PT. RAVISHANKAR SHUKLA UNIVERSITY

Center for Basic Sciences

CURRICULUM & SYLLABI
[Based on LOCF]

Five Year Integrated M.Sc. (Botany Stream)
(Semester System)

Session: 2024-25 & onwards

Approved by:	Board of Studies Botany	Academic Council
Date: 9/7/2024		

PT. RAVISHANKAR SHUKLA UNIVERSITY
RAIPUR, CHHATTISGARH

Center for Basic Sciences

Objectives

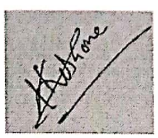
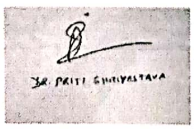
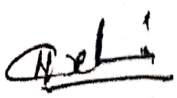
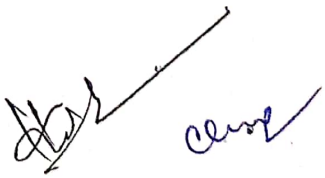
The CBS model of education is concept-based and inquiry-driven, as opposed to the more traditional content-based models. There is a strong emphasis on the interdisciplinary nature of today's science, and recognition of the importance of research experience in undergraduate education.

Courses offered in the Int. M. Sc. program at CBS form part of a comprehensive program that will enable the students-

- To understand the basic laws of nature and develop necessary skills to apply them to any desired area or discipline.
- To undertake projects to solve field base problems.
- To provide student centric learning facilities for the development of overall personality of learner. The program is planned as student-centric collaborative learning.
- Students get trained for a career in basic sciences or any related applied science or technology.

Integrated Master of Science in Botany

Courses offered during the first year (Semesters I to II) are meant as basic and introductory courses in Biology (Botany and Zoology), Chemistry, Mathematics, Physics and Environmental Science. These are common and mandatory for all [redacted] study. In addition, there will be Interdisciplinary Courses for computational skills and mathematical methods. Students are also given training to develop skills in Communication, Creative & Technical Writing and History of Science through courses in Humanities and Social Sciences.

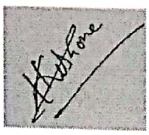
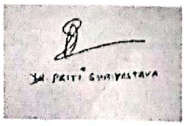
In the second year (Semester - III), students have the freedom to choose their stream for masters program on the basis of their interest. Courses offered in the first two years would help them make an informed judgment to determine their real interest and aptitude for a given subject.

One of the important features that the CBS has adopted is semester-long projects called Lab projects and reading projects, which are given the same weightage as a regular course. By availing this, a student can work in an experimental lab or take up a theory project every semester. This is meant to help the student get trained in research methodology, which will form a good basis for the 9th semester project work in the fifth year. The subjects/courses are described further with their credit points. Few courses are common to different streams.

Program Outcomes (POs)

Integrated M.Sc. Botany is 5-year, 10 semester course. The outcome goals can be realized by engaging with the diverse components integrated into the curriculum, as outlined below. Each of these components is meticulously crafted to yield particular outcomes sought upon the successful completion of the program.

PO-1	**Knowledge:** Provides deep understanding of all the theoretical as well as practical aspects in basic and applied areas of biological sciences especially plant sciences.
PO-2	**Critical Thinking and Reasoning:** Exhibit advanced critical thinking and reasoning skills, enabling them to critically evaluate and analyze complex biological fundamentals and experiments.
PO-3	**Problem Solving:** Applying the biological fundamentals and problem-solving skills to tackle intricate scientific and real-world issues.
PO-4	**Advanced Analytical and Computational Skills:** Proficient in employing advanced analytical techniques and computational tools to conduct in-depth biological problems and research.
PO-5	**Effective Communication**: Effectively communicate complex scientific concepts and research findings to both technical and non-technical audiences, using written reports, presentations, and teaching.
PO-6	**Social/Interdisciplinary Interaction**: Integrate biological concepts

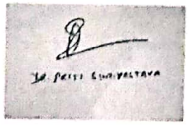



	especially plant sciences and methodologies into interdisciplinary contexts, collaborating effectively with professionals from various fields to address complex scientific and societal challenges.
PO-7	**Self-directed and Life-long Learning**: Recognize the importance of ongoing professional development and lifelong learning in the dynamic field of biological sciences and acquire knowledge and skills in different techniques related to plant sciences throughout their professional careers.
PO-8	**Effective Citizenship; Leadership and Innovation:** Capable to identify, formulate, investigate and analyze the scientific problems and innovatively to design and create products and solutions to real life problems.
PO-9	**Ethics**: Maintain the highest ethical standards in research and professional conduct within the field of plant sciences.
PO-10	**Further Education or Employment:** Pursue for Ph.D. program and get employment in academia, research institutions, industry, government, and other related sectors.
PO-11	**Global Perspective:** Recognize the global nature of scientific research in plant sciences and its impact, appreciating diverse cultural perspectives in scientific practices and considering international contexts in their work.

Program Specific Outcomes (PSOs)

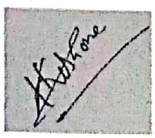
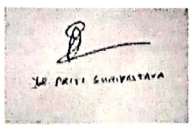
Upon successful completion of the program students will be able to attain following outcomes-

PSO1	Comprehensive understanding of fundamentals, principles and practical aspects of biological sciences especially plant sciences.
PSO2	Apply the knowledge of biology including Plant sciences in interdisciplinary fields to address and solve societal issues.
PSO3	Apply the analytical instruments and computation programs ensuring precision, efficiency, and innovation in scientific research, industry, healthcare, environment and education.
PSO4	Proficiently convey and promote ideas in the field of biological sciences to disseminate knowledge and enhance the awareness about plant science research and concepts in the community.
PSO5	Qualify national and state-level examinations like GATE, NET, SLET, and SET can lead to career opportunities in academia, research, and related fields.

Integrated M.Sc. in Botany

Specification of Course	Semester	No. of Courses	Credits
Core	I-IX	63	220
	➢ Theory	42	144
	➢ Practical	18	48
	➢ Project/Dissertation	03	28
Elective	X	04	20
Total		67	240
Additional Courses (Qualifying in nature, for Student admitted in CBS only)			
Additional Paper (EVS)	I	01	02
	II	01	02
Skill Enhancement /Value Added Courses	V	01	02
	VI	01	02
	VII	01	02
Skill Enhancement Course [only for Biology (Botany and Zoology) students]	VIII	01	02

Course Structure for the Integrated M.Sc. Botany Stream

Effective from Session 2024-25

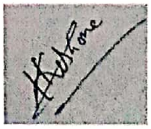
(Abbreviation: B: Biology (Botany +Zoology), C: Chemistry, M: Mathematics, P: Physics, G: General, H: Humanities, BL: Biology Laboratory, CL: Chemistry Laboratory, PL: Physics Laboratory, GL: General Laboratory, BOE: Botany Elective, BO: Botany, BOL: Botany Laboratory

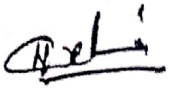
- Minimum total credits for Integrated M.Sc. degree is 240.
- Semesters I to VIII will carry 25 credits each.
- Semesters IX and X will carry 20 credits each.

FIRST YEAR

Semester –I

Course Nature	Course Code	Course Title	Course Type (T/P)	Contact Hours /Week (Theory +Tutorials)	Credits	Marks		
						CIA	ESE	Total
Core	B101	Biology – I	T	[2 + 1]	3	60	40	100
Core	C101	Chemistry – I	T	[2 + 1]	3	60	40	100
Core	M101/MB101	Mathematics – I	T	[2 + 1]	3	60	40	100
Core	P101	Physics – I	T	[2 + 1]	3	60	40	100
Core	G101	Computer Basics	T	[2 + 1]	3	60	40	100
Core	H101	Communication Skills	T	[2]	2	60	40	100
Core	PL101	Physics Laboratory – I	P	[4]	2	60	40	100
Core	CL101	Chemistry Laboratory – I	P	[4]	2	60	40	100
Core	BL101	Biology Laboratory – I	P	[4]	2	60	40	100
Core	GL101	Computer Laboratory	P	[4]	2	60	40	100
		(25 of 240 credits)		**Total**	**25**			
Additional Paper	ES101	Environmental Studies	T	[2]	2	60	40	100





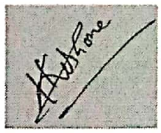

Semester- II

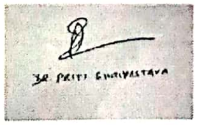
Course Nature	Course Code	Course Title	Course Type (T/P)	Contact Hours /Week (Theory +Tutorials)	Credits	Marks		
						CIA	ESE	Total
Core	B201	Biology – II	T	[2 + 1]	3	60	40	100
Core	C201	Chemistry – II	T	[2 + 1]	3	60	40	100
Core	M201/ MB201	Mathematics – II	T	[2 + 1]	3	60	40	100
Core	P201	Physics – II	T	[2 + 1]	3	60	40	100
Core	G201	Electronics and Instrumentation	T	[2 + 1]	3	60	40	100
Core	PL201	Physics Laboratory – II	P	[4]	2	60	40	100
Core	CL201	Chemistry Laboratory – II	P	[4]	2	60	40	100
Core	BL201	Biology Laboratory – II	P	[4]	2	60	40	100
Core	GL201	Electronics Laboratory	P	[4]	2	60	40	100
Core	H201	Communication Skills Lab	P	[4]	2	60	40	100
		(50 of 240 credits)		**Total**	**25**			
Additional Paper	ES201	Environmental Studies	T	[2]	**2**	60	40	100

SECOND YEAR

Semester- III

Course Nature	Course Code	Course Title	Course Type (T/P)	Contact Hours /Week (Theory +Tutorials)	Credits	Marks		
						CIA	ESE	Total
Core	CB301	Essential mathematics for Chemistry and Biology	T	[3 + 1]	4	60	40	100
Core	CB302	Biochemistry-I	T	[3 + 1]	4	60	40	100
Core	CB303	Organic Chemistry-I	T	[3 + 1]	4	60	40	100
Core	B301	Cell Biology – I	T	[3 + 1]	4	60	40	100
Core	H301	Creative Hindi	T	[2 + 0]	2	60	40	100
Core	H302 (IKS	History and Philosophy of	T	[2 + 0]	2	60	40	100





	Course)	Science						
Core	BL 301	Biology Laboratory	P	[6]	3	60	40	100
Core	GL301	Applied Electronics Laboratory	P	[4]	2	60	40	100
		(75 of 240 credits)		**Total**	**25**			

***H302 is Indian Knowledge System Course (IKS)**

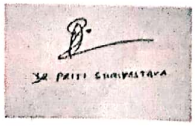
Semester- IV

Course Nature	Course Code	Course Title	Course Type(T/P)	Contact Hours /Week (Theory +Tutorials)	Credits	Marks		
						CIA	ESE	Total
Core	PCB401	Physical and Chemical Kinetics	T	[3 + 1]	4	60	40	100
Core	CB401	Introductory Spectroscopy (UV-vis, fluorescence, IR, Raman, NMR)	T	[3 + 1]	4	60	40	100
Core	B 401	Cell Biology – II	T	[2 + 1]	3	60	40	100
Core	B 402	Biochemistry – II	T	[2 + 1]	3	60	40	100
Core	G401	Statistical Techniques and Applications	T	[3 + 1]	4	60	40	100
Core	BL 401	Biology Laboratory	P	[6]	3	60	40	100
Core	GL 401	Computational Laboratory and Numerical Methods	P	[4]	2	60	40	100
Core	H401	Communication Skills Lab	P	[4]	2	60	40	100
		(100 of 240 credits)		**Total**	**25**			

THIRD YEAR

Semester- V

Course Nature	Course Code	Course Title	Course Type (T/P)	Contact Hours /Week (Theory +Tutorials)	Credits	Marks		
						CIA	ESE	Total
Core	CB501	Analytical Chemistry	T	[3 + 1]	4	60	40	100
Core	B501	Genetics	T	[3 + 1]	4	60	40	100
Core	B502	Molecular Biology	T	[3 + 2]	5	60	40	100
Core	BO501	Plant Systematics and Biodiversity	T	[3 + 2]	5	60	40	100
Core	H501	Scientific Writing in	T	[2]	2	60	40	100



		Hihdi						
Core	BOL501	Botany Laboratory	P	[10]	5	60	40	100
		(125 of 240 credits)		**Total**	**25**			
Skill Enhancement/Value Added Course								
	SEL501	English Language for Competence Skills	P	[4]	2	60	40	100

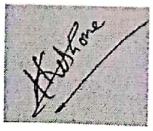
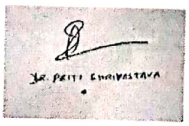
Semester- VI

Course Nature	Course Code	Course Title	Course Type (T/P)	Contact Hours /Week (Theory +Tutorials)	Credits	Marks		
						CIA	ESE	Total
Core	CB601	Biophysical Chemistry	T	[3 + 1]	4	60	40	100
Core	BO601	Microbiology, Phycology and Mycology Immunology	T	[2 + 1]	3	60	40	100
Core	BO602	Biology of Lower Plants	T	[3 + 1]	4	60	40	100
Core	BO603	Anatomy of Angiosperms	T	[3 + 1]	4	60	40	100
Core	BO604	Plant Physiology	T	[2 + 1]	3	60	40	100
Core	H601	Ethics in Science and IPR	T	[2 + 0]	2	60	40	100
Core	H602	Scientific Writing in English	T	[2]	2	60	40	100
Core	BOL601	Botany Laboratory	P	[6]	3	60	40	100
		(150 of 240 credits)		**Total**	**25**			
Skill Enhancement/Value Added Course								
	SEL-601	Pratiyogi Parikshao ke liye Hindi Bhasha	P	[4]	2	60	40	100

FOURTH YEAR

Semester- VII

Course Nature	Course Code	Course Title	Course Type (T/P)	Contact Hours /Week (Theory +Tutorials)	Credits	Marks		
						CIA	ESE	Total
Core	B 701	Evolutionary Biology	T	[3 + 1]	4	60	40	100
Core	B702	Imaging Technology in Biological Research	T	[3 + 1]	4	60	40	100
Core	B703	Immunology	T	[3 + 1]	4	60	40	100

Core	BO701	Developmental Biology of Plants	T	[3 + 1]	4	60	40	100
Core	BOPGD 701	Botany PG Dissertation/Project	P	[8]	4	60	40	100
Core	BOL 701	Advanced Botany Laboratory-I	P	[10]	5	60	40	100
		(175 of 240 credits)		Total	25			
Skill Enhancement/Value Added Course								
	SEL-701	Linux Operating System	P	[4]	2	60	40	100

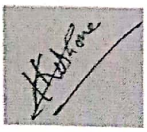
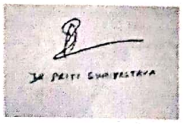
Semester- VIII

Course Nature	Course Code	Course Title	Course Type (T/P)	Contact Hours /Week (Theory +Tutorials)	Credits	Marks		
						CIA	ESE	Total
Core	B 801	Virology	T	[3 + 1]	4	60	40	100
Core	B 802	Biotechnology – I	T	[3 + 1]	4	60	40	100
Core	B 803	Bioinformatics	T	[3 + 1]	4	60	40	100
Core	B 804	Biotechnology – II	T	[3 + 1]	4	60	40	100
Core	BO L 801	Advanced Botany Laboratory-II	P	[10]	5	60	40	100
Core	BOPGD801	Botany PG Dissertation / Project	P	[8]	4	60	40	100
		(200 of 240 credits)		Total	25			
Skill Enhancement/Value Added Course								
	SEBL-801	Statistical Tools in Biological Research	P	[4]	2	60	40	100

FIFTH YEAR

Semester- IX

Course Nature	Course Code	Course Title	Course Type (T/P)	Contact Hours /Week (Theory +Tutorials)	Credits	Marks		
						CIA	ESE	Total
Core	BOPGD901	Botany PG Dissertation/ Project	P	-	20	-	400	400
		(220 of 240 Credits)		Total				

Semester- X

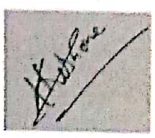
Course Nature	Course Code	Course Title	Course Type (T/P)	Contact Hours /Week (Theory +Tutorials)	Credits	Marks		
						CIA	ESE	Total
Elective	BE1001	Proteomics and Genomics	T	[4 + 1]	5	60	40	100
Elective	BE1002	Nanobiotechnology	T	[4 + 1]	5	60	40	100
Elective	BOE1001	Plant Genetic Engineering	T	[4 + 1]	5	60	40	100
Elective	BOE1002	Plant-Microbe Interaction	T	[4 + 1]	5	60	40	100
Elective	BOE1003	Plant Tissue Culture	T	[4 + 1]	5	60	40	100
Elective	BO E1004	Plants for Human Welfare	T	[4 + 1]	5	60	40	100
Elective	BOE1005	Phytochemistry and Herbal Technology	T	[4 + 1]	5	60	40	100
Elective	BOE1006	Plant Secondary Metabolite Production	T	[4 + 1]	5	60	40	100
		(240 of 240 credits)		Total	20			

***Four Subjects will be offered according to the availability of instructors and minimum number of interested students taking a course.**

Skill Enhancement/ Value Added Courses: (Offered to the students of CBS)

The candidates who have joined the 5-Year Integrated M.Sc. Program in Center for Basic Sciences shall undergo Skill Enhancement Course /Value Added Course (only qualifying in nature).

Semester	Course Code	Course Title	Course (T/P)	Hrs/ Week	Credits	Marks		
						CIA	ESE	Total
V	SEL501	English Language for Competence Skills	P	4	2	60	40	100
VI	SEL601.	Pratiyogi Parikshao ke liye Hindi Bhasha	P	4	2	60	40	100
VII	SEL701	Linux Operating System	P	4	2	60	40	100
VIII	SEBL801 [Only for Biology (Botany and Zoology)]	Statistical Tools in Biological Research	P	4	2	60	40	100




Indian Knowledge System Course:
(Offered to the students of CBS)

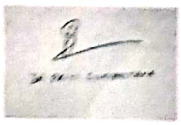
The candidates who have joined the 5-Year Integrated M.Sc. Program in Center for Basic Sciences shall undergo Indian Knowledge System course which is a core course.

Semester	Course Code	Course Title	Course Type (T/P)	Hrs/ Week	Credits	Marks		
						CIA	ESE	Total
III	B302	History and Philosophy of Science	T	[2 + 0]	2	60	40	100

Programme Articulation Matrix

Following matrix depicts the correlation between all the courses of the programme and Programme Outcomes

Course Code	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
B-101	√	√	√	×	√	√	√	√	×	√	√	√	√	√	√	√
C-101	√	√	√	×	√	√	√	√	×	√	√	√	√	√	√	√
MB-101	√	√	√	√	√	√	√	√	×	√	√	√	√	√	√	√
P101	√	√	√	√	√	√	√	√	×	√	√	√	√	√	√	√
G101	√	√	√	√	√	√	√	√	×	√	√	√	√	√	√	√
H101	√	√	×	×	√	√	√	√	×	√	√	√	√	√	√	√
ES101	√	√	√	×	√	√	√	√	×	√	√	√	√	√	√	√
BL101	√	√	√	×	√	√	√	√	√	√	√	√	√	√	√	√
PL101	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
CL101	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
GL101	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
B201	√	√	√	×	√	√	√	√	×	√	√	√	√	√	√	√
C-201	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
MB201	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
P201	√	√	√	√	√	√	√	×	√	√	√	√	√	√	√	√
G201	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
H201	√	√	√	×	√	√	√	√	×	√	√	√	√	√	√	√
ES201	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
BL201	√	√	√	×	√	√	√	√	×	√	√	√	√	√	√	√
PL201	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
CL201	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
GL201	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√

CB301	√	√	√	×	√	√	√	√	×	√	√	√	√	√	√	√
CB302	√	√	√	×	√	√	√	√	×	√	√	√	√	√	√	√
CB303	√	√	√	√	√	√	√	×	√	√	√	√	√	√	√	√
B301	√	√	√	×	√	√	√	√	×	√	√	√	√	√	√	√
H301	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
H302	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
BL301	√	√	√	×	√	√	√	√	×	√	√	√	√	√	√	√
GL301	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
PCB401	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
CB401	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
B401	√	√	√	×	√	√	√	√	×	√	√	√	√	√	√	√
B402	√	√	√	×	√	√	√	√	×	√	√	√	√	√	√	√
G401	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
BL401	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
GL401	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
H401	√	√	×	×	√	√	√	√	√	√	√	√	√	√	√	√
CB501	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
B501	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
B502	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
BO 501	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
H501	√	√	×	×	√	√	√	√	√	√	√	√	√	√	√	√
BO L501	√	√	√	×	√	√	√	√	√	√	√	√	√	√	√	√
CB601	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
BO 601	√	√	√	×	√	√	√	√	×	√	√	√	√	√	√	√
BO 602	√	√	√	×	√	√	√	√	×	√	√	√	√	√	√	√
BO 603	√	√	√	×	√	√	√	√	×	√	√	√	√	√	√	√
BO 604	√	√	√	√	√	√	√	√	×	√	√	√	√	√	√	√
H601	√	√	√	×	√	√	√	√	√	√	√	√	√	√	√	√
H602	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
BoL601	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
B701	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
B702	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
B 703	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
BO701	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
BL701	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
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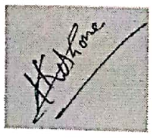


B801	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
B802	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
B803	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
B804	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
BO L801	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
BO PGD801	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
BO PGD901	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
BE1001	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
BE1002	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
BO E1001	√	√	√	×	√	√	√	√	√	√	√	√	√	√	√	√
BO E1002	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
BO E1003	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
BO E1004	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
BO E1005	√	√	√	×	√	√	√	√	√	√	√	√	√	√	√	√
BO E1006	√	√	√	×	√	√	√	√	√	√	√	√	√	√	√	√
	73	**73**	**69**	**50**	**73**	**73**	**73**	**73**	**54**	**73**	**73**	**73**	**73**	**73**	**73**	**73**
SEL501	×	×	×	×	√	√	√	√	√	√	√	√	√	√	√	√
SEL601	×	×	×	×	√	√	√	√	√	√	√	√	√	√	√	√
SEL701	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
SEBL801	√	√	√	×	√	√	√	√	√	√	√	√	√	√	√	√

Semester-wise Syllabus

Integrated M.Sc. Semester – I

Program	Subject	Year	Semester
Integrated M.Sc.	Botany	1	I

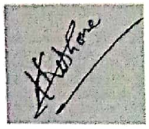
Course Code	Course Title	Course Type
B-101	**BIOLOGY -I**	**Core**

Credit	Hours Per Week (L-T-P)		
	L	T	P
3	2	1	0

Maximum Marks	CIA	ESE
100	60	40

Learning Objective (LO):

The aim of this paper is to provide students with a comprehensive understanding of basic biology, the evolution of life, taxonomy and classification, cell biology, cellular systems, and tissue systems. It enables the students to identify living organisms and ecosystems characteristics and basic needs. It explains the processes of growth and development in individuals and populations.



Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1.	With this introductory paper students will be able to comprehend general biological processes which are essential for students of all the streams Physics, Chemistry or mathematics.	U
2.	Theories of origin of life, evolution and process of development on earth.	U
3.	Identification of the levels of biological organization.	E
4.	Cellular mechanism which will further improve the understanding of processes of living beings.	U
5.	Physiology of different organ systems of the human body.	U

CL: Cognitive Levels (R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-create).

CO-PO/PSO Mapping for the course:

PO/CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	2	1	-	-	2	2	2	-	3	3	3	2	2	2	3
CO2	3	2	1	-	-	2	2	2	-	3	3	3	2	2	2	3
CO3	3	3	3	2	2	3	3	3	-	3	3	3	3	3	3	3
CO4	3	3	3	2	2	3	3	3	-	3	3	3	3	3	3	3
CO5	3	3	2	2	1	1	2	1	-	3	3	2	1	3	3	3

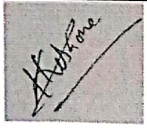
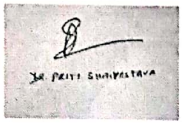
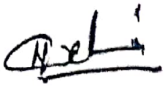
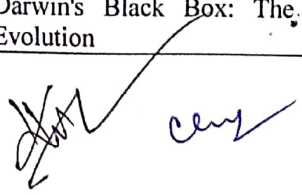
"3"–Strong;"2"–Moderate;"1"-Low;"-"No Correlation

Detailed Syllabus: B 101 Biology I (Introductory Biology-I)

Unit No.	Topics	No. of Lectures	CO No.
I	Life: History and origin of life, Concepts of biological evolution, Darwinism, Lamarckism, natural selection, speciation.	8	1
II	Classification of living things: Classification and domains of life, overview of taxonomy of plants, animals and microorganisms.	7	2
III	Cell Biology: Discovery of cell, cell theory, classification of cell types, Prokaryotes and Eukaryotes, cell wall, cell membrane, cytoplasm, structure and functions of cell organelles.	10	3
IV	Cell Division and System Development: cell cycle, mitosis, meiosis, and mechanism of development (stem cells), formation of tissues, cell-cell interactions, respiration.	10	4
V	Morphology and Anatomy of flowering plants, photosynthesis. Major Human Body Systems: Digestive, Circulatory, Lymphatic, Respiratory system.	10	5

BOOKS SUGGESTED:

S.No.	Author	Book
1	Neil A Campbell and JB Reece (2007)	Biology with Mastering Biology (8th Edition)
2	NA Campbell, JB Reece, MR Taylor and EJ Simon (2008)	Biology: Concepts & Connections with biology (6th Edition)
3	Charles Darwin (2008)	On the Origin of Species
4	B Alberts, D Bray, K Hopkin and AD Johnson (2009)	Essential Cell Biology
5	Rene Fester Kratz (2009)	Molecular and Cell Biology For Dummies
6	MJ Behe (2006)	Darwin's Black Box: The Biochemical Challenge to Evolution

Integrated M.Sc. Semester – I

Program	Subject	Year	Semester
Integrated M.Sc.	Botany	1	I

Course Code	Course Title	Course Type
ES-101	**Environmental Studies**	**Additional**

Credit	Hours Per Week (L-T-P)		
	L	T	P
2	2	2	0

Maximum Marks	CIA	ESE
100	60	40

Learning Objective (LO):
The objective of this course is to aware students about the ecology and environment. It will help individuals to develop an understanding of living and physical environment and how to resolve challenging environmental issues affecting the nature.

Course Outcomes (CO):

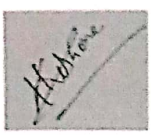
CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1.	Concepts of ecology and environment which are important for the student of any stream	U
2.	Basic concept of renewable and non-renewable energy resources	An
3.	Understanding of hierarchy of food on different ecosystem	E
4.	Types and characteristics of major ecosystems	An
5.	Environmental issues and measures to deal with them. Owns' role as a responsible citizen.	Ap

CL: Cognitive Levels (R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create).

CO-PO/PSO Mapping for the course:

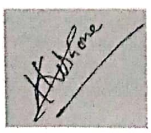
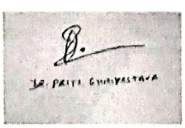
PO/CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	2	1	-	1	3	3	1	3	3	3	2	3	3	3
CO2	3	3	2	1	-	1	3	3	1	3	3	3	2	3	3	3
CO3	3	3	2	-	1	2	3	3	-	3	3	3	1	2	3	3
CO4	3	3	2	-	1	2	3	3	-	3	3	3	1	2	3	3
CO5	3	3	3	1	2	2	3	3	-	3	3	3	1	2	3	3

"3"–Strong;"2"–Moderate;"1"-Low;"-"No Correlation




Detailed Syllabus: ES 101 Environmental Studies

Unit No.	Topics	No. of Lectures	CO No.
I	THE MULTI DISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES Definition ,scope and importance Need for publish awareness.	3	1
II	Natural Resources Renewable and non-renewable resources: Natural resources and associated problems. a. Forest resources: use and over – exploitation, deforestation, case studies, timber extraction, Mining, dams and their effects on forests and tribal people. b. Water resources: use and over-utilization of surface and ground water, floods, drought, Conflicts over water, dams benefits and problems . c. Mineral resources: use and exploitation, environmental effects of extracting and using Mineral resources, case studies. d. Food resources: World food problems, changes caused by agriculture and overgrazing, Effects of modern agriculture, fertilizer –pesticide problems, water logging, salinity Case studies. e. Energy resources: Growing energy needs, renewable and non-renewable energy sources Use of alternate energy sources, case studies. f. Land resources: land as a resource, land degradation, man induced landslides, soil erosion& desertification. g. Role of an individual in conservation of natural resources. h. Equitable use of resources for sustainable life –styles.	8	2
III	Concept of an ecosystem. Structure and function of an ecosystem. • Producers, consumers and decomposers. • Energy flow in the ecosystem. • Ecological succession. • Food chains, food webs and ecological pyramids	6	3
IV	Introduction , types ,characteristic features , structure and function of the Following Ecosystem: • Forest ecosystem • Grassland ecosystem • Desert ecosystem • Aquatic ecosystem (ponds, streams, lakes, rivers, oceans, estuaries)	5	4
V	SOCIAL ISSUES AND THE ENVIRONMENT Environment Protection Act. • Air (prevention and control of pollution) Act. • Wildlife protection Act. • Forest conservation Act. • Issues involved in enforcement of environmental legislation. • Public awareness. • Value Education • HIV/ADIS • Women and child welfare. • Role of information technology in Environment and Human Health. • Case studies.	8	5


BOOKS SUGGESTED:

SN	Author	Title
1.	Agarwal K.C.	Environmental Biology 2001
2.	Bharucha Erach	The Biodiversity of India
3.	Bruinner R.C.	Hazardous Waste Incineration, 1989
4.	Bharucha E.	Textbook for Environmental Studies for undergraduate Courses
5.	Begon M., Town send C.R., Harper J.L.	Ecology From Individuals to Ecosystems

Integrated M.Sc. Semester – I

Program	Subject	Year	Semester
Integrated M.Sc.	Botany	1	I

Course Code	Course Title	Course Type
BL-101	**Biology Laboratory – I**	**Core**

Credit	Hours Per Week (L-T-P)		
	L	T	P
2	-	-	4

Maximum Marks	CIA	ESE
100	60	40

Learning Objective (LO):

Lab practical are highly visual, and may involve things like identifying a structure through a microscope, preparation of slides. Biological Science practicals will develop thinking and reasoning skills. It will gratify intellectual instincts and will make students aware of our surroundings and ourselves.

Course Outcomes (CO):

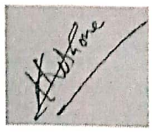
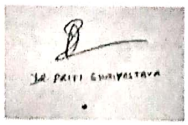
CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1.	Develop the ability to identify the unique characters of organisms, classify them, and understand the concept of evolution and phylogenetic tree	U
2.	Expertise in Microscopy and Micrometry	An
3.	Learn to prepare slide, staining of specimen and study of morphological characteristics. Differentiating dead v/s live cells using differential staining	E
4.	Acquire skills of section cutting stem, root, leaf and flower. Develop understanding of types, shapes and arrangements of leaves.	An
5.	Develop a deeper understanding of types of human blood cell by differential staining, and count the number of cells using Haemocytometer.	Ap

CL: Cognitive Levels (R-Remember;U-Understanding;Ap-Apply;An-Analyze;E-Evaluate;C-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	2	2	1	3	3	3	3	3	3	2	3	3	3
CO2	3	3	3	2	2	1	3	3	3	3	3	3	2	3	3	3
CO3	3	3	3	2	2	1	3	3	3	3	3	3	2	3	3	3
CO4	3	3	2	1	1	2	3	3	1	3	3	3	1	2	3	3
CO5	3	3	2	1	1	2	3	3	1	3	3	3	1	2	3	3

"3"–Strong;"2"–Moderate;"1"-Low;"-"No Correlation

Detailed Syllabus: BL101 Biology Laboratory – I

S. No.	Experiment	No. of Lab	CO No.
I	**Introduction to Biology laboratory:** Laboratory safety, calibration of instruments, introduction to general laboratory instruments their working principle and role.	5	1
II	**Introduction to Light Microscopy** Micrometry: Measuring size of microscopic specimens.	10	2
III	**Staining and Observing**: human cheek cells, plant cells. Study morphological characteristics of *S. cerevesiae*, differentiating, dead v/s live cells	15	3
IV	**Plant anatomy** Relationship between plant anatomy and habitat. Transverse section of dicot & monocot stem, root, leaf and flower. Observing and understanding types shapes and patterns of leaves.	15	4
V	**Staining human blood cells**: To observe human blood cell types by differential staining, Haemocytometery.	15	5

Integrated M.Sc. Semester – II

Program	Subject	Year	Semester
Integrated M.Sc.	Botany	1	II

Course Code	Course Title	Course Type
B-201	**Biology –II [Introductory Biology-II]**	**Core**

Credit	Hours Per Week(L-T-P)		
	L	T	P
3	2	1	0

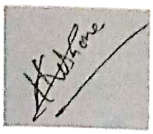
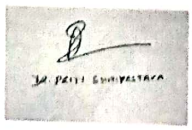
Maximum Marks	CIA	ESE
100	60	40

Learning Objective (LO):
It will provide insight of cell structure, functioning and metabolism. Progress in medicine, agriculture, biotechnology, and various other biological domains has led to enhancements in the quality of life.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1.	Students will be able to have a base knowledge about cell structure, function and role of biological molecules in regulating the basic mechanism of a cell.	U
2.	Understanding the concept of genetic material and gene regulation	U
3.	Knowledge about structure and function of essential and non-essential proteins	E
4.	Know the process of Cell Signalling.	An
5.	Fundamentals of biotechnology and recombinant DNA technology.	C

CL: Cognitive Levels (R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create).

CO-PO/PSO Mapping for the course:

PO/CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	2	2	3	3	2	-	3	3	3	3	2	2	3
CO2	3	3	3	2	2	3	3	2	-	3	3	3	3	2	2	3
CO3	3	3	3	2	2	3	3	2	-	3	3	3	3	2	2	3
CO4	3	3	3	1	1	3	2	3	-	3	3	3	3	2	3	3
CO5	3	3	3	3	2	3	3	2	3	3	3	3	3	2	3	3

"3"-Strong;"2"-Moderate;"1"-Low;"-"No Correlation

Detailed Syllabus: B 201 Biology II (Introductory Biology-II)

Unit No.	Topics	No. of Lectures	CO No.
I	Nucleic acids: DNA as the carrier of genetic information, Building blocks- nucleosides, nucleotides, DNA and RNA structure, types and function, chromatin structure, genes, repetitive DNA sequences.	8	1
II	Gene expression: Overview, genes regulatory elements, transcription mechanism in prokaryotes and eukaryotes (a comparison), Reverse transcription, genetic code.	7	2
III	Protein Structure and Function: Building blocks amino acids, peptides, secondary structure, three dimensional structure, membrane proteins, miscellaneous proteins, enzymes.	10	3
IV	Cell Signaling: Overview, signaling via hydrophobic molecules, signaling via ion channels, Signaling via G protein coupled receptors, signaling via cell surface enzymes, intracellular signalling.	10	4
V	Biotechnology:DNA cloning, Uses of recombinant DNA technology, Polymerase chain reaction (PCR), Production of recombinant proteins and SDS PAGE. Classification of living things: Classification and domains of life, overview of taxonomy of plants, animals and microorganisms.	10	5

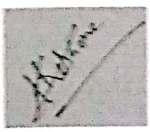
BOOKS SUGGESTED:

Sr.no	Author	Book
1.	B Alberts, A Johnson, J Lewis, and M Raff	Molecular Biology of the Cell
2.	J D. Watson, T A.Baker, S P. Bell, & A Gann	Molecular Biology of the Gene (6th Edition)
3.	John Wilson and Tim Hunt (2007)	Molecular Biology of the Cell:The Problems
4.	Benjamin Lewin (2007)	Genes IX (Lewin, Genes XI)

Integrated M.Sc. Semester – II

Program	Subject	Year	Semester
Integrated M.Sc.	Botany	1	II

Course Code	Course Title	Course Type
ES-201	**Environmental Studies-II**	**Additional**




Credit	Hours Per Week (L-T-P)		
	L	T	P
2	2	0	0

Maximum Marks	CIA	ESE
100	60	40

Learning Objectives (LO):

Environmental studies foster awareness about biodiversity and both renewable and nonrenewable resources in a particular region. This involves assessing the available resources and need to maintain a balance.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1.	Students will realize that people are dependent on intact habitats that sustain the various organisms we need to produce food, medicines, clothing, and other materials. Students will learn about certain species roles in an ecosystem.	E
2.	To describe the main pollutants and their effects on human health. To develop an activity where the student puts into practice the knowledge acquired.	An
3.	Understand waste management vs. waste reduction. Define the concept of integrated waste management.	C
4.	Define 'population growth' list causes and issues related to population growth. Analyze population changes in specific countries.	Ap
5.	Evaluate all the environmental factors considering with at all points such as technical, social, legal and economical aspect.	E

CL: Cognitive Levels (R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create).

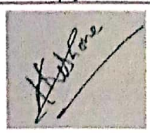
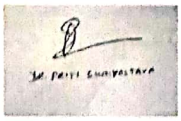
CO-PO/PSO Mapping for the course:

PO/CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	3	3	3	2	3	2	3	3	3	3	2	2	3
CO2	3	3	3	3	3	3	2	3	2	3	3	3	3	2	2	3
CO3	3	3	3	3	3	3	2	3	2	3	3	3	3	2	2	3
CO4	3	3	3	2	2	3	2	3	2	3	3	3	-	1	1	3
CO5	3	3	3	1	2	3	2	1	2	3	3	3	1	1	3	3

"3"–Strong;"2"–Moderate;"1"-Low;"-"No Correlation

Detailed Syllabus: ES 201 Environmental Studies-II

Unit No.	Topics	No. of Lectures	CO No.
I	Biodiversity and its Conservation: Introduction- Definition: genetics, species and ecosystem diversity. Bio geographical classification of India. Value of biodiversity: consumptive use productive use, social, ethical, aesthetical and option value. Biodiversity at global, National and local levels. India as mega-diversity nation. Hot-spots of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man wildlife conflicts. Endangered and endemic species of	6	1

	India. Conservation of biodiversity: in situ and ex-situ conservation of biodiversity.		
II	Environmental pollution. Definition Causes, effects and control measures of- a. Air pollution b. Water pollution c. Soil pollution d. Marine pollution e. Noise pollution f. Nuclear hazards.	6	2
III	Solid waste management: Causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution. Pollution case studies Disaster management: floods, earthquake, cyclone and landslides.	6	3
IV	Human population and the Environment: Population growth, variation among nation. Population explosion- Family welfare programme. Environment and human health. Human Rights.	6	4
V	Social Issues and the Environment: From unsustainable to Sustainable development. Urban problems related to energy. Water conservation, rain water harvesting, watershed management. Resettlement and rehabilitation of people, its problems and concerns. Case studies. Environment ethics: Issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies. Wasteland reclamation. Consumerism and waste products.	6	5

BOOKS SUGGESTED:

S. N.	Author	Title
1.	Agarwal K.C.	Environmental Biology 2001
2.	Bharucha Erach	The Biodiversity of India
3.	Bruinner R.C.	Hazardous Waste Incineration, 1989
4.	Bharucha E.	Textbook for Environmental Studies for undergraduate courses
5.	Begon M., Town C.R., Harper J.L.	Ecology From Individuals to Ecosystems

Integrated M.Sc. Semester – II

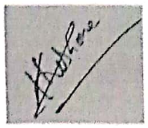
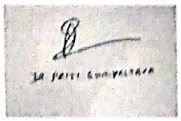
Program	Subject	Year	Semester
Integrated M.Sc.	Botany	I	II

Course Code	Course Title	Course Type
BL-201	**Biology Laboratory – II**	**Core**

Credit	Hours Per Week (L-T-P)		
	L	T	P
2	-	-	4

Maximum Marks	CIA	ESE
100	60	40

Learning Objective (LO):
Students will have the basic instrumentation used in biology laboratory. They will be able to Design and critically assess the scientific investigations. It will also demonstrate critical thinking skills.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1.	Gain the proficiency in a wide range of experimental instruments and methods in biology including Micro-Pipettes, Tissue Homogenizer, Electrophoresis apparatus, Colorimeter & Ultraviolet And Visible (Uv-Vis) Absorption, Laminar air flow system, Centrifuges, Spectrophotometer, Sonicator, PCR and Real-time PCR, Gel Documentation system and various Incubators	An
2.	Develop a deep understanding of the principle of instruments, and also gaining practical experience in verifying key theories.	AP
3.	Able to observe Microscopic cells and even measure their size and count the number. Observe the dividing cells and differentiate between the cells using various staining methods.	AP
4.	Learn to prepare different kinds of growth media to isolate various microbes, and their primary characterization.	AP
5.	Gain practical experience of extraction, estimation and separation of major biomolecules like Carbohydrate, protein content, lipid.	AP

CL: Cognitive Levels (R-Remember;U-Understanding;Ap-Apply;An-Analyze;E-Evaluate;C-Create).

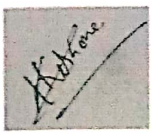
CO-PO/PSO Mapping for the course:

PO	POs											PSO				
CO	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	3	2	2	3	1	3	3	3	3	3	3	3	3
CO2	3	3	3	2	2	1	2	1	3	3	3	3	3	3	3	3
CO3	3	3	3	2	2	1	3	1	3	3	3	3	3	2	-	3
CO4	3	3	3	-	2	1	3	1	3	3	3	3	3	3	3	3
CO5	3	3	3	-	2	1	3	1	3	3	3	3	3	3	3	3

"3"–Strong;"2"–Moderate;"1"-Low;"-"No Correlation

Detailed Syllabus: BL201 Biology Laboratory – II

S. No.	Experiment	No. of Lab	CO No.
I	**Use and maintenance of Instruments:** Micro-Pipettes, Tissue Homogenizer, Electrophoresis apparatus, Colorimeter & Ultraviolet And Visible (Uv-Vis) Absorption, Laminar air flow system, Centrifuges, Spectrophotometer, Sonicator, PCR and Real-time PCR, Gel Documentation system and various Incubators	10	1
II	A demonstration of polymerase chain reaction on thermal cycler. A demonstration on SDS-PAGE technique and DNA gel electrophoresis.	8	2
III	**Microscopic observation** Bacterial cell counting using Neubauer chamber, mitosis in onion root tips, Gram Staining: To differentiate bacteria cells by Gram staining.	15	3
IV	Microscopic observation and comparative study of various microbes, and their primary characterization.	12	4
V	Qualitative estimation biomolecules like Carbohydrate, protein content, amino acid, DNA, RNA.	15	5




Integrated M.Sc. Semester – III

Program	Subject	Year	Semester
Integrated M.Sc.	Botany	2	III

Course Code	Course Title	Course Type
CB-302	**Biochemistry-I**	**Core**

Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	0

Maximum Marks	CIA	ESE
100	60	40

Learning Objective (LO):

Biochemistry combines biology and chemistry to study living matter. It powers scientific and medical discovery in fields such as pharmaceuticals, forensics and nutrition. With biochemistry, students will study chemical reactions at a molecular level to better understand the world and develop new ways to harness.

Course Outcomes (CO):

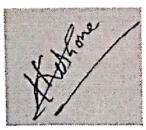
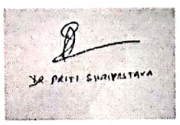
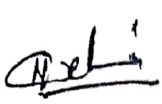
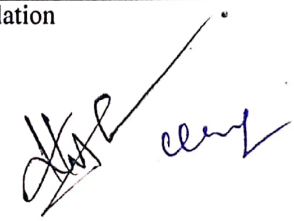
CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1.	To define the pH scale as a measure of acidity of a solution. Tell the origin and the logic of using the pH scale	Ap
2.	Describe the different types of simple and complex carbohydrates. Describe the functions of carbohydrates in the body. Describe the body's carbohydrate needs and how personal choices can lead to health benefits or consequences.	Ap
3.	Recognize the different types of lipids. Distinguish saturated from unsaturated fatty acids. Recognize lipids as important constituents of membranes.	E
4.	To understand how enzymes function so that we can better understand the function of our cells and treat diseases.	An
5.	Be aware, on a basic level, of how the structure of a protein can influence its interaction with other biomolecules.	An

CL: Cognitive Levels (R-Remember;U-Understanding;Ap-Apply;An-Analyze;E-Evaluate;C-Create).

CO-PO/PSO Mapping for the course:

PO/CO	Pos											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	3	3	3	2	3	2	3	2	3	3	3	2	3
CO2	3	3	2	2	3	2	2	2	-	2	2	3	3	3	2	3
CO3	3	3	3	3	3	3	2	3	2	3	2	3	3	3	2	3
CO4	3	3	2	2	3	2	2	2	-	2	2	3	3	2	2	2
CO5	3	3	2	2	3	3	2	2	-	3	2	3	3	2	2	3

"3"–Strong;"2"–Moderate;"1"-Low;"-"No Correlation

Detailed Syllabus: CB 302 Biochemistry-I

Unit No.	Topics	No. of Lectures	CO No.
I	General biochemistry concepts: The concept of pH, dissociation and ionization of acids and bases, pKa, buffers and buffering mechanism, Henderson Hasselbalch equation, dissociation of amino acids and determination of pKa.	10	1
II	Chemical structure of: carbohydrate, lipids, nucleic acids, proteins. Properties and classification of carbohydrates-monosaccharides, di-, oligo- and polysaccharides, cellulose, lignin, cell wall, Sugar derivatives, Glycosidic Bonds.	10	2
III	Enzymes: characteristics, nomenclature and classification. Mechanism of enzyme action, enzyme kinetics, enzyme inhibition and regulation.	10	3
IV	Structure and Functions of Lipid: General properties; Classifications: fatty acid, fats, oils, waxes, cholesterol, phospholipids, glycolipid, glycocalyx, Vitamins, Hormones	15	4
V	Protein structure and function: levels of structure of protein, Classification of proteins-globular and fibrous, Protein folding and modification, proteolysis, ubiquitin- proteasome.	15	5

BOOKS SUGGESTED:

S.No.	Author	Book
1	D. L. Nelson & M. M. Cox	Lehninger Principles of Biochemistry
2	Stryer L (1995)	Biochemistry, 4 th edition,
3	Starzak, Michael E.	Energy and Entropy equilibrium to stationary states
4	J. McMurry (1999)	Fundamentals of General Organic & Biological Chemistry

Integrated M.Sc. Semester – III

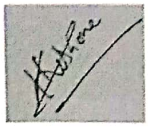
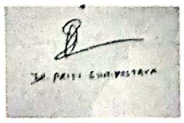
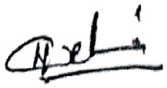
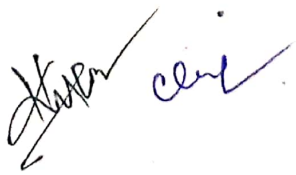
Program	Subject	Year	Semester
Integrated M.Sc.	Botany	2	III

Course Code	Course Title	Course Type
B-301	**Cell Biology -I**	**Core**

Credit	Hours Per Week(L-T-P)		
	L	T	P
4	3	1	0

Maximum Marks	CIA	ESE
100	60	40

Learning Objective (LO):
Cell biology aims to understand the structure and physiological function of individual cells, how they interact with their environment, and how large numbers of cells coordinate with each other to form tissues and organisms.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1.	Students will understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles	U
2.	Describe how organisms use physical phenomena to actively transport nutrients. Define osmosis, diffusion and semi-permeable membranes and understand how organisms use them	C
3.	Identify organelles in a cell and their function. Students will understand how these cellular components are used to generate and utilize energy in cell	E
4.	Describe the significance of different cytoskeletal components in homeostasis and disease as well as in different cell types.	Ap
5.	Genome maintenance activities including DNA repair, cell division cycle control, and checkpoint signaling pathways preserve genome integrity and prevent disease.	An

CL: Cognitive Levels (R-Remember;U-Understanding;Ap-Apply;An-Analyze;E-Evaluate;C-Create).

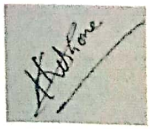
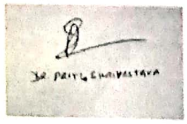
CO-PO/PSO Mapping for the course:

PO/CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	3	3	2	2	1	2	3	2	3	3	3	2	3
CO2	3	3	3	3	2	2	2	1	1	2	2	3	3	3	2	3
CO3	3	3	3	2	3	1	2	1	-	2	2	3	2	3	3	3
CO4	3	3	3	2	3	1	2	1	-	2	2	3	2	3	2	3
CO5	3	3	3	1	3	1	2	1	-	2	2	3	3	2	3	3

"3"–Strong;"2"–Moderate;"1"-Low;"-"No Correlation

Detailed Syllabus: B 301 Cell Biology -I

Unit No.	Topics	No. of Lectures	CO No.
I	Visualization of cell- History of cellular imaging; principles and applications of light microscopy, Different microscopic techniques for imaging cells-phase contrast, confocal, SEM, TEM.	10	1
II	Membrane system: The cell membrane and its structure, Models of the biomembrane: Charles Overton's "Lipid Membrane", Lipid monolayer model of Irwing Langmuir, Lipid bilayer model by Gorter and Grendel, Protein□containing lipid bilayer model of Daveson and Danielly, David Robertson's direct observation of the membrane, Fluid Mosaic model of Singer and Nicholson, Constituents and fluidity of plasma membrane, Transport across membrane, Ion channels.	10	2
III	Cellular organelles and their functions: Mitochondria: Structure of mitochondria, Different enzymes and their location, Electron transport complexes, ATP synthase, Mitochondrial DNA, Structure of chloroplast, Protein complexes and photosynthetic electron transport chain, DNA of the chloroplast, Structure and functions of the ribosomes, Endoplasmic reticulum, Golgi body, Lysosomes and Nucleus.	15	3
IV	Cytoskeleton, cilia and flagella: Structure and functions of Microtubules,	15	4

	microfilaments, and Intermediate filaments. Structure and function of tubulin, actin Molecular motors-structure and mechanisms of kinesins and dyneins. Myosin motor protein. Cilia and flagella: structure and functions, and mechanism of movement.		
V	Replication and Maintenance of the genome: DNA replication, DNA damage and repair, DNA rearrangements.	10	5

BOOKS SUGGESTED:

S. No.	Author	Book
1	D. L. Nelson & M. M. Cox	Lehninger, Principles of Biochemistry
2	Stryer L (1995	Biochemistry
3	Gerald Karp	Cell and Molecular Biology

Integrated M.Sc. Semester – III

Program	Subject	Year	Semester
Integrated M.Sc.	Botany	2	III

Course Code	Course Title	Course Type
BL-301	**Biology Laboratory**	**Core**

Credit	Hours Per Week (L-T-P)		
	L	T	P
3	-	-	6

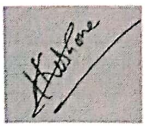
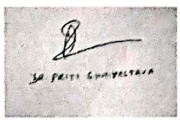
Maximum Marks	CIA	ESE
100	60	40

Learning Objective (LO):

Study of biological phenomena at cellular and molecular level will be studied to gain knowledge about the principles that govern complex biological systems. It provides the information on concept of biochemical calculation and understands the physiological and biochemical significance of enzymatic reactions. This course will also help the student to know the clinical aspects of various disorders due to deficiency of nutrients.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	Deep knowledge of pH, pKa, Buffers, and buffering mechanisms	AP
2	Proficient in Extraction and estimation of total free amino acids by ninhydrin reagent, of acid value, Iodine number, Saponification value, Peroxide value in unsaturated lipids	AP
3	Depth knowledge of the Carbohydrate extraction, estimation and identification from various sources like fruit sample, potato starch, qualitative tests of carbohydrates, identification by anthrone method, thin layer chromatography	AP
4	Apply enzymatic reaction; know the effects of pH, temperature and inhibitors on enzyme kinetics. Develop expertise on enzyme catalyzed reaction	AP


5	Understanding the practical insights into the formation of capsule, cell wall, lipid granules, metachromatic granules, endospores, Cell motility, Subcellular fractionation, western blotting and meiosis.	AP

CL: Cognitive Levels (R-Remember;U-Understanding;Ap-Apply;An-Analyze;E-Evaluate;C-Create).

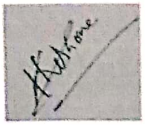
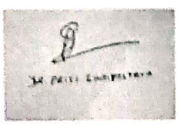
CO-PO/PSO Mapping for the course:

PO/ CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	2	2	3	3	3	2	3	2	3	2	3	2	3
CO2	3	3	3	2	2	2	2	3	2	2	2	3	3	2	2	1
CO3	3	3	3	2	2	2	2	2	2	2	2	3	2	2	2	2
CO4	3	3	3	2	2	3	3	3	2	3	2	3	3	3	2	3
CO5	3	3	3	2	2	2	2	2	2	2	2	3	2	2	2	2

"3"–Strong;"2"–Moderate;"1"-Low;"-"No Correlation

Detailed Syllabus: BL301 Biology Laboratory

S. No.	Experiment	No. of Lab	CO No.
I	**Biochemical calculation:** Concept of pH & Buffers, Hydrogen ion concentration in solution, Inorganic ion concentration in solutions, Inorganic Buffers and Biological fluids, Henderson-Hesselbach equation, Strong acid strong base titration, weak acid strong base titration, Amino acid titration, determine the pka value of the provided amino acid solutions using titration curve. Identify the amino acids using the reference table on the basis of pka values obtained.	15	1
II	**Extraction and estimation of** total free amino acids by ninhydrin reagent **Estimation of** acid value, Iodine number, Saponification value, Peroxide value in unsaturated fats and oils	20	2
III	**Carbohydrate extraction, estimation and identification** Extraction of carbohydrates from various sources like fruit sample, potato starch, qualitative tests of carbohydrates, identification by anthrone method, thin layer chromatography	15	3
IV	**Enzyme kinetics** Enzymatic reaction, determination of Vmax and Km for individuals salivary amylase, effects of pH and temperature on enzyme kinetics, Effect of inhibitors on enzyme kinetics, study an enzyme catalyzed reaction using hydroquinone as a substrate and peroxidase extracted from cabbage.	20	4
V	**Cell staining** – capsule, cell wall, lipid granules, metachromatic granules, endospores, Cell motility, Subcellular fractionation of mouse liver tissue, page & western blotting Immunoflourescence of cytoskeleton & nuclear proteins.	20	5

Integrated M.Sc. Semester – IV

Program	Subject	Year	Semester
Integrated M.Sc.	Botany	2	IV

Course Code	Course Title	Course Type
B-401	**Cell Biology -II**	**Core**

Credit	Hours Per Week(L-T-P)		
	L	T	P
4	3	1	0

Maximum Marks	CIA	ESE
100	60	40

Learning Objective (LO):
This course will help in broadening the knowledge of the biological functions of all living beings. It will provide deep knowledge signal transduction, cell division etc.

Course Outcomes (CO):

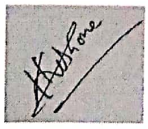
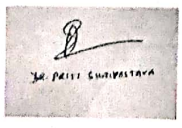
CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1.	Students will able to describe cell junctions found in plant cells (plasmodesmata) and animalcells (tight junctions, desmosomes, gap junctions).	E
2.	Understand the basic principles of signal transduction mechanisms, in particular the conceptsof response specificity, signal amplitude and duration, signal integration and intracellular location.	U
3.	Explain how cell division functions in reproduction, growth, and repair.	E
4.	Introduce the basic concept of physiological cell death referred to as apoptosis	U
5.	Techniques are used to study the physiological properties of cells, their structure, the organelles they contain, interactions with their environment, their life cycle, division, death and cell function	C

CL: Cognitive Levels (R-Remember;U-Understanding;Ap-Apply;An-Analyze;E-Evaluate;C-Create).

CO-PO/PSO Mapping for the course:

PO/CO	Pos											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	1	3	1	2	1	-	2	2	3	3	3	2	3
CO2	3	3	3	3	2	2	2	2	-	3	2	3	3	3	3	3
CO3	3	3	3	2	3	2	2	2	-	3	2	3	2	3	3	3
CO4	3	3	3	2	3	1	2	1	-	2	2	3	2	3	2	3
CO5	3	3	3	3	3	1	2	1	2	2	2	3	3	2	3	3

"3"–Strong;"2"–Moderate;"1"-Low;"-"No Correlation

Detailed Syllabus: B 401 Cell Biology -II

Unit No.	Topics	No. of Lectures	CO No.
I	Cell Junctions, Cell Adhesion, and the Extracellular Matrix: Introduction, Cell Junctions, Cell□Cell Adhesion, The Extracellular Matrix of Animals, Extracellular Matrix Receptors on Animal Cells. Integrins, Selectins, and other proteins involved in intercellular contacts. The Plant Cell Wall	10	1
II	Cell signaling: 1. Introduction: Components involved in signaling, Types of signaling, Three Major Classes of Signaling Receptors: Ion Channel□linked, G protein□coupled receptors (GPRs), Enzyme□Linked receptors: Tyrosine□Kinase Receptors, other enzyme□linked receptors, Second Messengers: cAMP, cGMP, IP3 and DAG, Ca+2, PIP3. Signaling Cascades.	15	2
III	Cell cycle and Cell division: Mechanisms and regulations of cell division, Cyclins and CDKs, Key events in G1 Phase, S-Phase, G2 Phase and Mitosis. Cell cycle checkpoints, Molecular mechanism of cytokinesis, uncontrolled cell division and cancer.	15	3
IV	Types of cell death: Apoptosis-Molecular mechanisms of apoptosis; Key proteins involved in apoptosis: Pro- and anti-apoptotic proteins. Necrosis, Anoikis, Oncosis, autophagy.	10	4
V	Techniques in Cell biology: Cell fractionation, DNA libraries, DNA transfer into eukaryotic cells and Mammalian embryos, Nucleic acid hybridization, Purification of nucleic acid, Isolation and fractionation of proteins.	10	5

BOOKS SUGGESTED:

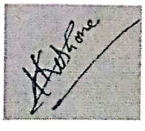
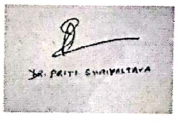
S.No.	Author	Book
1	Alberts et al.	Molecular biology of the Cell
2	Alberts, Bray et al	Essential Cell Biology Garland, Publication New York 1997
3	James E. Darnell, Harvey F. Lodish, and David Baltimore	Molecular Cell Biology
4	Geoffrey M Cooper	The Cell, 2nd edition, A Molecular Approach
5	Gerald Karp	Cell and Molecular Biology

Integrated M.Sc. Semester – IV

Program	Subject	Year	Semester
Integrated M.Sc.	Botany	2	IV
Course Code	**Course Title**		**Course Type**
B-402	**Biochemistry-II**		**Core**

Credit	Hours Per Week(L-T-P)		
	L	T	P
4	3	1	0

Maximum Marks	CIA	ESE
100	60	40

Learning Objective (LO):
To unravel the complex chemical reactions that occurs in a wide variety of life forms which will provide the basis for practical advances in medicine, veterinary medicine, agriculture, and biotechnology.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1.	Evaluate the role of conversion of energy for cellular activities in any biological system	E
2.	Describe the metabolism of carbohydrates, lipids, proteins and amino acids.	An
3.	Write chemical reactions for the individual steps in each pathway. Identification of the levels of biological organization.	E
4.	To know the digestion and absorption of carbohydrates. It knows where the products from the carbohydrate metabolism intermediate products are used in the body.	Ap
5.	Write the chemical reactions involved in biochemical pathways that produce ATP, such as citric acid cycle and electron transport.	C

CL: Cognitive Levels (R-Remember;U-Understanding;Ap-Apply;An-Analyze;E-Evaluate;C-Create).

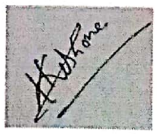
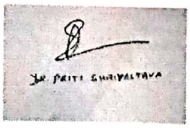
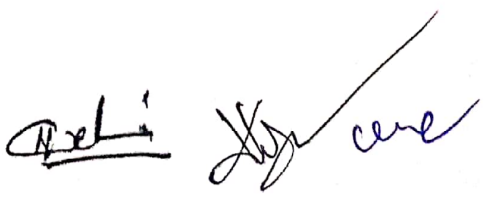
CO-PO/PSO Mapping for the course:

PO/CO	Pos											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	2	3	3	3	3	2	2	3	2	3	3	3	3	3
CO2	3	3	2	2	2	3	3	2	1	3	2	3	3	2	3	3
CO3	3	3	2	2	2	2	2	2	-	3	2	3	3	2	2	3
CO4	3	3	2	2	2	2	2	1	-	2	2	3	3	2	2	3
CO5	3	3	2	1	2	2	2	1	-	2	2	3	3	2	2	3

"3"–Strong;"2"–Moderate;"1"-Low;"-"No Correlation

Detailed Syllabus: B 402 Biochemistry-II

Unit No.	Topics	No. of Lectures	CO No.
I	Bioenergetics, and Basic concepts of Metabolism: catabolism and anabolism. Carbohydrate metabolism: Glycolysis and regulation, Feeder pathways of glycolysis, cori cycle, oxygen debt, Pasteur effect, Fates of pyruvate, ATP, NADH	15	1
II	TCA cycle, regulation of isocitrate, Gluconeogenesis, Glycogenolysis, Pentose phosphate pathway, Glyoxalate cycle. ETC, inhibitors of ETC, Oxidative Phosphorylation, chemiosmotic theory	15	2
III	Lipid metabolism: B oxidation of unsaturated and saturated fatty acids, propionyl Co A metabolism, significance of ketone bodies, biosynthesis of palmitate, Absorption and transport of fats.	10	3
IV	Amino acid Metabolism: Transamination, Direct amination, Fate of amino acid skeleton, urea cycle, precursors of compounds other than proteins.	10	4
V	Nucleotide Metabolism: Salvage and De novo pathways of purines and pyrimidines, formation of deoxyribonucleotides, origin of thymine	10	5

BOOKS SUGGESTED:

S.No.	Author	Book
1	D.L. Nelson, M.Cox	Lehninger Principles of Biochemistry
2	Stryer L	Biochemistry
3	Starzak Michael E.	Energy and Entropy equilibrium to stationary states
4	J McMurry	Fundamentals of General Organic and Biological Chemistry (Study Guide)

Integrated M.Sc. Semester – IV

Program	Subject	Year	Semester
Integrated M.Sc.	Botany	2	IV

Course Code	Course Title	Course Type
BL-401	**Biology Laboratory**	**Core**

Credit	Hours Per Week (L-T-P)		
	L	T	P
3	-	-	6

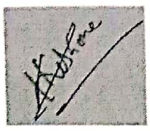
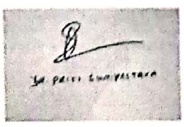
Maximum Marks	CIA	ESE
100	60	40

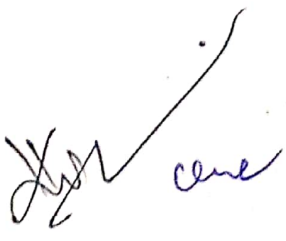
Learning Objective (LO):
Students will understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	Gain expertise in Isolation and Analysis of Biomolecules like carbohydrate, protein, RNA and DNA estimation	AP
2	Understand the mechanism of Nucleic acid extraction and their quantification. Having the practical knowledge about the ability of DNA to withstand pH and Temperature.	AP
3	Gain expertise on Chromatography (Paper chromatography, Thin layer chromatography, Ion-exchange chromatography, affinity chromatography etc.)	AP
4	Deep understanding of programmed Cell Death, DNA Laddering and Cell death assay	AP
5	Students will able to detectblood group and Rh factor in the blood sample.	AP

CL: Cognitive Levels (R-Remember;U-Understanding;Ap-Apply;An-Analyze;E-Evaluate;C-Create).



CO-PO/PSO Mapping for the course:

PO/CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	2	2	3	3	2	2	2	2	3	3	2	2	2
CO2	3	3	3	2	2	2	3	2	2	2	2	3	3	2	2	2
CO3	3	3	3	3	3	2	3	2	2	2	2	3	3	2	2	2
CO4	3	3	3	3	3	3	3	2	2	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	2	3	3	3	3	3	3	3

"3"–Strong;"2"–Moderate;"1"-Low;"-"No Correlation

Detailed Syllabus: BL401 Biology Laboratory

SN	Experiment	No. of Lab	CO No.
I	**Isolation and Analysis of Biomolecules** (i) Carbohydrate estimation by DNSA (ii) protein estimation by Peterson method (iii) RNA estimation by Orcinol method (iv) DNA estimation by DPA method	20	1
II	**Nucleic acid extraction** - from plant & animal tissue using ethanol precipitation. **Estimation using** Agarose gel electrophoresis **Analysis of DNA** under various conditions – pH and Temperature	15	2
III	**Chromatography** (a) Paper chromatography-chromatography of amixture of amino acids (b) TLC, Gel filtration (c) Ion-exchange chromatography, affinity chromatography	20	3
IV	**Study** Programmed Cell Death DNA Laddering and Cell death assay (quantification by Evans Blue), Barr bodies and Meiosis using lily anthers	15	4
V	**To detect** blood group and Rh factor in the blood sample. Isolation of organelles: mitochondria, chloroplast, nucleus, lysosome and their assay by succinate dehydrogenase activity (mitochondria), acid phosphatase activity (lysosome), acetocarmine staining (nucleus) and microscopic observation (chloroplast).	20	5

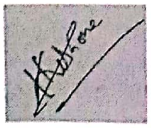
Integrated M.Sc. Semester – V

Program	Subject	Year	Semester
Integrated M.Sc.	Botany	3	V

Course Code	Course Title	Course Type
B-501	**Genetics**	**Core**

Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	0

Maximum Marks	CIA	ESE
100	60	40




Learning Objective (LO):

To develop deep understanding of genes and heredity of how certain qualities or traits are passed from parents to offspring as a result of changes in DNA sequence. The causes of important human diseases are being discovered, and therapies developed, based on fundamental genetic investigations.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1.	Compare and explain the inheritance of germline and somatic mutations. Describe the sequence of events involving DNA in meiosis from chromosome duplication through chromosome segregation.	U
2.	The transmission to the future generation of various traits that are because of alleles at gene loci on a sex chromosome is known as sex-linked inheritance.	An
3.	Understanding of bacterial genetics that allowed researchers to implant foreign DNA in their genome and produce proteins that have benefited humans	C
4.	Understand the link between environment and evolution. Be familiar with the different agents of evolution	Ap
5.	Calculate the measures of the centre of data: mean, median, and mode. Recognize and calculate the measures of the spread of data: variance, standard deviation, and range.	An

CL: Cognitive Levels (R-Remember;U-Understanding;Ap-Apply;An-Analyze;E-Evaluate;C-Create).

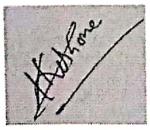
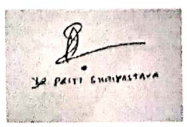
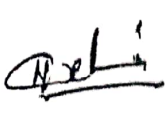
CO-PO/PSO Mapping for the course:

PO/CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	3	3	3	3	3	2	3	2	3	3	3	3	3
CO2	3	3	3	2	3	2	3	2	1	3	2	3	3	2	2	2
CO3	3	3	3	2	3	2	3	2	1	3	2	3	3	2	2	3
CO4	3	3	3	2	3	3	3	3	1	3	2	3	3	3	2	3
CO5	3	3	3	3	3	3	3	3	2	3	2	3	3	3	3	3

"3"–Strong;"2"–Moderate;"1"-Low;"-"No Correlation

Detailed Syllabus: B 501 Genetics

Unit No.	Topics	No. of Lectures	CO No.
I	Overview and Introduction of Genetics: Central Dogma, Genotype and Phenotype, Eukaryotic and Prokaryotic Genes, Forward and Reverse Genetics, Mendelian Inheritance: Law of Dominance, Law of Segregation, Law of Independent Assortment, Deviation from Mendelism: Incomplete dominance, Co-dominance.	10	1
II	Epistasis, Polygeneic Inheritance, Cytoplasmic Inheritance, Linkage and Recombination, Sex Linkage and Sex-Linked Inheritance, Pedigree Analysis	10	2
III	Bacterial Genetics: Transformation, Conjugation, Transduction (Lambda Phage), Human genome and genetics: Elements of human genetics & genetic disorders, Examples from *Drosophila*, yeast, maize and mouse, Immunogenetics.	15	3
IV	Genes and Evolution: The law of DNA constancy and C□value paradox: Numerical and structural changes in chromosomes; Molecular basis of spontaneous and induced mutations and their role in evolution; Environmental mutagenesis and toxicity testing; Population genetics	10	4


V	Biostatistics: Principles and practice of statistical methods in biological research; samples and populations; Basic statistics – average, statistics of dispersion, coefficient of variation; Standard error; Confidence limits; Probability distributions binomial, Poisson and normal; Tests of statistical significance; Simple correlation of regression; Analysis of variance.	15	5

BOOKS SUGGESTED:

S. No.	Author	Book
1	E. J. Gardner, D.P Snustad and M. J Simmons	Principles of Genetics
2	Leland Hartwell, Leroy Hood, Michael Goldberg, Ann Reynolds, Lee Silver, Ruth Veres.	Genetics: From genes to genomes
3	Anthony J. F. Griffiths. 2010	Introduction to genetic analysis
5	Marcello Pagano, 2000	Principles of Biostatistics
6	Peter J. Russell	Genetics:A Molecular Approach

Integrated M.Sc. Semester – V

Program	Subject	Year	Semester
Integrated M.Sc.	Botany	3	V

Course Code	Course Title	Course Type
B-502	**Molecular Biology**	**Core**

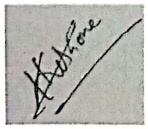
Credit	Hours Per Week (L-T-P)		
	L	T	P
5	3	2	0

Maximum Marks	CIA	ESE
100	60	40

Learning Objective (LO):
It will provide understanding of how molecules interact with one another in living organisms to perform the functions of life. Give knowledge of Major application of molecular biology are genetic analysis and gene cloning, DNA fingerprinting and forensics, genomics and computational approaches to genetics.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1.	Construct a model of the structure of the DNA molecule. Define key terms associated with the structure of DNA. Identify the four nitrogen bases that compose DNA. Summarize the history of human knowledge about DNA.	U
2.	Outline the basic steps involved in DNA replication, including major differences between eukaryotes and bacteria. Explain how eukaryotes overcome the difficulty of replicating the ends of linear chromosomes.	U
3.	Understand the purpose of the cell's performing transcription and translation. Predict RNA and protein sequences from a given gene. Analyze the effects of a DNA mutation on the RNA and protein produced from that DNA	An




4.	Gene regulation is necessary for making or synthesizing correct proteins where they are required. So it maintains the stability of the body. Hence, homeostasis is an outcome of gene regulation.	E
5.	State the potential effects of mutations on proteins produced as being beneficial, neutral, or harmful, the outcome of recombination is to ensure that each gamete includes both maternally and paternally derived genetic information	E

CL: Cognitive Levels (R-Remember;U-Understanding;Ap-Apply;An-Analyze;E-Evaluate;C-Create).

CO-PO/PSO Mapping for the course:

PO/CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	3	3	3	3	2	2	3	2	3	3	2	3	3
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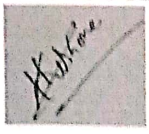
CO3	3	3	3	2	3	2	3	2	-	3	2	3	3	2	2	3
CO4	3	3	3	2	3	2	3	2	-	3	2	3	3	2	3	3
CO5	3	3	3	3	3	3	3	3	2	3	2	3	3	3	3	3

"3"–Strong;"2"–Moderate;"1"-Low;"-"No Correlation

Detailed Syllabus: B 502 Molecular Biology

Unit No.	Topics	No. of Lectures	CO No.
I	Molecular biology an overview: Concept and definition of the gene, complexity of the eukaryotic gene. Structural organization of the DNA in the nuclear material General properties of histones, nucleosomes and solenoid structure, RNAs and their structure & function.	15	1
II	DNA synthesis: The enzymes of DNA replication in prokaryotes and eukaryotes, mechanism of replication in bacteria and viruses, reverse transcriptase, salient features of eukaryotic nuclear and mitochondrial DNA replication.RNA synthesis: The enzymes of transcription in prokaryotes and eukaryotes, mechanism of transcription in bacteria, heteronuclear RNA, post transcriptional processing of RNA, role of ribozymes.	15	2
III	Protein synthesis: Concept of the genetic code, structure of t RNA and r RNA, enzymes of translation in prokaryotes and eukaryotes, mechanism of protein synthesis, post translational processing of proteins, translational inhibitors. Protein sorting, Vesicular traffic inside the cells, targeting & degradation	15	3
IV	Gene expression and its characterization: Regulation of gene expression in prokaryotes, eukaryotes, λ phage, structure and mechanism of different operons, Gene regulation during development, Gene function and phenotype loss of function & gain of function, Gene interaction, suppressors & enhancers.	15	4
V	Mutations and their consequences: Definition of mutation, mutagenesis & mutant selection, Alleles, Complementation, Recombination, recombination mapping and mechanism of recombination, Repair of DNA, Transposons & retroposons.	15	5

BOOKS SUGGESTED:




S. No.	Author	Book
1	Stryer L	Biochemistry, 4 th edition,
2	Watson J. D., Hopkins, N. H., Roberts, J. W., Steitz, J. A. and Weiner, A. M.	Molecular biology of the gene, 4th edition, The Benjamin/Cummings publishing companies
3	Benjamin Lewin	Genes VII, oxford University Press, Oxford
4	Weaver R. F.	Molecular biology
5	Brown T A	Essential molecular biology, vol. I, A practical approach, IRL press, Oxford.
6	Cox Lynne S	Molecular Themes in DNA Replication
7	Gerald Karp	Cell and Molecular Biology

Integrated M.Sc. Semester – V

Program	Subject	Year	Semester
Integrated M.Sc.	Botany	3	V

Course Code	Course Title	Course Type
BO 501	**Plant Systematics and Biodiversity**	**Core**

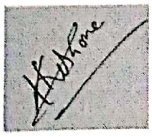
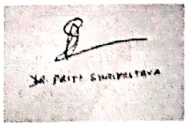
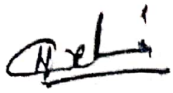
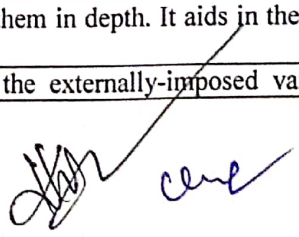
Credit	Hours Per Week(L-T-P)		
	L	T	P
5	3	2	0

Maximum Marks	CIA	ESE
100	60	40

Learning Objective (LO):
The primary goal of this course is to let students understand principles of general taxonomy and historical development of taxonomy. The main objective of studying biodiversity is to provide students a global vision of the variety of the plant world.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1.	Gaining knowledge of species, their names and phylogenetic relationships which will be helpful for further studies in other disciplines of biology, including conservation biology and nature protection.	U
2.	The main objective of plant taxonomy is to identify characteristics of undiscovered species by comparing with known species, to specify characteristics of recently discovered species, to arrange them in respective 'taxa' after looking at their similarities and to give them scientific names. This is important for conservation efforts, agriculture, and horticulture, as well as for scientific research.	C
3.	Classifying plants based on similarities helps organize the thousand different types of plants on earth into different taxonomic levels to study them in depth. It aids in the comprehension of organism evolution.	Ap
4.	For understanding the intrinsically-inbuilt plus the externally-imposed variability in and	U

	among plants existing in terrestrial, marine and other ecosystem at a specific period of time. Students will be aware of what are the major biodiversity threats.	
5.	Knowing the primary and secondary centres of crops across the globe and about crop domestication and its significances.	E

CL: Cognitive Levels (R-Remember;U-Understanding;Ap-Apply;An-Analyze;E-Evaluate;C-Create).

CO-PO/PSO Mapping for the course:

PO/CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	3	3	2	3	2	1	3	2	3	3	2	3	2
CO2	3	3	3	2	2	2	3	2	1	3	2	3	3	2	2	3
CO3	3	3	3	2	3	2	2	2	1	3	2	3	3	2	2	2
CO4	3	3	3	2	2	2	2	2	1	3	2	3	3	2	3	2
CO5	3	3	3	3	3	2	2	3	1	3	2	3	3	3	3	2

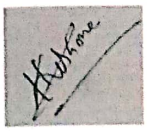
"3"–Strong;"2"–Moderate;"1"-Low;"-"No Correlation

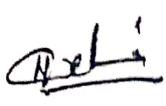
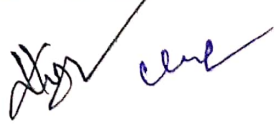
Detailed Syllabus: BO 501 Plant Systematics and Biodiversity

Unit No.	Topics	No. of Lectures	CO No.
I	Biosystematics, Principles of taxonomy, Concept of species and hierarchical taxa, Plant collection, Herbarium preparation, Important herbaria and botanical gardens of the world and India, E-flora, Taxonomic tools; Identification of plants, Keys-Single access and Multi-access.	15	1
II	Plant nomenclature- Principles and rules of nomenclature- Binomial, International Code for Nomenclature of Algae, Fungi and Plants; Ranks and names; Typification, author citation, valid and effective publication, rejection of names, principle of priority and its limitations; Names of hybrids.	15	2
III	Systems of classification-Major plant classification systems, Classification systems of Bentham and Hooker, Engler and Prantl, Hutchinson's and Takhtajan Characteristic features, dendrogram, phytochemistry and cytology in relation to taxonomy	15	3
IV	Study of major families with reference to systematic position and economic importance of dicot- Ranunculaceae, Annonaceae, Solanaceae, Meliaceae, Fabaceae, Cucurbitaceae, Umbelliferae, Asteraceae, Labiatae etc.	15	4
V	Study of major families with reference to systematic position and economic importance of monocot: Orchidaceae, Zingiberaceae, Cyperaceae, Poaceae etc.; Life cycle of typical angiospermic plants.	15	5

BOOKS SUGGESTED:

S. No.	Author	Book
1.	Cecie Starr, Ralph Taggart, Christine Evers, and Lisa Starr	Biology: The Unity and Diversity of Life
2.	Hawksworth, D. L. & Bull Alan T.	Plant Conservation and Biodiversity. Series: Topics in Biodiversity and Conservation, Vol. 6(Eds.) Reprinted from Biodiversity and Conservation, 16:6, 2007, VIII, 424 p.
3.	M P Singh	Plant Biodiversity & Taxonomy
4.	E.O.Wilson, Editor. Frances M. Peter	Biodiversity



5.	Peter H. Raven, Ray F. Evert, andSusan E. Eichhorn	Biology of Plants
6.	Simpson, M.G. (2006)	*Plant Systematics.* Elsevier Academic Press, San Diego, CA, U.S.A

Integrated M.Sc. Semester – V

Program	Subject	Year	Semester
Integrated M.Sc.	Botany	3	V

Course Code	Course Title	Course Type
BOL-501	**Botany Laboratory**	**Core**

Credit	Hours Per Week (L-T-P)		
	L	T	P
5	-	-	10

Maximum Marks	CIA	ESE
100	60	40

Learning Objective (LO):
Develop awareness and applications of various molecular biology techniques, preparation, and storage for chemicals. To aware students about genetics and its real life applications.

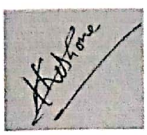
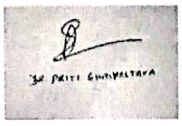
Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	Develop a strong foundation in the application of Bacterial Genetics Transformation, Conjugation, Transduction, Transposition, α□ Complementation, Karyotyping.	An
2	Understand the plant systematic and Biodiversity in surrounding area and identifying different monocot and dicot plants.	An
3	Develop a strong foundation on general Molecular Biology Laboratory Procedures like DNA extraction, detection and amplification using PCR	E
4	Develop expertise on Plasmid isolation and Purification, RE Digestion & Detection of the RE-digested product Using restriction mapping to teach basic skills in the molecular biology, Blunt□end cloning (after Ligation), Preparation of competent cells & Transformation of *E. coli* cells with plasmid	E
5	A deep understanding on protein extraction & separation using polyacrylamide gel electrophoresis SDS-PAGE, Western blot analysis	E

CL: Cognitive Levels (R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create).

CO-PO/PSO Mapping for the course:

PO/CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	2	3	2	3	2	2	2	2	3	3	2	2	3

CO2	3	3	3	2	3	2	3	2	2	2	2	3	3	2	2	3
CO3	3	3	3	3	3	2	3	3	2	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	2	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	2	3	3	3	3	3	3	3

"3"–Strong;"2"–Moderate;"1"-Low;"-"No Correlation

Detailed Syllabus: BOL501 Botany Laboratory

S. No.	Experiment	No. of Lab	CO No.
I	**Bacterial Genetics** *E. coli* Transformation, Conjugation, Transduction Phage Titration, Transposition, α□ Complementation, Karyotyping	25	1
II	**Plant Systematics and Biodiversity** Determination of minimal quadrat size for the study of herbaceous vegetation in the college campus by species area curve method. Methods of non destructive field collections and documentations Mounting of a properly dried and pressed specimen of any wild plant with herbarium label Study of vegetative and floral characters of the selected dicot and monocot families and identification upto families of local available flora. Field survey of a part of town or city to make the student aware of the diversity of plants in urban area.	35	2
III	**General Molecular Biology Laboratory Procedures** Extraction of genomic DNA Using Kit method & By conventional Ethanol Precipitation method, Detection of Nucleic acids (AGE), Polymerase Chain Reaction (PCR) & Detection of the PCR product and its purification	35	3
IV	**Plasmid isolation** and Purification, RE Digestion & Detection of the RE-digested products using restriction mapping to teach basic skills in the molecular biology, Blunt□end cloning (after Ligation), Preparation of competent cells & Transformation of *E. coli* cells with plasmid	30	4
V	**Protein extraction & separation** using polyacrylamide gel electrophoresis SDS-PAGE, Western blot analysis to illustrate relative control levels of the lac and ara promoters in *E. coli*	25	5

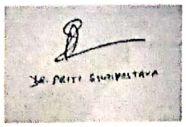
Integrated M.Sc. Semester – VI

Program	Subject	Year	Semester
Integrated M.Sc.	Botany	3	VI

Course Code	Course Title	Course Type
BO 601	**Microbiology, Phycology and Mycology**	**Core**

Credit	Hours Per Week(L-T-P)		
	L	T	P
3	2	1	0

Maximum Marks	CIA	ESE
100	60	40

Learning Objective (LO):

This course will provide basic understanding of microbial diversity bacteria algae and fungi. It will be helpful in understanding the structural similarities and differences among various physiological groups of bacteria. Phycology will give understanding of forms of algae, from very tiny microorganisms that float through the ocean to huge forests of seaweed.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1.	Exploring history and development of microbiology, characteristic features of prokaryotes (Bacteria and Archaea) and bacterial classification.	U
2.	Learning about microbial isolation, identification and cultivation techniques, their mode of nutrition and growth and alsothe ways to control their growth by physical and chemical means.	U
3.	For educating students about strategies of signal transduction, communication,adhesion and invasion of bacteria. To also aware them about bioterrorism and metagenomics.	E
4.	Studying general characteristic features and life cycle of algae and their economic importance.	Ap
5.	Knowing the general features, reproduction and life cycle of common fungi. To study symbiotic relationship of fungi with other organisms such as lichen and mycorrhiza in detail.	Ap

CL: Cognitive Levels (R-Remember;U-Understanding;Ap-Apply;An-Analyze;E-Evaluate;C-Create).

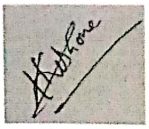
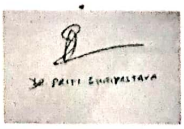
CO-PO/PSO Mapping for the course:

PO/CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	2	2	3	3	2	1	2	2	3	3	2	2	3
CO2	3	3	3	2	2	2	3	2	1	2	2	3	3	2	2	2
CO3	3	3	3	3	3	3	3	3	1	3	3	3	3	3	3	3
CO4	3	3	3	2	2	2	2	2	1	2	2	3	2	2	2	3
CO5	3	3	3	3	3	2	3	3	1	3	3	3	3	3	3	3

"3"–Strong;"2"–Moderate;"1"-Low;"-"NoCorrelation

Detailed Syllabus: BO 601 Microbiology, Phycology and Mycology

Unit No.	Topics	No. of Lectures	CO No.
I	History of Development of Microbiology, Bacterial classification, Prokaryotic Structure &Function, Gram Negative Bacteria, Gram Positive Bacteria & Archaea.	9	1
II	Microbial Nutrition, Microbial Growth, Control of Microbes. Isolation of a broad range of non-pathogenic bacteria from natural sources, Selective and Enrichment techniques, Microscopic, biochemical, and molecular identification.	9	2
III	Signal transduction in bacteria (Quorum Sensing),Bacterial cell-cell communications and biofilm formation, Strategies for bacterial adhesion and	9	3

	invasion, bioterrorism, Metagenomics		
IV	Algae- General characteristics, Ecology and distribution, Range of thallus organization and Morphology and life-cycles of common algae-Nostoc, Chlamydomonas etc., Economic importance of algae.	9	4
V	Fungi- General characteristics, ecology and significance, range of thallus organization, cell wall composition, nutrition, reproduction and life cycle of common fungi Rhizopus, Penicillium etc. Brief account of lichens, Mycorrhiza and their significance.	9	5

BOOKS SUGGESTED:

S.No.	Author	Book
1	Thomas D Brock	Brock's Biology of Microorganisms
2	Patrick R Murray	MedicalMicrobiology
3	Willey, Joanne, Sherwood, Linda, W oolverton, Christopher J.	Presscotts Microbiology
4	Webster, J. and Weber, R. (2007)	Introduction to Fungi, Cambridge University Press, Cambridge. 3rd edition
5	Sethi, I.K. and Walia, S.K. (2011).	Text book of Fungi and Their Allies, Macmillan Publishers India Ltd.
	Kumar, H.D. (1999).	Introductory Phycology. Affiliated East-West Press, Delhi.
	Lee, R.E. (2008)	Phycology, Cambridge University Press, Cambridge. 4th edition

Integrated M.Sc. Semester – VI

Program	Subject	Year	Semester
Integrated M.Sc.	Botany	3	VI

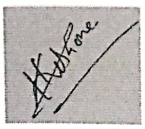
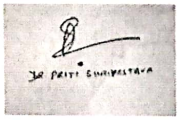
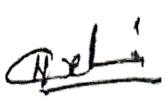
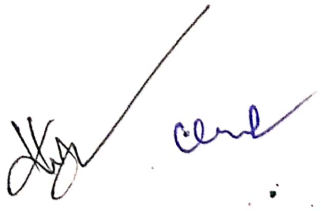
Course Code	Course Title	Course Type
BO 602	**Biology of Lower Plants**	**Core**

Credit	Hours Per Week (L-T-P)		
	L	T	P
3	2	1	0

Maximum Marks	CIA	ESE
100	60	40

Learning Objective (LO):

The major objective of this paper to build up a strong foundation of knowledge of lower plants growing in different habitats. Students will able to understand biology of lower plants such as Bryophytes, Pteridophytes and Gymnosperms.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1.	Exploring the structure and function of archegonia and antheridia and also learning their importance in plant reproduction. Understanding adaptation strategies to land and alternation of sexual and asexual phase of plants that helps them to adapt to different environments.	U
2.	Bryophytes are some of the earliest-evolved plants and are precursors to vascular plantsand studyingof bryophytes enables students develop better understanding of their structure, evolution and ecological significance.	E
3.	Pteridophytes produce neither flowers nor seeds, they are sometimes referred to as "cryptogams", meaning that their means of reproduction is hidden. Pteridology helps to understand characteristics and classification of ferns with their ecological and economical importance.	An
4.	Learning characteristic features and reproduction of the gymnosperms (also known as Acrogymnospermae), are a group of seed-producing plants including conifers, cycads, Ginkgo, and gnetophytes.	Ap
5.	Palaeobotany helps in gaining a thorough knowledge of the past climate and ecological systems in which plants were present and helps in understanding the evolution of the plant taxa.	Ap

CL: Cognitive Levels (R-Remember;U-Understanding;Ap-Apply;An-Analyze;E-Evaluate;C-Create).

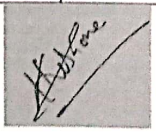
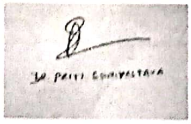
CO-PO/PSO Mapping for the course:

PO/CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	2	3	2	3	2	2	2	2	3	3	2	3	3
CO2	3	3	3	2	3	2	3	2	2	2	2	3	3	2	2	3
CO3	3	3	3	2	3	2	3	3	2	2	2	3	3	2	2	3
CO4	3	3	3	2	3	2	3	2	2	2	2	3	3	2	2	3
CO5	3	3	3	3	3	2	3	3	3	3	3	3	3	3	3	3

"3"–Strong;"2"–Moderate;"1"-Low;"-"No Correlation

Detailed Syllabus: BO 602 Biology of Lower Plants

Unit No.	Topics	No. of Lectures	CO
I	General features of archegoniates, Transition to land habit, Alternation of generations.	9	1
II	Bryophytes-General characteristics, Classification, Morphology, Range of thallus organization. Life cycle- Riccia, marchantia, Sphagnum. Ecological and economic importance of bryophytes (Sphagnum)	9	2
III	Pteridophytes-General characteristics, classification, morphology, anatomy, Reproduction of Psilotum, Selaginella, Equisetum. Ecological and economic importance Pteridophytes (Selaginella, Equisetum)	9	3
IV	Gymnosperms- General characteristics, classification, morphology, anatomy and reproduction of Cycas, Pinus and Gnetum. Ecological and economic importance of Gymnosperms.	9	4
V	Introduction to Palaeobotany, Ecological time scale, process of fossilization, Kinds of fossils, Importance of Palaeobotanical studies.	9	5

BOOKS SUGGESTED:

S. No.	Author	Books
1.	Vashistha, P.C., Sinha, A.K., Kumar, A. (2010)	Pteridophyta. S. Chand. Delhi, India.
2.	Bhatnagar, S.P. &Moitra, A. (1996)	Gymnosperms. New Age International (P) Ltd Publishers, New Delhi, India
3.	Parihar, N.S. (1991)	An introduction to Embryophyta: Vol. I.
4.	Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R. (2005)	Bryophyta. Central Book Depot. Allahabad. Biology. Tata McGraw Hill, Delhi.
5.	Vander-Poorteri 2009	Introduction to Bryophytes. COP.

Integrated M.Sc. Semester – VI

Program	Subject	Year	Semester
Integrated M.Sc.	Botany	3	VI

Course Code	Course Title	Course Type
BO 603	**Anatomy of Angiosperms**	**Core**

Credit	Hours Per Week(L-T-P)		
	L	T	P
4	3	1	0

Maximum Marks	CIA	ESE
100	60	40

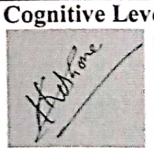
Learning Objective (LO):

The objective of this course is to enable students to understand the structural organization of angiosperms and their adaptations with respect to diverse environmental conditions. This subject talks about types of tissues, classification of tissue

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1.	Knowing about types of tissues, tissue systems and vascular bundles. To also understand plant cellular connectivity via pits and plasmodesmata.	U
2.	For learning about the epidermal tissue system that deals with the protection and coverage of the entire plant body and cell ingrowths. To explain anatomical adaptations of xerophytes and hydrophytes to survive unfavourable environments.	U
3.	To study types of vascular bundles and their role in plant nutrition and also explore structural organization of dicot and monocot root, stem and leaf. Explain about Kranz anatomy and lateral root of plants.	E
4.	To develop understanding of vascular cambium, its structure, types, function and seasonal activity, and also secondary growth in root and stem of plants. To introduce dendrochronology (or tree-ring dating) that is the scientific method of dating tree rings to know the exact year they were formed in a tree.	U
5.	Learning about the development, composition and characteristics ofperiderm, rhytidome and lenticels. To also describe secretory system of plants in depth.	E

CL: Cognitive Levels (**R**-Remember;**U**-Understanding;**Ap**-Apply;**An**-Analyze;**E**-Evaluate;**C**-Create).




CO-PO/PSO Mapping for the course:

PO/CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	2	2	1	2	2	1	2	2	3	2	1	1	2
CO2	3	3	3	2	3	2	2	1	-	2	2	3	2	2	2	2
CO3	3	3	3	2	3	2	2	1	-	1	2	3	2	1	2	2
CO4	3	3	3	2	3	1	2	1	2	1	2	3	2	1	1	2
CO5	3	3	3	2	3	2	2	1	-	2	1	3	2	2	1	2

"3"–Strong;"2"–Moderate;"1"-Low;"-"No Correlation

Detailed Syllabus: BO 603 Anatomy of Angiosperms

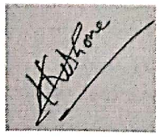
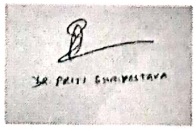
Unit No.	Topics	No. of Lectures	CO No.
I	Classification of tissues-Meristematic and permanent tissues, Simple and complex tissues, tracheary elements and sieve elements, Pits and plasmodesmata	10	1
II	Epidermal tissue system- cuticle, epicuticular waxes, trichomes, stomata, cell wall ingrowths- Adcrustation and incrustation. Anatomical adaptations of xerophytes and hydrophytes	15	2
III	Types of vascular bundles, Structure of dicot and monocot root, stem and leaf, Kranz anatomy, lateral root	10	3
IV	Vascular cambium- Structure, function and seasonal activity, Secondary growth in root and stem, Wood (heartwood and sapwood), Ring and diffuse porous wood, Early and late wood, tyloses, Dendrochronology.	15	4
V	Development and composition of periderm, rhytidome and lenticels, Secretory system- Hydathodes, cavities, lithocysts and laticifers.	10	5

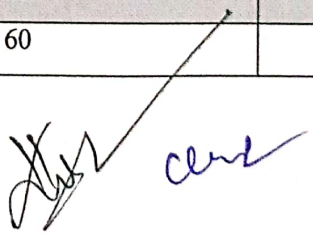
BOOKS SUGGESTED:

S.No.	Author	Book
1.	Dickison, W.C. (2000)	Integrative Plant Anatomy. Harcourt Academic Press, USA.
2.	Fahn, A. (1974)	Plant Anatomy. Pergmon Press, USA
3.	Mauseth, J.D. (1988)	Plant Anatomy. The Benjammin/Cummings Publisher, USA.
4.	Esau, K. (1977)	Anatomy of Seed Plants. John Wiley & Sons, Inc., Delhi

Integrated M.Sc. Semester – VI

Program	Subject	Year	Semester
Integrated M.Sc.	Botany	3	VI
Course Code	**Course Title**		**Course Type**
BO 604	**Plant Physiology**		**Core**
Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	0
Maximum Marks	CIA		ESE
100	60		40



Learning Objective (LO):

It will enable to analyze the processes in plants, namely – photosynthesis, mineral nutrition, respiration, transportation, and ultimately plant development and growth which are traits displayed by living entities.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1.	Students can describe how plants absorb minerals from the roots. All students can explain why plants need a variety of minerals for healthy growth. Most students can identify two mineral deficiencies in plants.	An
2.	Explain the process of photosynthesis. Compare the leaves of a plant that has all the components needed for photosynthesis to one that has a component missing.	E
3.	Describe how plants obtain the reactants needed for respiration, including the role of the roots and the stomata, explain how the products of respiration are removed from the plant, recognize the relationship between respiration and photosynthesis in a plant	U
4.	Students will understand basic principles, processes and functions of plant growth and reproduction, including photosynthesis, respiration, transpiration, vegetative growth and reproductive growth, fertilization and fruit formation.	Ap
5.	Students will learn about floral structure and why flowers are important to pollination and reproduction. They will do a flower dissection and drawing, labeling the parts of the flower in order to learn the structure of a plant reproductive system.	E

CL: Cognitive Levels (**R**-Remember;**U**-Understanding;**Ap**-Apply;**An**-Analyze;**E**-Evaluate;**C**-Create).

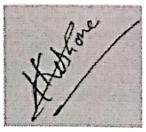
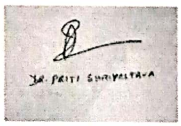
CO-PO/PSO Mapping for the course:

PO/CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	2	2	2	2	2	-	2	2	3	3	2	2	3
CO2	3	3	3	2	2	2	3	2	-	2	2	3	3	2	2	3
CO3	3	3	3	2	3	3	2	2	-	2	2	3	3	2	2	3
CO4	3	3	3	3	2	2	3	3	2	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	2	3	3	3	3	3	3	3

"3"–Strong;"2"–Moderate;"1"-Low;"-"NoCorrelation

Detailed Syllabus: BO 604 Plant Physiology

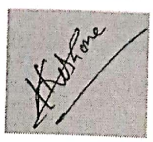
Unit No.	Topics	No. of Lectures	CO No.
I	**Plant Cells** - Model Organisms, Introduction to Plant Tissue Systems: Dermal, Ground, and Vascular, Structure of Chloroplast Glycosylglycerides, Specialized Vacuoles in Plant Cells, Cell walls: Structure, Biogenesis, and Expansion. **Water and Plant Cells**- Water transport process, Concept of water potential, Wilting and Plasmolysis, The Cohesion-Tension theory, Water movement from leaf to the atmosphere, Transpiration **Mineral nutrition**: Essential nutrients, Deficiencies and disorders, Soil, roots and microbes: Mycorrhizal fungi and its significance. **Solute Transport**- Passive and active transport, membrane transport process, membrane transport protein, ion transport in roots, Apoplastic and symplastic movement of solutes. Goldman Equation, Patch Clamp Studies in Plant Cells	12	1

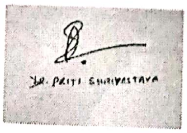



II	**Photosynthesis-** The Light reactions; Photosynthetic pigments, Key experiments in understanding photosynthesis, Action spectrum and absorption spectrum, Photochemical reaction centres, Red drop effect, Enhancement effect, Midpoint Potentials **The Carbon Reactions-** Organization of the photosynthetic apparatus, Photosystem I and II, Oxygenic and Anoxygenic photosynthesis. Organization of light absorbing antenna systems, mechanism of electron transport, Z-scheme, Photosynthesis: Carbon reactions; The Calvin cycle, regulation of the Calvin cycle, The C2 oxidative photosynthetic carbon cycle, C_4 cycle, CAM cycle, synthesis of starch and sucrose. Rubisco: A Model Enzyme for Studying Structure and Function **Physiological and Ecological Considerations-**Working with Light, Heat Dissipation from Leaves: The Bowen Ratio, The Geographic Distributions of C3 and C4 Plants **Translocation in the Phloem-**patterns of translocation: source to sink; Materials translocated in the phloem, rates of movement, The mechanism of translocation in the phloem: The pressure flow model, Phloem loading and unloading.	12	2
III	**Respiration-** Glycolysis, citric acid cycle, electron transport Multiple Energy Conservation Bypasses in Oxidative Phosphorylation of Plant Mitochondria, and ATP synthesis. **Lipid metabolism-** biosynthesis of triacylglycerols and polar glycerolipids. **Assimilation of mineral nutrients-** Nitrate assimilation, Ammonium assimilation, Biological nitrogen fixation, Development of root nodule, Sulphur assimilation, Phosphate assimilation, Oxygen assimilation.	12	3
IV	**Secondary metabolites and Plant defense-** Cutin, waxes and suberin, Biosynthesis of Terpenes, The Shikimic Acid Pathway, Detailed Chemical Structure of a Portion of a Lignin Molecules, Phenolic compounds, Flavonoids, Alkaloids, Cynogenic glycosides, Glucosinolates and their functions. Plant defence against pathogens, synthesis of antimicrobial compounds against pathogens, hypersensitive response by plants, Systemic acquired resistance, Phytoalexins.	12	4
V	**Phytochrome and light control of plant development-**The photochemical and biochemical properties of phytochrome. Blue light responses- Stomatal movements and morphogenesis, blue light photoreceptors: cryptochrome, phototropins, carotenoid and zeaxanthin. **Plant hormones**: Biosynthesis, metabolism, transport, physiological effects of auxins, gibberellins, cytokinins, abscisic acid and ethylene. **Stress physiology-** Response and adaptation to stress, water deficit and draught Resistance, drought stress, flood stress, salt stress, heat stress, chilling stress and freezing stress.	12	5

BOOKS SUGGESTED:

S. No.	Author	Book
1.	Hans Mohr, Peter Schopfer	Plant Physiology; Springer, 629 pages
2.	Taiz and Zeiger	Plant Physiology; 4th Edition. Sinauer
3.	Hopkins WG	Introduction to Plant Physiology. 2nd or 3rd Edition
4.	Stern KR	Introductory Plant Biology. 7th Ed. Wm C Brown Publishers
5.	Fosket	Plant Growth and Development: A molecular approach
6.	Buchanan R, Gruissem W	Biochemistry and Molecular Biology





Integrated M.Sc. Semester – VI

Program	Subject	Year	Semester
Integrated M.Sc.	Botany	3	VI

Course Code	Course Title	Course Type
H-601	Ethics of Science and IPR	Core

Credit	Hours Per Week(L-T-P)		
	L	T	P
2	2	0	0

Maximum Marks	CIA	ESE
100	60	40

Learning Objective (LO):
To introduce basic concepts of ethics and safety that is essential for Life Science Labs. To understand the procedures involved in protection of Intellectual property. To give an insight into different treaties signed. To gain knowledge about patent filing.

Course Outcomes (CO):

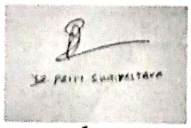
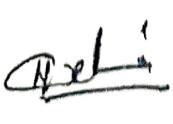
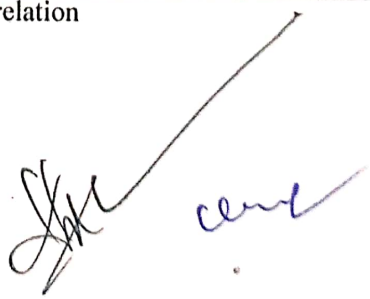
CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1.	Identify and analyze an ethical issue in the subject matter under investigation or in a relevant field. Identify the multiple ethical interests at stake in a real-world situation or practice.	U
2.	Analyze several contemporary ethical issues that arise in the practice of medicine from multiple perspectives, including that of medical professionals, patients and society in general	An
3.	Identify criteria's to fit one's own intellectual work in particular form of IPRs	E
4.	A patent provides a limited-term exclusive right to produce and market an invention in exchange for detailed information about that invention	Ap
5.	Distinguish and Explain various forms of IPRs	E

CL: Cognitive Levels (**R**-Remember;**U**-Understanding;**Ap**-Apply;**An**-Analyze;**E**-Evaluate;**C**-Create).

CO-PO/PSO Mapping for the course:

PO/CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	2	2	1	2	1	3	2	2	3	1	2	2	3
CO2	3	3	3	2	2	1	2	1	3	2	2	3	1	2	2	3
CO3	3	3	3	2	2	1	2	1	3	2	2	3	1	2	2	2
CO4	3	3	3	2	2	1	2	1	3	2	2	3	1	2	2	2
CO5	3	3	3	1	2	1	2	1	3	2	2	3	1	2	2	2

"3"–Strong;"2"–Moderate;"1"-Low;"-"NoCorrelation

Detailed Syllabus: H 601 Ethics of Science and IPR

Unit No.	Topics	No. of Lectures	CO No.
I	Introduction to Ethics– causes of unethical acts, Definition – moral, values, ethics; Role and importance of ethics in science; Professional ethics – professional conduct, Teaching ethical values to scientists, good laboratory practices, good manufacturing practices, Basic Approaches to Ethics; Posthumanism and Anti□Posthumanism.	6	1
II	Medical Ethics: Different themes pertaining to medical ethics including ethical issues in public health. Environmental Ethics, Bioethics, Journals and Publishers: Monopolistic practices by Academic Publishers. Plagiarism, softwares for plagiarism detection.	6	2
III	Introduction to IPR; Types of Intellectual property – Patents, Trademarks, Copyrights and related rights; Traditional vs. Novelty; Importance of intellectual property rights in the modern global economic environment, Importance of intellectual property rights in India.	6	3
IV	Patents: Definition, patentable and non patentable inventions; types of patent application – Ordinary, Conventional, PCT, Divisional, and Patent of addition; Concept of Prior Art; Precautions while patenting disclosure / nondisclosure;	6	4
V	Case studies and agreements □ Evolution of GATT and WTO and IPR provisions under TRIPS; Madrid agreement; Hague agreement; WIPO treaties; Budapest treaty; Indian Patent Act (1970)	6	5

BOOKS SUGGESTED:

S. No.	Author	Book
1	David B. Resnik	The Ethics of Science: An Introduction', Routledge, New York, 1998
2	V. K. Ahuja	Intellectual Property Rights in India', 2015
3	V. K. Ahuja	Law Relating to Intellectual Property Rights', 2017.

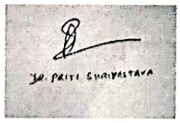
Integrated M.Sc. Semester – VI

Program	Subject	Year	Semester
Integrated M.Sc.	Botany	3	VI

Course Code	Course Title	Course Type
BOL-601	**Botany Laboratory**	**Core**

Credit	Hours Per Week (L-T-P)		
	L	T	P
3	-	-	6

Maximum Marks	CIA	ESE
100	60	40

Learning Objective (LO):

After completing the course the students will have the knowledge and application of various immunological techniques. Along with the deep understanding of the lower plants students will be able to identify different algae and fungi

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	Gain ability to understand the biology of lower plants. Staining and cross sections of thallus of model plants	AP
2	Develop expertise on various immunological assays like Differential Leucocyte count, Ag detection & Ab detection, Double diffusion, Radial Immunodiffusion, Total serum protein estimation, Estimation of glammaglobulins in serum, Determination of A:G ratio in serum sample	AP
3	Deep understanding of Plant Physiology. Estimation of catalase, peroxidase, Indole Acetic Acid oxidase activity. Students will be able to isolate, differentiate and characterize photosynthetic pigments	AP
4	Acquire hands on experience in media preparation, isolation and growth curve estimation along with mean generation time of microbes. Ability to characterize microbes based on their ability to antibacterial sensitivity, fermentation test, Catalase activity and Amylase activity	AP
5	Study of vegetative and reproductive structure of some important fungi and algal species.	AP

*CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).*

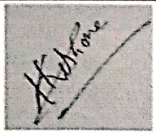
CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	2	3	1	3	2	-	2	2	3	3	2	2	2
CO2	3	3	3	3	3	2	3	2	3	3	3	3	3	3	3	3
CO3	3	3	3	2	3	2	3	2	-	2	2	3	3	2	2	2
CO4	3	3	3	3	3	3	3	3	2	3	3	3	3	3	3	3
CO5	3	3	3	2	3	3	3	3	-	3	3	3	3	3	3	3

"3"–Strong;"2"–Moderate;"1"-Low;"-"No Correlation

Detailed Syllabus: BOL601 Botany Laboratory

S. No.	Experiment	No. of Lab	CO No.
I	**Biology of Lower plants** a) Pinus- Morphology, transverse section of Needle, transverse section of stem, longitudinal section of /transverse section of male cone, whole mount of microsporophyll, whole mount of Microspores (temporary slides), longitudinal section of female cone, tangential longitudinal section & radial Longitudinal sections stem (permanent slide). b) Riccia – Morphology of thallus. c) Selaginella- Morphology, whole mount of leaf with ligule, transverse section of stem, whole mount of strobilus, whole mount of microsporophyll and megasporophyll (temporary slides), longitudinal section of strobilus (permanent slide).	18	1



II	**Morphological characterization of monocot and dicot plants and identification upto species** Monocot root, Monocot stem, Dicot root, Dicot stem	18	3
III	**Plant Physiology** Determination of osmotic pressure of cell sap by plasmolytic method. Determination of diffusion pressure deficit in potato tuber Determination of the rate of respiration by Ganong's Respirometer. Determination of the rate of respiration by Pipette manometer Determination of RQ of lipids, protein, carbohydrate by Ganong's Respirometer *Arabidopsis thaliana* - model organism and its development. Estimation of catalase activity, peroxidase, Indole Acetic Acid oxidase activity in plants. Photosynthesis - floating leaf disc experiment under various conditions (light, dark & light - dark) Demonstration of plasmolysis and deplasmolysis in plant cell. Demonstration of exosmosis and endosmosis in grapes and resins. Isolation and spectrophotometric characterization of photosynthetic pigments. An improved method for the extraction and thin-layer chromatography of chlorophyll a and b from spinach.	18	3
IV	**Microbiology** a) Media Preparation: Preparing and inoculating solid and liquid nutrient media for culturing microorganisms. Preparing nutrient media, Pouring nutrient agar plates and streaking bacterial culture on solid media, Inoculating nutrient broth with bacterial culture b) Growth Curve:Generating a bacterial growth curve under various pH and environmental conditions (steady and shaking); Calculations of Growth rate constant (μ), Calculation of generation time. c) Antibacterial activity testing d)Bacterial Fermentation test e)Isolation & Detection of coliform bacteria f) Catalase activity g) Amylase activity	18	4
V	Study of vegetative and reproductive structures of Nostoc, Chlamydomonas (electron micrographs), Volvox, Oedogonium, Coleochaete, Chara, Vaucheria, Ectocarpus, Fucus and Polysiphonia, Procholoron through temporary preparations and permanent slides. Thallus organization, spore production and accessory structure of common fungi aspergillus, Penicillium etc To study fungal growth curve.	18	5


Integrated M.Sc. Semester – VII

Program	Subject	Year	Semester
Integrated M.Sc.	Botany	4	VII
Course Code	**Course Title**		**Course Type**
B-701	**Evolutionary Biology**		**Core**
Credit	**Hours Per Week(L-T-P)**		
	L	**T**	**P**
4	3	1	0
Maximum Marks	**CIA**		**ESE**
100	60		40

Learning Objective (LO):
To understand and apply basic principles of the origin of life especially prokaryotes as well as eukaryotes in detail. To understand detailed outline of Extinctions and its types. To gain descriptive knowledge regarding Origin and Evolution of Man.

Course Outcomes (CO):

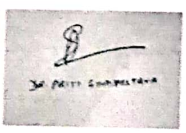
CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1.	Studying the origin and earliest evolution of life, along with the long-term evolution of the Earth's environments, helps us understand why the Earth became habitable and why terrestrial life has persisted for billions of years	U
2.	Understanding the role of genetic mechanisms in evolution.	U
3.	In order to discern a particular critical aspect, learners must experience variation in the dimension of that aspect.	E
4.	Understand how the link between environment and evolution. Understand how we can determine whether or not a population is evolving for a specific character. Be familiar with the different agents of evolution.	Ap
5.	Students will be able to: identify the characteristics of primates. distinguish between humans and other primates. discuss three species of human ancestors	An

CL: Cognitive Levels (R-Remember;U-Understanding;Ap-Apply;An-Analyze;E-Evaluate;C-Create).

CO-PO/PSO Mapping for the course:

PO/CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	2	3	2	2	2	-	2	2	3	3	2	2	3
CO2	3	3	3	2	3	2	2	2	-	2	2	3	3	2	2	2
CO3	3	3	3	3	3	3	2	3	1	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	2	3	2	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	2	3	2	3	3	3	3	3	3	3

"3"–Strong;"2"–Moderate;"1"-Low;"-"No Correlation

Detailed Syllabus: B 701 Evolutionary Biology

Unit No.	Topics	No. of Lectures	CO No.
I	Origin of life: Historical theories and background information, Experimental approaches, Chemogeny, Biogeny, RNA and DNA world, evolution of proteins, origin of photosynthesis, evolution of eukaryotes. Lamarckism, Darwinism, pre-Darwinian and post-Darwinian period, Neo-Darwinism. Theories of organic evolution. Evidences of evolution.	10	1
II	Sources of variations: Heritable variations and their role in evolution. Natural selection: types of natural selection (Directional, stabilizing and disruptive) and examples (Industrial melanism, Australian rabbits, resistant to pestiscides, heavy metal resistance in plants), Sexual selection, group and kin selection.	15	2
III	Polpulation genetics and evolution: Hardy-Weinberg Law (statement and derivation of equation, application of law to human Population); Evolutionary forces upsetting H-W equilibrium. Genetic Drift (mechanism, founder's effect, bottleneck phenomenon); Role of Migration and Mutation in changing allele frequencies	10	3
IV	Evolution above species level: Adaptation, adaptive radiation, microevolution, macroevolution, megaevolution, punctuated equilibria and related phenomenon. Isolation: Introduction and types of isolation. Speciation: species concept, modes of speciation: allopatric, sympatric	15	4
V	Origin and evolution of man, Unique hominin characteristics contrasted with primate characteristics, primate phylogeny from Dryopithecus leading to Homo sapiens, Phylogenetic trees, Multiple sequence alignment, construction of phylogenetic trees.	10	5

BOOKS SUGGESTED:

S. No.	Author	Book
1.	S. Freeman and J.C. Herron	Evolutionary Analysis, 4th Edn., Benjamin-Cummings (2007)
2.	D.J. Futuyma	Evolution, 2nd Edn., Sinauer Associates Inc.(2009)

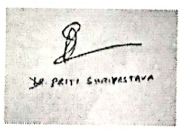
Integrated M.Sc. Semester – VII

Program	Subject	Year	Semester
Integrated M.Sc.	Botany	4	VII

Course Code	Course Title	Course Type
B-702	**Immunology**	**Core**

Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	0

Maximum Marks	CIA	ESE
100	60	40


Learning Objective (LO):

It will provide understanding for the development of new therapies and treatments that can manage or cure the condition by altering the way the immune system is working or, in the case of vaccines, priming the immune system and boosting the immune reaction to specific pathogens.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1.	Describe the purpose of the immune system. Identify the components of the immune system. Differentiate between the innate and adaptive immune response.	U
2.	To understand how the immune system develops, how the body defends itself against disease, and what happens when it all goes wrong.	E
3.	Explain the genetic events that lead to diversity of T-cell receptors. Compare and contrast the various classes and subtypes of T cells in terms of activation and function.	An
4.	Distinguish between an antigen and an antibody, describe the chemical structure of an antibody (immunoglobulin) protein, describe different mechanisms of how antibodies limit the effects of pathogens or toxins by opsonization, neutralization, agglutination, precipitation, lysis, and antitoxin action.	Ap
5.	Demonstrate the basic knowledge of immunological processes at a cellular and molecular level. Define central immunological principles and concepts.	C

CL: Cognitive Levels (R-Remember;U-Understanding;Ap-Apply;An-Analyze;E-Evaluate;C-Create).

CO-PO/PSO Mapping for the course:

PO/ CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	2	3	2	3	2	2	2	2	3	3	2	2	3
CO2	3	3	3	2	3	2	3	2	2	2	2	3	3	2	2	3
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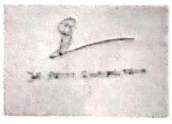
CO4	3	3	3	3	3	3	3	3	2	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	2	3	3	3	3	3	3	3

"3"–Strong;"2"–Moderate;"1"-Low;"-"No Correlation

Detailed Syllabus: B 702 Immunology

Unit No.	Topics	No. of Lectures	CO No.
I	Overview of the Immune system: Types of immunity, innate, acquired, passive and active, self vs nonself discrimination, Adaptive immune response, Autoimmunity	12	1
II	Cells and organs of the immune system: T cell receptors, T cell receptor genes & gene rearrangements, T cell maturation, activation & differentiation, B cell generation, activation & development	12	2
III	Antigens and Antibodies: Immunoglobulins structure and function, Immunoglobulin genes Organization and rearrangement, Antibody diversity, Antigen antibody reactions, MHC (antigens and genes), Antigen processing & presentation	12	3
IV	Immune response: Self Non self discrimination (mechanism), Clonal selection theory & idiotypic network hypothesis, Cytokines, The complement system, Cell mediated effector response, Leukocyte migration and inflammation,	12	4

	Hypersensitive reactions, Immune regulation, Immune response to infectious organisms, Vaccines, Immunodeficiency diseases (AIDS)		
V	Immunology & applications: Transplantation immunology, Tumour immunology, Immunotechnology, Animal models. Plant immunity	12	5

BOOKS SUGGESTED:

S. No.	Author	Book
1.	Goldsby, Kindt, and Osborne	Immunology
2.	Janice Kuby	Immunology
3.	Ivan Roitt	Essential Immunology, 8th Edition
4.	Cellular and Molecular Immunology	Kathyrn Austyn
5.	David	Biology of Immunological Diseases
6.	Richard Burry	Immunocytochemistry: A practical guide

Integrated M.Sc. Semester – VII

Program	Subject	Year	Semester
Integrated M.Sc.	Botany	4	VII

Course Code	Course Title	Course Type
B-703	**Imaging Technology in Biological Research**	**Core**

Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	0

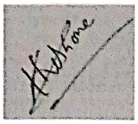
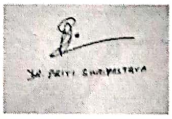
Maximum Marks	CIA	ESE
100	60	40

Learning Objective (LO):
This paper gives an insight of different imaging techniques used in biological research.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1.	Define and explain the propagation of light in conducting and non-conducting media; define and explain the physics governing laser behaviour and light matter interaction; apply wave optics and diffraction theory to a range of problems;	Ap
2.	Understand why and how the light microscope and electron microscope are used in biology	An
3.	Can analyze and understand NMR pulse sequences using basic NMR theory. master relevant academic tools and techniques in data recording and interpretation of NMR spectra.	E
4.	Imaging is a range of tests used to create images of parts of the body.	Ap
5.	Demonstrate the ability to use discipline specific research techniques.	C

CL: Cognitive Levels (**R**-Remember;**U**-Understanding;**Ap**-Apply;**An**-Analyze;**E**-Evaluate;**C**-Create).

CO-PO/PSO Mapping for the course:

PO/CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	2	3	3	3	2	1	3	2	3	3	2	2	2
CO2	3	3	3	2	3	3	3	2	2	3	2	3	3	2	2	2
CO3	3	3	3	3	3	3	3	3	2	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	2	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	2	3	3	3	3	3	3	3

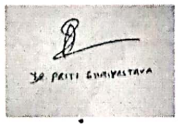
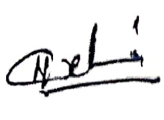
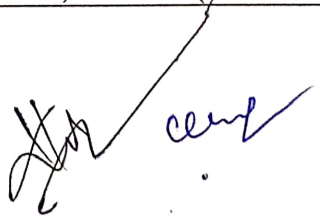
"3"–Strong;"2"–Moderate;"1"-Low;"-"No Correlation

Detailed Syllabus: B 703 Imaging Technology in Biological Research

Unit No.	Topics	No. of Lectures	CO No.
I	The power of ten (understanding how small cells and the sub-cellular contents are). An introduction to light and optics, exploring with lenses (what are lenses, looking through them, understanding the concept of magnification, mirrors, angles of reflection, refraction, prisms and colors)	10	1
II	Fundamentals of illumination (ray diagrams, types of light sources, LEDs, power levels, coherence of light, elliptical reflectors) Exploring microscopes (short history, magnifying glass, simple and compound microscopes, electron Microscopes, stereomicroscope)	10	2
III	Fluorescence microscopy (Understanding fluorescence, Fluorescence protein technology, GFP, YFP), two-photon fluorescence microscopy, matrix□assisted laser desorption/ionization mass spectrometry (MALDIMS) imaging	15	3
IV	Live cell imaging (confocal microscopes), Differential interference contrast (DIC) images. Comparing Confocal and Widefield Fluorescence Microscopy, Atomic force microscopy and optical tweezers force spectroscopy	15	4
V	NMR Imaging Spatially nonresolved NMR spectroscopy; low-field NMR instruments; 1H-nuclear magnetic resonance (NMR) microimaging ; 1H-magic angle spinning NMR spectroscopy; MAS-13C NMR spectroscopy, Spectral-resolution enhancement using magic angle spinning.	10	5

BOOKS SUGGESTED:

S. No.	Author	Book
1.	Ulf Grenander, Y Chow and Daniel M Keenan	Hands: A Pattern Theoretic Study of Biological Shapes (Research Notes in Neural Computing) (Volume□2) Alberts *et al.*
2.	Valery V Tuchin, Lihong Wang and Dmitry A Zimnyakov	Optical Polarization in Biomedical Applications (Biological and Medical Physics, Biomedical Engineering)
3.	RM Lambrecht	Biological Models in Radiopharmaceutical Development (Developments in Nuclear Medicine)
4.	Philippe Sansonetti	Bacterial Virulence: Basic Principles, Models and Global Approaches (Infection Biology (VCH)
5.	Richard Nuccitelli, Leslie Wilson and Paul T Matsudaira	A Practical Guide to the Study of Calcium in Living Cells, Volume 40 (Methods in Cell Biology)

Integrated M.Sc. Semester – VII

Program	Subject	Year	Semester
Integrated M.Sc.	Botany	4	VII

Course Code	Course Title	Course Type
BO 701	**Developmental Biology of Plants**	**Core**

Credit	Hours Per Week(L-T-P)		
	L	T	P
4	3	1	0

Maximum Marks	CIA	ESE
100	60	40

Learning Objective (LO):

Upon completion of the course the students will have a fundamental understanding of the physiological principles and processes involved in plant growth and development.

Course Outcomes (CO):

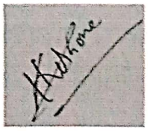
CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1.	To understand the various development processes along with stages during plant germination and growth. To explain the differences between plant and animal development mechanisms and organization of shoot and root apical meristem (SAM & RAM).	An
2.	To understand the processes of seed germination and dormancy and major factors affecting them. To also explain how overcoming seed dormancy occurs?	U
3.	Learning a cellular prospective of leaf development and phyllotaxy. To also learn molecular mechanism and regulations of floral development and sex determination.	U
4.	Detail study of gametogenesis in plants (a process of male and female gamete formation), pollination and fertilization.	Ap
5.	To develop understanding of plant embryogenesis, endosperm development, apomixis, polyembryony and types of seeds based on presence and absence of endosperm.	Ap

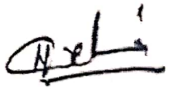
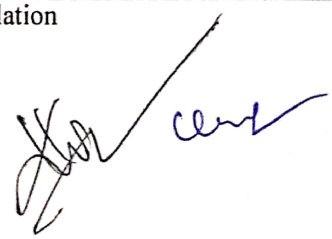
CL: Cognitive Levels (**R**-Remember;**U**-Understanding;**Ap**-Apply;**An**-Analyze;**E**-Evaluate;**C**-Create).

CO-PO/PSO Mapping for the course:

PO/CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	2	2	2	2	2	2	2	2	3	2	2	2	2
CO2	3	3	3	2	2	2	2	2	2	2	2	3	2	2	2	2
CO3	3	3	3	2	3	2	2	2	1	3	2	3	2	2	2	3
CO4	3	3	3	3	3	1	3	3	2	3	2	3	3	3	3	3
CO5	3	3	3	3	3	2	3	3	2	3	2	3	3	3	3	3

"3"–Strong;"2"–Moderate;"1"-Low;"-"No Correlation



Detailed Syllabus: BO 701 Developmental Biology of Plants

Unit No.	Topics	No. of Lectures	CO No.
I	Development processes in plants: How are the mechanisms different from that of animal development? Organization of SAM, RAM, Root and shoot development mechanisms.	10	1
II	Process of germination, Hormonal regulation of seedling growth, seed dormancy types, and its hormonal regulation, overcoming of seed dormancy.	15	2
III	Leaf development, phyllotaxy, control of leaf forms, Floral organs, Flower development, molecular regulation of flowering process, Floral evocation, Sex determination (Ex Coccinia)	15	3
IV	Gametogenesis- microsporogenesis and microgametogenesis, megasporogenesis and megagametogenesis, pollination and fertilization processes in angiosperms	10	4
V	Plant embryogenesis, Development of embryonic polarity, Endosperm development, apomixis, polyembryony, endospermic and non-endospermic seeds	10	5

BOOKS SUGGESTED:

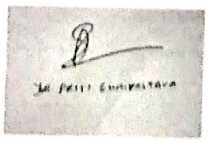
S.No.	Author	Book
1.	Alberts *et al.*	Molecular Biology of the Cell
2.	SF Gilbert	Developmental Biology
3.	Bhojwani, S.S. and Bhatnagar, S.P. (2011)	The Embryology of Angiosperms, Vikas Publishing House. Delhi. 5th edition
4.	Shivanna, K.R. (2003).	Pollen Biology and Biotechnology. Oxford and IBH Publishing Co. Pvt. Ltd. Delhi.
5.	Raghavan, V. (2000).	Developmental Biology of Flowering plants, Springer, Netherlands.
6.	Johri, B.M. I (1984).	Embryology of Angiosperms, Springer

Integrated M.Sc. Semester – VII

Program	Subject	Year	Semester
Integrated M.Sc.	Botany	4	VII
Course Code	**Course Title**		**Course Type**
BOL-701	**Advanced Botany Laboratory**		**Core**
Credit	Hours Per Week (L-T-P)		
	L	T	P
5	-	-	10
Maximum Marks	CIA		ESE
100	60		40

Learning Objective (LO):

Key goal of experiments is to understand and perform various experiments to study developmental stages of plants and factors affecting their growth. Students will also get practice of various in vitro conservation methods.



Course Outcomes (COs):

CO	Expected Course Outcomes	CL
	At the end of the course, the students will be able to:	
1	[illegible]	[illegible]
2	[illegible]	[illegible]
3	Understanding the factors affecting growth in plants. Preparation of MS media and Callus formation from explants	[illegible]
4	Study of effects of phytohormones on plant growth development and germination patterns under stress and normal conditions.	[illegible]
5	Synthetic seed preparation experiments	[illegible]
6	Understanding of conservation of plants by in vitro methods	[illegible]

CL: Cognitive Levels (R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create)

CO-PO/PSO Mapping for the course:

PO/CO	POs											PSOs				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
CO2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
CO3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
CO4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
CO5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

"3"-Strong;"2"-Moderate;"1"-Low;"-"No Correlation

Detailed Syllabus: BOL701 Advanced Botany Laboratory

S. No.	Experiments	No. of Lab	CO No.
I	**Immunology** d) Differential Leucocyte count a) Ag detection & Ab detection b) Double diffusion c) Radial Immunodiffusion d) Total serum protein estimation e) Estimation of glammaglobulins in serum f) Determination of A:G ratio in serum sample	30	1
II	**Developmental Biology** Isolation of protoplast from various plant tissues and testing their viability. Demonstration of protoplast fusion employing PEG. To study environmental impact in developmental activity using checklist as EIA method Study of microscopic gametogenesis in section of anthers. Pollen germination using hanging drop method, sitting drop culture, suspension culture and surface culture,	35	2
III	Seed set and fruit development Study of endospermic and non endospermic seeds. Isolation of zygotic, globular, heart shaped, torpedo stage in embryo Field survey of several type of flower with different pollination mechanism. Study of germination patterns under stress and normal conditions	35	3

IV	Study of effects of phytohormones on plant growth development a) effect of auxins b) effect of cytokinins	25	4
V	Organogenesis and somatic embryogenesis using appropriate explants and preparation of artificial seeds.	25	5

Integrated M.Sc. Semester – VIII

Program	Subject	Year	Semester
Integrated M.Sc.	Botany	4	VIII

Course Code	Course Title	Course Type
B-801	**Virology**	**Core**

Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	-

Maximum Marks	CIA	ESE
100	60	40

Learning Objective (LO):
It will provide understanding of different types of viruses, their structure, mode of replication. It will also provide understanding of various therapies in case of viral infections.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	Students will be able to comprehend the various concepts regarding Origin, architecture and nomenclature of the viruses. Replication mechanism and mode of transmission of viruses	U
2	Development of vaccines for the viral epidemics and also about antiviral chemotherapy.	L
3	Virus genetic structure and their mode of replication	U
4	Evolution of viruses and some serious infectious viruses such as HIV, Herpes and Pox virus	U
5	Study of bacteriophages, mode of replication and other infectious viruses	U

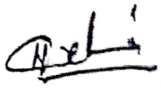
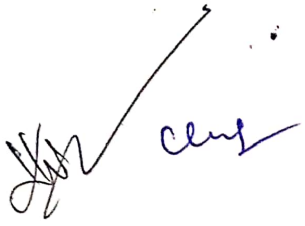
CL: Cognitive Levels (R-Remember;U-Understanding;Ap-Apply;An-Analyze;E-Evaluate;C-Create).

CO-PO/PSO Mapping for the course:

PO/CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	2	3	2	2	2	2	2	2	3	2	2	2	3
CO2	3	3	3	3	3	3	3	3	2	3	3	3	3	3	3	2
CO3	3	3	3	3	3	3	3	3	2	3	3	3	3	3	3	2
CO4	3	3	3	3	3	3	3	3	2	3	3	3	3	3	3	2
CO5	3	3	3	3	3	3	3	3	2	3	3	3	3	3	3	2

"3"–Strong;"2"–Moderate;"1"-Low;"-"No Correlation



Detailed Syllabus: B -801: Virology

Unit No.	Topics	No. of Lectures	CO No.
I	Introduction to Virology: definition, properties and origin of viruses, Virus architecture and nomenclature, Virus replication cycle, Basic virological methods, Basics of virus entry, spread and transmission	12	1
II	Host resistance to viral infection: immune responses, Vaccines and antiviral chemotherapy: the prevention and treatment of viral diseases, Epidemiology, Exploiting viruses as gene therapy and vaccine vectors	15	2
III	Viruses and cancer: oncoviruses and oncolytic viruses, Polioviruses and other single-stranded positive-strand RNA viruses, Rabies and other single-stranded non segmented negative-strand, Influenza virus and single-stranded segmented negative-strand RNA viruses.	12	3
IV	Evolution of viruses: new and reemerging viruses, Herpesviruses (nuclear large double-stranded DNA viruses), Poxviruses (cytoplasmic large double-stranded DNA viruses), HIV and other retroviruses	10	4
V	Hepatitis B virus (reverse-transcribing DNA virus) and other viruses causing hepatitis, Prion diseases, Plant viruses and common viral diseases in plants, Bacteriophages	11	5

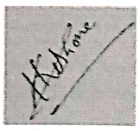
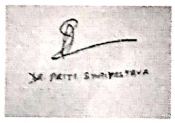
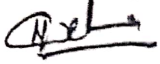
Books Recommended:

S.No.	Author	Book
1	L Collier, J Oxford and Paul Kellam	Human Virology (4th edition),
2	SJ Flint, LW Enquist, VR Racaniello and AM Skalka	Principles of Virology (3rd edition) 2009
3	AJ Cann	Principles of Molecular Virology,
4	Teri Shors, Jones and Bartlett	Understanding Viruses
5	NJ Dimmock, A Easton, K Leppard	IntroductiontoModernVirology6thedition,

Integrated M.Sc. Semester – VIII

Program	Subject	Year	Semester
Integrated M.Sc.	Botany	4	VIII
Course Code	Course Title		Course Type
B-802	**Biotechnology-1**		**Core**
Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	0

Maximum Marks	CIA	ESE
100	60	40

Learning Objective (LO):
It will give an overview of the basic biotechnology techniques, rDNA technology, PCR, Blotting and plant tissue culture technique.

Course Outcomes (CO):-

CO No.	Expected Course Outcomes At the end of the course,the students will be able to:	CL
1	Students will have in –depth understanding of • Basic principles of genetic engineering. • Transgenic animals, cloning and applications • Development of transgenic plants and their applications.	U
2	Different molecular techniques such as library construction, vector designing etc.	L
3	Learning hybridization techniques, sequencing and gene transfer methods	L
4	Study of trangenics plants and animals and gene therapy	L
5	Tissue culture techniques, cloning , micropropagation techniques	L

CL: Cognitive Levels(R-Remember;U-Understanding;Ap-Apply;An-Analyze;E-Evaluate;C-Create).

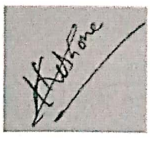
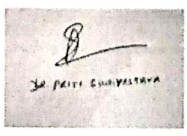
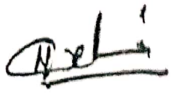
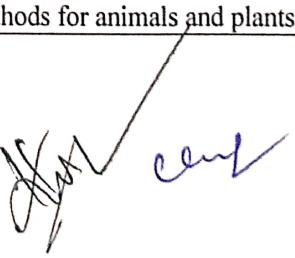
CO-PO/PSO Mapping for the course:

PO/CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	3	3	3	3	2	2	3	3	3	3	2	3	3
CO2	3	3	3	3	3	3	3	2	2	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	2	2	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	2	3	3	3	3	3	3	2
CO5	3	3	3	3	3	3	3	3	2	3	3	3	3	3	3	2

"3"–Strong;"2"–Moderate;"1"-Low;"-"No Correlation

Detailed Syllabus: B -802: Biotechnology-I

Unit	Topics	No of lectures	CO
Unit-I	Basic concept of genetic engineering, Methods for creating recombinant DNA molecule, properties of restriction endonucleases and their mode of action, Cloning Vectors-Lambda phage, Plasmid, M13 phage, cosmid, yeast, viral and Expression vectors, YACs, BACs, PACs. Introduction of DNA into living cells and selection of recombinants.	10	1
Unit II	Construction of DNA library:Genomic libraries: Partial digest, choice of vectors, construction and evaluation of a genomic library, growing and storing libraries, cDNA Library: methods of generating cDNA library, Genomic vs cDNA library, Expression libraries	10	2
Unit-III	Selection/screening: Analysis of genomic DNA by Southern hybridization, Northern and Western blotting techniques, Restriction mapping, DNA sequencing and analyses techniques, next gen sequencing, microarray technology. DNA manipulation techniques: Preparation of radiolabelled and synthetic probes, Amplification of DNA by polymerase chain reaction, Site directed mutagenesis, Gene transfer methods for animals and plants	15	3

Unit-IV	Transgenic animals/plants- Selectable markers, Reporter genes for promoter analysis, Embryonic stem cells, Super mouse,Pronuclear Transgenic Goats, Whole animal cloning e.g. Dolly, gene Knock-out, knock-down, knock-in technology, Gene therapy e.g. SCID], Agrobacterium mediated transformation in plants, Ti plasmid.	10	4
Unit-V	Cell and tissue culture in plants and animals: Primary culture; Cell line; Cell cl s; Callus cultures; Somaclonal variation; Micropropagation; Somatic embryoge is; Haploidy; Protoplast fusion and somatic hydridization; Cybrides; Artificial ds; Hybridoma technology.	15	5

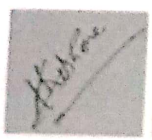
Books Recommended:

S.No.	Author	Book
1	Benjamin Lewin	Gene VII, Oxford Publishers
2	T A Brown	Genome, Second edition,
3	Old and Primrose	Principles of Gene Manipulation;
4	Simmons and Gardner	Principles of genetics;
5	Donald Voet and Judith Voet	Biochemistry 3rd Edition,
6	T D.Watson and others	Molecular Biology of the Gene , 6th Edition
7	GM Cooper	The Cell: A molecular approach: Library of Congress cataloging in publication data.
8	Griffiths A and Miller J	Anintroductiontogeneticanalysis;Freeman
9	Lodish H and Berk	A Molecular cell biology;
10	Sambrook J, Russell	Molecular cloning: Vol I, II , III; CSHL Press
11	TA Brown	Gene cloning and DNA analysis;
12	BGlick,JPasternak&CPatten	Molecular Biotechnology principles and applications of Recombinant DNA, 4th
13	K. Deb and Satish Totey	Stem Cells Basics and Applications;
14	Gary Stein and Maria B et al.	Human Stem Cell Technology and Biology;

Integrated M.Sc. Semester – VIII

Program	Subject	Year	Semester
Integrated M.Sc.	Botany	4	VIII
Course Code	Course Title		Course Type
B-803	**Bioinformatics**		**Core**
Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	0
Maximum Marks	CIA		ESE
100	60		40

Learning Objective (LO):
It will give an overview of fundamentals of bioinformatics, databases and different tools BLAST FASTA. Application of these tools for understanding the biological molecules.




Course Outcomes (CO):-

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	Students will have in –depth understanding of History, definition, importance and applications of Bioinformatics, Bioinformatics and computational Biology opportunities in India. Major Bioinformatics Resources	L
2	Introduction of Biological Database	L
3	Basics and techniques of alignment, Phylogenetic Analysis, Algorithms /methods of phylogenetic analysis	L
4	Protein structure analysis and prediction, Fundamentals of the methods for 3D structure prediction, sequence similarity/identity of target proteins of known structure, fundamental principles of protein folding	Ap
5	Genomics and Functional Analysis Methodologies for high throughput analysis including, Drug discovery and Development, Applications of Bioinformatics,	Ap

CL:CognitiveLevels(R-Remember;U-Understanding;Ap-Apply;An-Analyze;E-Evaluate;C-Create).

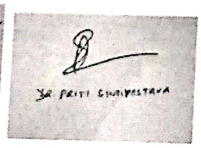
CO-PO/PSO Mapping for the course:

PO/CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	3	3	3	3	3	1	3	3	3	3	3	3	2
CO2	3	3	3	3	3	3	3	3	2	3	3	3	3	3	3	2
CO3	3	3	3	3	3	3	3	3	1	3	3	3	3	3	3	1
CO4	3	3	3	3	3	3	3	3	1	3	3	3	3	3	3	2
CO5	3	3	3	3	3	3	3	3	2	3	3	3	3	3	3	1

"3"–Strong;"2"–Moderate;"1"-Low;"-"No Correlation

Detailed Syllabus: B 803 Bioinformatics

Unit No	Topics	No of lectures	CO
Unit-I	Introduction to Bioinformatics: Bioinformatics - History, definition, importance and applications of Bioinformatics, Bioinformatics and computational Biology opportunities in India. Major Bioinformatics Resources: NCBI, EBI, ExPaSy	10	1
Unit II	Biological databases- Introduction of Biological Databases; (a) Nucleic acid databases (NCBI, DDBJ, and EMBL). (b) Protein databases (Primary, Composite, and Secondary)(c) Specialized Genome databases: (SGD, TIGR, and ACeDB) (d) Structure databases (CATH, SCOP, & PDBsum)	10	
Unit-III	Alignment: Basics and techniques, Local alignment and Global alignment, Pairwise sequence alignment:NEEDLEMAN and Wunsch algorithm, Smith and Waterman algorithm, The Dot Plot.Multiple Sequence Alignment (MSA): Definition, Objective, Methods for MSA: Heuristic approach, Dynamic programming approach and their combinations. database similarity searches-BLAST/FASTA algorithms, Phylogenetic Analysis: Phylogenetic-trees, Terminology of tree-reconstruction, rooted and un□rooted trees, gene vs species trees and their properties. Algorithms /methods of phylogenetic analysis: UPGMA, Neighbor-Joining Method.	15	3

Unit IV	Protein structure analysis and prediction: Identification/assignment of secondary structural elements from the knowledge of 3-D structure of macromolecule using DSSP and STRIDE methods , Prediction of secondary structure: PHD and PSI- PRED method Tertiary (3-D) Structure prediction: Fundamentals of the methods for 3D structure prediction (sequence similarity/identity of target proteins of known structure, fundamental principles of protein folding etc.)	15	4
Unit-V	Genomics and Functional Analysis Methodologies for high throughput analysis including NGS, application of bioinformatics in genomics. Comparative genomics. Drug discovery and Development : Introduction to Drug Design and Development, Drug targets, Lead Identification and Modification, Computer-Aided Drug Design, Drug Delivery, Applications of Bioinformatics: Pharmaceutical industries, immunology, agriculture, forestry; Legal, ethical and commercial ramifications of bioinformatics.	10	5

Books Recommended:

S.No.	Author	Book
1	E Wayne W Daniel	Biostatistics:AfoundationforAnalysisintheHealthSciences
2	Prem S Mann	Introductory Statistics, 5th Edition;
3	Olive Jean Dunn	Basic Statistics: A primer for Biomedical Sciences
4	C Stan Tsai	Computational Biochemistry;
5	SC Rastogi *et al.*,	Bioinformatics: Methods and Applications
6	A Caldwell et al.,	Integrated Genomics; Wiley Publishers

Integrated M.Sc. Semester – VIII

Program	Subject	Year	Semester
Integrated M.Sc.	Botany	4	VIII
Course Code	Course Title		Course Type
B-804	**Biotechnology II**		**Core**
Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	0

Maximum Marks	CIA	ESE
100	60	40

Learning Objective (LO):
It will give an overview of industrial, medical, environmental biotechnological processes. It will also provide concept regarding ethical concerns of GM crops.

Course Outcomes (CO):-

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	Principles of plant breeding, Important conventional methods, Ethics of GM crops and animal cloning, Plant diseases and defensive mechanisms,	U
2	Bioprocess Technology, basics of bioreactor kinetics and mathematical equations, Kinetics of microbial growth Solid state fermentation.	U
3	Industrial Biotechnology, Biopolymers	L
4	Remediation and Biotechnology their health effects, Solid waste management , Environmental and industrial pollution control	U
5	Medical Biotechnology, Tissue Engineering and applications, Biomaterialsand applications, Introduction to nanotechnology and nano-biotechnology, Nanomaterials and their uses.	Ap

CL: Cognitive Levels(R-Remember;U-Understanding;Ap-Apply;An-Analyze;E-Evaluate;C-Create).

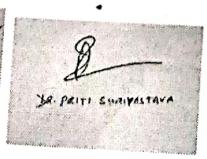
CO-PO/PSO Mapping for the course:

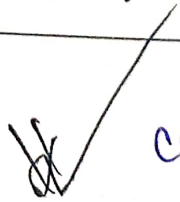
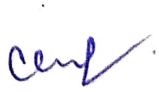
PO/CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	3	3	3	3	2	2	3	3	3	3	2	3	3
CO2	3	3	3	3	3	3	3	2	2	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	2	2	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	2	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	2	3	3	3	3	3	3	2

"3"–Strong;"2"–Moderate;"1"-Low;"-"No Correlation

Detailed Syllabus: B 804: Biotechnology-II

Unit No	Topics	No of lectures	CO
Unit-I	Principles of plant breeding: Important conventional methods of breeding self and cross pollinated and vegetatively propagated crops; Non□conventional methods; Polyploidy: Genetic variability; Plant diseases and defensive mechanisms. Ethics of GM crops and animal cloning. Model organisms - S. cereviceae, Dictostylium, Caenorhabditis elegans, Arabidopsis, Zebra Fish, Mouse, Drosophila	10	1
Unit II	Industrial Biotechnology-I Bioprocess Technology [basics of bioreactor kinetics and mathematical equations regarding bioreactors, scale-up and aeration of bioreactors in detail, Kinetics of microbial growth, substrate utilization and product formation: Batch, Fed- Batch and continuous processes, Scale up concepts with respect to fermenter design and product formation, Gas exchange and mass transfer: O2 transfer, critical oxygen concentration, determining the oxygen uptake rate, Solid state fermentation.	15	
Unit-III	Industrial Biotechnology-II Downstream Processing - Flocculation and floatation, Filtration, Centrifugation, Cell disruption, Liquid extraction, Precipitation, Adsorption, Dialysis, Reverse osmosis, Chromatography, Crystallization and drying, Common examples: Biopolymers	10	3

Unit-IV	Remediation and Biotechnology- Biodegradation of xenobiotic compound. Priority pollutants and their health effects, Microbial basis of biodegradation, Bioremediation- phytoremediation and metal, Environmental and industrial pollution control, Biopesticides, Microbial plastics, Solid waste management	10	4
Unit-V	Medical Biotechnology-a.Production of small biological molecules, Tissue Engineering -Growth Factors and morphogens: signals for tissue engineering and whole organ development, extracellular Matrix: structure, function and applications to tissue engineering, Cell adhesion and migration, Inflammatory and Immune responses to tissue engineered devices b. Biomaterials -Polymeric scaffolds, Bio mimetic materials, Nanocomposite scaffolds Introduction to nanotechnology and nano-biotechnology, Nanomaterials and their uses.	15	5

Books Recommended:

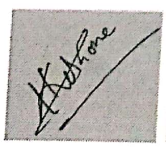
1	R.IanFreshney,GlynN.Stacey, Jonathan M. Auerbach	CultureofHumanStemCells.JohnWiley&Sons
2	BernardRGlick,JackJPasternak, Cheryl L Patten	Molecular Biotechnology: Principles and Applications of Recombinant DNA. ASM Press
3	Robert Lanza, Robert Langer, Joseph P Vacanti	Principles of Tissue Engineering
4	F Gilbert	Developmental Biology; 6th Edition;
5	Gordana Vunjak□Novakovic, R Ian Freshney	Culture of Cells for Tissue Engineering;
6	SB Primrose and Twyman	Principles of gene manipulation
7	RW Old and SB Primrose	Principles of gene manipulation
8	Watson	Recombinant DNA
9	TA Brown	Gene cloning and DNA analysis
10	D Clark, N Pazdernik	Bioprocess Technology□ Biotechnology□ Applying the genetics to revolution

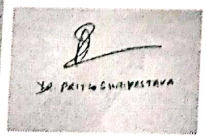
Integrated M.Sc. Semester – VIII

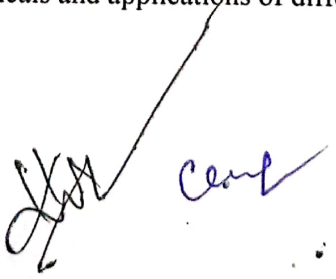
Program	Subject	Year	Semester
Integrated M.Sc.	Botany	4	VIII
Course Code	**Course Title**		**Course Type**
BOL-801	**Advanced Botany Laboratory**		**Core**
Credit	Hours Per Week (L-T-P)		
	L	T	P
5	-	-	10
Maximum Marks	CIA		ESE
100	60		40

Learning Objective (LO):

Key goal of experiments is to understand and perform various techniques to for the synthesis and application of nanoparticles. Extraction and estimation of phytochemicals and applications of different bioinformatics tools.







Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	Techniques for the synthesis of nanoparticles from plant sources and optimization.	AP
2	Experiments are designed to learn the techniques to extract phytochemicals by different methods.	AP
3	Observation of plant growth and study of different chemical stress on plant growth.	AP
4	Different biochemical tests for the detection of plant compounds.	AP
5	Applications of different bioinformatics tools to retrieve the data from different biological databases.	AP

*CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).*

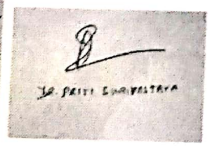
CO-PO/PSO Mapping for the course:

PO/CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	3	3	3	3	3	2	3	3	3	3	3	3	2
CO2	3	3	3	2	3	2	3	2	2	2	2	3	2	2	2	2
CO3	3	3	3	2	3	2	3	2	2	2	2	3	2	2	2	2
CO4	3	3	3	2	3	2	3	2	2	2	2	3	2	2	2	2
CO5	3	3	3	3	3	3	3	3	2	3	3	3	3	3	3	2

"3"–Strong;"2"–Moderate;"1"-Low;"-"No Correlation

Detailed Syllabus: BOL801 Advanced Botany Laboratory

S. No.	Experiment	No. of Lab	CO No.
I	Symptoms of virus diseases in plants Total DNA extraction from virus infected plants Detection and diagnosis of plant viruses with serological (ELISA) technique RNA extraction, cDNA preparation, PCR and RT PCR	25	1
II	Preparation of MS media Callus formation from carrot cells Pollen storage, pollen pistil interaction, self incompatibility in vitro pollination, Emasculation, bagging and hand pollination to study of pollen germination In vitro conservation studies a)Effect of temperature *b)Effect of osmotic agents*	35	2
III	Effect of salt and metal stress on plant growth Study of bioremediation of heavy metal Isolation and identification of microorganisms from industrial waste water Determination of thermal death point (TDP) and thermal death time (TDT) of microorganisms. Study the production of citric acid and its qualitative and quantitative estimation Bioethanol production	35	3

IV	Plant biochemical tests- total protein, proline etc. Essential oil extraction from aromatic plants Preparation of plant extracts using soxhlet method and phytochemical tests Silver Nanoparticle synthesis from plant extract. Silver Nanoparticle synthesis from tea extract RNA extraction cDNA preparation PCR and RT PCR	30	4
V	**Bioinformatics:** DNA sequence analysis using BLAST; sequence pattern, motifs and profiles. Prediction of secondary structure of proteins Prediction of tertiary structure of (fold recognition, homology search) Molecular modeling and dynamics: using small oligonucleotides and small protein with known crystal structure (available from data bank), Drug designing – using available data Applications of bio informatics, Primer designing.	25	5

Integrated M.Sc. Semester – IX

Program	Subject	Year	Semester
Integrated M.Sc.	Botany	5	IX
Course Code	Course Title		Course Type
BoPGD901	**Botany PG Dissertation/ Project**		**Core**
Credit	Hours Per Week (L-T-P)		
	L	T	P
20	-	-	-
Maximum Marks	CIA		ESE
400	-		400

Scheme for evaluation of Project/Dissertation work for 9th semester CBS

The Center for Basic Sciences (CBS) offers 5 Year Integrated M.Sc. program (total credits-240) in subject Botany. The complete program is for duration of 10 semesters. Each semester from 1-VIII carries 25 credits and semester IX to X will carry 20 credits each. As per the course structure of Int M.Sc. 9th semester, students have to carry out a project/Dissertation in their respective subjects for successful completion of the program. The project has to be carried out in recognized National/State laboratories/Institute/Universities.

The proposed evaluation scheme for Integrated M.Sc. 9th semester projects/Dissertation in subject Botany (BPGD 901) is as follows:

1		
2	Project/Dissertation (certified by the supervisor of the Institute)	Marks 150
3	Seminar based on Project/ Dissertation	150
	Viva-Voce based on Project report/ Dissertation and Seminar	100
	Total Marks	400

The valuation of all the projects/Dissertation will be done by the external examiner, internal examiner of the respective subjects and Director (CBS) or nominee of the Director.

Integrated M.Sc. Semester – X

Program	Subject	Year	Semester
Integrated M.Sc.	Botany	5	X

Course Code	Course Title	Course Type
BE1001	**Proteomics and Genomics**	**Elective**

Credit	Hours Per Week (L-T-P)		
	L	T	P
5	4	1	0

Maximum Marks	CIA	ESE
100	60	40

Learning Objective (LO):
It will give understanding on identifying the structures of proteins and biological functions of specific individual proteins, their cellular activities separation techniques, whole protein interaction networks: Genomics will give understanding of altering a genome with unparalleled efficiency and precision. Genomics is fostering an appreciation for what our DNA means for our health, identities and culture.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1.	Introduction and scope of proteomics, Protein separation techniques	U
2.	Introduction to spectrometry and its applications ; Strategies for protein identification; Protein sequencing; Applications of proteome analysis	U
3.	Protein-protein interaction, Protein engineering; Clinical and biomedical application of proteomics; Proteome database; Proteomics industry.	E
4.	Introduction and Classification of genomics; Methods of preparing genomic DNA; Genome sequencing methods (next-generation sequencing); Databases of genomes; Genetic mapping;	U
5.	Gene variation and Single Nucleotide Polymorphisms (SNPs); Expressed sequenced tags (ESTs); Gene disease association; DNA fingerprinting; Microarray based techniques for RNA analysis; metagenomics.	U

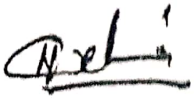
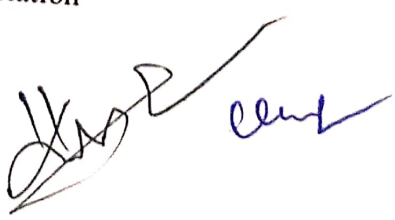
CL:CognitiveLevels(R-Remember;U-Understanding;Ap-Apply;An-Analyze;E-Evaluate;C-Create).

CO-PO/PSO Mapping for the course:

PO/CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	3	2	3	2	3	2	3	3	3	3	3	3	2
CO2	3	3	3	3	2	3	2	3	2	3	3	3	3	3	3	2
CO3	3	3	3	3	2	2	2	3	2	3	3	3	2	3	2	1
CO4	3	3	3	3	2	2	2	3	2	3	3	3	2	3	2	1
CO5	3	3	3	3	2	2	2	3	2	3	3	3	2	3	3	2

"3"–Strong;"2"–Moderate;"1"-Low;"-"NoCorrelation

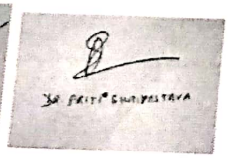


Unit No.	Detailed Syllabus: BE1001 Genomics and Proteomics Topics	No. of Lectures	CO No.
I	Introduction and scope of proteomics; Protein separation techniques: ion exchange, size-exclusion and affinity chromatography techniques; Polyacrylamide gel electrophoresis; Isoelectric focusing (IEF); Two dimensional PAGE for proteome analysis; Image analysis of 2D gels.	18	1
II	Introduction to mass spectrometry; Strategies for protein identification; Protein sequencing; Protein modifications and proteomics; Applications of proteome analysis to drug.	12	2
III	Protein-protein interaction (Two hybrid interaction screening); Protein engineering; Protein chips and functional proteomics; Clinical and biomedical application of proteomics; Proteome database; Proteomics industry.	16	3
IV	Introduction and Classification of genomics; Methods of preparing genomic DNA; Genome sequencing methods (next-generation sequencing);Databases of genomes; Genetic mapping; Mapping of human genome; Human genome project; Hap Map Project, The genome project, and The ENCODE Project.	14	4
V	Gene variation and Single Nucleotide Polymorphisms (SNPs); Expressed sequenced tags (ESTs); Gene disease association; DNA fingerprinting; Microarray based techniques for RNA analysis; metagenomics.	15	5

BOOKS SUGGESTED:

SN	Author	Book
1	John Wiley & Sons (1999)	Cantorand Smith, Genomics
2	Arthur M Lesk, Oxford University Press, 2007	Introduction to Genomics
3	R.M. Twyman 2004	Principles of Proteomics, BIOS Scientific Publishers
4	P. Michael Conn 2003	Handbook of Proteomic Method. Humana Press, Totowa, New Jersay, USA
5	L. Stryer 2007	Biochemistry, W. H. Freeman and Co., New York



Integrated M.Sc. Semester – X

Program	Subject	Year	Semester
Integrated M.Sc.	Botany	5	X

Course Code	Course Title	Course Type
BE1002	**Nanobiotechnology**	**Elective**

Credit	Hours Per Week (L-T-P)		
	L	T	P
5	4	1	0

Maximum Marks	CIA	ESE
100	60	40

Learning Objective (LO):

Course helps to understand numerous applications of nanotechnology in a wide variety of disciplines. Targeted drug delivery, djagnosis of diseases, bioimaging, nanomedicines, nanoarrays, and gene therapy are all being investigated as nanobiotechnology applications in biomedical sciences.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1.	Concept of Nano- biotechnology, Historical background, Development. Fundamental sciences and broad areas of Nanobiotechnology.	U
2.	Nanomaterial in biotechnology - nanoparticles, quantum dots, nanotubes and nanowires etc. Nanostructures-Overview and introduction,	U
3.	Biosensors, Application of various transducing elements as part of nanobiosensors.	E
4.	Miniaturized devices in nanobiotechnology - types and applications, Biological nanoparticles production - plants and microbial, methods, Properties, Characterization and applications.	Ap
5.	Nanobiotechnological applications in health and disease	Ap

CL: Cognitive Levels (R-Remember;U-Understanding;Ap-Apply;An-Analyze;E-Evaluate;C-Create).

CO-PO/PSO Mapping for the course:

PO/CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	2	3	3	3	3	2	3	2	3	2	3	2	2
CO2	3	3	3	3	3	3	3	3	2	3	3	3	3	3	3	2
CO3	3	3	3	3	2	3	3	3	1	3	3	3	3	3	3	1
CO4	3	3	3	3	2	3	3	3	1	3	3	3	3	3	3	1
CO5	3	3	3	3	2	3	3	3	2	3	3	3	3	3	3	2

"3"–Strong;"2"–Moderate;"1"-Low;"-"No Correlation


Unit No.	Detailed Syllabus: BE1002 Nanobiotechnology Topics	No. of Lectures	CO No.
I	The nanoscale dimension and paradigm, various definitions and Concept of Nano- biotechnology, Historical background, Development. Fundamental sciences and broad areas of Nanobiotechnology.	12	1
II	Nanomaterial in biotechnology - nanoparticles, quantum dots, nanotubes and nanowires etc. Cell – Nanostructure interactions. Protein-based Nanostructures, Cell as Nanobio-machine, DNA-Protein Nanostructures-Overview and introduction, DNA- Protein conjugates in microarray technology.	18	2
III	Biosensors; molecular recognition elements, transducing elements. Applications of molecular recognition elements in nanosensing of different analytes, Application of various transducing elements as part of nanobiosensors.	16	3
IV	Miniaturized devices in nanobiotechnology - types and applications, lab on a chip concept. Biological nanoparticles production - plants and microbial, methods, Properties, Characterization and applications.	14	4
V	Nanobiotechnological applications in health and disease - infectious and chronic. Nanobiotechnological applications in Environment and food - detection and mitigation.	15	5

BOOKS SUGGESTED:

SN	Author	Book
1	Christof M, Niemeyer (Editor), Chad A. Mirkin (Editor), Wiley VCH 2004	Nanobiotechnology: Concepts, Applications and Perspectives
2	Chad A Mirkin and Christof M. Niemeyer (Eds), Wiley VCH.	Nanobiotechnology-II more concepts and applications.
3	P. Michael Conn 2003	Nanotechnology in Biology and Medicine

Integrated M.Sc. Semester – X

Program	Subject	Year	Semester
Integrated M.Sc.	Botany	5	X

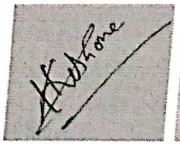
Course Code	Course Title	Course Type
BOE1001	**Plant Genetic Engineering**	**Elective**

Credit	Hours Per Week (L-T-P)		
	L	T	P
5	4	1	0

Maximum Marks	CIA	ESE
100	60	40

Learning Objective (LO):

It will provide understanding to introduce traits such as pest and disease resistance, improved protein quality, and herbicide tolerance from previously unavailable sources. Plant transformation provides a key tool for much basic research.



Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1.	Understanding of basic of gene transformation in plants, vector construction and mode of Agrobacterium infection	U
2.	Understanding the manipulation in various gene involved with nutrient uptake and biotic abiotic stress	U
3.	Evaluation of marker assisted selection and increased production of useful molecules	E
4.	Application of genetic engineering in chloroplast transformation and gene knockout/knockdown	Ap
5.	Understanding of plant metabolic engineering and application of secondary metabolites	Ap

CL: Cognitive Levels (**R**-Remember;**U**-Understanding;**Ap**-Apply;**An**-Analyze;**E**-Evaluate;**C**-Create).

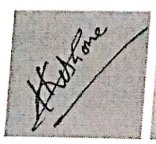
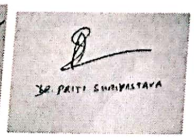
CO-PO/PSO Mapping for the course:

PO/CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	3	3	3	3	2	2	3	3	3	3	2	3	3
CO2	3	3	3	3	3	3	2	2	3	2	2	3	3	2	3	2
CO3	3	3	3	3	3	3	2	2	3	2	2	3	3	2	3	1
CO4	3	3	3	3	2	2	2	2	2	2	2	3	2	2	3	1
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

"3"–Strong;"2"–Moderate;"1"-Low;"-"No Correlation

Detailed Syllabus: BOE1001 Plant Genetic Engineering

Unit No.	Topics	No. of Lectures	CO No.
I	Plant transformation vectors and methods: T-DNA and viral vectors; Selectable marker and reporter genes, Plant transformation by Agrobacterium sp., Molecular mechanism of T-DNA transfer; in planta transformation; Direct gene transfer methods in plants.	14	1
II	Genetic engineering for increasing crop productivity by manipulation of Photosynthesis, Nitrogen fixation, Nutrient uptake efficiency. Genetic engineering for biotic stress tolerance (Insects, fungi, bacteria, viruses, weeds). Genetic engineering for abiotic stress (drought, flooding, salt, metal and temperature)	12	2
III	Genetic engineering for quality improvement of Protein, lipids, carbohydrates, vitamins & mineral nutrients, Plants as bioreactor, Marker-assisted selection of qualitative and quantitative traits. Concept of gene synteny, Concept of map-based cloning and their use in transgenics.	16	3
IV	Chloroplast transformation; Transgene analysis, silencing and targeting; Marker-free and novel selection strategies; Multigene engineering; Gene knock-down by ribozymes, antisense RNA and RNA interference.	18	4
V	Plant Metabolic Engineering. The concept of secondary metabolites, Historical and current views, Importance of secondary metabolites in medicine and agriculture, Introduction to various pathways, Flavanoid pathway, Terpenoid pathway, Polyketoid pathway, Plant vaccine.	15	5

BOOKS SUGGESTED:

SN	Author	Book
1	Bhojwani S.S: & Razdan M.K. (Elsevier)	Plant Tissue Culture: Theory and Practice
2	Slater A. Scott N. & Fowler M. Oxford University Press Inc.	Plant Biotechnology: The Genetic Manipulation of Plants
3	Chrispeels M.J. & Sadava D.E. Jones and Barlett Publishers	Plants, Genes and Crop Biotechnology
4	Primrose S. B. & Twyman R. M. Blackwell Publishing.	Principles of Gene Manipulation and Genomics
5	Gamborg O. L & Phillips G. C. Springer-Verlag.	Plant Cell, Tissue and Organ Culture: Fundamental Methods. (Eds).

Integrated M.Sc. Semester – X

Program	Subject	Year	Semester
Integrated M.Sc.	Botany	5	X

Course Code	Course Title	Course Type
BO E1002	**Plant Microbe Interaction**	**Elective**

Credit	Hours Per Week (L-T-P)		
	L	T	P
5	4	1	0

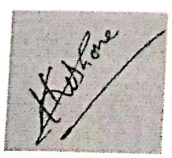
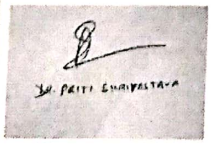
Maximum Marks	CIA	ESE
100	60	40

Learning Objective (LO):
It will provide Understanding of the molecular mechanisms of plant–microbe interaction which would help develop innovative genetic engineering strategies of symbiosis, mutualism, and disease resistance through gene editing, RNA silencing, and other approaches.

Course Outcome (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1.	Understanding of recent development in plant pathology, Significance of plant diseases, and plant-microbe associations	U
2.	Know about the beneficial Plant - Microbe association	U
3.	Better understanding of Parasitism and disease development, Pathogenecity, host range of pathogens, disease cycle and epidemics.	E
4.	Deeper insights of biotrophic and necrotrophic fungi, Virus and Viroid genes involved in pathogenicity	Ap
5.	Have intense knowledge of Molecular genetics of plant disease susceptibility and resistance	Ap

CL: Cognitive Levels (**R**-Remember;**U**-Understanding;**Ap**-Apply;**An**-Analyze;**E**-Evaluate;**C**-Create).

CO-PO/PSO Mapping for the course:

PO/CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	3	2	3	2	2	2	3	3	3	3	2	3	3
CO2	3	3	3	2	3	2	2	3	2	3	2	3	2	3	2	3
CO3	3	3	3	3	3	3	2	3	3	3	2	3	3	3	3	2
CO4	3	3	3	3	3	3	2	3	3	3	3	3	3	3	3	1
CO5	3	3	3	3	3	3	2	3	2	3	3	3	3	3	3	1

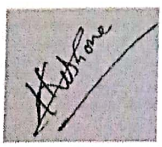
"3"–Strong;"2"–Moderate;"1"-Low;"-"No Correlation

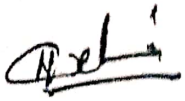
Detailed Syllabus: BOE1002 Plant Microbe Interaction

Unit No.	Topics	No. of Lectures	CO No.
I	History of Plant pathology and recent developments: Significance of plant diseases, and pathology, types of plant-microbe associations (pathogenic– bacteria, virus, fungi, and symbiotic).	12	1
II	Beneficial Plant - Microbe interactions (molecular aspects): a. Nitrogen fixing bacteria and blue green algae b. Mycorrhizal association c. Phytohormones and Biocontrol antibiotics	16	2
III	Parasitism and disease development: Pathogenecity, host range of pathogens, disease cycle and epidemics.	18	3
IV	Molecular biology of pathogenicity: Mechanisms of variability in pathogens, pathogenicity genes and mechanisms in pathogenic bacteria, biotrophic and necrotrophic fungi,Virus and Viroid genes involved in pathogenicity, Agrobacterium and plant interaction-a model system.	14	4
V	Molecular genetics of plant disease susceptibility and resistance: Types of plant resistance to pathogens (R gene resistance, quantitative and monogenic), basal and induced defense mechanisms, pre-formed inhibitors of pathogens, gene for gene interaction in plant defense, Systemic Acquired Resistance (SAR) and Induced Systemic Resistance (ISR), Recognition mechanism and signal transduction during plant - pathogen interaction.	15	5

BOOKS SUGGESTED:

SN	Author	Book
1	Agrios G. N. Academic Press	Plant Pathology
2	Dickinson M. BIOS ScientificPress	Molecular Plant pathology
3	Jeng-Sheng H. T Kluwer Academic Pubs. T Gen 904 (ii) MEDICA	Plant Pathogenesis and Resistance: Biochemistry and Physiology of Plant-Microbe Interactions






Integrated M.Sc. Semester – X

Program	Subject	Year	Semester
Integrated M.Sc.	Botany	5	X
Course Code	Course Title		Course Type
BOE 1003	Plant Tissue Culture		Elective
Credit	Hours Per Week (L-T-P)		
	L	T	P
5	4	1	0
Maximum Marks	CIA		ESE
100	60		40

Learning Outcome (LO): This course offers a comprehensive insight and systematic learning of how plants regenerate from explants and important cues for plant micropropagation and genetic modification.

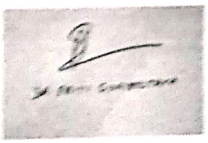
Course Outcomes(CO):-

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	Introduction, basic concepts and techniques of plant tissue culture.	U
2	Understand different stages and types of micropropagation along with its applications.	U
3	Let students know about various types of organ cultures with their applications, somaclonal variation and synseed technology.	U
4	For detail study of protoplast technology, somatic hybridization and cybridization with their application in plant research.	Ap
5	Production of secondary metabolites using plant cell cultures and general methods of phytochemical analysis.	Ap

CL:CognitiveLevels (R-Remember;U-Understanding;Ap-Apply;An-Analyze;E-Evaluate;C-Create).

CO-PO/PSO Mapping for the course-

PO/CO	POs													PSO					
	1	2	3	4	5	6	7	8	9	10	11	12	13	1	2	3	4	5	6
CO1	3	2	3	2	2	3	3	3	3	3	3	3	1	3	3	1	3	3	2
CO2	3	1	-	1	1	3	3	3	3	1	3	3	1	3	3	3	3	1	1
CO3	3	3	3	3	3	3	3	3	3	1	3	3	1	3	3	1	3	1	3
CO4	3	2	2	3	3	3	3	3	3	1	3	3	1	3	3	1	3	1	1
CO5	3	1	1	3	2	3	-2	3	3	1	3	3	1	3	3	1	3	1	1

Unit	Detailed Syllabus: BOE1003 Plant Tissue Culture Topics	No of lectures	CO
Unit-I	Plant Tissue Culture- History, scope and applications, Concept of cell totipotency, Concept of asepsis and methods of sterilization, Media-components, preparation and types, Maintenance of cultures- environmental conditions, Explants selection, sterilization and inoculation	15	1
Unit II	In vitro regeneration of plants- Stages of micropropagation Different pathways of micropropagation (Enhanced axillary branching, de novo shoot bud differentiation, somatic embryogenesis and callus organogenesis) and their applications. Micropropagation in forestry and horticulture.	15	2
Unit-III	Organ Culture- Anther, Pollen, Embryo and Endosperm culture, Meristem culture and their applications, Somaclonal variation-its causes and consequences, its role in crop improvement, Synseed production and applications.	15	3
Unit-IV	Protoplast technology: Protoplast isolation, culture, regeneration and viability tests, Methodology adopted in protoplast fusion, Somatic hybridizationandcybridization and application in plant research.	15	4
Unit-V	Secondary plant metabolites: Production by use of cell culture technology. Bioreactors, types and uses. Hairy root culture, cell immobilization. General methods of phytochemical analysis, methods of extraction, isolation, separation, identification and analysis. Production, function and uses of Alkaloids, phenols, tannins and antibiotics in culture	15	5

Books Recommended:

1. Bhojwani S.S. and Razdan M.K. (1983). Plant Tissue Culture: Theory and Practice. Elsevier, Amsterdam.
2. Razdan M.K., 2002. Introduction to Plant Tissue Culture. Oxford & IBH.
3. Reinert J. and Bajaj Y.P.S.1977. Plant Cell Tissue and Organ Culture. Springer Verlag.
4. Bhojwani S.S. 1990. Plant Tissue Culture: Application and Limitations. Elseiver.
5. Purohit, S.D. 2013. An Introduction to Plant Cell, Tissue and Organ culture. Prentice Hall, India.

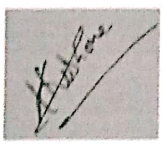
Integrated M.Sc. Semester – X

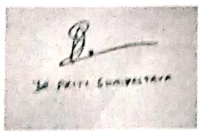
Program	Subject	Year	Semester
Integrated M.Sc.	Botany	5	X

Course Code	Course Title	Course Type
BOE1004	**Plants for Human Welfare**	**Elective**

Credit	Hours Per Week (L-T-P)		
	L	T	P
5	4	1	0

Maximum Marks	CIA	ESE
100	60	40





Learning Objective (LO):
It will provide knowledge that Plants provide many products for human benefits, such as timber, fibres, medicines, dyes, firewood, pesticides, oils, and rubber. Medicinal plants provide major source of molecules with medicinal properties due to presence of natural compounds.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1.	A general overview of economically important plants and their role in human welfare	U
2.	Medicinal: Traditional plants as source of drugs against several diseases Plant secondary metabolites; classification, knowledge of extraction, isolation, characterization and elicitation of bioactive metabolites.	U
3.	Nutraceuticals and functional foods, transgenic approaches and constraints for improvement	U
4.	Plant-based biofuels Extraction and economic viability; application as alternate source of fuel	Ap
5.	Plants as a source of timber, with special reference to their improvement through breeding and genetic transformation.	Ap

CL: Cognitive Levels (**R**-Remember;**U**-Understanding;**Ap**-Apply;**An**-Analyze;**E**-Evaluate;**C**-Create).

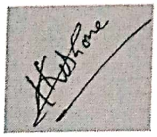
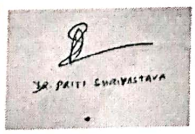
CO-PO/PSO Mapping for the course:

PO/CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	2	3	3	2	2	1	2	3	3	3	2	2	2
CO2	3	3	3	2	3	3	2	2	1	2	3	3	3	2	2	2
CO3	3	3	3	2	3	3	2	3	1	2	3	3	3	3	2	1
CO4	3	3	3	2	3	3	2	3	1	2	3	3	3	3	2	1
CO5	3	3	3	3	3	3	3	3	2	3	3	3	3	3	3	3

"3"–Strong;"2"–Moderate;"1"-Low;"-"No Correlation

Detailed Syllabus: BOE 1004 Plants for Human Welfare

Unit No.	Topics	No. of Lectures	CO No.
I	A general overview of economically important plants and their role in human welfare as food, oil, drugs, nutraceuticals, fuel. Food crops: Cereals; Spices and condiments; Alcoholic and non-alcoholic beverages.	12	1
II	Medicinal: Traditional plants as source of drugs against several diseases such as cancer, diabetes, malaria, dengue, psoriasis, etc. Plant secondary metabolites; classification, knowledge of extraction, isolation, characterization and elicitation of bioactive metabolites.	15	2
III	Nutraceuticals and functional foods; Important plants such as Aloe vera, Piper, Withania, Ginseng, Amaranthus etc. yielding antioxidants and nutraceutical compounds. Edible and non-edibleoils: Oil yielding plants, transgenic approaches and constraints for improvement indifferent oils. Essential oils.	16	3
IV	Plant-based biofuels e.g., Difference between first and 2nd generation biofuels, *Jatropha, Pongamia, Zea mays, Madhuca,* etc. Extraction and economic viability; application as alternate source of diesels, Bioelectricity.	14	4

V	Plants as a source of timber: e.g., *Tectona grandis, Salix sp., Dalbergia sisso*, Fibre yielding plants: Cotton (*Gossypium sp.*), Jute (*Corchorus sp.*) with special reference to their improvement through breeding and genetic transformation e.g., Bt cotton.	18	5

BOOKS SUGGESTED:

SN	Author	Book
1	R.N. Chopra, S.L. Nayar and I.C. Chopra, 1956. C.S.I.R, New Delhi	Glossary of Indian medicinal plants
2	Kanny, Lall, Dey and Raj Bahadur, 1984. International Book Distributors	The indigenous drugs of India
3	Agnes Arber, 1999. Mangal Deep Publications.	Herbal plants and Drugs
4	Acharya, Deepak; Anshu, Shrivastava (2008)	Indigenous Herbal Medicines: Tribal Formulations and Traditional Herbal Practices. Jaipur, India: Aavishkar Publishers

Integrated M.Sc. Semester – X

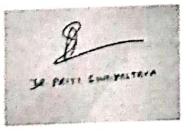
Program	Subject	Year	Semester
Integrated M.Sc.	Botany	5	X
Course Code	Course Title		Course Type
BOE1005	**Phytochemistry and Herbal Technology**		**ELECTIVE**
Credit	Hours Per Week (L-T-P)		
	L	T	P
5	4	1	0
Maximum Marks	CIA		ESE
100	60		40

Learning Objective (LO):
Through this course students will understand the importance of phytochemistry which will actually add therapeutic value to the medicinal plants.They will know the various techniques involved in the phytochemistry and get familiarize the bio-active components present in the plants.

Course Outcomes(CO):-

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	Introduction of phytochemistry and herbal technology, understanding of primary and secondary metabolites and their uses, and methods of herbal technology according to WHO guideline.	U
2	Detail knowledge of various techniques used for extraction, isolation and purification of phytochemicals.	L
3	Knowing techniques appropriately used for characterization of various phytochemicals.	U
4	Exploring the protocolsand parameters of standardization and validation of phytochemical.	Ap
5	Better understanding of validation of drug – guidelines, testing, storage and packing of drugs.	Ap

CL:CognitiveLevels(R-Remember;U-Understanding;Ap-Apply;An-Analyze;E-Evaluate;C-Create).

V	Plants as a source of timber: e.g., *Tectona grandis, Salix sp., Dalbergia sisso*, Fibre yielding plants: Cotton (*Gossypium sp.*), Jute (*Corchorus sp.*) with special reference to their improvement through breeding and genetic transformation e.g., Bt cotton.	18	5

BOOKS SUGGESTED:

SN	Author	Book
1	R.N. Chopra, S.L. Nayar and I.C. Chopra, 1956. C.S.I.R, New Delhi	Glossary of Indian medicinal plants
2	Kanny, Lall, Dey and Raj Bahadur, 1984. International Book Distributors	The indigenous drugs of India
3	Agnes Arber, 1999. Mangal Deep Publications.	Herbal plants and Drugs
4	Acharya, Deepak; Anshu, Shrivastava (2008)	Indigenous Herbal Medicines: Tribal Formulations and Traditional Herbal Practices. Jaipur, India: Aavishkar Publishers

Integrated M.Sc. Semester – X

Program	Subject	Year	Semester
Integrated M.Sc.	Botany	5	X
Course Code	Course Title		Course Type
BOE1005	**Phytochemistry and Herbal Technology**		**ELECTIVE**
Credit	Hours Per Week (L-T-P)		
	L	T	P
5	4	1	0
Maximum Marks	CIA		ESE
100	60		40

Learning Objective (LO):

Through this course students will understand the importance of phytochemistry which will actually add therapeutic value to the medicinal plants.They will know the various techniques involved in the phytochemistry and get familiarize the bio-active components present in the plants.

Course Outcomes(CO):-

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	Introduction of phytochemistry and herbal technology, understanding of primary and secondary metabolites and their uses, and methods of herbal technology according to WHO guideline.	U
2	Detail knowledge of various techniques used for extraction, isolation and purification of phytochemicals.	L
3	Knowing techniques appropriately used for characterization of various phytochemicals.	U
4	Exploring the protocolsand parameters of standardization and validation of phytochemical.	Ap
5	Better understanding of validation of drug – guidelines, testing, storage and packing of drugs.	Ap

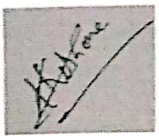
CL:CognitiveLevels(R-Remember;U-Understanding;Ap-Apply;An-Analyze;E-Evaluate;C-Create).


PO-CO/PSO Mapping of the course-

PO/CO	POs													PSO					
	1	2	3	4	5	6	7	8	9	10	11	12	13	1	2	3	4	5	6
CO1	3	2	3	3	2	3	3	3	3	1	3	3	1	3	3	1	3	3	1
CO2	3	2	2	3	2	3	3	3	3	1	3	3	1	3	3	1	3	3	1
CO3	3	2	2	3	2	3	3	3	3	1	3	3	1	3	3	1	3	3	1
CO4	3	2	2	3	3	3	3	3	3	1	3	3	1	3	3	1	3	3	1
CO5	3	1	1	3	2	3	2	3	3	1	3	3	1	3	3	1	3	3	1

Detailed Syllabus: BOE 1005 Phytochemistry and Herbal Technology

Unit No.	Topics	No. of Lectures	CO No.
I	Phytochemisrty: Scope of phytochemistry, plants as source of chemical compounds, primary and secondary metabolites and its applications; Definition, source of herbal raw materials, identification, authentication, standardization of medicinal plants as per WHO guidelines and different herbal pharmacopoeias; Natural pigments, natural products as markers for new drug discovery.	12	1
II	Extraction, isolation and purification of phytochemicals: Selection of plant samples, processing and storage of samples for extraction; Factors influencing the choice of extraction, principles of extraction methods, infusion, decoction, digestion, maceration, percolation, solvent extraction, fluid extraction, ultrasound, microwave assisted extraction, advantage and disadvantage involved in each method; Isolation of selected primary and secondary metabolites – amino acids, proteins and carbohydrate; Phenolics, flavonoids, alkaloids, lipids, oils, terpenes and saponins; Purification techniques for primary and secondary metabolites – solvent-solvent fractionation and chromatography techniques.	15	2
III	Characterisation of Phytochemicals: Preliminary, qualitative and quantitative techniques – paper chromatography, thin layer chromatography, column chromatography- HPLC, GC (qualitative and quantitative), colour reactions for amino acids, sugars, phenolics, flavonoids, alkaloids, terpenes, saponins, oils, lipids; Spectroscopic estimations/gravimetric determination of total sugars, amino acids, proteins, phenolics, flavonoids, alkaloids, terpenes, saponins, oils, lipids; Characterisation using spectroscopic techniques - UV/VIS, FTIR, DSC (differential scanning calorimeter), NMR, MS, MALDI. XRD – single crystal and powder.	16	3
IV	Standardisation and Validation of Phytochemical: Quality determination of herbal drugs; Role of processing methods and storage conditions on quality of drugs; Standardisation parameters- impurity limit, ash content, extractable matter, moisture content, other phytochemicals, microbial contaminants, pesticides;	14	4
V	Validation of drug – guidelines, limit of detection and quantification of impurities, organoleptic properties, physical, chemical, biological characteristics, stability testing, storage conditions and packing system/unit.	18	5




Books recommended

1) Braithwaite, A. and Smith, F.J. 1996. Chromatographic Methods. 5th edn., Blackie Academic & Professional, London.
2) Bourne, U.K. Kokate, Purohit, C.K. and Gokhale S.B. 1983. Pharmacognosy. NivaliPrakashan Publication.
3) Sadasivam. S. and A. Manickam, Bio Chemical methods 2ndedn. New Age International Pvt Ltd. New Delhi.
4) Harborne, J.B. 1984. Phytochemical Methods, 2ndedn. Chapman and Hall, London.
5) Harborne J.B., 1973: Phytochemical methods a guide to modern techniques of plants analysis. Chapman and Hall Ltd. London.

Integrated M.Sc. Semester – X

Program	Subject	Year	Semester
Integrated M.Sc.	Botany	5	X
Course Code	Course Title		Course Type
BOE1006	**Plant Secondary Metabolite Production**		**ELECTIVE**
Credit	Hours Per Week (L-T-P)		
	L	T	P
5	4	1	0

Maximum Marks	CIA	ESE
100	60	40

Learning Objective (LO):

Studying plant secondary metabolite and techniques used for their production with respect to their relevant functions encourages students to explore the possibility of plant secondary metabolites in modern medicines.

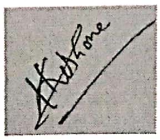
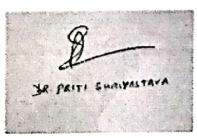
Course Outcomes (CO):-

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	What are secondary metabolites and their classes? To also know about bioactive compound production from fungi and other microbes.	L
2	Detail knowledge of secondary metabolite production using plant cell culturing methods.	U
3	Developing a better understanding of pharmaceutically important drugs and their production methods, basic concepts of biotransformations and cell immobilization.	L
4	Get familiarized with genetic engineering for recombinant protein production and genetic manipulation in the pathways of secondary metabolite synthesis. To understand edible vaccine and nutraceuticals.	Ap
5	To acquaint with bioreactor technology and plant tissue culture industries in India.	Ap

CL:Cognitive Levels (R-Remember;U-Understanding;Ap-Apply;An-Analyze;E-Evaluate;C-Create)

PO-CO/PSO Mapping:

PO/CO	POs													PSO					
	1	2	3	4	5	6	7	8	9	10	11	12	13	1	2	3	4	5	6
CO1	3	3	3	1	2	3	2	3	3	1	3	3	3	3	3	1	3	3	3
CO2	3	3	2	1	1	3	3	3	3	1	3	3	2	3	3	1	3	3	3

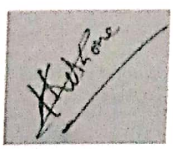
CO3	3	3	3	2	2	3	3	3	3	1	3	3	2	3	3	1	3	3	3
CO4	3	3	2	1	1	3	3	3	3	1	3	3	2	3	3	1	3	3	3
CO5	3	3	2	1	1	3	3	3	3	1	3	3	2	3	3	1	3	3	3

Detailed Syllabus: BOE-1006 Plant Secondary Metabolite Production

Unit No.	Topics	No. of Lectures	CO
I	Secondary metabolites: Primary and secondary metabolites. Principal classes of secondary metabolites with their occurrence and classification: Alkaloids, Terpenes and Shikimic acid and mevalonate pathways. Bioactive molecules from fungi (Fungal metabolites, Mycotoxins, colorant, enzymes) and Microorganisms.	15	1
II	Production of secondary metabolites: Basic concept of Callus and cell suspension cultures. Nutrients and media, approaches and factors affecting the production ofsecondary metabolites (optimization, effects of auxin, selection, hairy roots, elicitation, precursors, concept of growth and production media).	15	2
III	Production of pharmaceutically important drugs in culture: alkaloids (Catharanthus, Papaver), anti-tumour agents (taxol, podophyllotoxins, camptothecine), saponins and sterols (diosgenin, guggul, ginseng), food additives (sweetners, flavours andcolours). Basicconcepts of Biotransformations and Cell Immobilization.	15	3
IV	Molecular farming: Production of drugs and recombinant protein by genetic engineeringtechnology, metabolic engineering for the production of useful metabolites (Pathway manipulation of Tropane and Indole alkaloids), Edible vaccines, products on market,Production of Artemisinin in Artemisia annua. Basic concepts of functional foods.Nutraceuticals (Classification of Nutraceuticals, Phytochemicals as nutraceuticals).	15	4
V	Bioreactors: Types of bioreactors (stirred tank, air lift, membrane type, immobilized celland wave bioreactors), process and operation for small and large bioreactors. Bioreactorfor production of biomass (secondary metabolites and for micropropagation), scope ofcommercialization of bioreactor based technologies. Plant tissue culture industry in India.	15	5

BOOKS SUGGESTED:

1. Plant Secondary Metabolites by A. Crozier et al., Blackwell Publishers.
2. Biotechnology – Secondary Metabolites by K.G. Ramawat& J.M. Merillon, Science Publishers Inc.
3. Natural Products from Plant II Edition by L.J. Cseke et. al., Taylor andFrancis.
4. Bioactive Molecules and Medicinal Plants by K.G. Ramawat and J.M.Merillon, Springer, Germany.
5. Plant-derived Natural Products by A.E. Osbourn & V. Lonzotti, Springer, Germany




Integrated M.Sc. Semester – VIII

Program	Subject	Year	Semester
Integrated M.Sc.	Botany	4	VIII

Course Code	Course Title	Course Type
SEBL801	**Statistical Tools in Biological Research**	**Skill Enhancement Course**

Credit	Hours Per Week(L-T-P)		
	L	T	P
2	0	0	4

Maximum Marks	CIA	ESE
100	60	40

Learning Objective (LO):
To understand various statistical tools used in biological research.

Course Outcomes (CO):-

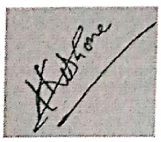
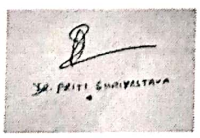
CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1.	Basic knowledge of SPSS software tool, Preparation and presentation of data	A
2.	Provide knowledge of calculating Descriptive statistics	E
3.	Provide knowledge of Parametric and Non-parametric test	E
4.	Provide knowledge of ANOVA, Comparison of means, preparation of different charts	E
5.	Provide basic knowledge of NTSYS Pc software, Jaccard coefficient, Principle component Analysis, Dendrogram construction	E

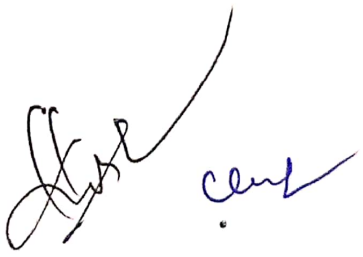
CL: Cognitive Levels (R-Remember;U-Understanding;Ap-Apply;An-Analyze;E-Evaluate;C-Create).

CO-PO/PSO Mapping for the course:

PO/CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	2	2	1	2	1	-	2	2	3	1	2	-	3
CO2	3	3	3	2	2	1	2	1	-	2	2	3	1	2	-	3
CO3	3	3	3	2	2	1	2	1	-	2	2	3	1	2	-	2
CO4	3	3	3	2	2	1	2	1	-	2	2	3	1	2	-	2
CO5	3	3	3	1	2	1	2	1	-	2	2	3	1	2	-	2

"3"–Strong;"2"–Moderate;"1"-Low;"-"No Correlation



Detailed Syllabus: SEBL801 Statistical Tools in Biological Research

Unit No.	Topics	No. of Lectures	CO No.
I	Introduction to SPSS software tool, Basic data preparation, Creating variables, entering data, Data management using SPSS	5	1
II	Experimental design strategy, Descriptive statistics using SPSS tool: Frequency distribution, Data types/Binomial Distribution, Poisson Distribution, Normal Distribution, Measures of central tendency, Measures of variability / Dispersion, Measures of deviation from the Normality	5	2
III	Parametric: One-sample t-test 2.4.2 Independent Sample t-test 2.4.3 Paired Sample t-test and Non-parametric tests, ANOVA, Comparison of means, Investigating relationship between variables-Correlation and Regression, Pearson Correlation, Spearman Rank Correlation, Partial Correlation	7	3
IV	Making Graphs and Charts using SPSS: Line Graphs, Bar Charts, Pie Charts, Histograms, Scatter Plots, Box Plots, Error Bars, High-Low Bars, Population Pyramids	7	4
V	Introduction to NTSYS Pc software, Creating data file, Jaccard coefficient, Principle component Analysis, Dendrogram construction	6	5