# Pt. Ravishankar Shukla University, Raipur(CG)

## CURRICULUM & SYLLABI

**(Based on CBCS & LOCF)**

**M.Sc. Bioscience**

**Semester System**

**Session: 2024-25 & onwards**

| Approved by: | Board of Studies | Academic Council |
|---|---|---|
| Date: 10/5/24 | Bio Science | |

10/5/24
(Chairman)

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# M.SC. BIOSCIENCE

**Program Objectives:**

Bioscience is an integrated approach to biological Sciences and inculcates the study of life and living organisms, their life cycles, physiological processes, adaptations, and environment. It covers a fascinating range of topics, from subjects likeZoology, Botany, Biochemistry, Developmental Biology, Environmental and Evolutionary Biology, Immunology, Microbiology,Molecular Biology, Physiology, Chronobiology,etc. giving the modern biologist an insight into numerous disciplines of Life Sciences.

The Master of Science in Bioscience is a four-semester program spread over the duration of two years and is designed to cater to the needs of students aspiring for higher education in Biological Sciences.

The Program comprises the following objectives-

1. **Imparting Knowledge-**Imparting a deeper insight into the knowledge of plant,animal, and microbial worlds, along with an integrated vision of the various life processes involved in the fascinating world of living organisms in totality.
2. **Development of aptitude for Critical Thinking and Reasoning**-Development of a capability of appreciation for the nature of living organisms and biological processes,besides critical thinking, and reasoning.
3. **Problem Solving-**Development of an aptitude to synthesize a range of biological concepts and ideas.
4. **Skill development-**Training in handling various modern biological techniques and tools besides developing analytical and critical thinking skills, including hypothesis generation and testing, scientific writing, and presentation skills.

All these will be helpful not only to construct a strong base for higher studies in Biological Sciences but also to prepare for a successful and productive career in teaching and research. After obtaining this degree, a student may enter into the job market or choose to undertake further higher studies in the subject. Options after post-graduation include joining industries, academia, public health, etc. Thus, the post-graduate will have an opportunity to contributeto the development of the welfare of society in a useful manner.

**Program Outcomes:**

Upon successful completion of the Master of Science in Bioscience program, students will be able to:

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| PO-1 | **Knowledge:**Acquire a deep insight into the knowledge of the plant and animal world individually and develop an integrated vision of the various life processes involved in the fascinating world of living organisms. |
| PO-2 | **Critical Thinking and Reasoning:**Identify the characteristics and basic needs of living organisms and ecosystems. Explain the processes of growth and development in individuals and populations. Demonstrate critical thinking and reasoning skills. |
| PO-3 | **Problem Solving:** Inculcate scientific attitude and scientific temper so that they can |

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| | understand the prevailing situations, perceive the problems, and work scientifically to resolve them. |
| PO-4 | **Skill development:** A degree in biosciences will impart skills that will help students stand out in a progressively competitive job market and propel him or her to academic success. It will not only help in the development of a capability to appreciate the nature of living organisms and biological processes but also inculcate a research interest. Besides, being trained in technical and analytical skills used in modern biological research,the student would also develop an aptitude to synthesize a range of biological concepts and ideas. |
| PO-5 | **Effective Communication:**Communicate complex biological ideas and results effectively to both technical and non-technical audiences, through written reports, presentations, and teaching. They will also possess the ability to effectively communicate the findings of biological research and incorporate these findings into the existing body of knowledge in biology: |
| PO-6 | **Social/ Interdisciplinary Interaction:** Integrate biological concepts and techniques into interdisciplinary contexts and collaborate effectively with professionals from other fields to address complex problems. |
| PO-7 | **Self-directed and Life-long Learning:**Recognize the importance of ongoing professional development and lifelong learning in the rapidly evolving field of Biology and will exhibit the ability to continue learning independently or in formal educational settings. |
| PO-8 | **Effective Citizenship,Leadership, and Innovation:** Lead and innovate in various biological contexts, contributing to advancements in the field and applying mathematical insights to emerging challenges. They would also understand the role of science and the ethical conduct of science in society and hence contribute their knowledge for the welfare of the entire humanity. |
| PO-9 | **Ethics:**Demonstrate ethical and responsible conduct in biological research, teaching, and collaboration, adhering to professional standards and best practices. |
| PO-10 | **Further Education or Employment:** Engage in further academic pursuits, including Ph.D. programs in biology or related fields. Get employment in academia, research institutions, industry, government, and other sectors. |
| PO-11 | **Global Perspective:**Recognize the global nature of biological research and its impact, appreciating diverse cultural perspectives in mathematical practices. |

**PROGRAMME SPECIFIC OUTCOMES (PSOs)**

At the end of the program, the student will be able to:

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| PSO1 | Understand the nature of the living world(animals,plants, and microbes) in totality and build an integrated vision of the various life processes involved. |
| PSO2 | Develop the capability to appreciate the nature of living organisms and biological processes and integrate with other interdisciplinary fields for effective collaborations to |

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| | address complex problems. |
| PSO3 | Pursue research in challenging areas of life sciences. |
| PSO4 | Employ confidently the knowledge of modern biological tools for scientific investigations in the field of medical sciences, environmental sciences, etc. |
| PSO5 | Qualify for national-level tests like NET/GATE etc. |

## M.Sc. Bioscience

| Specification of Course | Semester | No. of Courses | Credits |
|---|---|---|---|
| **Core [Theory]** | I-IV | 14 | 70 |
| **Core [Practical]** | | 07 | 15 |
| **Internship** | II | 01 | 02 |
| **Elective [Theory]** | IV | 02 | 10 |
| **Elective [Practical]** | | 01 | 03 |
| **Total** | | **25** | **100** |
| **Additional Courses(Qualifying in nature, for Students admitted to School of Studies,PRSU only)** | | | |
| **Generic Elective** | II-III | 02 | 06 |
| **Skill Enhancement (Value Added Courses)** | III | 01 | 02 |
| **Course on Indian Knowledge System** | I | 01 | 02 |

## M.Sc. Bioscience

## PROGRAMME STRUCTURE

| Semester | Course Nature | Course Code | Course Title | Course Type (T/P) | Hrs/ Week | Credits | Marks | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | CIA | ESE | Total |
| Semester-I | Core I | BS-22101 | Cell Biology | T | 5 | 5 | 30 | 70 | 100 |
| | Core II | BS-22102 | Biomolecules | T | 5 | 5 | 30 | 70 | 100 |
| | Core III | BS-22103 | Instrumentation and Techniques | T | 5 | 5 | 30 | 70 | 100 |
| | Core IV | BS-22104 | Biometry, Computer Application, and Scientometry | T | 5 | 5 | 30 | 70 | 100 |
| | Core LC-I | BSLC-22105 | Lab Course I (Based on Theory papers I & II) | P | 5 | 2 | 30 | 70 | 100 |
| | Core LC-II | BSLC-22106 | Lab Course II (Based on Theory papers III & IV) | P | 5 | 2 | 30 | 70 | 100 |
| Semester-II | Core I | BS-22201 | Genetics and Molecular Biology | T | 5 | 5 | 30 | 70 | 100 |
| | Core II | BS-22202 | Bioenergetics & Metabolism | T | 5 | 5 | 30 | 70 | 100 |
| | Core III | BS-22203 | Microbiology | T | 5 | 5 | 30 | 70 | 100 |
| | Core IV | BS-22204 | Immunology | T | 5 | 5 | 30 | 70 | 100 |
| | Core LC-I | BSLC-22205 | Lab Course I (Based on Theory papers I & II) | P | 5 | 2 | 30 | 70 | 100 |
| | Core LC-II | BSLC-22206 | Lab Course II (Based on Theory papers III & IV) | P | 5 | 2 | 30 | 70 | 100 |
| | Internship | | | T+ P | * | 2 | 30 | 70 | 100 |

*Total duration- 60 hours

17-9-2024

| Semester | Course Nature | Course Code | Course Title | Course Type (T/P) | Hrs/ Week | Credits | Marks | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | CIA | ESE | Total |
| Semester-III | Core I | BS-22301 | Plant Physiology | T | 5 | 5 | 30 | 70 | 100 |
| | Core II | BS-22302 | Ecology and Environmental Biology | T | 5 | 5 | 30 | 70 | 100 |
| | Core III | BS-22303 | Animal Physiology | T | 5 | 5 | 30 | 70 | 100 |
| | Core IV | BS-22304 | Developmental Biology | T | 5 | 5 | 30 | 70 | 100 |
| | LC-I Core | BSLC-22305 | Lab Course I (Based on Core papers I & II) | P | 5 | 2 | 30 | 70 | 100 |
| | LC-II Core | BSLC-22306 | Lab Course II (Based on Core papers III& IV) | P | 5 | 2 | 30 | 70 | 100 |
| Semester-IV | Core I | BS-22401 | Molecular Endocrinology | T | 5 | 5 | 30 | 70 | 100 |
| | Core II | BS-22402 | Genetic Engineering | T | 5 | 5 | 30 | 70 | 100 |
| | Elective - I | BS-22403-A | (A) Parasitology | T | 5 | 5 | 30 | 70 | 100 |
| | | BS-22403-B | (B) Basic Chronobiology | T | 5 | 5 | 30 | 70 | 100 |
| | | BS-22403-C | (C) Ethnobotany | T | 5 | 5 | 30 | 70 | 100 |
| | Elective - II | BS-22404-A | (A) Applied Immunology | T | 5 | 5 | 30 | 70 | 100 |
| | | BS-22404-B | (B) Applied Chronobiology | T | 5 | 5 | 30 | 70 | 100 |
| | | BS-22404-C | (C) Secondary Metabolites | T | 5 | 5 | 30 | 70 | 100 |
| | LC-I Core | BSLC-22405 | Lab Course I (Based on Core papers I & II) | P | 7 | 3 | 30 | 70 | 100 |
| | LC-II Elective | BSLC-22406 | Lab Course II (Based on Elective papers I & II) | P | 7 | 3 | 30 | 70 | 100 |
| | ***OR*** | | | | | | | | |
| | Project Work** | | | | | | | | |
| | | | Dissertation | | | 13 | 75 | 225 | 300 |
| | | | Seminar based on project | | | 8 | 50 | 150 | 200 |
| | | | Viva-voce | | | 5 | 25 | 75 | 100 |

**Note:**

1. In place of Elective Courses students can choose paper(s) from MOOC Courses (Swayam Portal) subject to the following conditions-
   a. The chosen paper will be other than the papers offered in the current course structure.
   b. The paper will be PG level with a minimum of 12 weeks' duration.
   c. The list of courses on SWAYAM keeps changing; the departmental committee will finalize the list of MOOC courses for each semester.

17.9.2024

d. The paper(s) may be chosen from the Swayam Portal on the recommendation of the Head of the Department.

2. The candidates who have joined the PG Programme in the School of Studies (University Teaching Department), shall undergo Generic Elective Courses (only qualifying in nature) offered by other departments/SoS in Semester II and Semester III.

3. The candidates, who have joined the PG Programme in the School of Studies (University Teaching Department), shall undergo the Skill Enhancement Course/Value Added Course (only qualifying in nature) in Semester III and a course based on the Indian Knowledge System in the Semester I

**Generic Elective Courses:** (Offered to PG students of SoS in Life Science/ other SoS of PRSU)

| Semester | Course Code | Course Title | Course Type (T/P) | Hrs/ Week | Credits | Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | CIA | ESE | Total |
| II | LS-CBCS-1 | Analytical Techniques in Biology | T | 2 | 2 | 30 | 70 | 100 |
| | LS-CBCS-2 | Applied Biology | T | 2 | 2 | 30 | 70 | 100 |
| III | LS-CBCS-3 | Nanobiology | T | 2 | 2 | 30 | 70 | 100 |
| | LS-CBCS-4 | Rhythms in Life | T | 2 | 2 | 30 | 70 | 100 |

**Skill Enhancement/Value Added Courses:** (Offered to the PG students of SoS in Bioscience)

| Semester | Course Code | Course Title | Course Type (T/P) | Hrs/ Week | Credits | Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | CIA | ESE | Total |
| I | **IKS-1** | Indian Knowledge in Life Science | T | 2 | 2 | 30 | 70 | 100 |
| III | **LS-VAC-1** | Survival Skills vs Wilderness and Metropolitan Challenges | T | 4 | 2 | 30 | 70 | 100 |
| III | **LS-VAC-2** | Intellectual Property Rights, Biosafety & Bioethics | T | 4 | 2 | 30 | 70 | 100 |

**Important Note:**

Each theory paper will have questions divided into three sections, A, B, & C. Section A will have 10 MCQs/Fill in the blanks/One-word answers of a total of 15 marks from the whole syllabus. Section B will have 4 short answer questions (100 words) of 05 marks each, one from each unit. Section C will have 4 questions, one from each unit with internal choice, of 10 marks each. The questions have to be answered in about 350 words each.

* "A"

17-9-2024

* After the revised marking attern (70+30) "A" will be decided by the university administration.

17.9.2024

**Continuous Evaluation of Performance***

Each student will be evaluated continuously throughout the semester. Each student will be required to submit a brief write-up (not more than 15-20 pages) on his/her poster/oral presentation.

Out of 30 marks allocated for internal Assessment for each paper-

- 15 marks are to be assigned for class test.
- 10 marks are to be assigned for assignment/seminar presentation.
- 5 marks are to be assigned for attendance.

The marks for attendance shall be as follows-

| | | |
|---|---|---|
| (i) | More than 65% but less than 70% | 1 Marks |
| (ii) | 70% or more but less than 75% | 2 Marks |
| (iii) | 75% or more but less than 80% | 3 Marks |
| (iv) | 80% or more but less than 85% | 4 Marks |
| (v) | 85% and above | 5 Marks |

**Scheme for Lab Course (for each Semester)** **Maximum Marks 100**

**External/Internal**

| | | |
|---|---|---|
| 1- | Major exercise based on paper I | 15 |
| 2- | Minor exercise based on paper I | 10 |
| 3- | Major exercise based on paper II | 15 |
| 4- | Minor exercise based on paper II | 10 |
| 5- | Spotting/ Interpretation• | 10 |
| 6- | Viva-voce | 10 |

**Internal**

| | | |
|---|---|---|
| 1- | Sessional | 30 |
| | **Total** | **100** |

- A student will be required to interpret the displayed item/material.

| **Project Work**** | |
|---|---|
| | A student of the IV semester will have the choice to opt for project work in lieu of four theory papers and two lab courses provided he/she secures at least **65%** or more marks in aggregate in semesters I and II. |
| | The project has to be carried out in recognized national Institutes/Laboratories or UGC-recognized universities. No student will be allowed to carry out project work in private laboratories/colleges/ institutions, excluding the colleges recognized as research centers by the RDC of Pt. Ravishankar Shukla University, Raipur. |
| | The valuation of all the projects will be carried out by an external examiner and HoD of UTD or its nominee at the UTD Centre. |

17.9.2024

**M. Sc. Bioscience (Program code-M. Sc. 0405)**
**FIRST SEMESTER(July 2024 – December 2024)**
**CORE - I: CELL BIOLOGY (Course code: BS-22101)**
**[Credit: 5 and Maximum Marks: 75]** 70

(Each theory paper will have questions divided into three sections, A, B, & C.Section A will have 10 MCQs/Fill in the blanks/One-word answers of a total of 15 marks from the whole syllabus. Section B will have 4 short answer questions (100 words) of 05 marks each, one from each unit. Section C will have 4 questions, one from each unit with internal choice, of 10 marks each. The questions have to be answered in about 350 words each).

UNIT-I: Molecular organization of membranes - Asymmetrical organization of lipids, proteins, and carbohydrates. Membrane transport: Passive transport, Osmosis, ion channels, membrane pumps, and Active transport: ATP-powered pumps-types, properties and mechanisms, electrical properties of membranes.

UNIT-II: Protein trafficking: Transport of proteins into mitochondria, chloroplast, endoplasmic reticulum, and nucleus [in and out]. Transport by vesicle formation: exocytosis, endocytosis, and its molecular mechanism.

UNIT-III: Cell signaling: Signaling via G-protein linked and enzyme-linked cell surface receptors, MAP kinase pathways.
Eukaryotic cell division cycle: different phases and molecular events, regulation and control of cell cycle. Oncogenes: retinoblastoma, E2F, and p53 proteins.
Apoptosis: regulation by CASPases and formation of apoptosome. Pro- and anti-apoptotic factors.

UNIT-IV: States of chromosomes during cell cycle. Mitotic chromosome. Organization of genes in chromosomes. Banding pattern of chromosomes. Lampbrush and Polytene chromosomes. DNA packaging: Chromatin, nucleosomes, heterochromatin, and euchromatin.

Lab Course:

1. Study of chromosome behaviour during Mitosis and meiosis (Onion / Garlic root tips, Onion buds, human lymphocytes, rat or bird testis /grasshopper testis or any other materials).
2. Calculation of mitotic index in growing Onion / Garlic root tips
3. Squash preparation: Polytene chromosome (in Chironomus/ Drosophila or other insect salivary gland) and Barr body (in buccal epithelial cells).
4. Demonstration of secretory granules in the salivary gland cells of insects.
5. Demonstration of mitochondria by vital staining.
6. Study of permanent slides.
7. Estimation of DNA
8. Estimation of RNA
9. Sub-cellular fractionation and marker enzymes
10. Identification of biomolecules in different tissues by histochemical techniques
11. Preparation of mitotic plate by carmine squashing method and phase identification.
12. Demonstration of the nuclear matrix networks in onion cells.

10/5/24 10.V.2024 9 p.5.24 10/05/2024 10/5/24

13. Study of the effect of chemical agents on chromosome plant cells.
14. Isolation of protoplast, measurement of cell density plating efficiency.
15. Preparation of Karyotype of the metaphase plate.
16. Preparation of Meiotic plate and determination of phases.
17. Computation of Chaisma frequency and Terminalization of phases.
18. Micrometry and Camera Lucida drawings.

**Books Recommended:**

| | |
|---|---|
| H. Lodish, A. Berk, S L Zipursky, P. Matsudaira D. Baltimore, and James Darnell. | Molecular Cell Biology |
| B. Alberts, D. Bray, K. Hopkin, A. Johnson | Essential of Cell Biology |
| H. Lodish, A. Berk, C. A. Kaiser & M. Krieger | Molecular cell Biology |
| B. Alberts, A. Johnson, J. Lewis and M. Raff | Molecular Biology of the Cell |
| Gerald Karp | Cell and Molecular Biology |
| | Concepts and experiments |

**Learning Outcomes:**

After completion of the course, students will gain a thorough knowledge of-

a. Cell structure and function, structure and organization of chromosomes and cell division in prokaryotes and eukaryotes and structure, types and function of DNA and RNA, cell structure, organelles, and their roles.
b. Organization of DNA, its replication, damage, and repair processes.
c. Cell-cell communication and cell junctions present between the cells.
d. Cell division and regulation mechanisms.
e. Process of apoptosis and other types of cell death.

**M. Sc. Bioscience (Program code-M. Sc. 0405)**
**FIRST SEMESTER(July 2024 – December 2024)**
**CORE – II: Biomolecules (Course code: BS-22102)**
**[Credit: 5 and Maximum Marks: 75]** 70 A+

(Each theory paper will have questions divided into three sections, A, B, & C.Section A will have 10 MCQs/Fill in the blanks/One-word answers of a total of 15 marks from the whole syllabus. Section B will have 4 short answer questions (100 words) of 05 marks each, one from each unit. Section C will have 4 questions, one from each unit with internal choice, of 10 marks each. The questions have to be answered in about 350 words each).

**UNIT-I** Classification, structure, and function of Carbohydrates, Carbohydrates:Monosaccharides, homo and hetero-polysaccharides, Peptidoglycan glycoproteins and liposaccharide. Lipids: Simple; cholesterol and complex; phospholipids and TAG

**UNIT-II** Classification, structureand functions of amino acids, Synthesis of peptides, Protein-properties, the secondary, tertiary, and quaternary structure of proteins, Ramachandran plot. Nucleic Acid: Structure and functions of Purine and pyrimidine, DNA-types, linking number, RNA-types.

**UNIT-III** Enzyme: apoenzymes, cofactors, coenzymes, active site, factors contributing to the catalytic efficiency of enzyme; enzyme kinetics- Michaelis-Menten equation, determination of Km, enzyme inhibition, allosteric enzymes, isoenzymes, multienzyme complexes

10/5/24 10.05.2024 10.5.24 10/05/2024 10/5/24

**UNIT-IV** Structure and biological role of: Porphyrins in biology, structure of hemoglobin and chlorophyll

Animal hormones: protein, peptide, and steroid hormones. Vitamins: fat and water soluble.

**Lab Course:**

1. Specific tests for sugars, amino acids and lipids
2. Formal titration of amino acids
3. Estimation of proteins using ninhydrin and biuret method
4. Estimation of sugar by anthrone and Folin-Wu method.
5. Saponification value and iodine number of fat.
6. Estimation of ascorbic acid.
7. Achromic point determination using salivary amylase
8. Effect of ions on salivary amylase activity.
9. Enzyme assay and kinetics (ex. Amylase, Protease)

**Books Recommended:**

| | |
|---|---|
| Nelson, Cox and Lehninger | Principles of Biochemistry |
| G. Zubay | Biochemistry |
| Stryer | Biochemistry |
| Garrett and Grosham | Biochemistry |
| West, Tood, Mason &Bbruglen | Text book of biochemistry |
| White, Handler & Smith | Biochemistry-clinical application |
| D. Voet and J C Voet | Biochemistry |

**Learning Outcomes:**

After completion of the course, students will have a knowledge based on-

a. Concepts of Biomolecules.
b. Structures, properties, and functions of carbohydrates, lipids, and proteins
c. Structureandroleofdifferentpigmentsandelectroncarriers.

## M. Sc. Bioscience (Program code-M. Sc. 0405)
## FIRST SEMESTER(July 2024– December 2024)
## CORE- III: Instrumentation and Techniques(Course code: BS-22103)
## [Credit: 5 and Maximum Marks: 75] 70

(Each theory paper will have questions divided into three sections, A, B, & C.Section A will have 10 MCQs/Fill in the blanks/One-word answers of a total of 15 marks from the whole syllabus. Section B will have 4 short answer questions (100 words) of 05 marks each, one from each unit. Section C will have 4 questions, one from each unit with internal choice, of 10 marks each. The questions have to be answered in about 350 words each).

**UNIT-I** Centrifugation: Principle, techniques, and applications. Preparative, analytical, and ultracentrifuges, factors affecting sedimentation coefficient. Photometry: principles of colorimetry, UV- visible spectrophotometry & IR- spectrophotometry. Atomic absorption spectroscopy: Principle, Instrumentation and applications.

**UNIT-II** Chromatography: Paper, thin Layer, Gas, and HPLC. Gel filtration, Ion exchange, and Affinity chromatography. Electrophoresis: Agarose, PAGE, *Lyophilization*: Principle and applications. Microtomy and its applications.

10/5/24 10.5.24 10/05/2024 10/5/24

**UNIT-III** Microscopic techniques:dark and bright field microscopy, confocal microscope, phase-contrast microscopy, scanning and transmission electron microscopy, atomic force microscope.Sample preparations, surface modifications, and imaging in electron microscopy. Immobilization and functionalization techniques and their applications.

**UNIT-IV** Biosensor techniques: Cyclic voltammetry (CV), differential pulse voltammetry (DPV), electrochemical impedance spectroscopy (EIS), and surface plasmon resonance (SPR). Biosensor types, DNA biosensors, Immunosensors, biosensors for infectious diseases and food pathogens. Electrophoretic deposition and matrix fabrication.

**Lab Course:**

1. Verification of Beers Law
2. Determination of absorption maxima
3. Polyacrylamide Gel Electrophoresis
4. Separation of biomolecules by chromatography
5. Ion exchange and gel filtration chromatography
6. Agarose gel Electrophoresis of genomic DNA
7. Identification and characterization of nanomaterials
8. Electrophoretic deposition and matrix fabrication
9. Identification of analyte for biosensing applications
10. Biosensor development using CV, DPV, and EIS techniques.

**Books Recommended:**

| | |
|---|---|
| K Wilson and John Walker | Practical Biochemistry: Principles & Techniques |
| RF Boyer | Biochemistry Laboratory: Modern Theory & Techniques |
| S Carson, H Miller and D Scott | Molecular Biology Techniques: A Classroom Laboratory Manual |
| TC Ford and J. M. Graham | An Introduction to Centrifugation |
| TA Jennings | Lyophilization: Introduction and Basic Principles |
| James M. Miller | Chromatography: Concepts and Contrasts |
| LR Synder, JJ Kirkland and JL Glajch | Practical HPLC Method Development, 2nd Edition |
| Anna Pratima Nikalje & D. Bhosale | A Handbook of Chromatography |
| Mark F. Vitha | Chromatography: Principles and Instrumentation |
| AGE Pearse | Histology and Histochemical methods |
| PA Midgley | The principles of microscopy |
| DB Murphy & MW Davidson | Fundamentals of Light Microscopy and Electronic Imaging, Second Edition |
| IW Watt | The Principles and Practice of Electron Microscopy |
| RF Egerton | Physical Principles of Electron Microscopy |
| | An Introduction to TEM, SEM, and AEM |
| Skoog. D. A, James Holler. F, Nieman. T. A | Principles of Instrumental Analysis, Harcourt College, 2007 |
| Janos. H. Fenders (Ed) | Nanoparticles and Nanostructured Films: Preparations, Characterization and Applications, Wiley – VCH, 1998. |
| Turner, Anthony, Isao Karube, and George S. Wilson. | Biosensors: fundamentals and applications. Oxford University Press, 1987 |

**Learning Outcomes:**

This is a very crucial paper that will be going to benefit students in further research in biological sciences. It will give an in-depth understanding and knowledge base of-

a. Imaging techniques and instruments, sample preparation procedure, operation of

10/5/24 10. Dr. 10.5.24 12 10/05/2024 10/5/24

instruments, and data interpretation of different instruments in biological research.

b. Concept of the lights, different types of microscopes including confocal and atomic force microscopy, optical tweezers.
c. Advanced and sophisticated instruments NMR technique.
d. Students will be able to comprehend various concepts of Nanotechnology in biology, Nanomaterial and Nanostructures, Biosensors, and nanobiosensors.
e. Nanobiotechnological applications in health and disease and environment.

**M. Sc. Bioscience (Program code-M. Sc. 0405)**
**FIRST SEMESTER(July 2024 – December 2024)**
**CORE- IV: BIOMETRY, COMPUTER AND SCIENTOMETRY(Course code: BS-22104)**
**[Credit: 5 and Maximum Marks: 75]** 70 AS

(Each theory paper will have questions divided into three sections, A, B, & C.Section A will have 10 MCQs/Fill in the blanks/One-word answers of a total of 15 marks from the whole syllabus. Section B will have 4 short answer questions (100 words) of 05 marks each, one from each unit. Section C will have 4 questions, one from each unit with internal choice, of 10 marks each. The questions have to be answered in about 350 words each).

**Unit-I** Introduction to biostatistics. Types of biological data: data on different scales.Frequency distributions. Cumulative frequency distributions. Random sampling. Parameters and statistics. Measures of central tendency and dispersion: Mean,Median, Mode, Range, Variance, and Standard deviation. Coefficient of variation.
The effects of coding data. Data transformations: Log transformation, Square-root transformation, and Arcsine transformation. Distribution: normal & binomial.
Probability: Basic laws of probability, addition law, multiplication law.

**Unit-II** Statistical errors in hypothesis testing. Testing goodness of fit: Chi-square goodness offit. Independence of attributes. Heterogeneity Chi-square. The 2 x 2 contingency table. One sample hypothesis. Two-sample hypothesis. Testing for the differencebetweentwomeans (t-test). Testing for the differencebetweentwovariances (F-test). The paired sample t-test. Multiple-sample hypothesis (ANOVA): Single factor and two factors ANOVA. Multiplecomparisons: Duncan'smultiple-rangetests. Simple linear regression. Regressionvs. Correlation. Regression equation. Interpretation of regression functions. Simple linear correlation. The correlation coefficient.

**Unit-III** Introduction to MS Office software: Word processing; creating a new document, editing documents, adding graphics to documents, Word tables. Management of Workbook & Worksheets; Applications, Features, Using formulas and functions, Features for Statistical data analysis, Excel ToolPak for data analysis, Generating charts/graphs. Presentation software; Working in PowerPoint, Creating new presentations, and working with slides.

**Unit-IV** Introduction to Internet and Applications. Basics of internet, e-mailing, Search engines – Google and Yahoo; Pub med, Scopus, Web of Science, Google Scholar, Indian Citation Index, Science Citation Index (SCI), h-index, i-10-index. Journal Impact Factor (JIF). Introduction to Plagiarism and Cyber laws.

10/5/24 10.5.24 10.05.2024 10/05/2024 10/5/24

**Lab Course:**

1. Exercises for data distribution
2. Exercises for computation of measures of central tendency
3. Exercises for computation of measures of variability
4. Computation of correlation coefficient, r, and regression constants
5. Data analysis by ANOVA and multiple-range tests
6. Hypothesis testing by t-test, F-test, and Chi-square test
7. Graphical presentation of data using a suitable package
8. Statistical analysis of data using a suitable package
9. Preparation of document using a suitable package
10. Preparation of slides using a suitable package
11. Hands-on-practice for finding indices [SCI, h-index, i-10 index] of articles using relevant database

**Books Recommended:**

| | |
|---|---|
| Campbell RC | Statistics for biologists |
| Zar JH | Biostatistical Analysis |
| Wardlaw AC | Practical Statistics for Experimental Biologists |
| Snedecor GW & Cochran WG | Statistical Methods |
| Sokal RR & Rohlf FJ | Introduction to Biostatistics |
| Sumner M | Computers: Concepts & Uses |
| White R | How Computers Work |
| Cassel P et al. | Inside Microsoft Office Professional |
| Coleman P and Dyson P | Mastering Internets |
| Gralla P | How the Internet Works |
| Shelly GB, Vermaat ME, Cashman TJ | Microsoft 2007: Introductory Concepts & Techniques |
| Habraken J | Microsoft Office 2003 All in One |
| | Microsoft Office 2010 In Depth |
| Gilmore B | Plagiarism: Why it happens, How to prevent it? |
| Buranen L & Roy AM | Perspectives on Plagiarism & Intellectual Property in a Post-Modern World |
| Kumar Anupa P | Cyber Law |
| Sood V | Cyber Law Simplified |

**Learning Outcome:**

After successfully completing this course, the students will be able to-

a. Understand biostatics and its significance in biology.
b. Understand the concept of research and different types of research in the context of biology.
c. Have a basic awareness of data analysis and hypothesis testing procedures.
d. Develop laboratory experiment-related skills.
e. Have basic knowledge of qualitative research techniques.
f. Develop competence in data collection and process of scientific documentation.
g. Analyze the ethical aspects of research
h. Understand the concept of IPR

10/5/24 10.5.24 10/5/24 10/05/2024

i. Develop skills in qualitative and quantitative statistical data analysis in biological studies
j. Know the applications and limitations of different statistical methods.
k. Understand the use of computers for various applications
l. Recognize advanced resources for accessing scholarly literature from the internet.
m. Utilize bibliography management software while typing and downloading citations
n. Demonstrate knowledge and practical skills in using instruments in research.
o. Apply the knowledge in future courses of their career development in higher education andresearch.

**M. Sc. Bioscience (Program code-M. Sc. 0405)**
**SECOND SEMESTER (January 2025 – June 2025)**
**CORE – I: Genetics and Molecular Biology(Course code: BS-22201)**
**[Credit: 5 and Maximum Marks: 75]** 70

(Each theory paper will have questions divided into three sections, A, B, & C.Section A will have 10 MCQs/Fill in the blanks/One-word answers of a total of 15 marks from the whole syllabus. Section B will have 4 short answer questions (100 words) of 05 marks each, one from each unit. Section C will have 4 questions, one from each unit with internal choice, of 10 marks each. The questions have to be answered in about 350 words each).

**UNIT- I** Gene mapping methods: Linkage maps, tetrad analysis, mapping with molecular markers, mapping by using somatic cell hybrids, development of mapping population in plants, complementation analysis.
Mutation: Types, mutagens, and detection.
Mutant types – lethal, conditional, biochemical, loss of function, gain-of-function, germinal versus somatic mutants, insertional mutagenesis.

**UNIT-II** DNA replication in eukaryotes and prokaryotes: enzymes involved, replication origin and replication fork, fidelity of replication, extrachromosomal replicons. DNA damage and repair mechanisms: Repair of Base-excision, Nucleotide excisions, Mismatch, and Double Strand. $p_{53}$ and $p_{21}$.

**UNIT-III** RNA synthesis and processing: enzymes involved, formation of initiation complex, transcriptionactivatorandrepressor, elongation, and termination, RNA processing, capping, RNA editing, splicing,polyadenylation, RNA transport.

**UNIT-IV** Protein synthesis and processing: Ribosome, formation of initiation complex, initiation factors, elongation and elongation factors and their regulation, termination. Aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase, and translational proof-reading, translational inhibitors. Post-translational modification of proteins.

**Lab Course:**

1. Isolation, purification, and estimation of RNA
2. Isolation, purification, and estimation of DNA
3. Determination of Tm of nucleic acid
4. Fraction of poly (A) RNA
5. Restriction Mapping

10/5/24 10.5.24 10/05/2024 10/5/24

6. Restriction Digestion
7. Ligation
8. DNA molecular size determination

**Books Recommended:**

| | |
|---|---|
| Molecular Cell Biology | H. Lodish, A. Berk, SL Zipursky, P. Matsudaira, D. Baltimore, and James Darnell. |
| Essential Cell Biology | B. Alberts, D. Bray, K. Hopkin and A. Johnson |
| Molecular Biology of the Cell | B. Alberts, A. Johnson, J. Lewis and M. Raff |
| Cell and Molecular Biology: Concepts and experiments | Gerald Karp |
| Molecular Biology of the Gene | JD Watson et al. |
| Molecular Biology of the Cell | John Wilson, Tim Hunt |
| Molecular Biology of the Cell | Bruce Albert's, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter |
| Genes VIII | Benjamin Lewin |

**Learning Outcome:**

Students will be able to understand-

a. General principles, importance of genetics, and interpretation of the various laws of genetics
b. Hereditary nature of the gene and how it codes different proteins of the cells.
c. Genetic diseases linked to genes/DNA.
d. Relationship between gene and evolution.
e. Basic concept of molecular biology.
f. Central dogma and molecular mechanism in prokaryotes and eukaryotes.
g. Synthesis and control the protein synthesis,
h. Gene expression in prokaryotes and eukaryotes.
i. Mutation, its types, causes, and consequences.
j. They would also possess the ability to develop a concept on Genetic code, Apoptosis,
k. Molecular mechanism of recombination and basic concept of genetics including Mendelian
l. genetics, mutations, and transgenic animals and plants.

## M. Sc. Bioscience (Program code-M. Sc. 0405)
## SECOND SEMESTER (January 2025 – June 2025)
## CORE – II: Bioenergetics & Metabolism(Course code: BS-22202)
## [Credit: 5 and Maximum Marks: 75] 70

(Each theory paper will have questions divided into three sections, A, B, & C.Section A will have 10 MCQs/Fill in the blanks/One-word answers of a total of 15 marks from the whole syllabus. Section B will have 4 short answer questions (100 words) of 05 marks each, one from each unit. Section C will have 4 questions, one from each unit with internal choice, of 10 marks each. The questions have to be answered in about 350 words each).

**UNIT-I** First and second laws of thermodynamics. Gibbs free energy G, free energy change $\Delta G$, endergonic & exergonic reactions. Standard state free energy changes-$\Delta G$, $\Delta G^0$ and $\Delta G'^0$, Relationship between equilibrium constant and $\Delta G'^0$, Feasibility of reactions. Structure, properties, and energy currency of the cell, Importance of Coupled reactions, and other high-energy compounds.

**UNIT-II** Carbohydrate metabolism: Glycolysis, Kreb's cycle, glycogenolysis, glycogenesis, pentose phosphate pathway, gluconeogenesis, and glyoxylate pathway. Regulation of carbohydrate metabolism.

10/5/24 10.5.24 10/05/2024 10/5/24

**UNIT-III** Electron transport and oxidation phosphorylation: electron carriers, complexes I to IV, substrate level phosphorylation, mechanism of oxidative phosphorylation. Shuttle system for entry of electrons.
Biosynthesis and degradation of Lipids. Regulation of lipid metabolism

**UNIT-IV** Nitrogen Assimilation: Overview of Nitrogen in biosphere and uptake by organism. Biosynthesis and degradation of amino acids. Regulation of amino acid metabolism Biosynthesis and degradation of purine and pyrimidine nucleotides.

**Lab Course:**

1. Protein estimation by Lowry, Bradford, and Spectrophotometric method
2. Estimation of blood cholesterol
3. Estimation of sugar by Nelson-Somogyiand Benedict's reagent
4. Isolation and estimation of lipids from seeds and egg.
5. Estimation of inorganic and total phosphorus by Fiske-Subba Rao method
6. Assay of phosphatases in blood and seeds
7. Urease estimation in plant tissues

**Books Recommended:**

| | |
|---|---|
| Principles of Biochemistry | Nelson, Cox and Lehninger |
| Biochemistry | G. Zubay |
| Biochemistry | Stryer |
| Biochemistry | Garrett and Grosham |
| Text book of biochemistry | West, Tood, Mason &Bbruglen |
| Biochemistry | White,Handler& Smith |
| Biochemistry with clinical application | D. Voet and J C Voet |
| Enzymes | Dixon and Webb |
| Fundamentals of Enzymology | Price and Steven |
| Practical biochemistry | Plummer |
| Enzyme biotechnology | G. Tripathi |
| Enzyme Reaction Mechanism | Walsh |
| Enzyme catalysis and regulation | Hammes |

**Learning Outcome:**

The aim of the course in Bioenergetics & Metabolism will enable the students to-

a. Better understanding of different metabolic pathways related to the synthesis and degradation of major macro molecules.
b. Intricate biochemical reactions occurring in the biological systems.
c. Concepts of enzymes and enzyme kinetics
d. Protein structure, folding , and modification processes.
e. Basics of photosynthesis process and electron carriers involved.
f. Develop transferable quantitative skills.
g. Apply modern instrumentation theory and practice to biochemical problems.
h. Identify social and health-related dimensions of biochemical investigations.

10/5/24 10.5.24 17 10/05/2024 10/5/24

**M. Sc. Bioscience (Program code-M. Sc. 0405)**
**SECOND SEMESTER (January 2025 – June 2025)**
**CORE – III: Microbiology(Course code: BS-22203)**
**[Credit: 5 and Maximum Marks: 75]** 70 A/S

(Each theory paper will have questions divided into three sections, A, B, & C.Section A will have 10 MCQs/Fill in the blanks/One-word answers of a total of 15 marks from the whole syllabus. Section B will have 4 short answer questions (100 words) of 05 marks each, one from each unit. Section C will have 4 questions, one from each unit with internal choice, of 10 marks each. The questions have to be answered in about 350 words each).

**UNIT-I** General characteristics of fungi, classification of fungi, life cycle of the selected fungal genus (Aspergillus, Penicillium, Fusarium, and Mucor). Economic importance of fungi. Fungi and bioremediation, Heterothallism, sex hormone in fungi, Microbial association, parasitism, mutualism, and symbiosis with plants and animals. Mycorrhiza, VAM. Algae: Distribution, classification, reproduction, ecology, and importance.

**UNIT-II** Morphology and ultra-structure of bacteria: Morphological types, cell wall of archaebacteria, gram-negative, gram-positive eubacteria. Bacterial cell membranes – structure, composition, and properties. Structure and function of flagella, cilia, pili, and gas vesicles. Cyanobacteria, protozoa, mycoplasma, and Rickettsia. Gene transfer mechanisms: transformation, transduction, conjugation, and transfection. Plasmids and cosmid vector for gene cloning

**UNIT-III** Nutritional types (autotrophs, heterotrophs, phototrophs, chemotrophs), growth curves, measurement of growth, factors affecting growth, generation time, and growth kinetics. Batch and continuous culture, Basis of microbial classification, classification and salient feature of bacteria according to Bergey's manual of determinative bacteriology.

**UNIT-IV** Viruses: Structure and classification; General concepts: Viral genome, capsids, envelopes, viroids, and prions). Virus reproductions: Lysogeny and Lytic phase, Bacteriophages and their types. Introduction to Plant and animal viruses (TMV, HIV, Ebola, Nipah, and Corona Virus), Route of transmission of viruses, Laboratory diagnosis and treatment, and Antiviral therapy.

**Lab Course:**

1. Glassware preparation and sterilization techniques- wet heat- dry heat- filter types- laminar flow chamber types- CDC- safety levels.
2. Preparation of liquid & solid media, plating, pouring, inoculation, and incubation for the growth of microorganisms
3. Methods of obtaining a pure culture of microorganisms (a) streak plate (b) Pour plate, and (c) spread plate methods.
4. Identification and Microscopic examination of microorganisms.
5. Motility of bacteria by hanging drop technique.
6. Bacterial genomic DNA isolation from *E-coli* culture.
7. Grams' staining for Gram-positive and Gram's negative Bacteria.
8. Study of bacterial growth by Turbidimetry/ spectrophotometry

10/5/24 10.5.24 10/05/2024 10/5/24

9. Isolation and enumeration of microorganisms from the soil by serial dilution agar plating method.
10. Enumeration of viruses by plaque assay technique.

**Books Recommended:**

| | |
|---|---|
| Microbiology | L.M. Prescott, J.P. Harley and D.A. Klein |
| General Microbiology | RY Stanier, J L Ingrahamana, ML Wheelis & P. R. Painter |
| Principles of Microbiology | R.M. Atlas |
| Microbiology | Peleczar, Chan & Krieg. |
| General Virology | Luria, Darnell, Baltimore and Campell. |
| Introduction to Mycology | CJ Alexopoulos and CW Mims |
| Principles of Virology: Molecular Biology, Pathogenesis, and Control of Animal Viruses | S. J. Flint,V. R. Racaniello, L. W. Enquist, V. R. Rancaniello, A. M. Skalka |

**Learning Outcome:**

Students will be able to gain an in-depth understanding of-

a. Microscopic organisms unicellular, multicellular or acellular.
b. Concepts of mycology, parasitology ,and bacteriology.
c. Disease mechanisms associated with these microorganisms.
d. Structure and classification of animal and plant viruses, and bacteriophages.
e. Replication mechanisms and diseases caused by them.
f. Development of vaccines for the viral epidemics and also about antiviral chemotherapy.

**M. Sc. Bioscience (Program code-M. Sc. 0405)**
**SECOND SEMESTER (January 2025 – June 2025)**
**CORE – IV: Immunology(Course codeBS-22204)**
**[Credit: 5 and Maximum Marks: 75]** 70

(Each theory paper will have questions divided into three sections, A, B, & C.Section A will have 10 MCQs/Fill in the blanks/One-word answers of a total of 15 marks from the whole syllabus. Section B will have 4 short answer questions (100 words) of 05 marks each, one from each unit. Section C will have 4 questions, one from each unit with internal choice, of 10 marks each. The questions have to be answered in about 350 words each).

**UNIT-I** Innate and adaptive immune response. Cells of the immune system: Haematopoiesis and differentiation, mononuclear cells and granulocytes, antigen-presenting cells. Ontogeny and phylogeny of lymphocytes. Primary and Secondary lymphoid organs and tissues. Lymphocyte traffic. Major Histocompatibility Complex- types, structural organization, function, and distribution. Complement system.

**UNIT-II** Antigen receptor molecules: B-cell receptor complex, Immunoglobulin- structure, types and function. Generation of diversity in BCR. Light and heavy chain gene recombination. Recombination Signal sequences. Class switching. Membrane and secreted immunoglobulins. T-cell receptor complex. Organization, arrangement of T-cell receptor genes, and recombination.

10/5/24 10.5.24 10/05/2024 10/5/24

**UNIT-III** Antigens: nature of antigens, factor affecting immunogenicity, Haptens, and superantigens. Antigenic determinants. Recognition of antigens by T and B cells.
Antigen processing. Role of MHC molecules in antigen presentation and co-stimulatory signals. Transplantation and Rejection. Antigen and antibody interaction: Precipitation, Agglutination, EIA, RIA, and FIA.

**UNIT-IV** Cell-mediated immune response. Cytokines and interleukins- structure and function. Immunity to infections. Hypersensitive reactions and their types. Immunodeficiency disorders. Autoimmunity and autoimmune disorder. Immunological tolerance. Principles of Vaccination. Immunization practices.

**Lab Course:**

1. Identification of cells of the immune system.
2. Identification of Lymphocytes and their subsets.
3. Lymphoid organs and their microscopic organization.
4. Isolation and purification of Antigens.
5. Estimation of Levels of gamma globulins and A/G ratio in blood.
6. Antigen-antibody reaction by Double Diffusion, Counter current and IEP, RID, and EIA.

**Books Recommended:**

| | |
|---|---|
| Kuby's Immunology | R.A. Goldsby, T. J Kindt and B. A. Osborne |
| Immunology- A Short Course | E. Benjamini, R. Colco and G. Sunshine |
| Immunology | Roitt, Brostoff and Male |
| Fundamentals of Immunology | William Paul |
| Immunology | Tizard |
| Immunology | Abbas et al |

**Learning Outcome:**

After completing the course, the student should be able to-

a. Demonstrate the basic knowledge of immunological processes at a cellular and molecular level and define central immunological principles and concepts.
b. Outline, compare, and contrast the key mechanisms and cellular players of innate and adaptive immunity and how they relate; to the key players involved in the immune response, their identification, and characteristics at the molecular and cellular levels.
c. They would be able to decipher how the nature of the antigen shapes the resulting effector responses, factors affecting antigen-antibody reactions, and the role of the Major Histocompatibility Complex.
d. Besides, they would also develop concepts about humoral immune response, immunoglobulin structure, properties and their types, monoclonal antibodies, complements and their biological importance, characterization and types of T cells, macrophage activation, cytokines, Antibody-Dependent Cell-Mediated Cytotoxicity; Hypersensitivity: types; Autoimmunity; Immunodeficiency diseases.

**M.Sc. Bioscience (Program code-M. Sc. 0405)**
**Third Semester (July 2025 – December 2025)**
**CORE- I: Plant Physiology (Course code: BS-22301)**
**[Credit: 5 and Maximum Marks: 75]** 70 AE

(Each theory paper will have questions divided into three sections, A, B, & C.Section A will have 10 MCQs/Fill in the blanks/One-word answers of a total of 15 marks from the whole syllabus. Section B will have 4 short answer questions (100 words) of 05 marks each, one from each unit. Section C will have 4 questions, one from each unit with internal choice, of 10 marks each. The questions have to be answered in about 350 words each).

**Unit-I**
Photosynthesis – Light-harvesting complexes (LH-a and LH-II)
Photosystems I and II (Electron Transport Chain)
Carbon fixation- C3, C4 and CAM pathways
Nitrogen Metabolism – Nitrate and ammonia assimilation

**Unit-II**
Photorespiration – Definition, process, significance, and benefit in plants.
Tricarboxylic acid cycle (TCA) in plant
Mitochondrial electron transport chain (Components, steps involved and function)
ATP synthesis and alternate oxidase in plants

**Unit-III**
Phytohormones: Introduction and types.Auxin: Structure, biosynthesis and function
Cytokinin: Structure, biosynthesis, and function;Gibberellins: Structure, biosynthesis, and function.Abscisic acid: Structure, biosynthesis and function.Ethylene and Brassinosteroids.

**Unit-IV**
Amino Acid Biosynthesis.
Stress physiology in plant – Biotic and Abiotic stresses.
Plant Secondary metabolites – Terpenes, phenols, and nitrogenous compounds.
Senescence and Programmed Cell Death and Phyto-remediation.

**Lab Course:**

1. Estimation of Chlorophyll content in plant tissues (Spectrophotometric analysis).
2. Separation of plant pigments (chlorophyll by chromatography).
3. To demonstrate the evolution of oxygen during photosynthesis in aquatic plants.
4. To study the different concentrations of CO2 on the rate of photosynthesis.
5. To study the effect of light intensity (by changing the distance) on the rate of photosynthesis using aquatic plants.
6. To demonstrate the process of plasmolysis in onion cells.
7. To demonstrate osmosis in living plant cells by potato osmoscope.
8. Measurement of Relative Water Content (RWC) in plant tissues.
9. Measurement of Stomatal density, Stomatal index, and perimeter of stomata in different leaves.

**Recommended Books:**

JA Hopkins — Introduction to Plant Physiology

10/5/24 10.5.24 10/05/2024 10/5/24

| | |
|---|---|
| BB Buchanan, W Gruissem & RL Jones | Biochemistry & Molecular Biology of Plants |
| MB Wilkins | Advanced Plant Physiology |
| Leopold AC &Kriedemann PE | Plant Growth & Development |
| Moore TC | Biochemistry & Physiology of Hormones |
| FB Salisburry& CW Ross | Plant Physiology |
| Dr. V.K. Jain | Fundamentals of Plant Physiology 19 Edition |
| S.S. Bhojwani and M.K. Razdan | Plant Tissue Culture: Theory and Practice, a Revised Edition |
| Arun Chandra Sahu | Plant Physiology and Metabolism |
| Fosket DF | Plant Growth & Development |

**Learning Outcome:**

Students will gain an in-depth understanding of-

a. Fundamentals of Plant morphology, plant ecology.
b. Phytochemistry including the plant growth regulators.
c. Phenomena like photoperiodism, photomorphogenesis ,and circadian rhythms.

**M.Sc. Bioscience (Program code-M. Sc. 0405)**
**Third Semester (July 2025 – December 2025)**
**CORE II: Ecology and Environmental Biology(Course code: BS-22302)**
**[Credit: 5 and Maximum Marks: 75]** 70 AE

(Each theory paper will have questions divided into three sections, A, B, & C.Section A will have 10 MCQs/Fill in the blanks/One-word answers of a total of 15 marks from the whole syllabus. Section B will have 4 short answer questions (100 words) of 05 marks each, one from each unit. Section C will have 4 questions, one from each unit with internal choice, of 10 marks each. The questions have to be answered in about 350 words each).

**Unit-I**
Ecosystem: Concept, Components and Types. Productivity, Ecological energetics, Energy flow in an ecosystem, Energy flow models, Ecological pyramids, Food chain, Food web. Ecological succession, Ecological niche.

**Unit-II**
Aquatic ecosystem: Biotic and abiotic components, lentic and lotic ecosystems, wetlands.
Terrestrial ecosystems: Forest types of India with special reference to Chhattisgarh. Natural and plantation (artificial) forests, Agroforestry, Social forestry, National parks and Sanctuaries in Chhattisgarh.

**Unit-III**
Environmental pollution: Definition, types (air, water, soil, noise, thermal & radioactive), causes, effects, and control.
Solid waste management: Causes, effects and control measures of urban and industrial wastes.
Disaster management: Floods, earthquakes, cyclones, and landslides.

**Unit-IV**
Biodiversity, ex-situ, and in-situ conservation. Intellectual property rights (IPR) with special reference to India. Natural resources: Water, Forest, and Medicinal plants.

**Lab Course:**

1. To determine the minimum size of the quadrate by 'Species–Area-Curve'

10/8/24 10.5.24 10-5-24 10/5/24 10/05/2024

method

2. To study the community by quadrate method by determining the frequency, density, and abundance of different species present in the community
3. Chromatographic separation of chlorophyll pigments in leaf
4. Measurement of pH and Total alkalinity in water
5. Measurement of Free carbon dioxide and dissolved oxygen in given water
6. Identification and drawing of at least 15 medicinal plants

**Recommended Books:**


| | |
|---|---|
| A Beattie and PR Ehrlich | Biodiversity, 2001 |
| EP Odum | *Fundamentals of Ecology*, 2nd ed., 494-496 |
| EP Odum | *Basic Ecology* (Philadelphia: Saunders, 1983), 518. |
| PD Sharma | Ecology and Environment, 2009, Rastogi Publications |
| M Calver | Environmental Biology, Murdoch University, Western Australia |
| Aggarwal | Concept of Ecology |
| NS Subrahmanyam | Ecology, Narosa Publications |


**Learning Outcome:**

After successfully completing this course, the students will be able to:

a. Understand the importance of ecology, and the factors affecting our ecosystem and gain knowledge on energy flow, food webs and food chains, ecological pyramids, and ecological succession. This would not only help him/her conceptualize an important aspect of biology but also help develop an awareness and love for nature conservation.

b. Gain knowledge on various types of pollution, their health hazards, management, impact assessment, and environmental protection laws. In a world facing the threat of a rapidly changing climate such students will act as Environmental volunteers for the creation of awareness among the common masses, a need of the present hour.

**M.Sc. Bioscience (Program code-M. Sc. 0405)**
**Third Semester (July 2025 – December 2025)**
**CORE-III: Animal Physiology (Course code: BS-22303)**
**[Credit: 5 and Maximum Marks: 75]** 70

(Each theory paper will have questions divided into three sections, A, B, & C.Section A will have 10 MCQs/Fill in the blanks/One-word answers of a total of 15 marks from the whole syllabus. Section B will have 4 short answer questions (100 words) of 05 marks each, one from each unit. Section C will have 4 questions, one from each unit with internal choice, of 10 marks each. The questions have to be answered in about 350 words each).

**Unit-I** **Blood and Circulation**: Composition of blood, Cell types, Hematopoiesis, Structure, and function of hemoglobin - Oxygen and carbon dioxide transport, Blood Coagulation. Blood volume and its regulation. Blood group.
**Respiration**: Mechanism and regulation of breathing, Factors influencing oxygen uptake, Diving, and high-altitude adaptations. Measurement of metabolic rate and $Q_{10}$

**Unit-II** **Nervous system**: Mechanisms of conduction along axon and across synapses, Nernst equation and measurement of action potential, Neurotransmitters, Types and physiology of reflexes.

| | |
|---|---|
| | **Myology**: Types of muscles, Ultrastructure, mechanism, and regulation of contraction of skeletal muscle. |
| **Unit-III** | **Cardiovascular System:** Anatomy of heart structure, ECG–its principle and significance, cardiac cycle, blood pressure, and its neural and chemical regulation. |
| | **Excretory system:**Physiology of excretion, kidney, urine formation, urine concentration, waste elimination, regulation of water balance, electrolyte balance, acid-base balance. |
| **Unit-IV** | **Digestive system:** Digestion, absorption, energy balance, BMR. |
| | **Thermoregulation**: Comfort zone, body temperature – physical, chemical, neural regulation, acclimatization. |

**Lab Course:**

1. Examination of RBC in Piscine/Avian/Human blood.
2. Examination of WBC in Piscine/Avian/Human blood.
3. Differential leukocyte counts in Human blood.
4. Determination of Hb/Hct/ Absolute values in Piscine/Avian/Human blood.
5. To determine the prevalence of different types of polymorphs in human blood (Based on Arneth's classification).
6. Demonstration of hemin crystal.
7. To determine absolute Eosinophil count in Human blood
8. To determine blood pressure in different body positions [standing, supine, seating position]
9. To determine the effect of exercise on blood pressure
10. Computation of mean arterial pressure
11. To evaluate peak expiratory flow rate [lung efficiency] as a function of age and gender
12. To study different stages of melanophores in scales of live fish
13. To study the effect of temperature on melanophores in scales of live fish
14. To observe the effect of adrenalin [neurotransmitter] on melanophores in scales of live fish

**Books Recommended:**

| | |
|---|---|
| PJ Bentley | Comparative vertebrate endocrinology |
| WF Ganong | Review of medical physiology |
| A Gorbman& HA Bern | A textbook of endocrinology |
| AC Guyton | Textbook of medical physiology |
| WS Hoar & DJ Randall | Fish physiology [Series] |
| CR Martin | Endocrine physiology |
| CL Prosser & FA Brown | Comparative animal physiology |
| K Schmidt-Nielsen | Animal physiology: Adaptation & environment |
| CD Turner & JT Bagnara | General endocrinology |
| JD Wilson & DW Foster | Textbook of endocrinology |
| D Randall, W Burggren& K French | Animal Physiology: Mechanisms and adaptations |

**Learning Outcome:**

Students will be able to comprehend the basics of-

a. Organization and mechanism of working of various organ systems of the human body like the nervous system, muscular system, and respiratory system.
b. Process of nerve stimulation, neurotransmission, cardiac control, temperature control, blood pressure, etc.
c. Have an enhanced knowledge and appreciation of animal physiology;
d. Understand the functions of important physiological systems including the cardio-respiratory, renal, reproductive, and metabolic systems, and comprehend how these separate systems interact to yield integrated physiological responses.

e. Be able to perform, analyze, and report on experiments and observations in physiology.
f. Be able to recognize and identify principal tissue structures.
g. Gain a foundation to work in science, academia, or medicine.
h. Develop critical thinking, analytical, communication, and laboratory skills for pursuing careers in research, medical sales, healthcare, pharmaceuticals, or teaching.

**M.Sc. Bioscience (Program code-M. Sc. 0405)**
**Third Semester (July 2025– December 2025)**
**CORE IV: Developmental Biology (Course code: BS-22304)**
**[Credit: 5 and Maximum Marks: 75]** 70

(Each theory paper will have questions divided into three sections, A, B, & C.Section A will have 10 MCQs/Fill in the blanks/One-word answers of a total of 15 marks from the whole syllabus. Section B will have 4 short answer questions (100 words) of 05 marks each, one from each unit. Section C will have 4 questions, one from each unit with internal choice, of 10 marks each. The questions have to be answered in about 350 words each).

**Unit-I** Gametogenesis in animals. Molecular events during fertilization. Activation of egg metabolism. Cleavage patterns and fat maps. Regulation of Cleavage cycle. Cleavage and nuclear activity.

**Unit-II** Concepts of determination, competence, induction, and differentiation. Determination in *Caenorhabditis elegans*. Germ cell determination, migration, and differentiation. Totipotency and nuclear transfer experiments. Embryonic induction. Formation of vulva in *C. elegans*. Mechanism of differentiation in *Dictyostelium*.

**Unit-III** Morphogenetic determinants in egg cytoplasm. Role of maternal contributions in early embryonic development. Genetic regulation of early embryonic development in Drosophila. Homeotic genes. Genetic interaction during differentiation. Hox genes and limb patterning.

**Unit-IV** Metamorphosis: the hormonal reactivation of development. Multiple ovulation and Embryo transfer technology, Superovulation. Invitro fertilization. Cryopreservation. Stem cells. Transgenic and mutants in the analysis of development. Aging: the biology of senescence. Teratology.

**Lab Course:**

1. Study of developmental stages in Snail/Amphibian/Chick
2. Study on Drosophila development
3. Role of hormones in metamorphosis and development
4. Effect of Vitamin A on tail regeneration in frog
5. Biochemical estimations in developing embryos
6. Structure of hen's egg and its vital staining
7. Demonstration of cell death by vital staining
8. Study of permanent slides of chick embryos
9. Histological studies of Gametogenesis
10. Induced breeding in fishes

**Recommended Books**

10/5/24 10.5.24 10/05/2024 10/5/24

| | |
|---|---|
| Alberts *et al.* | Molecular Biology of the Cell |
| SF Gilbert | Developmental Biology |
| Lewin Benjamin | Gene VIII |

**Learning Outcome:**

Students will be able to comprehend-

a. Developmental processes in animals and plants.
b. Biochemical and molecular regulation of development.
c. Concepts of epigenetics and how environmental factors influence the development of plants and animals.

**M.Sc. Bioscience (Program code-M. Sc. 0405)**
**Fourth Semester (January 2026 – June 2026)**
**CORE I: Molecular Endocrinology(Course code: BS-22401)**
**[Credit: 5 and Maximum Marks: 75]** 70

(Each theory paper will have questions divided into three sections, A, B, & C.Section A will have 10 MCQs/Fill in the blanks/One-word answers of a total of 15 marks from the whole syllabus. Section B will have 4 short answer questions (100 words) of 05 marks each, one from each unit. Section C will have 4 questions, one from each unit with internal choice, of 10 marks each. The questions have to be answered in about 350 words each).

**Unit-I** Definition and scope of molecular endocrinology. Chemical nature and general classes of hormones: Peptide, Amino acid derived, Steroid, Neurotransmitters, Neuropeptides, Chalones, Eicosanoids, and Pheromones. Hypothalamic octapeptide hormones: Oxytocin and Vasopressin. Purification and characterization of hormones. Hypothalamo-hypophyseal axis.

**Unit-II** Genetic control of hormone synthesis: Structure and expression of protein hormone encoding gene. Molecular aspects of peptide hormone biosynthesis and secretion. Molecular aspects of synthesis and delivery of thyroid hormones, biogenic amines, and steroid hormones. Production of protein hormones by recombinant DNA technology

**Unit-III** Molecular mechanism of hormone action: Membrane, cytoplasmic and nuclear hormone receptors, Non-genomic mechanism of hormone action, Receptor-ligand interactions. Hormonal signal transduction: G-proteins and second messengers. Genomic mechanism of hormone action: Steroid and thyroid hormones.

**Unit-IV** Molecular aspects of reproductive endocrinology: Genetics of sex. Testicular and ovarian determining genes. Mullerian inhibiting substance genes. Stem cell renewal in testis. Molecular basis of male and female contraception. Endocrine disruptors. Neuroendocrine control of reproduction and feedback mechanism.

**Lab Course:**

1. Purification of any protein hormone.
2. Assay of steroid dehydrogenase
3. Isolation and characterization of steroid/prostaglandin.
4. In vivo bio-assay for estrogen/testosterone/LH
5. Perfusion technique for the fixation of endocrine tissue
6. Identification of hypothalamic nuclei following histological/histochemical methods
7. Histological / Cytological / Histochemical study of endocrine glands.
8. Study of estrus cycle by vaginal smear technique.
9. Extraction and estimation of Gondotrophin/ Pregnanediole from urine.
10. Sperm count and motility.
11. Study of neurosecretory cells/ materials/granules in the given materials.

10/5/24 10-5-24 10/05/2024 10/5/24

**Recommended Books**

| | |
|---|---|
| Franklyn F. Bolander | Molecular Endocrinology |
| Freedman and Birkhauser | Molecular Biology of Steroid and Nuclear Hormone Receptors |
| An Introduction to Neuroendocrinology | Brown R. |
| Endocrinology | Mac E. Hadley |
| Endocrinology (Vol. I-III) | D Groot. L. J. (ed.), W. B. Saunder |
| Vertebrate Endocrinology | Norris, D. O. |
| Essential Endocrinology | Brook, C.G.D. and Marshall, N.J. |
| Williams Textbook of Endocrinology | Shlomo Melmed et al, |
| Basic Medical Endocrinology | Goodman. H.M. |
| Introduction to Endocrinology | Negi. |
| Reproductive Endocrinology | Yen et al (ed) |
| Reproductive Endocrinology | Adashi et al, |
| Experimental Endocrinology | Zarrow et al. |
| Essential techniques in reproductive physiology and Endocrinology | Chinoy et al. |
| Cell and Molecular Biology of Testis | Claude D and Larry L. E (ed) |
| Biochemical actions of hormones | Litwack, G. |
| Nuclear Receptors: Current Concepts | CM Bunce, MJ Campbell and Future Challenges |

**Learning Outcomes:**

Students should be able to:

a. Compare and contrast the synthesis, secretion, transport, and general metabolism (degradation) for protein/peptide, biogenic amines, steroids, eicosanoids, and thyroid hormones.
b. Explain why hormones are regulated at so many levels.
c. Explain why most actions of steroid hormones are slower than peptide hormones.
d. Describe the post-transcriptional/post-translational processing of protein/peptide hormonesynthesis.
e. Predict the biological effect of a novel steroid based on the chemical structure (e.g., number of carbons, position of double bonds, attached groups).
f. Compare and contrast the various types (subtypes) of membrane and intracellular bioregulator receptors with respect to their structure (domains), location, and how each generally produces a measurable effect (genomic vs. non-genomic) in a target cell.
g. Predict what will happen to the signal transduction pathway if you administer a drug that selectively inhibits the following G-proteins: Gs (including alpha, beta/gamma subunits), Gi, or Gq.
h. Predict what would happen to the biological effect of steroid hormone receptors if you administer drugs that selectively inhibit different domains of the steroid hormone receptor
i. Describe the mechanisms and predict the consequences of upregulation, downregulation, and recycling of the receptor.
j. Predict the physiological consequences of steroid administration taking into accountcytoplasmic conversion.
k. Hypothesize how activation of one pathway could influence the activation of another pathway (cross talk).
l. Compare and contrast cAMP and IP3 signal transduction pathways.

10/5/24 10.5.24 10.5.24 10/05/2024 10/5/24

m. Predict how other bioregulators or pharmacological agents could alter cAMP or IP3 pathways induced by a specific bioregulator.

## M.Sc. Bioscience (Program code-M. Sc. 0405)
### Fourth Semester (January 2026 – June 2026)
### CORE II: Genetic Engineering (Course code: BS-22402)
### [Credit: 5 and Maximum Marks: 75] 70

(Each theory paper will have questions divided into three sections, A, B, & C.Section A will have 10 MCQs/Fill in the blanks/One-word answers of a total of 15 marks from the whole syllabus. Section B will have 4 short answer questions (100 words) of 05 marks each, one from each unit. Section C will have 4 questions, one from each unit with internal choice, of 10 marks each. The questions have to be answered in about 350 words each).

**Unit-I** Molecular tools and their applications: restriction enzymes, modification enzymes. Molecular techniques: polymerase chain reaction, DNA sequencing, DNA barcoding, protein sequencing.

**Unit-II** Gene cloning vectors: plasmids, lambda phage as a vector, M13 phage as a vector, cosmids, artificial chromosomes (BAC, PAC, YAC). Genomic DNA library construction and screening methods, cDNA library construction and screening methods, DNA microarray.

**Unit-III** Gene knockout technique: Site-directed mutagenesis, Random mutagenesis, and applications, Genome editing: CRISPR-Cas 9, Gene Knockdown, Gene Silencing. Study of gene regulation: reporter assays.

**Unit-IV** Expression strategies for heterologous genes: vector engineering and codon optimization, host engineering, in vitro transcription and translation. Processing of recombinant proteins: recombinant proteins purification, refolding, characterization and stabilization, Applications of recombinant proteins.

**Lab Course:**

1. Antibiotic selection media and bacterial culture
2. Preparation of competent cells
3. Isolation of plasmid DNA.
4. Isolation of Genomic DNA.
5. Quantitation of nucleic acids.
6. Agarose gel electrophoresis and restriction mapping of DNA.
7. Construction of restriction map of plasmid DNA.
8. Cloning in plasmid/phagemid vectors.
9. Isolation of RNA.
10. Synthesis of cDNA.
11. RAPD analysis by PCR.
12. Protein purification.

**Recommended Books:**


Benjamin Lewin — Genes VIII
DST Nicholl — An Introduction to Genetic Engineering
SB Primrose and Richard — Principles of Gene Manipulation and Genomics


10/5/24 10.5.24 10/05/2024 10/5/24

| | |
|---|---|
| CJ Howe | Gene Cloning and Manipulation |
| R Hodge | Genetic Engineering (Genetics and Evolution |
| A Kumar & N Garg | Genetic Engineering |
| L Yount | Biotechnology & Genetic Engineering |
| P Baldi & G Wesley | DNA Microarrays & Gene Expression |
| L Alphey | Experiments to Data Analysis and Modeling DNA Sequencing (Intro. to Biotechniques) |
| Richard R. Burgess | Guide to Protein Purification, 2nd Edition |
| Paul Cutler | Protein Purification Protocol, 2nd Edition |
| Jan-Christer Janson | Protein Purification, 3rd Edition |

**Learning Outcomes:**

Students will have an in-depth understanding of-

a. Basic principles of genetic engineering.
b. Animal cell culture.
c. Types of cell culture media. Cell lines, Stem cell research ,and gene transfer technology in animals
d. Plant transformation techniques.
e. Transgenics for increasing crop productivity.
f. Transgenics for quality improvement.
g. Chloroplast transformation.
h. Plant Metabolic Engineering, Plant vaccines.
i. Protein separation and identification techniques.
j. Protein and Genome sequencing methods.
k. Functional proteomics and itsapplications.
l. Human genome, Gene disease association, and metagenomics.
m. Transgenic animals, cloning, and applications.
n. Development of transgenic plants and their applications.
o. Medical biotechnology applications like tissue engineering.
p. Synthesis and application of nanoparticles.

**M.Sc. Bioscience (Program code-M. Sc. 0405)**
**Fourth Semester (January 2026 – June 2026)**
**ELECTIVE I: (A) Parasitology (Course code: BS-22403-A)**
**[Credit: 5 and Maximum Marks: 75]** 70

(Each theory paper will have questions divided into three sections, A, B, & C.Section A will have 10 MCQs/Fill in the blanks/One-word answers of a total of 15 marks from the whole syllabus. Section B will have 4 short answer questions (100 words) of 05 marks each, one from each unit. Section C will have 4 questions, one from each unit with internal choice, of 10 marks each. The questions have to be answered in about 350 words each).

**Unit-I** Parasites and parasitism. The Infection process: Modes of Parasite transmission, invasion, migration within the host, maintaining the station, obtaining nutrients, and resisting host attack. Concept of Disease: Inflammation and Repair, Degeneration, Necrosis. Mechanism of Disease transmission with particular reference to vectors. Vector control measures.

**Unit-II** General organization and life cycle patterns of Protozoa; Epidemiology, pathogenesis, diagnosis, and control of major human diseases, such as Malaria, Leishmaniasis, and

Trypanosomiasis.

**Unit-III** General organization and life cycle patterns of Trematodes and Cestodes; Epidemiology, pathogenesis, diagnosis, and control of major human diseases, such as Schistosomiasis and Hydatidosis. Arthropod-related ectoparasitic diseases: Ticks, mites, and flies.

**Unit-IV** General Organization and life cycle patterns of Acanthocephala and Nematoda; Epidemiology, pathogenesis, diagnosis, and control of major nematode diseases, such as Ascariasis, Ancylostomiasis, and Filariasis. Biology of plant parasitic nematodes.

**Lab Course:**

1. Identification and comments on permanent mounts of parasitic organisms
2. Host examination for parasites; preparation of permanent slides and identification
3. Histology/Histopathology/Histochemistry by routine and differential staining
4. Biochemistry of parasites and pathophysiology of the hosts
5. Root-knot nematodes: Extraction and isolation (Cobb's sieving and decantation method and Baerman's Funnel technique), preparation of perennial pattern mounts
6. Detection of blood parasites: Malarial parasite
7. Macroscopic and microscopic examination of stool samples, concentration methods

**Recommended Books:**


| | |
|---|---|
| KD Chatterjee | Parasitology (Protozoology and Helminthology) in Relation to Clinical Med. 9th Ed. |
| TC Cheng | General Parasitology. Second Ed., |
| CKJ Panicker | Textbook of Medical Parasitology.Jaypee Brothers |
| TV Rajan | Textbook of Medical Parasitology. |
| D Rollinson, and SI Hay, | Advances in Parasitology; Volumes 1 to 78, |
| JD Smyth and DW Halton | The Physiology of Trematodes. |
| DJ*Wyler,*Ed. | *Modern* Parasite Biology: Cellular, I*mmunological* and M*olecularAspects*. |


**Learning Outcomes:**

Upon successful completion, students will know-

a. Identify, describe, and contrast unicellular parasites and parasitic worms.
b. Describe specific human and non-human parasitic diseases
c. Prepare and observe live parasitic specimens and test students' seropositivity for a particular parasiticinfection.
d. Report on observations of biological specimens such as parasites
e. Appraise the impacts of parasitic diseases on human societies
f. Evaluate the complexity of the parasite/host relationship (parasite evasion mechanisms *vs* host defensive mechanisms)
g. Assemble a presentation on a current topic in parasitology (literature research, selection of relevant sources of information, evaluation of the information/data, formulation of the research's results)

**M.Sc. Bioscience (Program code-M. Sc. 0405)**
**Fourth Semester (January 2026 – June 2026)**
**ELECTIVE I : (B) Basic Chronobiology (Course code: BS-22403-B)**
**[Credit: 5 and Maximum Marks: 75]** 70

(Each theory paper will have questions divided into three sections, A, B, & C.Section A will have 10 MCQs/Fill in the blanks/One-word answers of a total of 15 marks from the whole syllabus. Section B will have 4 short answer questions (100 words) of 05 marks each, one from each unit. Section C will have 4 questions, one from each unit with internal choice, of 10 marks each. The questions have to be answered in about 350 words each).

**Unit-I** Historical developments in chronobiology. Different types of geophysical and biological cycles with examples of circadian rhythms. Quantification of biological rhythms - Average, amplitude, phase, and period. A brief introduction to time series analysis. Methods of time series analyses: Cosinor, autocorrelation, chi-square periodogram.

**Unit-II** Characteristics of circadian rhythm: Free-run, Temperature and nutrition compensation, and Entrainment. Zeitgeber Time (ZT) and Circadian Time (CT). After-effects and Aschoff's rule. Aging and circadian clocks. Photoperiodism. Plant Rhythms

**Unit-III** Synchronization (=Entrainment) and masking. Entrainment by single light pulse, complete and skeleton photoperiods. Zeitgebers for circadian clocks. Key properties of a Zeitgeber. Photic and non-photic zeitgebers. Mechanisms of entrainment. Phase response curves (PRC), phase transition curves, strong and weak PRC.

**Unit-IV** Circadian pacemakers in insects with special reference to *Drosophila*. Suprachiasmatic nucleus as mammalian circadian clock. Multi-oscillatory organization: master and slave oscillators, morning and evening oscillators, pacemakers, and peripheral oscillators. Adaptive significance of circadian rhythms. Social consequence of circadian rhythms.

**Lab Course:**

1. Terminology in Chronobiology
2. Study of locomotor activity rhythm in suitable animal models
3. Actogram construction of locomotor activity of suitable animal models
4. Study of phase shift in circadian rhythm in a suitable variable, such as locomotor activity
5. Construction of Cosinor Curves using Mesor (M), amplitude (A), and acrophase/ peak (∅) of circadian, and other low and high-frequency rhythms
6. Computation of period (τ), phase angle (Ψ)
7. Circadian changes in the volume of nuclei in onion peel (*Allium cepa*) cells (microscopic observation)
8. Observation of leaf movement of a plant on circadian and longitudinal time scales
9. Periodogram, amount of activity, and spectral analysis of rhythm data using TSA-Cosinor software

**Recommended Books:**


| | |
|---|---|
| MJ Berridge | Biochemical oscillations and cellular rhythms. The molecular bases of periodic and chaotic behaviour |
| E Bunning | The physiological clock |
| FH Columbus | Trends in chronobiology |
| G Cornelissen & F Halberg | Introduction to chronobiology |
| JC Dunlap, JJ Loros& PJ DeCoursey | Chronobiology: Biological timekeeping |
| JC Hall | Genetics and molecular biology of rhythms in *Drosophila* and other insects |
| PJ Lumsden& AJ Millar | Biological rhythms and photoperiodism in plants |
| JD Palmer | The living clock |
| AK Pati | Chronobiology: The dimension of time in biology and medicine; PINSA (Biological Sciences), December 2001 |

| | |
|---|---|
| AK Pati (Ed.) | Chronobiology |
| DS Saunders | An introduction to biological rhythms |
| B Thomas & D Vince-Prue | Photoperiodism in plants |
| V Kumar (Ed.) | Biological rhythms |
| MK Chandrashekaran | Time in the Living World |
| AT Winfree | The Geometry of Biological Time |
| MC Moore, FM Sulzman, & CA Fuller | The Clocks That Time Us, Harvard University Press,1982 |
| DS Saunders | Insect clocks, Pergamon, 2002 |


**Learning Outcomes:**

After successfully completing this course, the students will be able to-

a. Conceptualize how species beneficially occupy the temporal environment and space out their activities at different times of the day and seasons.
b. Understand the basic principles of biological rhythms that keep the organisms in sync with the environmental rhythms.
c. Develop a critical viewpoint and interpret observations from experiments on biological rhythms regulating daily and seasonal biology.
d. Plan studies on biological rhythms in both human and non-human species.

**M.Sc. Bioscience (Program code-M. Sc. 0405)**
**Fourth Semester (January 2026 – June 2026)**
**ELECTIVE I: (C) Ethnobotany (Course code: BS-22403-C)**
**[Credit: 5 and Maximum Marks: 75]** 70

(Each theory paper will have questions divided into three sections, A, B, & C.Section A will have 10 MCQs/Fill in the blanks/One-word answers of a total of 15 marks from the whole syllabus. Section B will have 4 short answer questions (100 words) of 05 marks each, one from each unit. Section C will have 4 questions, one from each unit with internal choice, of 10 marks each. The questions have to be answered in about 350 words each).

**Unit-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 lifestyles. Plants used by the tribals as (a) Food plants (b) Intoxicants and Beverages (c) Resins, oils, and miscellaneous uses.

**Unit-II** **Methodology of Ethnobotanical studies**

Fieldwork: collection and confirmation of tribal information; its documentation; assessment of its valuation Herbarium: its role in the confirmation of ethnic data; assessment of similarities of data across different habitats ancient literature; Archaeo-ethnological findings; Sacred Grooves- their role in the confirmation of ethnic data

**Unit-III** **Role of Ethnobotany in modern medicine**

Medico- Ethnobotanical sources in India. Significance of the following plants in ethno-botanical practices (along with their habitat and morphology) (a) *Saussurea costus*(b) *Arnebia benthamii*(c) *Fritillaria roylei*(d) *Rheum webbianum*(e) *Tribulus terrestris*(f) *Aconitum heterophyllum*(g) *Digitalis purpurea* (h) *Indigofera heterantha*.

Role of Ethnobotany in modern medicine with special examples a) *Digitalis purpurea* b)

*Atropa acuminata* c) *Artemisia* sp. d) *Withania* sp. Role of ethnic groups in the conservation of plant genetic resources. Endangered taxa and forest management (participatory forest management).

**Unit-IV** **Ethnobotany and legal aspects**

Ethnobotany as a tool to protect the interests of ethnic groups.
Sharing of wealth concept with a few examples from India.
Biopiracy, Intellectual property rights, and traditional knowledge.

**Lab Course:**

1 Investigation of Food plants used by tribes.
2 Investigation of plants used as Beverages by tribes.
3 Preparation of herbarium of ethnomedicinal plants.
4 Ethnomedicinal investigation on plants.
5 Gardening rare plant Species.

**Recommended Books:**


| | |
|---|---|
| S.K. Jain | Manual of ethnobotany |
| S.K. Jain (ed.) | Glimpses of Indian Ethnobotany |
| S.K. Jain, (ed.) | Methods and approaches in ethnobotany |
| S.K. Jain | Contributions of Indian ethnobotany. |
| Colton C.M. | Ethnobotany- Principles and applications. |
| Rama R. N. and A.N. Henry | The ethnobotany of Eastern Ghats in Andhra Pradesh, India. Botanical Survey of India |
| Rajiv K. Sinha | Ethnobotany- the renaissance of traditional Herbal Medicine |


**Learning Outcomes:**

Upon successful completion, students will have the knowledge of-

a. Taxonomy of plants.
b. Distribution and diversity of plants.
c. Identify and classify various plant species that would provide the correct direction for their grouping and categorization and preparation of phylogenetic relationship.
d. Improve existing knowledge of plant biodiversity thus strengthening the list of rare, endangered, vulnerable, and extinct species.
e. Understate the importance of plants in human and animal life and identify new food crops and plants with ethnomedicinal potential.
f. Understand the economic and pathological importance of plants, bacteria, and viruses.
g. Understand the complexity of biological systems in a simple manner after exploring the world of fungi, and pathogens of plants.
h. Learn the group of plants and microbes and their symbiotic relationship with their morphological characteristics/structures.
i. Develop a critical understanding of how microbes are beneficial for the environment and ecosystem.
j. Biodiversity, threats,and conservation needs.

## Fourth Semester (January 2026 – June 2026)
## ELECTIVE II: (A) Applied Immunology (Course code: BS-22404-A)
## [Credit: 5 and Maximum Marks: 75]

(Each theory paper will have questions divided into three sections, A, B, & C.Section A will have 10 MCQs/Fill in the blanks/One-word answers of a total of 15 marks from the whole syllabus. Section B will have 4 short answer questions (100 words) of 05 marks each, one from each unit. Section C will have 4 questions, one from each unit with internal choice, of 10 marks each. The questions have to be answered in about 350 words each).

**Unit-I** Generation of diversity in BCR. Light and heavy chain gene recombination. Recombination Signal sequences. Class switching. Membrane and secreted immunoglobulins. Organization, arrangement of T-cell receptor genes, and recombination.
Regulation of immune response by antigen, antibody, immune complex, MHC, and cytokines.

**Unit-II** Immunoprophylaxis:Principles of Vaccination. Immunization practices. Vaccines against important bacterial and parasitic diseases. DNA vaccines; passive prophylactic measures. Viral vaccines and antiviral agents. Vaccination schedules and safety. Production of vaccines.

**Unit-III** Diagnosis of microbial diseases - Collection, transport, and preliminary processing of Clinical pathogens. Clinical, microbiological, immunological, and molecular diagnosis of diseases.
Principles of immunodiagnostics. Antigen-antibody-based diagnosis and the techniques involved – Enzyme, Radio, and Fluorescence Immunoassays, Immunoblotting, and Flow cytometry. Effector cell assays, Cytotoxic assays. Isolation of pure antibody. Monoclonal & Designer antibody and their application in immunodiagnostics.

**Unit-IV** Modern methods of microbial diagnosis. Use of nanotechnology in diagnosis. Synthesis of Nanomaterials, Nanoparticle-based drug delivery, Toxicity, and environmental risks of nanomaterials.
Biosensors: Biosensor development, types, and characteristics, DNA biosensors, application of biosensors in clinical diagnostics: detection of infectious diseases, food pathogen, and environmental monitoring.

**Lab Course:**

1. Preparation of Parasite Antigen and analysis by PAGE
2. Immunizations and production of antibody
3. The antigen-antibody reaction by Double Diffusion, Counter current and IEP, RID, and EIA
4. Western Blot Analysis
5. Immunodiagnosis using commercial kits
6. Identifications of nanomaterials using physical and chemical properties.
7. Green and chemical route for synthesis of nanomaterials.
8. Nanomaterial characterizations using UV-Vis and FT-IR spectroscopy.
9. Assessment of antibacterial properties of nanomaterials.
10. Identification of different analyte/ biomolecules for biosensing system.

**Recommended Books:**


RA Goldsby, TJ Kindt and BA Osborne — Kuby's Immunology
E Benjamini, R Coico and G Sunshine — Immunology-A Short Course
Roitt, Brostoff and Male — Immunology

| | |
|---|---|
| William Paul | Fundamentals of Immunology |
| Stewart Snell | Immunology, Immunopathology and Immunity |
| Elgert | Understanding Immune System |
| M. Wilson, K. Kannangara, G Smith, M. Simmons, B. Raguse | Nanotechnology: Basic Science and Emerging Technologies |
| G. Cao | Nanostructures and Nanomaterials: Synthesis, properties and applications |
| Challa S.S.R. Kumar | Nanomaterials for medical diagnosis and therapy |
| Charles P. Poole Jr. and Franks. J. Qwens | Introduction to Nanotechnology |
| C. M. Niemeyer, C. A. Mirkin (Editor) | Nanobiotechnology: Concepts, Applications and Perspectives |

**Learning Outcomes:**

Students will develop a knowledge base in:

a. Concepts of the immune system and types of immunity.
b. Mechanism of activation of immune system components
c. Concepts of immunodeficiency, allergies, autoimmune disorders, transplant immunology, immunotherapy, development of vaccines, etc.

**M.Sc. Bioscience (Program code-M. Sc. 0405)**
**Fourth Semester (January 2026 – June 2026)**
**ELECTIVE II: (B) Applied Chronobiology (Course code: BS-22404-B)**
**[Credit: 5 and Maximum Marks: 75]** 70

(Each theory paper will have questions divided into three sections, A, B, & C.Section A will have 10 MCQs/Fill in the blanks/One-word answers of a total of 15 marks from the whole syllabus. Section B will have 4 short answer questions (100 words) of 05 marks each, one from each unit. Section C will have 4 questions, one from each unit with internal choice, of 10 marks each. The questions have to be answered in about 350 words each).

**Unit-I** Molecular mechanisms underlying clock functions in organisms: Autoregulatory transcriptional feedback loops; Circadian clock mutant types in *Drosophila* (*per*, *tim*, *dbt*, *clock*, *cycle*, *vrille*, *pdf*, *lark*, *takeout*), *Neurospora,* cyanobacteria, mouse, and humans. Temporal expression pattern of clock genes, Regulation of expression of clock genes, Expression patterns under constant light and darkness; Autonomous functions of clock genes in peripheral tissues.

**Unit-II** Human circadian organization: Methods to study human circadian rhythm; Free-running rhythms in humans, Constant routine protocol, and Forced desynchronization protocol. Chronotypes and their assessment methods. Marker rhythms in humans: Core body temperature (CBT), melatonin, and cortisol. Sleep-wake alertness and performance rhythms in humans.

**Unit-III** Circadian rhythms and human health: Chronopharmacology; Basics of chronopharmacology – clinical chronopharmacology – circadian dependence of drug pharmacokinetics. Chronotherapy; Application of chronotherapy in the treatment of cancer, cardiovascular diseases, allergies, asthma, and circadian rhythm sleep disorders (for example, DSPS and ASPS) & mood disorders (SAD).

**Unit-IV** Circadian rhythms in occupational and travel stresses: Shift work; Types of shift system, direction and frequency of shift rotation, Effect on rhythm parameters, Desynchronization of circadian rhythm, Consequences on sleep, Psychosocial problems,

10/5/24 10.5.24 10/05/2024 10/5/24

Clinical and non-clinical problems. Shift work tolerance/ intolerance. Shift optimization: Nap, Bright light therapy, Melatonin therapy.

Jet lag: Consequences of jet lag; direction asymmetry & variable asymmetry; Approaches to jet lag alleviation.

**Lab Course:**

1. Study of circadian rhythms in objective variables in human subjects using Autorhythmometry technique.
2. Study of circadian rhythms in subjective variables in human subjects using Autorhythmometry technique.
3. Chronotyping in human population.
4. Study of circadian rhythm in the rest-activity of humans by using wrist actigraphy.
5. Study of circadian rhythm in blood pressure of humans by using Ambulatory Blood Pressure Monitor.
6. Circadian variations in RBC and WBC in suitable animal models.
7. Circadian rhythm in cortisol and melatonin by ELISA.
8. Computation of mid-sleep and social jetlag
9. Observation of functional status of in-built alarm clock in humans.

**Recommended Books:**


| | |
|---|---|
| JC Dunlap, JJ Loros& PJ DeCoursey | Chronobiology: Biological timekeeping |
| JC Hall | Genetics and molecular biology of rhythms in *Drosophila* and other insects |
| WJM Hrushesky | Circadian cancer therapy |
| BG Katzung | Basic and clinical pharmacology |
| G Klein and P Becker | Farewell to the internal clock: a contribution in the field of Chronobiology |
| AK Pati | Chronobiology: The dimension of time in biology and medicine; PINSA (Biological Sciences), December 2001 |
| AK Pati, Ed. | Chronobiology |
| TT Postolache | Sports Chronobiology: An issue of clinics in sports medicine |
| D Purves *et al.* | Molecular mechanisms of biological clocks |
| PH Redfern and B Lemmer | Physiology and pharmacology of biological rhythms |
| R Refinetti | Circadian Physiology |
| A Reinberg | Clinical chronopharmacology: Concepts, kinetics, applications |
| A Sehgal | Molecular biology of circadian rhythms |
| LE Scheving | Chronobiotechnology and chronobiological engineering |
| Y Touitou *et al.* | Handbook of Medical Chronobiology |


**Learning Outcomes:**

After successfully completing this course, the students are expected to have acquired knowledge and skills that enable them to:

a. Understand the molecular, cellular, and system levels in various organisms and the generation and coordination of internal timing.
b. Understand the underlying mechanism of circadian rhythms in the human body

c. Understand the various techniques that help investigate the endogenous nature of biological rhythms in humans.
d. Understand the consequence of the disruption of internal rhythms on work performance and health in the modern world.
e. Acknowledge the role of Chronobiology and chronodisruption in several physio-pathological events.
f. Experience a hands-on recording of your body rhythms in a basic class experiment.
g. Learn to understand the relationship between sleep and circadian biology by an analysis of students' sleep rhythm.
h. Acknowledge the relevance of circadian rhythms in therapeutic interventions.

**M.Sc. Bioscience (Program code-M. Sc. 0405)**
**Fourth Semester (January 2026 – June 2026)**
**ELECTIVE II: (C) Secondary Metabolites (Course code: BS-22404-C)**
**[Credit: 5 and Maximum Marks: 75]**

(Each theory paper will have questions divided into three sections, A, B, & C.Section A will have 10 MCQs/Fill in the blanks/One-word answers of a total of 15 marks from the whole syllabus. Section B will have 4 short answer questions (100 words) of 05 marks each, one from each unit. Section C will have 4 questions, one from each unit with internal choice, of 10 marks each. The questions have to be answered in about 350 words each).

**Unit-I** **Introduction to secondary metabolites:** Definition and systematic of secondary metabolites. Major classes of secondary metabolites i.e. alkaloids, terpenoids/ or isoprenoids, flavonoids, and phenolics. Significance of secondary metabolites in plant life. Roles in chemical defense system, taxonomical and ecological functions. Pharmacological and biological properties of secondary metabolites. Industrial and commercial significance of secondary metabolites

**Unit-II** **Biosynthesis and regulation of secondary metabolites:** Biosynthesis of alkaloids derived from Shikimic acid pathway. Biosynthesis of isoprenoids via 3C-methyl-D-erythritol-4-phosphate (MEP) pathway. Biochemical pathways of flavonoids and polyphenol (lignin) biosynthesis. Integration of secondary metabolism with primary metabolic pathways. Regulation: Genetic, developmental, seasonal, and geographical factors, roles of precursor feeding, metabolic channeling, and compartmentalization. Cross-talk/exchange of intermediates between biochemical pathways. Use of specific enzyme inhibitors in regulation

**Unit-III** **Production of secondary metabolites:** Methods of production of secondary metabolites: Tissue, organ, and hairy root cultures. Roles of Endophytes in the production of secondary metabolites. Production of secondary metabolites in bioreactors. Effects of precursors, co-factors, and elicitors on production. Production of Taxol, Camptothecin, Berberine, and rubber.

**Unit-IV** **Metabolic Engineering of secondary metabolic pathways:** Cloning and characterization of enzymes of the Shikimate and MEP pathways. Functional genomics approaches for improvement of secondary metabolite production. Metabolic engineering of *Escherichia coli* and yeast for the production of flavonoids, terpenoids, and alkaloids.

**Lab Course:**

1 Isolation of essential oil and determination of the oil yield.

2 Qualitative test for determination of
- a- terpenoids
- b- alkaloids
- c- flavonoids
- d- saponins

3 Quantitative assay for determination of:
- a- terpenoids
- b- alkaloids
- d- saponins
- e- phenolics

4 Determination of the antimicrobial activity of the plant extracts.

5 Demonstration of hairy root culture for production of secondary metabolites

6 RNA extraction and gene expression of key enzymes of Biosynthesis of alkaloids; *Strictosidine Synthase [STR1], Strictosidine glucosidase (SG), Acetylajmalan Esterase (AAE), etc.*

**Recommended Books:**

| | |
|---|---|
| David S. Seigler | Plant Secondary Metabolism, |
| Alan Crozier | Plant Secondary Metabolites: Occurrence, Structure and Role in the Human Diet |
| Y. M. Shukla | Plant Secondary Metabolites |
| R. Verpoorte, A. W. Alfermann | Metabolic Engineering of Plant Secondary Metabolism. |
| Herbert, R.B. | The Biosynthesis of Secondary Metabolites |
| Fett-Neto, Arthur Germano (Ed.) | Biotechnology of Plant Secondary Metabolism Methods and Protocols |
| Keller, Nancy P., Turner, | Fungal Secondary Metabolism |
| Bell, E.A., Charlwood, B.V. (Eds.) | Secondary Plant Products |
| Petroski, Richard J., McCormick, Susan P. (Eds.) | Secondary-Metabolite Biosynthesis and Metabolism |
| Makkar, Harinder P.S., Sidhuraju, P., Becker, Klaus | Plant Secondary Metabolites |

**Learning Outcomes:**

Students will develop an understanding of-

a. Food crops and medicinal plant secondary metabolites.
b. Knowledge of extraction,isolation ,characterization, and elicitation of bioactive metabolites.
c. Nutraceuticals and functional foods.
d. Plant-based biofuels.

**PROJECT WORK**

**Learning Outcomes:**

Project work will enable the student to:

a. Develop an inquisitive mind and be methodical in his approach to solving the research problem.

b. Demonstrate skill and knowledge of current information and technological tools and techniques specific to the professional field of study.
c. Develop scientific temperament, work ethics, creativity, collaboration, and communication skills increasing their chances of employability.
d. Build an important network of future partners, mentors, and/or collaborators that will be helpful in their future endeavors.
e. Open a window to career opportunities hitherto undiscovered by them.
f. Gain experience in their field of interest through learning activities giving them a competitive edge.
g. Refine their interests and gain confidence in moving forward.
h. The main objective of such projects is to develop research aptitude in students at an early age.
i. This is the second phase where the students will undertake some research problems and solve them through experiments.
j. Further a report will be submitted and presented for discussion.

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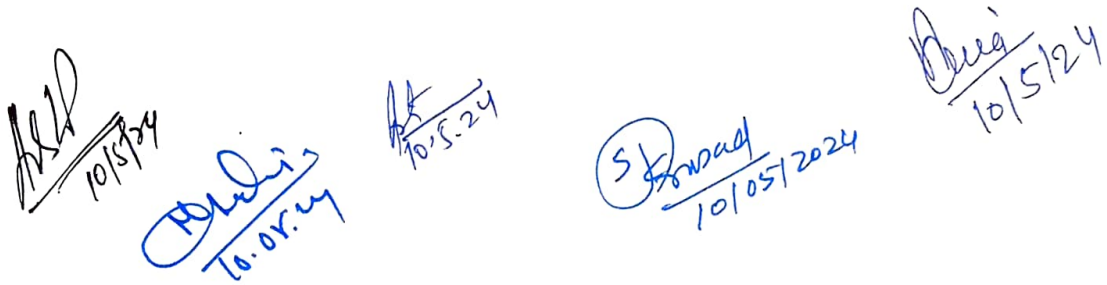

# Pt. Ravishankar Shukla University
# School of Studies in Life Science (Syllabus 2024-2026)

**M. Sc. Bioscience (Program code-M. Sc. 0405)**
**Skill Development and Value-Added Course for First Semester (July-December)**

**Paper: Indian Knowledge in Life Science**

**Course code: IKS-1**
**Credit: 2 and Maximum Marks: 75 + 25** 70 + 30

**Unit 1: Indian Knowledge System:**

- Tribal and ethnic communities in India: Communication and knowledge sharing method.
- Ethnic groups in India, understanding and application of Ethnic Studies, Tattoos, and Magico religious beliefs.

**Unit 2: Life sciences: The historical evolution of medical tradition in ancient India:**

- Survey and inventory of plant usages, search for newer plant resources, and conservation practices.
- Agriculture, Social forestry, Shift cultivation, and Edible plants.

**Unit 3: Life sciences: Ayurveda for life, health and well-being:**

- Various aspects of how Ayurveda is a holistic study and practice that balances the inner environment with the external.
- Appraise the concept of good health and explore the role of dietary and behavioral changes in restoring health.

**Unit 4: Traditional Knowledge:**

- Traditional music, beverages and ethno-veterinary.
- Edible mushrooms and their importance.
- Opportunities and challenges for the life sciences in India.

**Course Outcome:**
At the end of the course, students will be able to gain insights into the concept of traditional knowledge and its relevance. They will also be able to understand and connect the basics of Indian traditional knowledge with a modern perspective.

**Reference Books:**

1. A Handbook of Ethnobotany. S K Jain, V. Mudgal 1999 Dehradun, India

10/5/24 10.5.24 10.05.24 10/5/24 10/05/2024

# Pt. Ravishankar Shukla University
# School of Studies in Life Science (Syllabus 2024-2026)

**M. Sc. Bioscience (Program code-M. Sc. 0405)**
**Skill Development and Value-Added Course for Third Semester (July-December)**
**Paper: Survival Skills vs Wilderness and Metropolitan Challenges**

**Course code: LS-VAC-1**
**Credit: 2 and Maximum Marks: 75 + 25** 70 + 30

**Objectives:**
1. Development of survival skills under adverse circumstances by using biological information.
2. Development of willpower, self-confidence, and self-dependency in social life.
3. Development of creativity and novel problem-solving approaches.
4. Development of skill-based practical approaches for survival ship.

**Course Outcome:**
1. Understanding the role of biological information for life survival in an ecosystem.
2. Helps to recognize the basic necessity of life in various conditions.
3. Helps to use basic natural resources for survival ship and strengthening self-existence.
4. To understand the precautionary approach/s under low or minimal limiting factors of life.
5. Understanding the importance of survival techniques for human existence.
6. This will help to understand the importance of family, group, and team under adverse conditions.
7. That will help them to achieve their goals and lead independent approaches in social life.
8. Acquire the skills necessary to become independent, productive, and satisfied adults.
9. Explore and refine their interests and goals.
10. Learn to access, navigate, and contribute to the community.
11. Learn about careers and lifestyle opportunities.
12. Recognize the elements of a well-balanced life.
13. Develop lifelong learning habits.
14. Learn to handle life's challenges- big and small

**Goal: This can be achieved by seven skills set:**
1. Importance of Mobility because you need to know how to get where you are going.
2. Management of Shelter because you need to have a roof over your head.
3. Management of Health because you need to maintain your body and brain.
4. Management of Tools (Wilderness)/ Financial independence (Urban)
5. Self-awareness because to be happy you have to know what you want, what you need, and how to get it.
6. Skill of Communication because we all have to talk and listen to each other.
7. Community Participation because we all need to support and help each other.

**UNIT 1: Basic Principle of Life Survival**
1. Basic necessities of life (Wilderness and Metropolitan)
2. Understanding and arrangement of tools for survival ship using natural resources.

10/5/24 10.5.24 10.5.24 10/05/2024 10.5.24

3. Types of Survival ships: Wilderness and Metropolitan.

**UNIT 2: Preliminary Survival Skills**

1. Importance of Mobility in Wilderness and Metropolitan Environment.
2. Management of health in wilderness and Metropolitan environment: Challenges of food and nutrition under unfavorable conditions.
3. Sources of medicines and health care in absence of high technology and resources.

**UNIT 3: Secondary Survival Skills**

1. Challenges of safety: Shelter and Fire
2. Self-awareness with special reference to Wilderness and Metropolitan ecosystem.
3. Communication skills: Understanding signs and marks.

**UNIT 4: Special survival skills and value-added approaches to Life Survival**

1. Use of waste for Life Survival.
2. Real-life stories and examples of survival skills/techniques.
3. Importance and opportunities for survival experts.

# Pt. Ravishankar Shukla University
## School of Studies in Life Science (Syllabus 2024-2026)

**M. Sc. Bioscience (Program code-M. Sc. 0405)**
**Skill Development and Value-Added Course for Third Semester (July-December)**

**Paper: Intellectual Property Rights, Biosafety & Bioethics**

**Course code: LS-VAC-2**
**Credit: 2 and Maximum Marks: 75 + 25** 70+30

**Course Objectives:**

- To introduce basic concepts of ethics and safety that are essential for Life Science Labs.
- To understand the procedures involved in the protection of Intellectual property.
- To give an insight into different treaties signed. To gain knowledge about patent filing.

**Course Outcomes:**

- Gain Knowledge of working principles in a laboratory taking all safety measures,
- handling of live cultures, disposal of infectious waste, and care of the equipment requiring
- Get an insight into Biosafety guidelines.
- Analyse and Manage the Risks involved with GMOs.
- Understand the International Agreements and Regulations with respect to Biosafety.
- Gain Knowledge about Intellectual Property Rights
- Understand guidelines to protect biological inventions.
- Understand different treaties, rights, and duties of Patent owners.
- Understand the process of filing a patent.

**UNIT I: BIOSAFETY INTRODUCTION AND GUIDELINES**

Introduction: Biosafety Issues; Biological Safety, Cabinets & their Types; Primary Containment for Biohazards; Biosafety Levels of Specific Microorganisms. Biosafety Guidelines: Biosafety guidelines and regulations (National and International); Role of Institutional Biosafety Committees (IBSC).

**UNIT II: RISK ANALYSIS AND GUIDELINES**

Genetically modified organisms (GMOs), GMO applications in food and agriculture, Risk Analysis; Risk Assessment and Risk Management; Experimental models: Use of Animals in Research and its Alternatives, Animal Cloning, and their Ethical Aspects. Testing of drugs on Human Volunteers.

**UNIT III: INTRODUCTION TO INTELLECTUAL PROPERTY**

Introduction to Intellectual Property and History. Patents, Trademarks, Copyright, Trade secrets, Industrial Design and Rights, Traditional Knowledge, Importance of IPR- patentable and non-patentable; World Intellectual Property Rights Organization (WIPO), Pros and Cons of IP protection.

10/5/24 10.5.24 10.05.2024 10.5.24

10/05/2024

**UNIT IV: PATENT FILING AND GRANT**

Types of patent applications: Ordinary, PCT, Conventional, An introduction to Patent Filing Procedures; Patent licensing and agreement; Agreements and Treaties: GATT, TRIPS Agreements; WIPO Treaties; Budapest Treaty; Indian Patent Act 1970 & recent amendments. Patenting of Living Organisms.

**Books for Study and Reference:**

1. Introduction to Plant Biotechnology, H S Chawla.
2. M K Sateesh. Bioethics and Biosafety. Kindle Edition.
3. Shomini Parashar, Deepa Goel IPR, Biosafety and Bioethics Pearson India 2013.
4. Private Power, Public Law: The Globalization of Intellectual Property Rights by Susan K. Sell Cambridge University Press, 2000.
5. Essentials of Intellectual Property: Law, Economics, and Strategy by Alexander I. Poltorak; Paul J. Lerner Wiley, 2011 (2nd edition).
6. Diane O. Fleming, Debra L. Hunt Biological Safety: Principles and Practices, 4th Edition. ASM 2006.

**Lab Course:**

1. Study of Intellectual Property Rights, Biosafety & Bioethics.
2. Study of Biosafety guidelines and regulations
3. Study and Demonstration of Biosafety Levels I, II, and III.
4. Study of Patent filing, licensing, and agreement.
5. Risk analysis of Genetically modified organisms (GMO)

10/5/24 10.5.24 10.05.2024 10.5.24 10/05/2024

# Pt. Ravishankar Shukla University, Raipur (Chhattisgarh)

## School of Studies in Life Science (Syllabus 2024-2026)

**M. Sc. Bioscience (Program code-M. Sc. 0405)**
**Choice Based Syllabus for Second Semester (January-June)**
**Generic Elective Paper: Analytical Techniques in Biology**
**Course code: LS-CBCS-1**
**Credit: 2; Maximum marks 75 + 25** 70 + 30

**Unit I**

Biochemical Evaluation Techniques: Concept of pH, preparation of buffers, Centrifugation, Chromatography techniques, Electrophoretic techniques, Principles and applications of visible and UV spectroscopy.

**Unit II**

Imaging and related techniques: Principles of microscopy; Light microscopy; Fluorescence microscopy; Confocal microscopy; use of fluorochromes: Flow cytometry (FACS), applications of fluorescence microscopy. Electron microscopy and sample preparation

**Unit III**

Immunochemical techniques – Enzyme-linked immunosorbent assay, general principles, and applications of immunodiffusion, immunoelectrophoresis, radioimmunoassay, fluorescence immunoassay

**Unit IV**

Proteomic techniques: Tools to study Expression proteomics, applications ofexpression proteomics, Structural proteomics, and their application in modern biology

Course Outcome: The students will be able to get an insight on the various important tools and techniques used in biology.

**Recommended Books:**


| | |
|---|---|
| K Wilson and John Walker<br>RF Boyer | Practical Biochemistry: Principles & Techniques<br>Biochemistry Laboratory: Modern Theory & Techniques |
| TC Ford and J. M. Graham | An Introduction to Centrifugation |
| Mark F. Vitha | Chromatography: Principles and Instrumentation |
| DB Murphy & MW Davidson | Fundamentals of Light Microscopy and Electronic Imaging, Second Edition |
| IW Watt | The Principles and Practice of Electron Microscopy |
| RF Egerton | Physical Principles of Electron Microscopy |
| John Goers<br>Daniel C. Liebler | Immunochemical Techniques: Laboratory Manual<br>Introduction to Proteomics: Tools for the New Biology |
| Sanjeeva Srivastava | From Proteins to Proteomics Basic Concepts, Techniques, and Applications |


10/5/24 10.5.24 10.5.24 10.5.24 10/05/2024

# Pt. Ravishankar Shukla University, Raipur (Chhattisgarh)

## School of Studies in Life Science (Syllabus 2024-2026)

**M. Sc. Bioscience (Program code-M. Sc. 0405)**
**Choice Based Syllabus for Second Semester (January-June)**
**Generic Elective Paper: Applied Biology**
**Course code: LS-CBCS-2**
**Credit: 2; Maximum marks 75 + 25** 70 + 30

**Unit-I Mushroom**

Mushroom : Structure and its parts (Anatomy and morphology).
Mushroom Farming: Introduction, Process and economic importance.
Edible Mushrooms: Wild and Cultivated varieties with special reference to Chhattisgarh.
Mushrooms of medicinal importance.

**Unit-II Plant Breeding**

Plant Breeding Technique: Traditional methods and Modern techniques.
Indoor and Rooftop plant cultivation.
Plant Nursery establishment.
Hydroponics and Aquaponics.

**Unit-III Animal Husbandry**

Animal husbandry: An introduction and an importance in our life.
Poultry and Dairy farming: Introduction, Technique and importance.
Apiculture and sericulture: introduction, Technique and importance.
Aquaculture: Introduction, Technique and importance.

**Unit-IV Government Policy**

Animals used in sports, pleasure and research.
Edible Vaccines
Harvest festivals in India
Role of government in applied bioscience with special reference to India: NLM, NMSA, PMFBY, PMKSY, PKVY and Micro irrigation fund scheme, others scheme and government Support.

**Course outcome**: The student will be able to apply biology for achieving career and economic benefits.

**Book Recommended**


1. Tavish Lynch: Mushroom Cultivation
2. S.R. Mishra: Technique of Mushroom Cultivation
3. B.D. Singh: Plant Breeding; Principle of methods.
4. Dr. Varsha Kumari: Crucials of Plant breeding.
5. Shukla & Upadhyay: Economic Zoology, Rastogi Publication, Meerut
6. Panda et al: Quail production technology, Central avian research institute, Izatnagar
7. Venketaraman: Economic Zoology, Sudarsana Publication
8. Srivastava: a Text Book of Applied Entomology, Vol. II & III, Kalyani Publication.


10/5/24 10.5.24 10.5.24 10.5.24 10/05/2024

# Pt. Ravishankar Shukla University, Raipur (Chhattisgarh)

## School of Studies in Life Science (Syllabus 2024-2026)

**M. Sc. Bioscience (Program code-M. Sc. 0405)**
**Choice Based Syllabus for Third Semester (July-December)**
**Generic Elective Paper: Nanobiology**
**Course code: LS-CBCS-3**
**Credit: 2; Maximum marks 75 + 25** 70 + 30

**Unit I:Nanobiology Overview**
Introduction of nanotechnology, nanobiology, bio-nanotechnology, Emergence of nanotechnology, challenges in Nanotechnology, Nano biomaterials, Application of Nanobiology in daily life.

**Unit II: Nanomaterials in Nanobiology**
Nanomaterials: Metal and carbon nanomaterials, Nanoparticles and nanocomposites, Toxicity and environmental risks of nanomaterials. Synthesis of nanomaterials and biomaterials, Quantum Dots for Biological Applications, Applications of Nanomaterials.

**Unit III: Characterizations Techniques**
Fourier transform infrared (FTIR) spectroscopy, X-ray diffraction (XRD), Atomic Force Microscopy (AFM), Field Emission Scanning Electron microscope (FESEM), scanning tunneling microscopy (STM), High-Resolution Transmission electron microscopy (HR-TEM). Energy-dispersive X-ray spectroscopy (EDAX) and X-ray photoelectron spectroscopy (XPS)

**Unit IV: Biosensor Technology**
Biosensors: Types of biosensors, characteristics of biosensors, Nanobiosensors: genosensors, biosensor-fabrication, nanomaterial-based biosensors, applications of biosensors in healthcare. Microfluidics and Lab-on-a-chips devices, Biosensor Techniques: cyclic voltammetry (CV), Difference Pulse voltammetry (DPV), and Electrochemical Impedance Spectroscopy (EIS).

**Course Outcome**: The students will be able to understand the nature and properties of nanomaterials. They will also gain a scientific understanding of application of nanomaterials and nanotechnology in agriculture, health and environmental conservation.

1. **Books for Study and Reference:**
   M. Wilson, K. Kannangara, G Smith, M. Simmons, B. Raguse, Nanotechnology: Basic Science and Emerging Technologies, Overseas Press India Pvt Ltd, New Delhi, First Edition,2005.
2. Manoj K. Patel and Pratima R. Solanki. Nanobiotechnology for Sensing Applications: From Lab to Field. Nanomaterials Based Immunosensors for Clinical Diagnostics Applications. Apple Academic Press, Waretown, New Jersey 08758 USA (2015).
3. Challa S.S.R. Kumar, Nanomaterials for medical diagnosis and therapy, Wiley-VCH, 2007.

10/5/24 10.5.24 10.05.2024 10/05/2024 10.5.24

# Pt. Ravishankar Shukla University, Raipur (Chhattisgarh)

## School of Studies in Life Science (Syllabus 2024-2026)

**M. Sc. Bioscience (Program code-M. Sc. 0405)**
**Choice Based Syllabus for Third Semester (July-December)**
**Generic Elective Paper: Rhythms in Life**
**Course code: LS-CBCS-4**
**Credit: 2; Maximum marks 75 + 25** 70 + 30

**Unit I: Origin and evolution of rhythms; Types of rhythms and how to study rhythms?**
Historical developments in chronobiology. Different types of geophysical and biological cycles with examples of circadian, ultradian, and infradian rhythms. Autorhythmometry – Study of behavioral and physiological rhythms in humans (Self).

**Unit II: Rhythms are ubiquitous from microbe to man**
Characteristics of circadian rhythm: Free-run, Temperature compensation, and Entrainment. Zeitgeber Time (ZT) and Circadian Time (CT). Quantification of biological rhythms - Average, amplitude, phase, and period.

**Unit III: Circadian rhythms in organisms**
Examples of circadian rhythms in plants, cyanobacteria, fungi, *Drosophila*, fish, and mammals.

**Unit IV: Chronobiology and Human Health**
Application of principles of Chronobiology in the management of diseases with specific examples based on cancer, sleep disorders, Shift work, and Jet Lag

**Course outcome:** The students will be able to learn basic concepts of biological rhythms and their underlying mechanisms. They will also understand the basic principles of biologicalrhythms that keep the organisms in sync with the environmental rhythms.

**Recommended Books/Reading Materials:**


| | |
|---|---|
| JC Dunlap, JJ Loros & PJ DeCoursey | Chronobiology: Biological timekeeping |
| S Binkley | Biological Clocks – Your Owner's Manual |
| MK Chandrashekaran | Time in the Living World |
| R Refinetti | Circadian Physiology |
| WG van Doorn and U van Meeteren | Flower opening and closure: a review |
| AK Pati | Chronobiology: The dimension of time in biology and medicine; PINSA (Biological Sciences), PART B 67 (6), 323-372, December 2001 |
| AK Pati, A Chandrawanshi, A Reinberg | Shift work: Consequences and management, Current Science, 81 (1), 32-52, 2001 |
| AK Pati, A Parganiha | Shift work: Circadian rhythm disruption and beyond PINSA (Biological Sciences), PART B 71 (5/6), 229, 2005 |
| AK Pati | Chronobiology: Implications of circadian rhythms, National Academy Science Letters 27 (7-8), 233-248, 2004. |
| JD Palmer | The living clock |


10/5/24 10.5.24 10.05.2024 10.5.24 10/05/2024

# Pt. Ravishankar Shukla University, Raipur

*School of Studies in Life Science*

**Syllabus for Ph.D. Course Work in Bioscience (2024-25)**

**Program Code-Ph.D. BS (0409)**

**One Semester**

There are two papers: each with maximum marks 100. The candidate must independently obtain 50% or more marks in each paper to qualify in the course work. The answer papers will be assessed independently by two examiners.

| No. | | Name of paper | Lectures | Marks |
|---|---|---|---|---|
| **Paper I Couse code – Ph.D. BS (0409A)** | | **Research Methodology, Advanced Tools & Techniques, Quantitative Data Analyses and Computer Fundamentals** | -- | **100** |
| | **A** | **Research Methodology:** | **25** | |
| | | Introduction and Scope<br>Research problem: Identification, Selection, and Formulation of research objectives | 3L | |
| | | Research design: Components, Importance, Types | 3L | |
| | | Types of data, Data Collection - Methods and Tools | 2L | |
| | | Research ethics, Institutional ethics committee | 2L | |
| | | Plagiarism – Pitfall, Regulation [UGC, ICMR, ICAR, DBT] | 2L | |
| | | Patents and IPR: Patent laws, process of patenting research findings, Copyright, Cyber laws | 3L | |
| | | Bibliometrics: Measurement of academic output- Citation Index: Science Citation Index (SCI), h-index, i-10-index. Journal Impact Factor (JIF); Style of Bibliography, Reference Management Tools, Project, Research Paper, and Review Writing Literature search technique using SCOPUS, Google Scholar, PUBMED, Web of Science | 10L | |
| | **B** | **Advanced Tools & Techniques:** Principle, protocol and application | **25** | |
| | | Histological, Histochemical, Cytochemical, Immunohistological and Immunohistochemical techniques | 5L | |
| | | Chromatography – GLC & HPLC, Electrophoresis | 5L | |
| | | DNA laddering, DNA Methylation, Comet Assay | 5L | |
| | | PCR, Real-time PCR, DNA Microarray, DNA Sequencing, Protein Sequencing | 5L | |
| | | Biosensors: DNA Biosensors, Immunosensors, Biosensors Techniques, Biosensor Applications | 5L | |
| | **C** | **Quantitative Data Analyses** | **20** | |
| | | Hypothesis testing | 2L | |
| | | Normal and Binomial distributions and their property | 3L | |
| | | Tests of significance: Student *t*-test, *F*-test, *Chi-square* test | 5L | |
| | | Correlation and Regression | 4L | |
| | | ANOVA – One-way and Two-way, Multiple-range test | 6L | |
| | **D** | **Computer Fundamentals** | **10** | |
| | | Introduction to MS Office software: MS Word (Track change) | 2L | |
| | | MS Excel, PowerPoint | 3L | |
| | | Features for Statistical data analysis using computers and software, Microsoft Excel Data Analysis ToolPak, SPSS | 5L | |

| | | | | |
|---|---|---|---|---|
| **Paper II Course code – Ph.D. BS (0409 B)** | | **Review of Literature & Seminar** | -- | **100** |
| | **A** | Review of Literature – Writing a review of literature in the area of the proposed Ph.D. work | | 50 |
| | **B** | Seminar – Based on the review of the literature | | 50 |

**Note: Research and Publication Ethics (2 credit course) – As per guidelines of Pt. Ravishankar Shukla University, Raipur (C.G.)**

## Recommended Books:


| | |
|---|---|
| Al Vogel | Analytical Chemistry |
| Buranen L and Roy AM | Perspectives on Plagiarism and Intellectual Property in a Post-Modern World |
| Campbell RC | Statistics for biologists |
| Cassel P *et al.* | Inside Microsoft Office Professional |
| Chatwal and Chatwal | Instrumentation |
| Coleman P and Dyson P | Mastering Internets |
| CR Kothari | Research Methodology: Methods & techniques, 2008 |
| Gilmore B | Plagiarism: Why it happens, How to prevent it? |
| Gralla P | How the Internet Works |
| Habraken J | Microsoft® Office 2003 All in One, Microsoft® Office 2010 In Depth |
| Kumar Anupa P | Cyber Law |
| R Panneerselvam | Research Methodology |
| Shelly GB, Vermaat ME, Cashman TJ | Microsoft® 2007: Introductory Concepts and Techniques |
| Snedecor GW & Cochran WG | Statistical Methods |
| Sokal RR & Rohlf FJ | Introduction to Biostatistics |
| Sood V | Cyber Law Simplified |
| Sumner M | Computers: Concepts &Uses |
| Upadhyaya and Upadhyaya | Instrumentation |
| Wardlaw AC | Practical Statistics for Experimental Biologists |
| White R | How Computers Work |
| Zar JH | Biostatistical Analysis |