-A&B** Section-A: Q1.Objective- 10x1=10 marks Q2. Short answer type question-5x4=20marks Section-B: Descriptive answer type question, 1 out of 2 from each unit- 10x4= 40 Marks	

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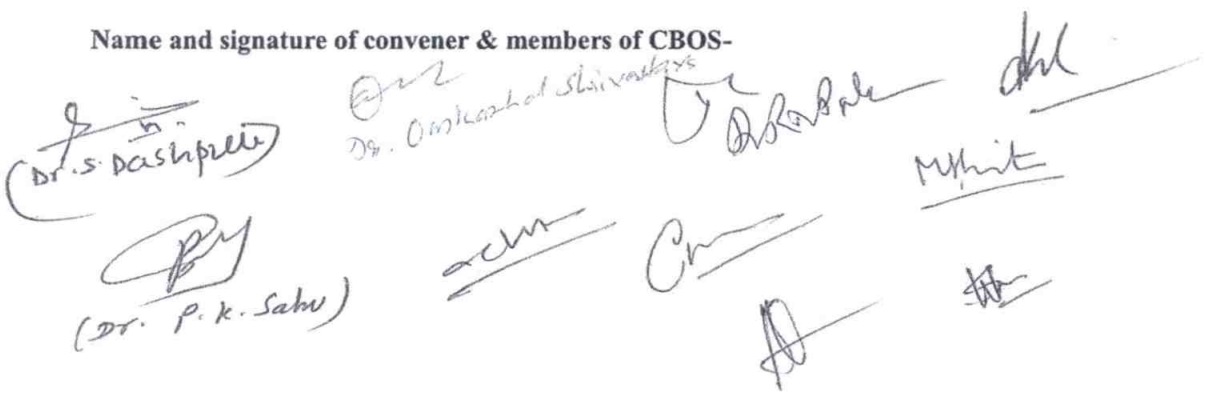

FOUR YEAR UNDER GRADUATE PROGRAM(2024-28)

DEPARTMENT OF MATHEMATICS

COURSE CURRICULUM

Part A: Introduction				
Program: Bachelor in Science (Degree/Honors)		**Semester - VI**	**Session:2024-2025**	
1	Course Code	**MASE-04**		
2	Course Title	**Number Theory**		
3	Course Type	**Discipline Specific Elective (DSE)**		
4	Pre-requisite (if any)	Basic idea of theory of equation and congruence relations		
5	Course Learning Outcome (CLO)	**This Course will enable the students to:** ➢ Know about distribution of prime and congruence. ➢ Solve Number theoretic functions ➢ Learn primitive, Quadratic Reciprocity Law and Public Key Encryption		
6	Credit Value	4C	1Credit = 15 hours- Learning and observation	
7	Total Marks	Maximum Marks : 100	Minimum Passing Marks : 40	

Part B: Content of the Course		
Total no of teaching – learning period =60 Periods (60 Hours)		
UNIT	**Topics**	**No of Periods**
I	**Distribution of Primes and Theory of Congruences** Linear Diophantine equation, Prime Counting function, Prime number theorem, Goldbach conjecture, Fermat and Mersenne primes, Congruence relation and it's properties, Linear congruence and Chinese remainder theorem, Fermats' little theorem, Wilson's theorem.	15
II	**Number Theoretic Functions** Number theoretic functions for dum and number of divisors, Multiplicative function, The Mobius inversion formula, The greatest integer function. Euler's phi-function and properties, Euler's theorem.	15
III	**Primitive** The order of an integer modulo n, Primitive roots for primes, Composite numbers having primitive roots; Definition of quadratic residue of an odd prime, and Euler's criterion.	15
IV	**Quadratic Reciprocity Law and Public Key Encription** The Legendre symbol and it's properties, Quadratic reciprocity, Quadratic congruences with composite moduli; Public key encription, RSA encription and decription.	15

Dr. S. Dasgupta

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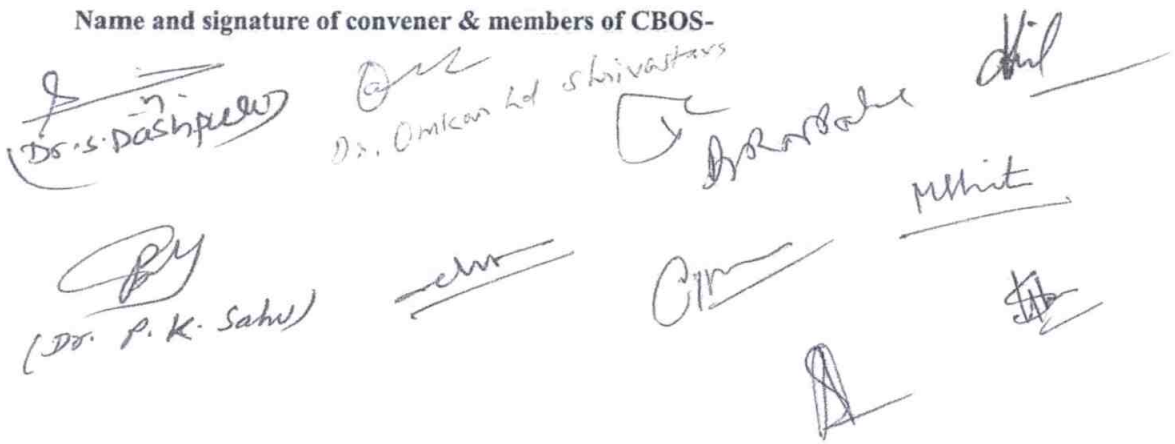
Part C - Learning Resource
Text Books, Reference Books, Other Resources
Text Books Recommended- 1. Burton, David M. (2012) : Elementary Number Theory(7th ed.) Mc-Graw Hill Education Pvt. Ltd. Indian Reprint.
Reference Books Recommended- 2. Jones, G. A., & Jones, J. Mary. (2005) : Elementary Number Theory. Undergraduate Mathematics Series(SUMS). First Indian Print.
E-Recourses: https://onlinecourses.nptel.ac.in https://epqp.inflibnet.aci.in https://swayam.gov.in https://www.mooc.org

Part D: Assessment and Evaluation		
Suggested Continuous Evaluation Methods: **Maximum Marks:** **100 Marks** **Continuous Internal Assessment (CIA):** **30 Marks** **End Semester Examination (ESE):** **70 Marks**		
Continuous Internal Assessment (CIA) (Conducted by course teacher)	Test /Quiz – 20+20 Marks Assignment/Seminar- 10 Marks	Better marks out of two test/quiz + obtained marks in Assignment shall be considered against 30 marks
End Semester Examination (ESE)	**Two Section-A&B** Section-A: Q1.Objective- 10x1=10 marks Q2. Short answer type question-5x4=20marks Section-B: Descriptive answer type question, 1 out of 2 from each unit- 10x4= 40 Marks	

Name and signature of convener & members of CBOS-



FOUR YEAR UNDERGRADUATE PROGRAM(2024-28)

DEPARTMENT OF MATHEMATICS

COURSE CURRICULUM

Part A: Introduction			
Program: Bachelor in Science (Honors/Honors with Research)		**Semester - VII**	**Session:2024-2025**
1	Course Code	**MASE-05**	
2	Course Title	**Integral Transforms**	
3	Course Type	**Discipline Specific Elective (DSE)**	
4	Pre-requisite (if any)	Basic idea of differentiation and integration	
5	Course Learning Outcome (CLO)	**This Course will enable the students to:** ➢ Know about piece wise continuous functions,Dirac delta function,Laplace transforms and its properties. ➢ Solve ordinary differential equations using Laplace transforms. ➢ Explain Parseval's identity,Plancherel's theorem and applications of Fourier transforms to boundary value problems.	
6	Credit Value	4C	1Credit = 15 hours- Learning and Observation
7	Total Marks	Maximum Marks : 100	Minimum Passing Marks : 40

Part B: Content of the Course		
Total no of teaching – learning period =60 Periods (60 Hours)		
Unit	**Topics**	**No. of Periods**
I	**LaplaceTransforms:** Integral transform, Kernel of an integral transform, Reduction of integral transform intoLaplace transform, Linearity, Existence theorem, Laplace transforms of derivatives andintegrals, Shifting theorems, Change of scale property, Laplace transforms of periodicfunctions,Dirac'sdeltafunction.	15
II	**Laplace Transforms (Continued) and Applications:** Differentiation and integration of transforms, Convolution theorem, Integral equations, Inverse Laplace transform, Lerch's theorem, Linearity property of inverse Laplace transform, Translations theorems of inverse Laplace transform, Inverse transform of derivatives, Applications of Laplace transform in obtaining solutions of ordinary differential equations and integral equations.	15
III	**FourierTransforms:** Fourier and inverse Fourier transforms, Fourier sine and cosine transforms, Inverse Fouriersine and cosine transforms, Linearity property, Change of scale property, Shifting property, Modulation theorem, Relation between Fourier and Laplace transforms.	15

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IV	**Solution of Equations by FourierTransforms :** Solution of integral equation by Fourier sine and cosine transforms,Convolution theorem for Fourier transform, Parseval's identity for Fourier transform, Plancherel's theorem, Fourier transform of derivatives, Applications of infinite Fourier transforms to boundary value problems, Finite Fourier transform, Inversion formula for finite Fourier transforms.	15

Part C - Learning Resource

Text Books, Reference Books, Other Resources

Text Books Recommended-

1. JamesWardBrown&RuelV.Churchill.*Fourier Seriesand BoundaryValueProblems*.McGraw-HillEducation. 2011
2. CharlesK.Chui.*An Introduction to Wavelets*.AcademicPress 1992

Reference Books Recommended-

3. ErwinKreyszig.*Advanced Engineering Mathematics*(10th edition).Wiley. 2011
4. WalterRudin.*Fourier Analysison Groups*.DoverPublications. 2017
5. A.Zygmund.*TrigonometricSeries*(3rd edition).CambridgeUniversityPress. 2002

E-Recourses:

https://onlinecourses.nptel.ac.in
https://epqp.inflibnet.aci.in
https://swayam.gov.in
https://www.mooc.org

Part D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Examination (ESE):	**70 Marks**

Continuous Internal Assessment (CIA) (Conducted by course teacher)	Test /Quiz – 20+20 Marks Assignment/Seminar- 10 Marks	Better marks out of two test/quiz + obtained marks in Assignment shall be considered against 30 marks
End Semester Examination (ESE)	**Two Section-A&B** Section-A: Q1.Objective- 10x1=10 marks Q2. Short answer type question-5x4=20marks Section-B: Descriptive answer type question, 1 out of 2 from each unit- 10x4= 40 Marks	

Name and signature of convener & members of CBOS-

Dr. S. Dashpute

(Dr. P. K. Sahu)

FOUR YEAR UNDER GRADUATE PROGRAM(2024-28)

DEPARTMENT OF MATHEMATICS

COURSE CURRICULUM

Part A: Introduction			
Program: Bachelor in Science (Honors/Honors with Research)		**Semester - VII**	**Session:2024-2025**
1	Course Code	**MASE-06**	
2	Course Title	**Topology**	
3	Course Type	**Discipline Specific Elective (DSE)**	
4	Pre requisite(if any)	Knowledge of basic ideas of set theory and analysis including metric spaces.	
5	Course Learning Outcome (CLO)	**This Course will enable the students to:** ➢ Understand the concept of countable and uncountable sets and its properties. Understand the concept of topological spaces and its examples, bases, sub-bases, subspaces and relative topology. ➢ Understand the concept of countable, separable spaces and separation axioms with their characterizations and basic properties. ➢ Understand the concept and properties of compactness, continuous functions. ➢ Understand the concept and properties of countable compactness in metric spaces. ➢ Understand the concept and properties of connectedness, continuous functions.	
6	Credit Value	**4C**	1Credit = 15 hours- Learning and Observation
7	Total Marks	Maximum Marks : 100	Minimum Passing Marks : 40

Part B: Content of the Course

Total no of teaching – learning period =60 Periods (60 Hours)

Unit	Topics	No. of Periods
I	**Topological Space :** Cardinal numbers and its arithmetic. Definition and examples of topological spaces. Neighbourhood Systems, Limit point. Derived sets and closed sets; Interior, Exterior and Frontier points ,Bases and sub-bases.. Alternate methods of defining a topology in terms of Kuratowski Closure Operator , Subspaces and relative topology.	15
II	**Continuous function of Topological space:** Continuous functions and homeomorphism. First and Second Countable spaces. Lindelof's theorems. Separable spaces. Second countability and separability.	15
III	**Compactness and Connectedness:** Compactness. Continuous functions and compact sets. Basic properties of Compactness. Compactness and finite intersection property. Sequentially and countably compact sets. Local compactness, Connected spaces, Connectedness on the real line.Components, Locally connected spaces. Totally connected spaces.	15

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IV	**Separation axioms:** Separation axioms; T0, T1, T2, T3 ,T4; their Characterizations and basic properties. Urysohn's lemma, Tietze extension theorem. T5 spaces and Tychonoff spaces	15

Part C - Learning Resource

Text Books, Reference Books, Other Resources

Text Books Recommended :

1. Introduction to General Topology By K.D.Joshi, Wiley Eastern Ltd., 1983.
2. Topology, A First Course By James R. Munkres, Prentice Hall of India Pvt. Ltd., New Delhi,2000.

References Books Recommended :

1. J. Dugundji, Topology, Allyn and Bacon, 1966 (reprinted in India by Prentice Hall of India Pvt. Ltd.).
2. George F.Simmons, Introduction to Topology and modern Analysis, McGraw-Hill Book Company
3. J.Hocking and G Young, Topology, Addison-Wiley Reading, 1961.
4. J.L. Kelley, General Topology, Van Nostrand, Reinhold Co., New York,1995.
5. L. Steen and J. Seebach, Counter examples in Topology, Holt, Rinehart and Winston, New York, 1970.
6. W.Thron, Topologically Structures, Holt, Rinehart and Winston, New York,1966.
7. N. Bourbaki, General Topology Part I (Transl.),Addison Wesley, Reading, 1966.
8. R. Engelking, General Topology, Polish Scientific Publishers, Warszawa, 1977.
9. W. J. Pervin, Foundations of General Topology, Academic Press Inc. New York,1964.
10. E.H.Spanier, Algebraic Topology, McGraw-Hill, New York,1966.
11. S. Willard, General Topology, Addison-Wesley, Reading, 1970.

E-Recourses:

https://onlinecourses.nptel.ac.in
https://epgp.inflibnet.aci.in
https://swayam.gov.in
https://www.mooc.org

Part D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Examination (ESE):	**70 Marks**

Continuous Internal Assessment (CIA) (Conducted by course teacher)	Test /Quiz – 20+20 Marks Assignment/Seminar- 10 Marks	Better marks out of two test/quiz + obtained marks in Assignment shall be considered against 30 marks

End Semester Examination (ESE)	**Two Section-A&B** Section-A: Q1.Objective- 10x1=10 marks Q2. Short answer type question-5x4=20marks Section-B: Descriptive answer type question, 1 out of 2 from each unit- 10x4= 40 Marks

Name and signature of convener & members of CBOS-

(Dr. S. Dashpute) (Dr. Omkar Nath Shrivastava) (Dr. P. K. Sahu)

FOUR YEAR UNDER GRADUATE PROGRAM(2024-28)

DEPARTMENT OF MATHEMATICS

COURSE CURRICULUM

Part A: Introduction			
Program: Bachelor in Science (Honors/Honors with Research)		**Semester - VII**	**Session:2024-2025**
1	Course Code	**MASE -07**	
2	Course Title	**Complex Analysis - I**	
3	Course Type	**Discipline Specific Elective (DSE)**	
4	Pre-requisite(if any)	Basic knowledge of complex analysis and calculus.	
5	Course Learning Outcome (CLO)	**This Course will enable the students to:** ➢ Understand Complex number and their properties. ➢ Learn about properties of linear transformation and isomorphism theorems. ➢ Understand the concept of Limit, Continuity, Differentiability of Complex and Analytic function. ➢ Obtain various variants of Mobius transformations. ➢ Obtain various Conformal mapping and types of transformations.	
6	Credit Value	**4C**	1Credit = 15 hours- Learning and Observation
7	Total Marks	Maximum Marks :100	Minimum Passing Marks :40

Part B: Content of the Course		
Total no of teaching – learning period =60 Periods (60 Hours)		
Unit	**Topics**	**No. of Periods**
I	**Complex Numbers and Their Geometrical Representation:** Complex numbers as ordered pairs, Geometrical representation of complex numbers, Modulus and argument of complex numbers and its Properties, Equation of straight line and circle, Cauchy's inequality and Lagrange's identity.	15
II	**Continuity and Differentiability of Complex and Analytic Functions**: Limit, Continuity, Differentiability of functions of a Complex variables, Analytic function, Cauchy – Riemann equations, Conjugate function, Laplace's Differential equations, Harmonic functions, Orthogonal system and Construction of Analytic function.	15
III	**Mobius Transformation:** Jacobian of Transformation, Linear Transformation, Mobius Transformation, Linear Group, Fixed point of Mobius transformation, Cross ratio, Inverse Point, Properties of Mobius transformation.	15
IV	**Conformal Mappings:** Conformal mapping, Necessary and sufficient condition for $w = f(z)$ to represent a conformal mapping, Transformation $w = z^a$, Inverse, exponential, logarithmic and trigonometrical transformation.	15

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Part C - Learning Resource
Text Books, Reference Books, Other Resources
Text Books Recommended : 1. Complex Analysis By L.V.Ahlfors, McGraw - Hill, 1979. 2. J.B. Conway, Functions of one Complex variable, Springer-Verlag, International student- Edition, Narosa Publishing House, 1980. 3. H.K. Pathak, Complex Analysis and Applications, ShikshaSahityaPrakashan , 2019
Reference Books Recommended : 1. H.A. Priestly, Introduction to Complex Analysis, Clarendon Press, Oxford 1990. 2. Complex Function Theory By D.Sarason 3. Liang-shin Hahn & Bernard Epstein, Classical Complex Analysis, Jones and Bartlett Publishers International, London, 1996. 4. S. Lang, Complex Analysis, Addison Wesley, 1977. 5. D. Sarason, Complex Function Theory, Hindustan Book Agency, Delhi, 1994. 6. Mark J.Ablowitz and A.S. Fokas, Complex Variables: Introduction and Applications, Cambridge University press, South Asian Edition, 1998. 7. C.Caratheodory, Theory of Functions (2 Vols.) Chelsea Publishing Company, 1964. 8. E.C Titchmarsh, The Theory of Functions, Oxford University Press, London. 9. S.Ponnusamy, Foundations of Complex Analysis, Narosa Publishing House, 1997.
E-Recourses: https://onlinecourses.nptel.ac.in https://epqp.inflibnet.aci.in https://swayam.gov.in https://www.mooc.org

Part D: Assessment and Evaluation		
Suggested Continuous Evaluation Methods: **Maximum Marks:** **100 Marks** **Continuous Internal Assessment (CIA):** **30 Marks** **End Semester Examination (ESE):** **70 Marks**		
Continuous Internal Assessment (CIA) (Conducted by course teacher)	Test /Quiz – 20+20 Marks Assignment/Seminar- 10 Marks	Better marks out of two test/quiz + obtained marks in Assignment shall be considered against 30 marks
End Semester Examination (ESE)	**Two Section-A&B** Section-A: Q1.Objective- 10x1=10 marks Q2. Short answer type question-5x4=20marks Section-B: Descriptive answer type question, 1 out of 2 from each unit- 10x4= 40 Marks	

Name and signature of convener & members of CBOS-

(Dr. P. K. Sahu)

FOUR YEAR UNDER GRADUATE PROGRAM(2024-28)
DEPARTMENT OF MATHEMATICS
COURSE CURRICULUM

Part A: Introduction			
Program: Bachelor in Science (Honors/Honors with Research)		**Semester - VII**	**Session:2024-2025**
1	Course Code	**MASE-08**	
2	Course Title	**Discrete Mathematics**	
3	Course Type	**Discipline Specific Elective (DSE)**	
4	Pre-requisite (if any)	Basic idea of logic and order relations.	
5	Course Learning Outcome (CLO)	**This Course will enable the students to:** ➢ The course aims at introducing the concepts of Lattices, sub Lattices and Homomorphisms between Lattices. ➢ Understand the uses ofBoolean algebra in daily life. ➢ Understand the uses of grammer and languages in daily life. ➢ Learn about the Finite state machines in different fields. ➢ Solve real-life problems using finite-state and Tuning machines.	
6	Credit Value	4C	1Credit = 15 hours- Learning and observation
6	Total Marks	Maximum Marks : 100	Minimum Passing Marks:40

Part B: Content of the Course		
Total no of teaching – learning period =60 Periods (60 Hours)		
Unit	Topics	No. of Periods
I	**Lattices**-Lattices as partially ordered sets-their properties. Lattices as Algebraic Systems. Sublattices. Direct products and Homomorphisms. Some special Lattices e.g. Complete, Complemented and Distributive Lattices.	15
II	**Boolean Algebras**: Boolean Algebras. Boolean Algebras as Lattices. Various Boolean Identities. Boolean Functions, The Switching Algebra example, Sub-algebras.	15
III	**Grammars, Languages and Regular sets**. Phrase-structure Grammars. Rewriting rules. Derivations. Sentential forms. Language generated by a Grammar. Regular, Context-Free and Context Sensitive Grammars and Languages. Regular expressions and the Pumping Lemma. Kleen's theorem. Notions of Syntax Analysis. Polish Notations. Conversion of Infix Expressions to Polish notation. The Reverse Polish notations.	15
IV	**Finite state machines** – Equivalent machines. Finite state machines as language recognizers. Finite Automata. Acceptors. Non-deterministic Finite Automata and equivalence of its power to that of Deterministic Finite Automata. Moore and mealy Machines. Turing Machine and Partial Recursive Functions.	15

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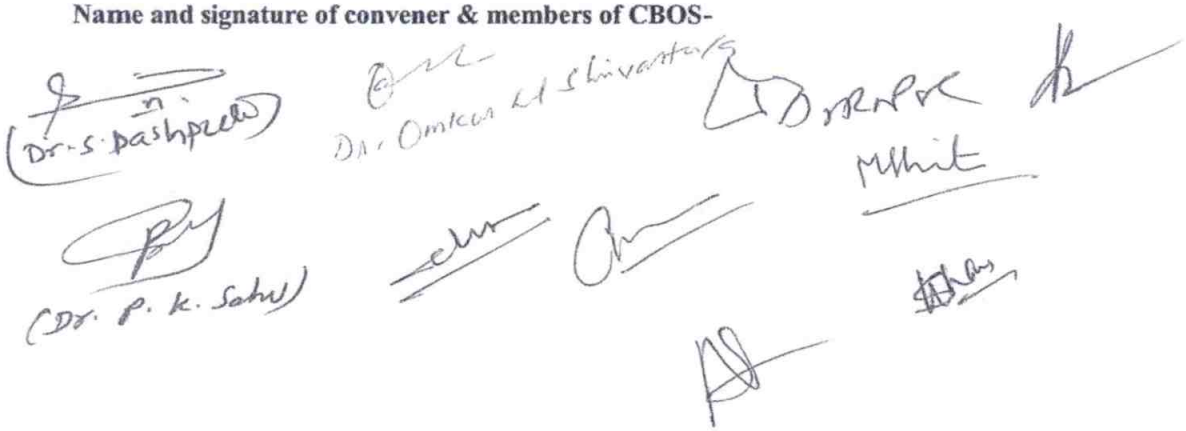
Part C - Learning Resource		
Text Books, Reference Books, Other Resources		
Text Books Recommended : 1. M.K. Gupta.Discrete Mathematics.Krishna Prakashan Media(P) Ltd 2. J.P. Tremblay & R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, McGraw-Hill Book Co. New York.		
Reference Books Recommended : 1. C.L. Liu, Elements of Discrete Mathematics, McGraw-Hill Book Co. 3. Seymour Lepschutz, Finite mathematics McGraw-Hill Book Co. New York. 4. S. Wiitala Discrete mathematics McGraw-Hill Book Co. New York		
E-Recourses: https://onlinecourses.nptel.ac.in https://epgp.inflibnet.aci.in https://swayam.gov.in https://www.mooc.org		
Part D: Assessment and Evaluation		
Suggested Continuous Evaluation Methods: **Maximum Marks:** **100 Marks** **Continuous Internal Assessment (CIA):** **30 Marks** **End Semester Examination (ESE):** **70 Marks**		
Continuous Internal Assessment (CIA) (Conducted by course teacher)	Test /Quiz – 20+20 Marks Assignment/Seminar- 10 Marks	Better marks out of two test/quiz + obtained marks in Assignment shall be considered against 30 marks
End Semester Examination (ESE)	**Two Section-A&B** Section-A: Q1.Objective- 10x1=10 marks Q2. Short answer type question-5x4=20marks Section-B: Descriptive answer type question, 1 out of 2 from each unit- 10x4= 40 Marks	

Name and signature of convener & members of CBOS-



FOUR YEAR UNDER GRADUATE PROGRAM(2024-28)

DEPARTMENT OF MATHEMATICS

COURSE CURRICULUM

Part A: Introduction			
Program: Bachelor in Science (Honors/Honors with Research)		**Semester - VIII**	**Session:2024-2025**
1	Course Code	**MASE-09**	
2	Course Title	**Measure Theory**	
3	Course Type	**Discipline Specific Elective (DSE)**	
4	Pre-requisite(if any)	Knowledge of real analysis	
5	Course Learning Outcome (CLO)	**This Course will enable the students to:** ➢ Understand development of measure and integration theory and Borel, Lebesgue measurability, and compare integration theory of Lebesgue and Riemann with examples and counter examples. ➢ Understand the concept and properties of functions of bounded variation. .	
6	Credit Value	**4C**	1Credit = 15 hours- Learning and Observation
7	Total Marks	Maximum Marks : 100	Minimum Passing Marks:40

Part B: Content of the Course		
Total no of teaching – learning period =60 Periods (60 Hours)		
Unit	Topics	No. of Periods
I	**Measurable Sets:** Lebesgue outer measure, Lebesgue measure, Properties of measurable sets, Borel sets and their measurability characterization of measurable sets, Non measurable set.	15
II	**Measurable Function:** Definition and properties, Simple, Step and characteristics function, Continuous function, sets of measure Zero. Sequence of functions, Egoroff's theorem structure of measurable function, Lusin theorem, Frechet theorem, Convergence in measure, Riesz theorem.	15
III	**Lebesgue Integral:** Lebesgue integral of a bounded function, Comparison of Riemann integral and Lebesgue integral, Bounded Convergence Theorem, Integral of non negative measurable functions, Fatou's lemma, Monotone convergence theorem, General Lebesgue integral, Lebesgue dominated convergence theorem.	**15**
IV	**Differentiation and Integration:** Dini derivatives, Differentiation of monotone functions, Lebesgue theorem, Function of bounded variation, Differentiation of an integral, Lebesgue sets, Absolutely Continuous Functions, Integral of the derivatives	**15**

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Part C - Learning Resource

Text Books, Reference Books, Other Resources

Text Books Recommended :

1. G.de Barra, Measure Theory and Integration, Wiley Eastern Limited, 1981.
2. P.K. Jain and V.P. Gupta, Lebesgue Measure and , New Age International (P) Limited Published, New Delhi, 1986 Reprint 2000).
3. Inder K. Rana, An Introduction to Measure and Integration, Norosa Publishing House, Delhi, 1997

Reference Books Recommended :

1. Richard L. Wheeden and AntoniZygmund, Measure and Integral: An Introduction to Real Analysis, Marcel Dekker Inc.1977.
2. J.H. Williamson, Lebesgue Integration, Holt Rinehart and Winston, Inc. New York. 1962
5. P.R. Halmos, Measure Theory, Van Nostrand, Princeton, 1950.
6. T.G. Hawkins, Lebesgue's Theory, of Integration: Its Origins and Development, Chelsea, New York, 1979.
7. K.R. Parthasarathy, Introduction to Probability and Measure, Macmillan Company of India Ltd., Delhi, 1977.
8. R.G. Bartle, The Elements of Integration, John Wiley & Sons, Inc. New York, 1966.

E-Recourses:

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Part D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

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Name and signature of convener & members of CBOS-

Dr. S. Dashpute

Dr. Omkar M Shivastava

(Dr. P. K. Sahu)

FOUR YEAR UNDER GRADUATE PROGRAM (2024-28)

DEPARTMENT OF MATHEMATICS

COURSE CURRICULUM

Part A: Introduction			
Program: Bachelor in Science (Honors/Honors with Research)		**Semester - VIII**	**Session:2024-2025**
1	Course Code	**MASE – 10**	
2	Course Title	**General and Algebraic Topology**	
3	Course Type	**Discipline Specific Elective (DSE)**	
4	Pre-requisite(if any)	Knowledge of Topological spaces and related concepts	
5	Course Learning Outcome (CLO)	**At the end of the course, the students will be able to :** ➢ Understand the concept of products in different topological spaces. ➢ Understand embedding, metrization and its related theorems. ➢ Understand the concept of net, filter and its various topological properties and their inter-relations. ➢ Understand fundamental group and covering spaces.	
6	Credit Value	**4C**	1Credit = 15 hours- Learning and Observation
7	Total Marks	Maximum Marks :100	Minimum Passing Marks :40

Part B: Content of the Course		
Total no of teaching – learning period =60 Periods (60 Hours)		
Unit	Topics	No. of Periods
I	**Product Topology** Tychonoff product topology; Separation axioms and product spaces; Compactness and product spaces; Connectedness and product spaces; Countability and product spaces.	15
II	**Embedding and metrization** Embedding lemma and Tychonoff embedding. The Urysohnmetrization theorem. Metrization theorems and Paracompactness-Local finiteness. The Nagata-Smirnov metrization theorem. Para compactness. The Smirnov metrization theorem.	15
III	**Nets and filter** Topology and convergence of nets.Hausdorffness andnets. Compactness and nets. Filters and their convergence. Canonical way of converting nets to filters and vice-versa. Ultra-filters and Compactness.	15
IV	**The fundamental group and Covering spaces** Homotopy of paths; The fundamental group; Covering Spaces; The fundamental group of the circle and the fundamental theorem of algebra.	15

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Part C - Learning Resource

Text Books, Reference Books, Other Resources

Text Books Recommended :

1. Introduction to General Topology ByK.D.Joshi, Wiley Eastern Ltd., 1983.
2. Topology, A First Course By James R. Munkres, Prentice Hall of India Pvt. Ltd., New Delhi,2000.

References Books Recommended:

1. J. Dugundji, Topology, Allyn and Bacon, 1966 (reprinted in India by Prentice Hallof India Pvt. Ltd.).
2. George F.Simmons, Introduction to Topology and modern Analysis, McGraw-Hill Book Company, 1963.
3. J.Hocking and G Young, Topology, Addison-Wiley Reading, 1961.
4. J.L. Kelley, General Topology, Van Nostrand, Reinhold Co., New York,1995.
5. L. Steen and J. Seebach, Counter examples in Topology, Holt, Rinehart and Winston, New York, 1970.
6. W.Thron, Topologically Structures, Holt, Rinehart and Winston, New York,1966.
7. N. Bourbaki, General Topology Part I (Transl.),Addison Wesley, Reading, 1966.
8. R. Engelking, General Topology, Polish Scientific Publishers, Warszawa, 1977.
9. W. J. Pervin, Foundations of General Topology, Academic Press Inc. New York,1964.
10. E.H.Spanier, Algebraic Topology, McGraw-Hill, New York,1966.
11. S. Willard, General Topology, Addison-Wesley, Reading, 1970.
12. Crump W.Baker, Introduction to Topology, Wm C. Brown Publisher, 1991.
13. Sze-Tsen Hu, Elements of General Topology, Holden-Day,Inc.1965.

E-Recourses:

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Part D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
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End Semester Examination (ESE)	**Two Section-A&B** Section-A: Q1.Objective- 10x1=10 marks Q2. Short answer type question-5x4=20marks Section-B: Descriptive answer type question, 1 out of 2 from each unit- 10x4= 40 Marks

Name and signature of convener & members of CBOS-

(Dr. S. Dashpute) (Dr. Omkar Kulkarni) (Dr. P. K. Sahu)

FOUR YEAR UNDER GRADUATE PROGRAM(2024-28)

DEPARTMENT OF MATHEMATICS

COURSE CURRICULUM

Part A: Introduction			
Program: Bachelor in Science (Honors/Honors with Research)		**Semester - VIII**	**Session:2024-2025**
1	Course Code	**MASE-11**	
2	Course Title	**Complex Analysis - II**	
3	Course Type	**Discipline Specific Elective (DSE)**	
4	Pre-requisite(if any)	Basic discussion of complex numbers, complex variable functions and analytic functions.	
5	Course Learning Outcome (CLO)	**This Course will enable the students to:** ➢ Understand the fundamental Complex integration. ➢ Understand the concept of residues and apply Cauchy's residue theorem to evaluate integrals. Understand the concept of conformal mappings, bilinear transformations, their properties and classifications. Understand the concept about the spaces of analytic functions. ➢ Understand the concept of Weierstrass' factorization theorem, Riemann Zeta function, Gamma function and its properties. Understand the concept of Analytic Continuation and its properties. Gain knowledge of power series of analytic function. Understand the concept and properties of Harmonic functions on a disc. ➢ Understand the concept of Canonical products, entire function and exponent of Convergence. ➢ Understand the advanced concepts of Analytic functions and its properties.	
6	Credit Value	**4C**	1Credit = 15 hours- Learning and Observation
7	Total Marks	Maximum Marks :100	Minimum Passing Marks :40

Part B: Content of the Course		
Total no of teaching – learning period =60 Periods (60 Hours)		
Unit	Topics	No. of Periods
I	**Complex integration:** Complex integration, Cauchy-Goursat. Theorem. Cauchy's integral formula. Higher order derivatives. Morera's Theorem. Cauchy's inequality and Liouville's theorem. The fundamental theorem of algebra. Taylor's theorem. Laurent's series. Isolated singularities. Meromorphic functions. Maximum modulus principle. Schwarz lemma. The argument principle. Rouche'stheorem Inverse function theorem.	15
II	**Calculus of Residues:** Residues. Cauchy's residue theorem. Evaluation of integrals. Branches of many valued functions with special reference to arg z, logz and z^a. Bilinear transformations, their properties and classifications. Definitions and	15

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	examples of Conformal mappings. Spaces of analytic functions. Hurwitz's theorem. Montel's theorem Riemann mapping theorem.	
III	**Entire Functions and Analytic Continuation:** Weierstrass' factorisation theorem. Gamma function and its properties. Riemann Zeta function. Riemann's functional equation. Runge's theorem. Mittag-Leffler's theorem. Analytic Continuation. Uniqueness of direct analytic continuation. Uniqueness of analytic continuation along a curve. Power series method of analytic continuation Schwarz Reflection Principle. Monodromy theorem and its consequences.	15
IV	**Harmonic Functionand Canonical products:** Harmonic functions on a disk. Harnack's inequality and theorem. Dirichlet Problem. Green's function, Canonical products. Jensen's formula. Poisson-Jensen formula. Hadamard's three circles theorem. Order of an entire function. Exponent of Convergence. Borel's theorem. Hadamard's factorization theorem.	15

Part C - Learning Resource

Text Books, Reference Books, Other Resources

Text Books Recommended :

1. Complex Analysis By L.V.Ahlfors, McGraw - Hill, 1979.
2. J.B. Conway, Functions of one Complex variable, Springer-Verlag, International student-Edition, Narosa Publishing House, 1980.
3. H.K. Pathak, Complex Analysis and Applications, ShikshaSahityaPrakashan , 2019

References Books Recommended:

1. H.A. Priestly, Introduction to Complex Analysis, Clarendon Press, Oxford 1990.
2. Complex Function Theory By D.Sarason
3. Liang-shin Hahn & Bernard Epstein, Classical Complex Analysis, Jones and Bartlett Publishers International, London, 1996.
4. S. Lang, Complex Analysis, Addison Wesley, 1977.
5. D. Sarason, Complex Function Theory, Hindustan Book Agency, Delhi, 1994.
6. Mark J.Ablowitz and A.S. Fokas, Complex Variables: Introduction and Applications, Cambridge University press, South Asian Edition, 1998.
7. E. Hille, Analytic Function Theory (2 Vols.) Gonn& Co., 1959.
8. W.H.J. Fuchs, Topics in the Theory of Functions of one Complex Variable, D.VanNostrand Co., 1967.
9. C.Caratheodory, Theory of Functions (2 Vols.) Chelsea Publishing Company, 1964.
10. M.Heins, Complex Function Theory, Academic Press, 1968.
11. Walter Rudin, Real and Complex Analysis, McGraw-Hill Book Co., 1966.
12. S.Saks and A.Zygmund, Analytic Functions, MonograficMatematyczne, 1952.
13. E.C Titchmarsh, The Theory of Functions, Oxford University Press, London.
14. W.A. Veech, A Second Course in Complex Analysis, W.A. Benjamin, 1967.
15. S.Ponnusamy, Foundations of Complex Analysis, Narosa Publishing House, 1997.

E-Recourses:

https://onlinecourses.nptel.ac.in
https://epgp.inflibnet.aci.in
https://swayam.gov.in
https://www.mooc.org

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Part D: Assessment and Evaluation		
Suggested Continuous Evaluation Methods: **Maximum Marks:** **100 Marks** **Continuous Internal Assessment (CIA):** **30 Marks** **End Semester Examination (ESE):** **70 Marks**		
Continuous Internal Assessment (CIA) (Conducted by course teacher)	Test /Quiz – 20+20 Marks Assignment/Seminar- 10 Marks	Better marks out of two test/quiz + obtained marks in Assignment shall be considered against 30 marks
End Semester Examination (ESE)	**Two Section**-A&B Section-A: Q1.Objective- 10x1=10 marks Q2. Short answer type question-5x4=20marks Section-B: Descriptive answer type question, 1 out of 2 from each unit- 10x4= 40 Marks	

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FOUR YEAR UNDER GRADUATE PROGRAM(2024-28)

DEPARTMENT OF MATHEMATICS

COURSE CURRICULUM

Part A: Introduction			
Program: Bachelor in Science (Honors/Honors with Research)		**Semester - VIII**	**Session:2024-2025**
1	Course Code	**MASE-12**	
2	Course Title	**Graph Theory**	
3	Course Type	**Discipline Specific Elective (DSE)**	
4	Pre-requisite(if any)	Basic discussion of Graph , Trees and matrices.	
5	Course Learning Outcome (CLO)	**This Course will enable the students to:** ➢ Appreciate the definition and basics of graphs along with types and their examples. ➢ Understand the definition of a tree and learn its applications to fundamental circuits. ➢ Know the applications of graph theory to network flows. ➢ Understand the notion of planarity of a graph. ➢ Relate the graph theory to the real-world problems.	
6	Credit Value	4C	1Credit = 15 hours- Learning and observation
7	Total Marks	Maximum Marks :100	Minimum Passing Marks :40

Part B: Content of the Course		
Total no of teaching – learning period =60 Periods (60 Hours)		
Unit	Topics	No. of Periods
I	**Paths, Circuits and Graph Isomorphisms :** Definition and examples of a graph, Subgraph, Walks, Paths and circuits; Connected graphs, disconnected graphs and components of a graph; Euler and Hamiltonian graphs, Graph isomorphisms, Adjacency matrix and incidence matrix of a graph, Directed graphs and their elementary properties.	15
II	**Planar Graphs :** Planar graph, Euler theorem for a planar graph, Various representations of a planar graph, Dual of a planar graph, Detection of planarity, Kuratowski's theorem. Weighted graph, Travelling salesman problem, shorted path Dijkstra's algorithm.	15

III	**Cut-Sets and Cut-Vertices :** Cut-set of a graph and its properties, Fundamental circuits and cut-sets, Cut-vertices, Connectivity and separability, Network flows, 1-isomorphism and 2- isomorphism.	15
IV	**Trees and Fundamental Circuits :** Definition and properties of trees, Rooted and binary trees, Cayley's theorem on a counting tree, Spanning tree, Fundamental circuits, Minimal spanning trees in a connected graph.	15

Part C - Learning Resource

Text Books, Reference Books, Other Resources

Text Books Recommended :

1. R. Balakrishnan & K. Ranganathan (2012). A Textbook of Graph Theory. Springer.
2. Narsingh Deo (2016). Graph Theory with Applications to Engineering and Computer Science. Dover Publications.

References Books Recommended :

3. Reinhard Diestel (2017). Graph Theory (5th edition). Springer.
4. Edgar G. Goodaire & Michael M. Parmenter (2018). Discrete Mathematics with Graph Theory (3rd edition). Pearson.
5. Douglas West (2017). Introduction to Graph Theory (2nd edition). Pearson.:

E-Recourses:

https://onlinecourses.nptel.ac.in
https://epgp.inflibnet.aci.in
https://swayam.gov.in
https://www.mooc.org

Part D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 100 Marks

FOUR YEAR UNDER GRADUATE PROGRAM(2024-28)

DEPARTMENT OF MATHEMATICS

COURSE CURRICULUM -2024-25

Part A: Introduction			
Program: Bachelor in Science (Certificate/Diploma/Degree/Honors)		SEMESTER-II/IV/V/VI	Session: 2024-2025
1	Course Code	**MASEC-1**	
2	Course Title	**Introduction to LATEX**	
3	Course Type	Skill Enhancement Course (SEC)	
4	Pre-requisite (if, any)	Basic understanding of document editing, familiarity with markup languages, and willingness to learn LaTeX syntax and formatting conventions.	
5	Course Learning Outcome (CLO)	**This Course will enable the students to:** ➢ Make different Alignments in a document and an Application for a job. ➢ Generate Bio-Data, and Table Structures. ➢ Create Mathematical Statements using LaTex. ➢ Prepare Articles and Inserting Pictures. ➢ Prepare Question paper and PowerPoint presentation in LaTeX format.	
6	Credit Value	2 Credits (1C + 1C)	*Credit = 15 Hours – Theoretical learning and = 30 Hours Laboratory or Field learning/Training*
7	Total Marks	Max. Marks: 50	Min Passing Marks: 20

Part B: Content of the Course		
Total No. of Teaching–learning Periods: Theory – 15 Periods (15 Hrs) and Lab. or Field learning/Training 30 Periods (30 Hours)		
Unit	**Topics (Course contents)**	**No. of Period**
I	**Basics:** Introduction to LaTeX, Text, Symbols and Commands, Document layout and organization, displayed text. Mathematical formulas, Graphics inclusion and color. Floating tables and figures, User customizations. **Beyond the Basics:** Document management, Postscript and PDF, Beamer, Frames, Bibliographic data bases and BiBTeX, Presentation material.	15
II	**Practicals Based on-** **1.Introduction to TeX and LaTeX-** Creating and typesetting a simple LaTeX document, **2.Adding basic information to documents-** Environments, Footnotes, Sectioning, Displayed material. **3.Accents and symbols-** Mathematical typesetting (elementary and advanced): Subscript/ Superscript, Fractions, Roots, Ellipsis,	30

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	4.Mathematical symbols- Arrays, Delimiters, Multiline formulas, **5.Putting one thing above another**-Spacing and changing style in math mode. **6.Pictures and graphics in LaTeX**-Simple pictures using PSTricks, Plotting of functions. **7.Beamer, Frames**-Setting up beamer document, Enhancing beamer presentation **8.Bibliographic data bases and BiBTeX**-Create and manage bibliographic references using BiBTeX	

Part C - Learning Resource
Text Books, Reference Books, Other Resources
Text Books Recommended- 1. Murugan Swaminathan, Latex For Beginners, Publisher: Notion Press
Reference Books Recommended 2. Dilip Datta,Latex in 24 Hours A Practical Guide for Scientific Writing,Springer
E-resources: Free Online LaTeX Editor- https://www.overleaf.com/

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:
Maximum Marks: 50 Marks
Continuous Internal Assessment (CIA): 15 Marks
End Semester Exam (ESE): 35 Marks

Continuous Internal Assessment (CIA): (By Course Coordinator)	Internal Test / Quiz-(2): 10 & 10 Assignment/Seminar +Attendance - 05 Total Marks - 15	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 15 Marks
End Semester Exam (ESE):	Laboratory / Field Skill Performance: On spot Assessment A. Performed the Task based on learned skill - 20 Marks B. Spotting based on tools (written) – 10 Marks C. Viva-voce (based on principle/technology) - 05 Marks	Managed by Coordinator as per skilling

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FOUR YEAR UNDER GRADUATE PROGRAM(2024-25)

DEPARTMENT OF MATHEMATICS

COURSE CURRICULUM

Part A: Introduction			
Program: Bachelor in Science (Certificate/Diploma/Degree/Honors)		Class: B.Sc. II/IV/V/VI Semester	Session: 2024-2025
1	Course Code	**MASEC-2**	
2	Course Title	**Python**	
3	Course Type	**Skill Enhancement Course (SEC)**	
4	Pre-requisite (if, any)	Basic understanding of programming concepts, familiarity with syntax.	
5	Course Learning Outcome (CLO)	**This Course will enable the students to:** ➢ To write python programs , develop a small application .and logic for problem solving. ➢ To be familiar about the basic constructs of programming such as data, operations, conditions, loops, functions etc. ➢ To be familiar with string and its operation. ➢ To develop basic concepts of function and terminology. ➢ To determine the methods to create and develop Python programs by ➢ Utilizing the data structures like lists and tuples.	
6	Credit Value	2 Credits (1C + 1C)	*Credit = 15 Hours – Theoretical learning and = 30 Hours Laboratory or Field learning/Training*
7	Total Marks	Max. Marks: 50	Min Passing Marks: 20

Part B: Content of the Course		
UNIT	Topics	No. of Hours
I	**(A) Python Basic and IDE** :- Introduction of Python, Installing Python, Running Simple Program, Removing Keys, Traversing a Dictionary . Basic of Python :-Data type of Python., Variable declaration rule, Python Identifier and reserved words, Input Output Function Operator of Python, Advanced Python operator(Membership and identity), Comments in Python, Line and Indentation, **(B) Conditional structure** :- if Statements, if -else and statement, Nested if , if-elif-else ladder Loop Control Structure, While loop, For loop, Nested loop, Break Statement, Continue Statement, Pass Statement - Practical 6 ,7& 8 **(C) String and Function** String Basics, Accessing and updating String, Built-in String Methods Function in Python, Declaration and Calling function, Function Argument, Anonymous Functions Python Lists, Accessing and updating List, Basic List Operation, Built-in List Methods, Python Tuple, Accessing and updating tuple, Basic tuple operation, Built-in tuple Method.	**15**

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II	**List of practicals based on Python :-** ▪ Practical 1 - Write a Python program that asks the user for their name and age, then prints a message greeting the user with their name and mentioning their age. ▪ Practical 2 - Define a list with at least three elements of different data types and print the list. ▪ Practical 3- Writeaprogram thattakestwonumberandprint thesumof thesenumbers. ▪ Practical 4 -Writeaprogramtocheckwhethertheinputnumberiseven orodd. ▪ Practical 5- Write a program to compare three numbers and print the largest one. ▪ Practical 6- Writeaprogramtoprintfactors ofagivennumber. ▪ Practical 7-Writeaprogram toprint tableusingwhileLoop. ▪ Practical 8 -Writeaprogramtocreatethe followingPattern ▪ Practical 9- Write a Python program that takes a lowercase string from the user and converts it to uppercase. ▪ Practical 10- Write a function that takes a string input and checks if it is a palindrome or not. ▪ Practical 11- Write a Python program that defines a function to calculate the sum of two numbers. ▪ Practical 12- Create a tuple representing the days of the week and update the last element with "Sunday". Print the updated tuple. ▪ Practical 13- Write a Python program that concatenates two tuples and prints the concatenated tuple. ▪ Practical 14- WAP to create a list of numbers and sort the list in ascending order. ▪ Practical 15- Write a list function to convert a string into a list, as in list (-abc) gives [a, b, c].	30

Part C - Learning Resource

Text Books, Reference Books, Other Resources

Text Books Recommended-

1. Fundamentals of Python first programs, 2nd Edition, Kenneth A. Lambert.
2. Beginning Python from Novice to Professional, Third Edition, Magnus Lie Hetland

Reference Books Recommended-

3. Python for Science and Engineering, Hans-PetterHalvorsen.
4. Python Programming: An Introduction to Computer Science, Third Edition, John Zelle.
5. Introduction to Scientific Computing in Python, Continuum Analytics and Robert Johansson.

E-Recourses:

https://onlinecourses.nptel.ac.in
https://epgp.inflibnet.aci.in
https://swayam.gov.in
https://www.mooc.org

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	50 Marks
Continuous Internal Assessment (CIA):	15 Marks
End Semester Exam (ESE):	35 Marks

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Continuous Internal Assessment (CIA): (By Course Coordinator)	Internal Test / Quiz-(2): 10 & 10 Assignment/Seminar +Attendance - 05 Total Marks - 15	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 15 Marks
End Semester Exam (ESE):	Laboratory / Field Skill Performance: On spot Assessment A. Performed the Task based on learned skill - 20 Marks B. Spotting based on tools (written) – 10 Marks C. Viva-voce (based on principle/technology) - 05 Marks	Managed by Coordinator as per skilling

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FOUR YEAR UNDER GRADUATE PROGRAM(2024-28)

DEPARTMENT OF MATHEMATICS

COURSE CURRICULUM

Part A: Introduction			
Program: Bachelor in Science (Certificate/Diploma/Degree/Honors)		Class: B.Sc. I/III/V Sem	Session:2024-2025
1	Course Code	**MAVAC-1**	
2	Course Title	**Basic Mathematics and Logic**	
3	Course Type	**Value Addition Course**	
4	Course Learning Outcome (CLO)	**This Course will enable the students-** ➢ To orient them towards life-long learning, to develop power of concentration and to overcome the fear of mathematics from their mind. ➢ To cultivate scientific temper through systematic, critical and lateral thinking. ➢ To enhance their logical, analytical and reasoning skills useful for competitive exams. ➢ To make understand the relevance and need of quantitative methods for making business decisions.	
5	Credit Value	2 Credits	*Credit = 15 Hours - learning & Observation*
6	Total Marks	Max. Marks: 50	Min Passing Marks: 20

PART -B: Content of the Course		
Total No. of Teaching–learning Periods (01 Hr. per period) - 30 Periods (30 Hours)		
Unit	Topics (Course contents)	No. of Period
	Basic Mathematics	
I	Brief history of Vedic Mathematics (In Indian Knowledge Tradition), Sanskrit terminology involved in 16 Sutras and 13 Sub-Sutras and their meaning , Addition , Subtraction , Multiplication & Division using different techniques of Vedic Mathematics , Squaring numbers , Square roots of perfect squares , Cube roots of perfect cubes , Methods of quick verification of answers through Digit Sum Method	**8**
II	Problem based on Numbers, Decimal Fractions, Average, Simple Interest , Percentage ,Clocks	**8**
III	Problems on Profit & Loss , Discount, Ages, Speed, Time & Distance, Train , Ratio & Proportion, Mixture	**8**

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IV	**Logical Ability:** Problems on Series Completion , Coding- Decoding , Inserting the Missing Character , Problems on Mirror Image & Water Image Problems on Blood relations , Direction Sense Tests , Cubes & Dice , Logical Deductions based on Universal, Particular, Affermative & Negative Premises.	6

Part C - Learning Resource

Text Books, Reference Books, Other Resources

Text Books Recommended-

1. Dr. R.S. Aggarwal, Quantitative Aptitude, S. Chand and Company Ltd., New Delhi.
2. AbhijitGuha, Quantitative Aptitude, Tata McGraw Hill Publishing Company Limited.,New Delhi.
3. Dr. R.S. Aggarwal , Verbal & Non –Verbal Reasoning , S. Chand and Company Ltd., New Delhi

Reference Books Recommended-

4. Rajesh Kumar Singh , Tricky Mathematics , Success Mantra Publications , Patna
5. Govind Prasad Singh &Rakesh Kumar , Text Book of Quickest Mathematics (For all Competitive Examinations)
6. Vedic Mathematics Made Easy Published by Dhaval Bhatia

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	50 Marks
Continuous Internal Assessment (CIA):	15 Marks
End Semester Exam (ESE):	35 Marks

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): 10 & 10 Assignment/Seminar +Attendance - 05 Total Marks - 15	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 15 Marks
End Semester Exam (ESE):	Two section – A & B Section A: Q1. Objective – 05 x1= 05 Mark; Q2. Short answer type- 5x2 =10 Marks Section B: Descriptive answer type qts.,1out of 2 from each unit- 4x05 =20 Marks	

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