PT. RAVISHANKAR SHUKLA UNIVERSITY

Center for Basic Sciences

CURRICULUM & SYLLABI
[Based on LOCF]

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

Session: 2024-25 & onwards

Approved by:	Board of Studies Bioscience	Academic Council
Date: 10/5/24	10/5/24	

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 Biology

Courses offered during the first year (Semesters I to II) are meant as basic and introductory courses in Biology, Chemistry, Mathematics, Physics and Environmental Science. These are common and mandatory for all students. These courses are intended to give a flavour of the various approaches and analyses and to prepare the students for advanced courses in later years of 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 bases 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

Integrated M.Sc. Biology 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.
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

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	teaching.
PO-6	**Social/Interdisciplinary Interaction**: Integrate biological concepts 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 biological techniques 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 biological 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 biological 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
PSO2	Apply the knowledge of biology including Plant sciences and Animal 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 biological

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	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 Biology

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 students)	VIII	01	02

Course Structure for the Integrated M.Sc. Biology Stream

Effective from Session 2024-25

(Abbreviation: B: Biology, C: Chemistry, M: Mathematics, P: Physics, G: General, H: Humanities, BL: Biology Laboratory, CL: Chemistry Laboratory, PL: Physics Laboratory, GL: General Laboratory, BE: Biology Elective

- 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

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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 Course)	History and Philosophy of Science	T	[2 + 0]	2	60	40	100

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

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Core	B 501	Genetics	T	[3 + 1]	4	60	40	100
Core	B 502	Molecular Biology	T	[3 + 2]	5	60	40	100
Core	B 503	Biodiversity plants/animals	T	[3 + 2]	5	60	40	100
Core	H501	Scientific Writing in Hindi	T	[2]	2	60	40	100
Core	BL501	Biology 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	B 601	Immunology	T	[2 + 1]	3	60	40	100
Core	B 602	Animal Physiology	T	[2 + 1]	3	60	40	100
Core	B 603	Plant Physiology	T	[3 + 1]	4	60	40	100
Core	B 604	Microbiology	T	[3 + 1]	4	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	BL601	Biology 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

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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	B 702	Immunology – II	T	[3 + 1]	4	60	40	100
Core	B 703	Developmental Biology	T	[3 + 1]	4	60	40	100
Core	B 704	Imaging Technology in Biological Research	T	[3 + 1]	4	60	40	100
Core	BPGD 701	Biology PG Dissertation/Project	P	[8]	4	60	40	100
Core	BL 701	Advanced Biology 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	BL 801	Advanced Biology Laboratory-II	P	[10]	5	60	40	100
Core	BPGD801	Biology 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

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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	BPGD901	Biology 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	BE1	Proteomics and Genomics	T	[4 + 1]	5	60	40	100
Elective	BE2	Nanobiotechnology	T	[4 + 1]	5	60	40	100
Elective	BE3	Plant Genetic Engineering	T	[4 + 1]	5	60	40	100
Elective	BE4	Plant-Microbe Interaction	T	[4 + 1]	5	60	40	100
Elective	BE5	Neurobiology	T	[4 + 1]	5	60	40	100
Elective	BE6	Plants for Human Welfare	T	[4 + 1]	5	60	40	100
Elective	BE7	Animal Tissue Culture	T	[4 + 1]	5	60	40	100
Elective	BE8	Earth Science and Energy & Environmental Sciences	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. The chosen four subjects will have codes BE1001, BE1002, BE1003 and BE1004.**

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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 Type (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 stream)	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	H302	History and Philosophy of Science	T	[2 + 0]	2	60	40	100

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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	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√

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CB401	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
B401	√	√	√	×	√	√	√	√	×	√	√	√	√	√	√	√
B402	√	√	√	×	√	√	√	√	×	√	√	√	√	√	√	√
G401	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
BL401	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
GL401	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
H401	√	√	×	×	√	√	√	√	√	√	√	√	√	√	√	√
CB501	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
B501	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
B502	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
B503	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
H501	√	√	×	×	√	√	√	√	√	√	√	√	√	√	√	√
BL501	√	√	√	×	√	√	√	√	√	√	√	√	√	√	√	√
CB601	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
B601	√	√	√	×	√	√	√	√	×	√	√	√	√	√	√	√
B602	√	√	√	×	√	√	√	√	×	√	√	√	√	√	√	√
B603	√	√	√	×	√	√	√	√	×	√	√	√	√	√	√	√
B604	√	√	√	√	√	√	√	√	×	√	√	√	√	√	√	√
H601	√	√	√	×	√	√	√	√	√	√	√	√	√	√	√	√
H602	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
BL601	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
B701	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
B702	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
B703	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
B704	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
BL701	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
BPGD701	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
B801	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
B802	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
B803	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
B804	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
BL801	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
BPGD801	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
BPGD901	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
BE1	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
BE2	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√

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BE3	√	√	√	×	√	√	√	√	√	√	√	√	√	√	√	√
BE4	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
BE5	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
BE6	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
BE7	√	√	√	×	√	√	√	√	√	√	√	√	√	√	√	√
BE8	√	√	√	×	√	√	√	√	√	√	√	√	√	√	√	√
	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.	Biology	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:

POCO	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
7	SD Garber (2002)	Biology: A Self-Teaching Guide, (2nd Edition)

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Integrated M.Sc. Semester – I

Program	Subject	Year	Semester
Integrated M.Sc.	Biology	I	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. An environmental study is all about learning the way we should live and how we can develop sustainable strategies to protect the environment. It helps 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;"-"NoCorrelation

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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 resources, 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 ecosystems. 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

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S. No.	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.	Biology	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	Pos											PSO				
CO	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

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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:** Taxonomy, Methods of Classification, Dichotomous key, Hierarchical Classification, Phylogenetic Classification	5	1
II	**Introduction to Light Microscopy** Micrometry: Measuring size of a microscopic specimen.	5	2
III	**Staining and Observing:** human cheek cells plant cells. Study morphological characteristics of *S. cerevesiae*, differentiating dead v/s live cells	6	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.	8	4
V	**Staining human blood cells:** To observe human blood cell types by differential staining, Haemocytometer.	6	5

Integrated M.Sc. Semester – II

Program	Subject	Year	Semester
Integrated M.Sc.	Biology	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.	Students have the 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 andRNA 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

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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.	Biology	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 Objective (LO):

Environmental studies foster awareness about biodiversity and both renewable and nonrenewable resources in a particular region. This involves assessing the available resources, their utilization patterns and the need to maintain a balance for future generations.

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

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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;"-"NoCorrelation

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 India. Conservation of biodiversity: in situ and ex-situ conservation of biodiversity.	6	1
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.	Biology	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 / 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	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

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"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	5	1
II	**Understand the principle and use of** Centrifugation, colorimeter and spectrophotometer,	4	2
III	**Microscopic observation** Bacterial cell counting using Neubauer chamber, mitosis in onion root tips, Gram Staining: To differentiate bacteria cells by Gram staining.	8	3
IV	**Introduction to Research Laboratory:** Different kinds of microbial plates, liquid growth media for microbes, verify Beer-Lamberts law.	6	4
V	**Extraction & estimation** –Carbohydrate, protein content, lipid **Separation of biomolecules using:** Adsorption chromatography; Partitioning of indicators in various solvent systems, Paper chromatography, Reverse phase thin layer chromatography (PRTLC)	7	5

Integrated M.Sc. Semester – III

Program	Subject	Year	Semester
Integrated M.Sc.	Biology	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 these.

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,	15	5

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	ubiquitin- proteasome.		

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.	Biology	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, 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.	15	4
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

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Integrated M.Sc. Semester – III

Program	Subject	Year	Semester
Integrated M.Sc.	Biology	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 oftotal free amino acids by ninhydrin reagent, and Estimation of acid value, Iodine number, Saponification value, Peroxide value in unsaturated fats and oils	AP
3	Depth knowledge of the Carbohydrate extraction, estimation and identificationfrom 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	**10**	**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.	**10**	**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, Meiosis using lily anthers.	**10**	**5**

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Integrated M.Sc. Semester – IV

Program	Subject	Year	Semester
Integrated M.Sc.	Biology	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 animal cells (tight junctions, desmosomes, gap junctions).	E
2.	Understand the basic principles of signal transduction mechanisms, in particular the concepts of 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

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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.	Biology	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

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Maximum Marks	CIA	ESE
100	60	40

Learning Objective (LO):
To unravel the complex chemical reactions that occur in a wide variety of life forms which will provide the basis for practical advances in medicine, veterinary medicine, agriculture, and biotechnology. It underlies and includes such exciting new fields as molecular genetics and bioengineering.

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, 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

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IV	Amino acid Metabolism: Transamination, Deamination, 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.	Biology	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):

Describe the evolution, diversity and replication of cells; Explain the role of compartmentalization and signalling in cellular biology; Interpret and explain key experiments of cell biology; Evaluate and apply knowledge of modern techniques in cellular biology. 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

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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	10	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	10	2
III	**Chromatography** (a) Paper chromatography-chromatography of amixture of amino acids (b) TLC, Gel filtration (c) Ion-exchange chromatography, affinity chromatography	10	3
IV	**Study** Programmed Cell Death DNA Laddering and Cell death assay (quantification by Evans Blue), Barr bodies and Meiosis using lily anthers	10	4
V	**To detect** blood group and Rh factor in the blood sample. Introducing undergraduate students to **real-time PCR**	5	5

Integrated M.Sc. Semester – V

Program	Subject	Year	Semester
Integrated M.Sc.	Biology	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;"-"NoCorrelation

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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
4	Harvey Motulsky, 2010	Intuitive Biostatistics: A Nonmathematical Guide to Statistical Thinking
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.	Biology	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).

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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
CO2	3	3	3	2	3	2	3	2	-	3	2	3	3	2	2	3
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.	10	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.	10	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.	10	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.	Biology	3	V

Course Code	Course Title	Course Type
B-503	**Biodiversity of plants/animals**	**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):

Studying the concept of biodiversity involves counting the total number of species living in a specific area. The study of the diversity of plants and animals will result in awareness about many organisms and help in the conservation of species that are on the verge of extinction.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1.	Understand the principles of general taxonomy and use of nomenclature rules of plants. Understand historical development of taxonomy.	U
2.	The main objectives 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	C
3.	Compare the important differences between bryophytes, pteridophytes, gymnosperms and angiosperms. Identify the structures and evolutionary trends associated with the diversification of plants in terrestrial habitats (e.g., decrease in the significance of the haploid generation, endosporic development of gametophytes, vascular tissue, heterospory, seeds, pollen, etc.).	Ap
4.	Cellular mechanism which will further improve the understanding of processes of living beings.	U
5.	Identify ecological requirements and maintaining factors for priority species and ecosystems.	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: B 503 Biodiversity of plants/animals

Unit No.	Topics	No. of Lectures	CO No.
I	Principles of taxonomy: Concept of species and hierarchical taxa, Biologicalnomenclature, Taxonomical structure, Outline classification of animals, important criteria used for classification in each Taxon, **Classification** of animals Levels of Structural organizations: Larval forms and their evolutionary significance, Unicellular, colonial, and multicellular forms, Levels of organization of tissues, organs, and systems, Comparative anatomy.	10	1
II	Classical and quantitative methods in taxonomy: Biosystematics, Interrelationship among major invertebrate phyla and minor invertebrate phyla; Evolutionary relationship among taxa, Natural History of Indian subcontinent: Major habitat types, Geographical origin and migration of species, Common Indian flora and fauna.	15	2
III	Taxonomy of plants: Plant identification, nomenclature, collecting and documentation, plant phylogeny and systematics. Gymnosperms: Characteristic features, outline classification, morphology and anatomy of ovules and female gametophyte, microspore and male gametophyte, seeds, stem and leaves.	15	3
IV	Angiosperms: Characteristic features, outline classification, comparison of monocotyledons and dicotyledons, vascular anatomy, leaves, flower, fruits and seeds. Comparative anatomy and morphology of angiosperms and gymnosperms.	10	4
V	Concepts and characteristics of biodiversity: The concepts of biodiversity, Different strategies for conserving biodiversity. a. Conservation Strategies, b. Laws and Legal Actions, c. Grassroots Action Program Comparison of historical and current rate of species extinction, Importance of preserving biodiversity, Genetic diversity, Causes and consequences of biodiversity loss: Address the major threats to biodiversity- a. Habitat Loss & Alteration b. Exotic Species c. Chemical Pollutants d. Loss of Genetic Diversity in Crops.	10	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, and Susan E. Eichhorn	Biology of Plants

Integrated M.Sc. Semester – V

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

Course Code	Course Title	Course Type
BL-501	**Biology 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 of sample types, preparation, and storage for molecular biology tests. A key goal of molecular genetics is to identify and study genetic mutations. Researchers search for mutations in a gene or induce mutations in a gene to link a gene sequence to a specific phenotype. Develop awareness of sample types, preparation, and storage for molecular biology tests. Understand applicability of testing to various sample types.

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, Phage Titration, Transposition, α- Complementation, Karyotyping.	AP
2	Understand the Biodiversity in surrounding soil, air and water samples. Isolation of microflora and their morphological and microscopic characterization	AP

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3	Develop a strong foundation on general Molecular Biology Laboratory Procedures like DNA extraction, detection and amplification using PCR	AP
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	AP
5	A deep understanding on protein extraction & separation using polyacrylamide gel electrophoresis SDS-PAGE, Western blot analysis	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	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: BL501 Biology Laboratory

S. No.	Experiment	No. of Lab	CO No.
I	**Bacterial Genetics** *E. coli* Transformation, Conjugation, Transduction Phage Titration, Transposition, α- Complementation, Karyotyping	10	1
II	**Biodiversity** Biodiversity in soil, air & Winogradsky's Column – Plating , Colony Characterization & Gram Staining	10	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	10	3
IV	**Plasmid isolation** and Purification, RE Digestion & Detection of the RE-digested productUsing 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	10	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*	10	5

Integrated M.Sc. Semester – VI

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

Course Code	Course Title	Course Type
B-601	Immunology	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 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
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;"-"NoCorrelation

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Detailed Syllabus: B 601 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	10	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	15	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	10	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, Hypersensitive reactions, Immune regulation, Immune response to infectious organisms, Vaccines, Immunodeficiency diseases (AIDS)	15	4
V	Immunology & applications: Transplantation immunology, Tumour immunology, Immunotechnology, Animal models. Plant immunity	10	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 practicalguide for Biomedical Research

Integrated M.Sc. Semester – VI

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

Course Code	Course Title	Course Type
B-602	Animal Physiology	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):
Understanding the basics of animal anatomy and physiology will help the students to manage and care for animals. Appropriate for beginners and intermediate students alike, this course will help you learn the baselines for animal health and biological systems. It will help to understand how to diagnose disease.

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.	Name and describe functions of the nervous system. Define key terms, like neurons and motor functions. Demonstrate knowledge of the nervous system through writing	E
3.	The students will learn how many muscles are in the human body. The students will learn about the three types of muscle tissue: visceral (smooth), cardiac, and skeletal. The students will be able to identify the name and location of major muscles in the body.	An
4.	List the major functions of the respiratory system. Outline the forces that allow for air movement into and out of the lungs. Outline the process of gas exchange. Summarize the process of oxygen and carbon dioxide transport within the respiratory system.	Ap
5.	Define excretion, and identify organs of the excretory system. Outline the structures and functions of the urinary system. Explain how the kidneys filter blood and produce urine. Describe how the kidneys help maintain homeostasis.	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;"-"NoCorrelation

Detailed Syllabus: B 602 Animal Physiology

Unit No.	Topics	No. of Lectures	CO No.
I	Cell Structure & Metabolism: Homeostasis, Mechanisms of Cellular Control, Membrane Transport, Membrane Potentials (a review). Body Control: Hypothalamic/Pituitary Axis, Mystic Rhythms	5	1
II	Neurons and the Nervous system: Synapses, Sense Perception, Special Senses, CNS Design: Autonomic Nervous System, Action Potential, - Basic structures of neurons and glia, Neurotransmission: Ion channels, Membrane potentials, Resting potential – Depolarization, repolarization and hyperpolarization. Electrotonic and Action potential, Mechanism of neurotransmission. Membrane channels –voltage	15	2

	gated, ligand gated, mechanically gated. Basics of a synapse (electrical and chemical).Introduction to central nervous system design: Structural and functional outline of the brain and the spinal cord, Hypothalamus: Osmoregulation, temperature control, and role in neuroendocrine system: Hypothalamus-hypophyseal portal system, Autonomic Nervous System (sympathetic and parasympathetic pathways). Reflex action.		
III	Muscular system: Skeletal Muscle, Muscle Characteristics, Muscle Control, Muscle Exercise, Smooth Muscle. Cardiovascular Systems: Cardiac Muscle, Heartbeat, Cardiac Control, Blood: Hemostasis, Temperature Control, Vessels, Tissue Exchange, EKGs and Blood Pressure. Digestion: Absorption	10	3
IV	Respiratory Systems: Respiration, Respiratory Control. Energy Balance and Metabolism: Fuel Metabolism (both plants and Animals)	10	4
V	Processes: Excretion Control Salt & Water Balance, An example of a process going wrong.Diabetes. Comparative Physiology	5	5

BOOKS SUGGESTED:

S. No.	Author	Books
1.	Linda S. Costanzo	Physiology: Board Review Series
2.	William Ganong	Review of Medical Physiology (Lange BasicScience)
3.	Guyton and Hall	Physiology Review
4.	Appleton and Lange	Review of Physiology
5.	Linardakis	Illustrated review of Physiology

Integrated M.Sc. Semester – VI

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

Course Code	Course Title	Course Type
B-603	**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.

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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: B 603 Plant Physiology

Unit No.	Topics	No. of Lectures	CO No.
I	**Plant Cells** - Model Organisms, The Plant Kingdom, Flower Structure and the Angiosperm Life Cycle, Plant Tissue Systems: Dermal, Ground, and Vascular, Structure of Chloroplast Glycosylglycerides, Specialized Vacuoles in Plant Cells **Water and Plant Cells**- Water transport process, Diffusion, Osmosis, Diffusion pressure deficit, Concept of water potential, measuring of water potential, The Matric Potential, Wilting and Plasmolysis **Water Balance of Plants**- Water absorption by roots, Water transport through xylem, The Cohesion-Tension theory, Water movement from leaf to the atmosphere, **Mineral nutrition**: Essential nutrients, Deficiencies and Plant 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	10	1

	movement of solutes. Goldman Equation, Patch Clamp Studies in Plant Cells		
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 **Photosynthesis- 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, proton transport and ATP synthesis in chloroplast, Repair and regulation of photosynthetic machinery, genetic, assembly and evolution of photosynthetic systems. Photosynthesis: Carbon reactions; The Calvin cycle, regulation of the Calvin cycle, The C2 oxidative photosynthetic carbon cycle, C_4 cycle, Crassulacean acid metabolism (CAM CYCLE), synthesis of starch and sucrose. Rubisco: A Model Enzyme for Studying Structure and Function **Photosynthesis- 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** Translocation in the phloem, pathways of translocation, 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.	10	2
III	Respiration and lipid metabolism- 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. 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. Cell walls: Structure, Biogenesis, and Expansion, rate of cell elongation, wall degradation and plant defense.	10	3
IV	**Growth and Development-** Embryogenesis, Meristems in plant development, Cell differentiation. **Phytochrome and light control of plant development-**The photochemical and biochemical properties of phytochrome. Localization of phytochrome in tissues and cells. Characteristics of phytochrome induced whole plant responses.	15	4

	Ecological functions: Shade avoidance, circadian rhythms, phytochrome specialization. **Blue light responses-** Stomatal movements and morphogenesis, blue light photoreceptors: cryptochrome, phototropins, carotenoid and zeaxanthin. Plant hormones: Biosynthesis, metabolism, transport, physiological effects and signal transduction pathways of auxins, gibberellins, cytokinins, abscisic acid and ethylene. **Gibberellins-** Regulators of Plant Height and Seed Germination,Structures of Some Important Gibberellins, Gibberellin Biosynthesis, Effects of GAs on Flowering **Cytokinins-** Regulators of Cell Division, Structures of Some Naturally Occurring Cytokinins, Cytokinin Can Promote Light-Mediated Development, Cell Expansion and Greening in Cotyledons, Interact with Elements of the Circadian Clock **Ethylene-** The Gaseous Hormone, Ethylene in the Environment Arises Biotically and Abiotically, ACC Synthase Gene Expression and Biotechnology, The *hookless* Mutation Alters the Pattern of Auxin Gene Expression, Ethylene Inhibits the Formation of Nitrogen-Fixing Root Nodules in Legumes, Ethylene Biosynthesis Can Be Blocked with Anti-Sense DNA, Abscission and the Dawn of Agriculture, Specific Inhibitors of Ethylene Biosynthesis Are Used Commercially to Preserve Cut Flowers **Abscisic Acid-** A Seed Maturation and Stress-Response Hormone, The Structure of Lunularic Acid from Liverworts, ABA May Be an Ancient Stress Signal, Structural Requirements for Biological Activity of Abscisic Acid, Yellow Cameleon: A Noninvasive Tool for Measuring Intracellular Calcium, Phosphatidic Acid May Stimulate Sphingosine-1-Phosphate Production, The ABA Signal Transduction Pathway Includes Several Protein Kinases, The *ERA1* and *ABH* Genes Code for Negative Regulators of ABA Response, ABA may play a Role in Plant Pathogen Responses, Proteins Required for Desiccation Tolerance, The Types of Coat-Imposed Seed Dormancy, Types of Seed Dormancy and the Roles of Environmental Factors, The Longevity of Seeds, Genetic Mapping Of Dormancy: Quantitative Trait Locus (QTL), Scoring of Vegetative Dormancy Combined with a Candidate Gene Approach ABA-Induced Senescence and Ethylene.		
V	**The control of flowering-** Floral meristems and floral organ development, the characteristics of shoot meristems in Arabidopsis change with the development, The four different types of floral organs are initiated as separate whorls, Three types of gene regulate floral development, Meristem identity genes regulate meristem function, Homeotic genes control floral organ identity, The ABC model for determination of floral organ identity. **Floral evocation-** Internal and external cues, the shoot apex and phase changes, Combinatorial model of shoot development in maize, Phase changes can be influenced by Nutrients, Gibberellins and other chemical signals, Competence	15	5

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	and determination are two stages of floral evocation, Circadian rhythms: The Clock within, Phase Shifting Adjusts Circadian Rhythms to different Day-Night Cycles, Phytochrome and Crptochromes entrain clock. **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.		

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.	Biology	3	VI

Course Code	Course Title	Course Type
B-604	**Microbiology**	**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 insights into the complexity of microorganism which in turn provide many different health, environmental, social, cultural, industrial and economic benefits and harms.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1.	Microbial diversity is the key to human survival and economic security as it provides a vast variety and reservoir of resources which can be utilized by humans for their benefits	U
2.	Describe diversity of microorganisms, bacterial cell structure and function, microbial growth and metabolism, and the ways to control their growth by physical and chemical means.	U
3.	Introduce basic principles and application relevance of clinical disease for students	E

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4.	Students will be able to recognize of parasites which are important for human health and caused disease.	Ap
5.	Student should be able to describe unique characters of protozoa, and their importance in human life.	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: B 604 Microbiology

Unit No.	Topics	No. of Lectures	CO No.
I	General Microbiology - History of Development of Microbiology, Bacterial classification, Gram Negative Bacteria, Gram Positive Bacteria, & Archaea, Prokaryotic Structure & Function, Microbial Nutrition, Microbial Growth, Control of Microbes. Fundamentals of General Microbiology – Isolation of a broad range of non-pathogenic bacteria from natural sources, Selective and Enrichment techniques, Microscopic, biochemical, and molecular identification.	15	1
II	Bacterial Genetics -description of fundamental genetic processes such as mutation, repair, genetic exchange, recombination, and gene expression. Signal transduction in bacteria (Quorum Sensing in Gram positive & Gram-Negative Bacteria), Metagenomics.	10	2
III	Prokaryotic Diversity - Structure, biochemical properties, and genetics of the major groups of prokaryotes. Microbial Ecology - various roles of microorganisms particularly bacteria and cyanobacteria in environmental processes, Microbial interactions, Aquatic Ecology, Terrestrial Ecology; food, industrial microbiology.	10	3
IV	Medical Bacteriology- Medically important bacterial pathogens in terms of the clinical, therapeutic, and epidemiological aspects of diseases caused by them, molecular mechanisms of pathogenesis, procedures for isolation and identification of pathogenic bacteria, testing their susceptibility to antibiotics. Bacterial cell-cell communications and biofilm formation, Strategies for bacterial adhesion and invasion, bioterrorism.	10	4
V	Medical Mycology and Parasitology- Consideration of medically important fungi and parasites,with emphasis on their biology in relation to disease and its laboratory diagnosis.	15	5

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	Protozoan infections: Introduction to protozoa, major protozoan infections of humans, Biology and pathogenesis of Plasmodium, pathology of human malaria, biochemical and cell biological similarities and differences with other apicomplexa (Babesia,Cryptosporidium, Toxoplasma, etc.), Biology and pathogenesis of Toxoplasma, Leishmania, Trypanosoma		

BOOKS SUGGESTED:

S. No.	Author	Book
1	Thomas D Brock	Brock's Biology of Microorganisms
2	Patrick R Murray	Medical Microbiology: with STUDENT CONSULT Access
3	Willey, Joanne, Sherwood, Linda, Woolverton, Christopher J.	Presscotts Microbiology
4	Alfred E Brown	Benson's Microbiological Applications: Laboratory Manual in General Microbiology (Spiral-bound)
5	Ananthanarayan and Paniker Orient Blackswan	Textbook of Microbiology: Medical microbiology

Integrated M.Sc. Semester – VI

Program	Subject	Year	Semester
Integrated M.Sc.	Biology	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. The Intellectual Property Rights have two main objectives, firstly to promote the creation of intellectual property by providing incentives and secondly to promote the dissemination of the knowledge in intellectual properties by affording protection to its creators.

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	An

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	multiple perspectives, including that of medical professionals, patients and society in general	
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.	Biology	3	VI

Course Code	Course Title	Course Type
BL-601	**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):
After completing the course the students should be able to Demonstrate practical skills in fundamental microbiological and immunology techniques.

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 culture animal cell culture and microscopic observation of Gross anatomy of the animal brain &Staining of mouse brain sections and wound Healing Assay	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.	AP
5	Ability to characterize microbes based on their ability to antibacterial sensitivity, fermentation test, Catalase activity and Amylase activity.	AP

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*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: BL601 Biology Laboratory

S. No.	Experiment	No. of Lab	CO No.
I	**Animal Physiology** a) Animal cell culture and microscopy b) Gross anatomy of the animal brain &Staining of mouse brain sections c) Wound Healing Assay	10	1
II	**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	15	2
III	**Plant Physiology** a) *Arabidopsis thaliana* - model organism and its development b) Estimation of catalase activity in plant sample c) Estimation of peroxidase activity in plant sample d) Estimation of Indole Acetic Acid oxidase activity in plants e) Photosynthesis - floating leaf disc experiment under various conditions (light, dark & light - dark) f) Isolation and spectrophotometric characterization of photosynthetic pigments g) An improved method for the extraction and thin-layer chromatography of chlorophyll a and b from spinach.	15	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	10	4

	rate constant (μ); Calculation of generation time		
V	c) Antibacterial activity testing d)Bacterial Fermentation test e)Isolation & Detection of coliform bacteria f) Catalase activity g) Amylase activity	**15**	**5**

Integrated M.Sc. Semester – VII

Program	Subject	Year	Semester
Integrated M.Sc.	Biology	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;"-"NoCorrelation

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 ofequation,applicationoflawtohumanPopulation);EvolutionaryforcesupsettingH-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.	Biology	4	VII

Course Code	Course Title	Course Type
B-702	Immunology-II (Immunity and Disease)	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 fundamental principles of immunology and to develop an appreciation of the importance of synthesizing key concepts from a vast amount of experimental data that is rapidly emerging in this field.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1.	The host gene array complements to the parasite gene array and studying the host cell undergoing infection, transcription profiling, growth latency, and mortality gives a clear idea about the development and survival of parasites in the host cell	An
2.	To explain the function of structures of bacterial cells that is important for causing disease.	E
3.	Identify, describe and contrast unicellular parasites and parasitic worms. Describe specific human and non-human parasitic diseases.	E
4.	Health and Hygiene Learning Outcomes Key Concepts Students will be able to - Concept of Allergy - define the terms allergy and allergens, and differentiate between them	Ap
5.	Learning about the immune system malfunctions, it mistakenly attacks healthy cells, tissues, and organs	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

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Detailed Syllabus: B 702 Immunology-II (Immunity and Disease)

Unit No.	Topics	No. of Lectures	CO No.
I	Host-Pathogen relationship Diseases caused by Viruses and the immune response to them- HIV and AIDS-immune responses	10	1
II	Bacterial diseases – and the immune response to bacteria Vaccines-mechanisms, types of vaccines	15	2
III	Parasites – protozoan parasites, parasitic worms and the immune response to them- eg malaria, leishmaniasis, worm infestations	10	3
IV	Immediate Hypersensitivity and allergy, anaphylaxis Hypersensitivity and chronic inflammatory diseases- tuberculosis and leprosy Cancer immunology	15	4
V	Autoimmune diseases- generalized- SLE, Rheumatoid arthritis; localized-multiple sclerosis, Diseases due to immune cross reactivity- Rh incompatibility, transfusion, transplantation, Inherited immune diseases	10	5

BOOKS SUGGESTED:

S.No.	Author	Book
1.	Charles A Janeway, JP Travers, Mark Walport and Mark J Shlomchik	Immunobiology, 5th edition; The Immune System in Health and Disease
2.	Baron S, Galveston	Medical Microbiology; 4th Edition; University of Texas Medical Branch at Galveston
3.	RA Goldsby et al.	Kuby's Immunology
4.	E Benjamini, R Coico and G Sunshine	Immunology- A short Course
5.	Roitt, Brostoff and Male	Immunology

Integrated M.Sc. Semester – VII

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

Course Code	Course Title	Course Type
B-703	**Developmental 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):
Developmental biology aims to understand how an organism develops—how a single cell becomes an organized grouping of cells that is then programmed at specific times to become specialized for certain tasks. Describe levels of organization and related functions in plants and animals.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1.	They can analyse variations at different stages of embryonic development and distinguish between healthy and pathological tissues in specimens.	An
2.	Distinguish the stages of embryonic development that occur before implantation. Describe the process of implantation.	U
3.	The organ systems contribute to the body anatomy and morphology of an organism, therefore organogenesis plays a significant role in the development of an organism.	U
4.	Describe the function of stem cells in plants and animals and potential benefits and risks of using stem cells in medicine. Outline how cell fractionation can be used to study the components of cells.	Ap
5.	Students will be able to identify plant vegetative and reproductive structures. Students will understand basic principles, processes and functions of plant growth and reproduction	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;"-"NoCorrelation

Detailed Syllabus: B 703 Developmental Biology

Unit No.	Topics	No. of Lectures	CO No.
I	Basic concepts of molecular regulation of development: Transcription factors in differential gene expression; morphogens and axis formation; autocrine and paracrine regulation. How cell proliferation, apoptosis, and fate specification determine developmental processes. Fertilization: Structure of oocytes and spermatocytes. The process of fertilization.	10	1
II	Comparative study of early embryonic development: (Caenorhabditis elegans, amphibians, birds, and mammals), Cleavage formation, Gastrulation, Axis formation: Signaling cascades and molecular understanding of anteroposterior, mediolateral, and dorsoventral axes development.	15	2
III	Organogenesis in vertebrates: Germ layer formation. Regulation of formation of the somites, heart, kidney, blood vessels, and limb. Changes in circulation pattern between fetus and newborn.Metamorphosis and regeneration process: Hormonal control of metamorphosis in amphibians and insects; wing imaginal disc formation in drosophila. Regeneration in planeria and that of vertebrate limb.	15	3

IV	Stem cells: Concepts of totipotent, pluripotent, and multipotent cells. Factors regulating "stemness" of a cell. Embryonic vs. adult stem cells. Sources of stem cells in vertebrates and their applications. Developmental disorders and aging: Regulatory role of genetic and environmental factors. Role of carcinogens and teratogens.	10	4
V	Development processes in plants: How are the mechanisms different from that of animal development? Gametogenesis, pollination, and fertilization processes in angiosperms. Plant embryogenesis, tissue differentiation, Hormonal regulation of seed dormancy and the process of germination. Meristems in plant development, Root and shoot development mechanisms. Reproductive phase: photoperiod sensitivity and molecular regulation of flowering process. Host-Pathogen relationship Diseases caused by Viruses and the immune response to them- HIV and AIDS-immune responses	10	5

BOOKS SUGGESTED:

S. No.	Author	Book
1.	Alberts *et al.*	Molecular Biology of the Cell
2.	SF Gilbert	Developmental Biology
3.	Lewin Benjamin	Gene VIII
4.	PO Moody	Introduction to Evolution, 1970
5.	Dobzhansky et al.	Evolution, W. H. Freeman. New York

Integrated M.Sc. Semester – VII

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

Course Code	Course Title	Course Type
B-704	**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;"-"NoCorrelation

Detailed Syllabus: B 704 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-	10	5

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	resolution enhancement using magic angle spinning.		

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.	Biology	4	VII

Course Code	Course Title	Course Type
BL-701	**Advanced Biology 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 immunological techniques. Study of developmental stages of plants and factors affecting their growth. Researchers also get the information of different bioinformatics tools and their applications.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	Different immunological tests like Serum Electrophoresis, ELISA - direct &indirect, Widal – Tube & Slide, Immunoelectrophoresis, Rocket immunoelectrophoresis, VDRL	AP

2	Understanding the factors affecting growth in plants. Preparation of MS media and Callus formation from explants.	AP
3	Study of effects of phytohormones on plant growth development and germination patterns under stress and normal conditions. Synthetic seed preparation	AP
4	Silver Nanoparticle synthesis from plant extract using Soxhlet method and Phytochemical tests	AP
5	A deep understanding bioinformatics tools sequence analysis using BLAST; sequence pattern, motifs and profiles. Prediction of secondary structure of proteins Prediction of tertiary structure (fold recognition, homology search) Molecular modeling and dynamics	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	2	2	2	2	2	3	2	2	2	3
CO2	3	3	3	2	3	2	2	2	2	2	2	3	2	2	2	3
CO3	3	3	3	2	3	2	2	2	2	2	2	3	2	2	2	3
CO4	3	3	3	3	3	3	3	3	2	3	2	3	3	3	3	2
CO5	3	3	3	3	3	3	3	3	2	3	2	3	3	3	3	2

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

Detailed Syllabus: BL701 Advanced Biology Laboratory

S. No.	Experiment	No. of Lab	CO No.
I	**Immunology** a) SerumElectrophoresis b) ELISA - direct &indirect c) Widal – Tube &Slide d) Immunoelectrophoresis e) Rocket immunoelectrophoresis f) VDRL	18	1
II	**Developmental Biology** a) Preparation of MS media b) Callus formation from carrot cells c) In vitro culture methods	12	2
III	Study of effects of phytohormones on plant growth development a) Auxins b) Cytokinins	15	3
IV	Study of germination patterns under stress and normal condition	18	4

	a) Temperature b) Salinity c) pH d) Heavy metals		
V	Synthetic seed preparation a) In vitro conservation methods b) Effect of temperature c) Effect of osmotic agents	12	5

Integrated M.Sc. Semester – VIII

Program	Subject	Year	Semester
Integrated M.Sc.	Biology	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 nomencleture 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: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	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 nonsegmented negative-strand, Influenza viruse and ther 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, 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,

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Integrated M.Sc. Semester – VIII

Program	Subject	Year	Semester
Integrated M.Sc.	Biology	4	VIII
Course Code	Course Title		Course Type
B-802	BIOTECHNOLOGY-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):
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 Attheendofthecourse,thestudentswillbeableto:	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: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	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

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	
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 D NA by polymerase chain reaction, Site directed mutagenesis, Gene transfer methods for a nimals and plants	15	3
Unit-IV	Transgenic animals/plants- Selectable markers, Reporter genes for promoter analysis, Embryonic stem cells, Super mouse,Pronuclear Transgenic Goats, Wh ole 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; l clones; Callus cultures; Somaclonal variation; Micropropagation; Soma embryogenesis; Haploidy; Protoplast fusion and somatic hydridization; (rides; Artificial seeds; 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.

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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.	Biology	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 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	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,	10	5

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	Computer-Aided Drug Design, Drug Delivery, Applications of Bioinformatics: Pharmaceutical industries, immunology, agriculture, forestry; Legal, ethical and commercial ramifications of bioinformatics.		

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.	Biology	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	U

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	management , Environmental and industrial pollution control	
5	Medical Biotechnology, Tissue Engineering and applications, Biomaterialsand applications, Introduction to nanotechnology and nano-biotechnology, Nanomaterials and their uses.	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	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

	B -804: BIOTECHNOLOGY II	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 (phyto 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.	Biology	4	VIII

Course Code	Course Title	Course Type
BL-801	**Advanced Biology 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: BLS01 Advanced Biology Laboratory

S. No.	Experiment	No. of Lab	CO No.
I	Silver Nanoparticle synthesis from plant extract. Silver Nanoparticle synthesis from tea extract	18	1
II	Preparation of plant extracts using soxhlet method and phytochemical tests	12	2
III	Effect of salt and metal stress on plant growth	15	3
IV	Plant biochemical tests- total protein, proline etc. Essential oil extraction from aromatic plants	18	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	12	5

	with known crystal structure (available from data bank), Drug designing – using available data Applications of bio informatics, Primer designing.		

Integrated M.Sc. Semester – IX

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

Course Code	Course Title	Course Type
BPGD901	**Biology PG Dissertation/ Project**	**Core**

Credit	Hours Per Week (L-T-P)		
	L	T	P
20	-	-	0

Maximum Marks	CIA	ESE
100	60	40

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 Biology. The complete program is for duration of 10 semesters. Each semester from I-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 Biology (BPGD 901) is as follows:

1		Marks
2	Project/Dissertation (certified by the supervisor of the Institute)	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.	Biology	5	X

Course Code	Course Title	Course Type
BE1	**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.

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

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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

Detailed Syllabus: BE1 Genomics and Proteomics

Unit No.	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

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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

Detailed Syllabus: BE1 Genomics and Proteomics

Unit No.	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.	Biology	5	X

Course Code	Course Title	Course Type
BE2	**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, diagnosis of diseases, bioimaging, nanomedicines, nanoarrays, and gene therapy are all being investigated as nanobiotechnology applications in biomedical sciences.

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

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Detailed Syllabus: BE2 Nanobiotechnology

Unit No.	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: Methods, Devices, and Applications

Integrated M.Sc. Semester – X

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

Course Code	Course Title	Course Type
BE3	**Plant Genetic Engineering**	**Elective**

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

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Maximum Marks	CIA	ESE
100	60	40

Learning Objective (LO):
It will provides 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, such as the study of gene functions and interactions, protein–protein interactions, developmental processes, as well as applications for crop improvement and the development of plant bioreactors to produce vaccines.

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: BE3 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,	16	3

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	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.		
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.	Biology	5	X

Course Code	Course Title	Course Type
BE4	**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: BE4 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,	15	5

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	Systemic Acquired Resistance (SAR) and Induced Systemic Resistance (ISR), Recognition mechanism and signal transduction during plant - pathogen interaction.		

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.	Biology	5	X
Course Code	Course Title		Course Type
BE-5	NEUROBIOLOGY		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): It will give deep understanding of nervous system, brain and its structure and functions.

Course Outcomes(CO):-

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	Chemical composition of the brain: cells , structure , function and metabolism	U
2	Neurotransmitters, mechanism of action of neurotransmission	U
3	Sleep and Learning and memory: Electroencephalogram. Role of second messenger pathways in learning and memory process. Role of synaptic plasticity.	U
4	Sensory organs:Vision: Audition:	Ap
5	Chemical senses: Olfaction and Taste, mechanism of function Touch/pain: Pathologies of the nervous system:	Ap

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

CO-PO/PSO Mapping for the course-

POCO	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

Detailed Syllabus: BE-5: NEUROBIOLOGY

Unit	Topic	No of lectures	CO
Unit-I	The glial system: Generation of Astrocytes, Oligodendrocytes, and Schwan cells. Function of glia in normal brain and in neuroprotection. Chemical composition of the brain: metabolism (utilization and uptake of glucose and amino acids). Blood-Brain barrier.	15	1
Unit II	Neurotransmitters: Synthesis, storage, release, uptake, degradation and action of neurotransmitters, Acetyl choline, GABA, Serotonin, Dopamine, Glutamate, Nitrous oxide, etc. Receptors: different subtypes (cholinergic, dopaminergic, adrenergic, and glutamatergic), mechanism of action, Agonists and Antagonists – their mode of action and effects. Exocytosis of neurotransmitter – Role of synapsins, synaptogamins, SNAP, SNARE and other proteins in docking, exocyotosis and recycling of vesicles.	15	2
Unit-III	Sleep and Learning and memory: Mechanism of short-term memory and Long-term memory (longterm potentiation). Role of sleep in memory consolidation. Electroencephalogram. Role of second messenger pathways in learning and memory process. Role of synaptic plasticity.	15	3
Unit-IV	Sensory organs:Vision: Biochemistry of vision: Rod and cone cells, mechanism and regulation of vision, color vision, visual field, visual acuity. Visual pathway and topographic mapping. Audition: functional anatomy of the middle and inner ear. Amplification of sound. Functional anatomy and mechanism of detection of specific sound frequency in the inner ear. Mechanism of action of the mechanosensory receptors in the inner ear.	15	4
Unit-V	Chemical senses: Olfaction: The olfactory pathway, mechanism and the combinatorial code of detecting a smell. Taste: Mechanism of taste perception. Touch/pain: The touch/pain/temperature pathway (ascending and descending). Higher order integration in the brain. Pathologies of the nervous system: Molecular basis of Parkinson's disease, Alzheimer's disease, Schizophrenia, Myasthenia gravis and	15	5

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	Multiple sclerosis, stress and antidepressants.		

Books Recommended:

S.No.	Author	Book
1.	Ferdinand Hucho	Neurochemistry
2.	MP Spiegel	Basic Neurochemistry
3.	Koenig and Edward	Cell Biology of the Axon, Series: Results & Problems in Cell Differentiation, Vol. 48
4.	Eric Kendel, JH Schwartz, T Jessel	Principles of neural Sciences
5.	A Guyton and J Hall	Textbook of medical Medical physiolog

Integrated M.Sc. Semester – X

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

Course Code	Course Title	Course Type
BE6	**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.

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: BE6 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	Herbal plants and Drugs

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	Publications.	
4	Acharya, Deepak; Anshu, Shrivastava (2008)	Indigenous Herbal Medicines: Tribal Formulations and Traditional Herbal Practices. Jaipur, India: Aavishkar Publishers
5	Raven, Peter H., Evert, Ray F., Eichhorn, Susan E (2005)	Biology of Plants (7th ed.). New York: W. H. Freeman and Company

Integrated M.Sc. Semester – X

Program	Subject	Year	Semester
Integrated M.Sc.	Biology	5	X
Course Code	Course Title		Course Type
BE-7	**Animal Tissue Culture**		**ELECTIVE**
Credit	Hours Per Week (L-T-P)		
	L	T	P
5	4	1	0
Maximum Marks	CIA		ESE
100	60		40

Course Outcomes(CO):-

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	Introduction and significance of Animal cell culture, historical background of cell culture. Types of cell culture: Laboratory requirements for animal cell culture	U
2	Culture requirements and reagents	L
3	Types of cell culture: Different types of cell cultures, Cell lines:Introduction, development of cell lines	U
4	Stem cell research, Current status and application in medicine. Application of animal cell culture for in vitro testingofdrugs; Application of cell culture technology in production of human and animal viral vaccines and pharmaceutical proteins.	Ap
5	Gene transfer technology in animals,:Techniques,relevance and ethical issues.	Ap

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

PO-CO/PSO Mapping of the course-

POCO	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: BE- 7 Animal Tissue Culture

Unit	Topics	No of lectures	CO
Unit-I	Introduction and significance of Animal cell culture, historical background of cell culture. Types of cell culture: Primary and secondary cell culture.Laboratory requirements for animal cell culture: Sterile. Sterilization of different materials used in animal cell culture, Aseptic concepts. Instrumentation and equipments for animal cell culture.	15	1
Unit II	Culture requirements and reagents: Culture media, properties of media, Types of cell culture media, Ingredients of media, Physiochemical properties, Antibiotics, growth supplements, Foetal bovine serum; Serum free media, Trypsin solution, Selection of medium and serum, Conditioned media, Other cell culture reagents, Preparation and sterilization of cell culture media, different types of serum and other reagents.	15	
Unit-III	Types of cell culture: Different types of cell cultures, Trypsinization, Cell separation, Continuous cell lines, Suspension culture, Organ culture. Cell lines: Introduction, development of cell lines, Characterization and maintenance of cell lines, stem cells, Cryopreservation, Common cell culture contaminants.	15	3
Unit-IV	Stem cell research: Stem cell types, properties and biological significance, Current status and application in medicine. Application of animal cell culture for in vitro testing of drugs; Application of animal viral vaccines and pharmaceutical proteins. Production of different recombinant proteins. General account of in vitro regulation of blood cells production.	15	4
Unit-V	Gene transfer technology in animals: Different method in gene transfer technology in animals, viral and non-viral methods,	15	5

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	Production of transgenic animals, current status in the field of transgenic animals. Animal cloning: Techniques, relevance and ethical issues.		

Books recommended:

1. Freshney,CultureofAnimalCells,5thEdition,Wiley-Liss,2005
2. Ed. John R.W. Masters, Animal Cell Culture - Practical Approach, 3rd Edition, Oxford University Press,2000.
3. Ed.MartinClynes,AnimalCellCultureTechniques,Springer,1998.
4. B.Hafez,E.S.EHafez,ReproductioninFarmAnimals,7thEdition,Wiley-Blackwell, 2000.
5. Louis-MarieHoudebine,TransgenicAnimals:GenerationandUse,1stEdition,CRC Press,1

Integrated M.Sc. Semester – X

Program	Subject	Year	Semester
Integrated M.Sc.	Biology	5	X
Course Code	Course Title		Course Type
BE8	**EARTH SCIENCE AND ENERGY & ENVIRONMENTAL SCIENCES**		**ELECTIVE**
Credit	Hours Per Week (L-T-P)		
	L	T	P
5	4	1	0

Maximum Marks	CIA	ESE
100	60	40

Course Outcomes(CO):-

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	It will provide understanding of -Origin of the earth, type of rocks in different layers, their physical and chemical properties.	L
2	Geodynamo and the internal magnetic field of the earth. Seismology and its use in understanding of the different layers in the earth's interior.	U
3	Introduction to Environmental Science. Natural Environments	L
4	Water harvesting, storage and treatment.Natural calamities,	Ap
5	Energy conservation, Alternative to fossil fuels, Bio-based fuels.	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: BE8-Earth Science And Energy & Environmental Sciences

Unit	Topic	No of lectures	CO
Unit-I	Origin of the earth, type of rocks in different layers, their physical and chemical properties.Mechanism of their formation and destruction. Radioactivity and its role in geochronology, Platetectonics and geodynamics and the role of mantle plumes in sustaining these processes.Gravity, electrical, seismic and magnetic properties of the different layers in the earth.Their variations in different geological terrains. Instrumentation, field procedures used in these studies. Response of the earth to the elastic (Seismic) and electromagnetic waves, use of this phenomena to study the earth's interior.	15	1
Unit II	Geodynamo and the internal magnetic field of the earth. Paleomagnetic studies, Polar wandering and reversal, possible theoretical arguments for understanding the phenomena.Seismology and its use in understanding of the different layers in the earth's interior.Utility of the different geophysical techniques (discussed above) in exploration for academic as well as for harnessing resources.		
Unit-III	Introduction to Environmental Science. Natural Environments: Ecosystems and ecology, biodiversity. Socio-cultural environments: demography, population density, human organizations. Land use and its planning. Global climate change and effects on environment. Carbon cycle from human activity, calculation of carbon budgets.	15	3
Unit-IV	Water harvesting, storage and treatment.Natural calamities, hazards, and effects of humana ctivity: Chemical and other technological hazards. Introduction to energy Sources- evolution of energy sources with time. Power production, per capita consumption in the world, and relation to development index. Energy scenario in India:Various issues related to consumption and demands -energy crisis issues in India. Renewable andnon -renewable energy sources- technology and commercialization of energy sources, local (decentralized)versus centralized energy production, constraints and opportunities of renewable energy (hydrocarbon and coal	15	4

	based energy sources).		
Unit-V	Energy conservation calculation of energy requirements for typical and home and industrial applications. Alternative to fossil fuels -solar, wind, tidal, geothermal. Bio-based fuels. Hydrogen as a fuel. Energy transport and storages, comparison of energy sources -passage from source to delivery (source, production, transport, delivery)-efficiencies, losses and wastes. Nuclear energy: Power production: Components of a reactor and its working, types of reactors and comparison. India's three stage nuclear program. Nuclear fuel cycle. Thorium based reactors. Regulations on nuclear energy.	15	5

Books Recommended:

S.No.	Author	Book
1	Merill RT, McElhinny MW and McFadden PL	The magnetic field of the Earth: International Geophysical Series
2	EdwardJ,TarbuckEJandLutgensFK	Earth Science
3	HR Sheehan *et al.*,	Introduction to Applied Geophysics: Exploring the Shallow Subsurface Burger
4	Condie KC	Mantle Plumes and Their Recording Earth History; Cambridge University Press, Cambridge, UK

Integrated M.Sc. Semester – VIII

Program	Subject	Year	Semester
Integrated M.Sc.	Biology	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	7	4

	Charts, Histograms, Scatter Plots, Box Plots, Error Bars, High-Low Bars, Population Pyramids		
V	Introduction to NTSYS Pc software, Creating data file, Jaccard coefficient, Principle component Analysis, Dendrogram construction	6	5