Pt. Ravishankar Shukla University,

Raipur (C.G.), India 492010

CURRICULUM & SYLLABUS

(Based on CBCS & LOCF)

M.Sc.- Bioscience

(Semester System)

Semester: I-IV

Session: 2025-27

Approved by: Board of Studies :	**Bioscience**
Dates:	**23.5.2025**
Name of Chairman :	Prof. Arti Parganiha
Name of Member's :	Prof. S.K. Prasad
	Prof. Amia Ekka
	Dr. Shivendra Singh Dewhare
	Dr. Manoj Kumar Patel
	Prof. Binata Nayak (External Expert)
	Prof. Anita Jagota (External Expert)
	Dr. Singam Srinivas Rao (Expert from Industry)
	Dr. Ragini Shirali (Expert from Industry)

Ms. Richa Pathak

M.Sc. Bioscience

The two-year, four-semester Master of Science in Bioscience program aims to give students a thorough understanding of complex biological concepts and how they are applied. During the first few semesters, students build a solid foundation of knowledge through a well-rounded curriculum that covers a variety of topics. Students can customize their education as the program goes on by selecting specialized electives that fit with their interests and professional aspirations. Students will graduate from the program with the skills necessary for a variety of employment pathways, including those in academia, research, and technology. They will succeed as analytical thinkers and make valuable contributions to a variety of professions if they have a strong biological background. An integrated approach to biological sciences, bioscience fosters the study of life and living things, including their environments, adaptations, life cycles, and physiological processes. It provides the modern biologist with an understanding of many topics in the life sciences, including zoology, botany, biochemistry, developmental biology, environmental and evolutionary biology, immunology, microbiology, molecular biology, physiology, chronobiology, etc.

Program Outcomes:

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

PO-1	**Knowledge:** Acquire a deep understanding of both plant and animal biology, and cultivate an integrated perspective on the complex life processes that govern living organisms.
PO-2	**Critical Thinking and Reasoning:** Recognize the fundamental characteristics and ecological needs of living organisms. Analyze and explain biological growth and development at individual and population levels using logical reasoning and critical thinking.
PO-3	**Problem Solving:** Inculcate scientific reasoning and a rational mindset to understand real-world biological issues, identify problems, and employ methodical, evidence-based approaches to solve them.
PO-4	**Skill development:** A degree in biosciences will impart skills that will help students stand out in a progressively competitive job market and propel him or her to academic success. It will not only help in the development of a capability to appreciate the nature of living organisms and biological processes but also inculcate a research interest. Besides, being trained in technical and analytical skills used in modern biological research, the student would also develop an aptitude to synthesize a range of biological concepts and ideas.
PO-5	**Effective Communication:** Communicate complex biological concepts and research findings clearly and effectively to both scientific and general audiences through written, oral, and visual means, including presentations, reports, and teaching.
PO-6	**Social/ Interdisciplinary Interaction:** Integrate bioscience knowledge with other disciplines and collaborate productively across fields to solve multifaceted biological and societal challenges.
PO-7	**Self-directed and Life-long Learning:** Demonstrate a commitment to lifelong learning and continuous professional development in the dynamic and evolving field of biology, both independently and through formal education.
PO-8	**Effective Citizenship, Leadership, and Innovation:** Lead and innovate within academic, industrial, and research settings. Understand the societal and ethical responsibilities of biological research and contribute meaningfully to scientific and human advancement.
PO-9	**Ethics:** Uphold ethical standards in all aspects of biological research, teaching, and collaboration, maintaining integrity and professional accountability.

PO-10	**Further Education or Employment:** Pursue advanced studies, including doctoral programs, or secure employment in academia, research, industry, governmental agencies, or other professional sectors related to biosciences.
PO-11	**Global Perspective:** Appreciate the international scope and cultural diversity of biological research, and understand its impact on global health, environment, and sustainability.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

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

PSO-1	**Comprehensive Understanding of Life Forms:** Develop an in-depth understanding of the structure, function, and diversity of all living organisms—including bacteria, plants, and animals—and gain a holistic view of the various life processes that sustain them.
PSO-2	**Interdisciplinary Integration and Teamwork:** Enhance knowledge of biological processes and living systems, and integrate this understanding with concepts from other disciplines. Collaborate effectively in interdisciplinary teams to address complex scientific and societal challenges.
PSO-3	**Advanced Inquiry in Biological Sciences:** Engage in the exploration and critical analysis of advanced and emerging topics in biological sciences, fostering scientific curiosity and research competence.
PSO-4	**Application of Modern Biological Techniques:** Apply contemporary biological tools and techniques confidently in research, particularly within the fields of environmental and medical sciences, to generate and interpret scientific data effectively.
PSO-5	**Preparation for Competitive Examinations:** Build a strong academic foundation and subject proficiency to qualify for national-level competitive examinations such as GATE, CSIR-NET, and related assessments, enabling further education and career advancement in biosciences.

M. Sc. BIOSCIENCE

Specification of Course	Semester	No. of Courses	Credits
Core [Theory]	I-IV	14	70
Core [Practical]		07	17
Elective [Theory]	IV	02	10
Elective [Practical]		01	03
Total		24	100
Additional Courses(Qualifying in nature, for Student admitted in School of Studies only)			
Generic Elective	II-III	04	08
Skill Enhancement (Value Added Courses)	III	01	02
Indian Knowledge System (IKS) in Life Science	I	01	02
Internship	II	-	02

M.Sc. Bioscience
PROGRAMME STRUCTURE

Semester	Course Nature	Course Code	Course Title	Course Type (T/P)	Hrs/ Week	Credits	Marks		
							CIA	ESE	Total
Semester-I	Core I	BS-22101	Cell Biology	T	5	5	30	70	100
	Core II	BS-22102	Biomolecules	T	5	5	30	70	100
	Core III	BS-22103	Instrumentation and Techniques	T	5	5	30	70	100
	Core IV	BS-22104	Biometry, Computer Application, and Scientometry	T	5	5	30	70	100
	Core LC-I	BSLC-22105	Lab Course I (Based on Theory papers I & II)	P	6	3	30	70	100
	Core LC-II	BSLC-22106	Lab Course II (Based on Theory papers III & IV)	P	6	3	30	70	100
Semester-II	Core I	BS-22201	Genetics and Molecular Biology	T	5	5	30	70	100
	Core II	BS-22202	Bioenergetics & Metabolism	T	5	5	30	70	100
	Core III	BS-22203	General Microbiology	T	5	5	30	70	100
	Core IV	BS-22204	Biology of Immune system	T	5	5	30	70	100
	Core LC-I	BSLC-22205	Lab Course I (Based on Theory papers I & II)	P	5	2	30	70	100
	Core LC-II	BSLC-22206	Lab Course II (Based on Theory papers III & IV)	P	5	2	30	70	100
Semester-III	Core I	BS-22301	Plant Physiology	T	5	5	30	70	100
	Core II	BS-22302	Ecology and Environmental Biology	T	5	5	30	70	100
	Core III	BS-22303	Animal Physiology	T	5	5	30	70	100
	Core IV	BS-22304	Developmental Biology	T	5	5	30	70	100
	LC-I Core	BSLC-22305	Lab Course I (Based on Core papers I & II)	P	5	2	30	70	100
	LC-II Core	BSLC-22306	Lab Course II (Based on Core papers III & IV)	P	5	2	30	70	100
Semester-IV	Core I	BS-22401	Molecular Endocrinology	T	5	5	30	70	100
	Core II	BS-22402	Genetic Engineering	T	5	5	30	70	100
	Elective - I	BS-22403-A	(A) Parasitology	T	5	5	30	70	100
		BS-22403-B	(B) Basic Chronobiology	T	5	5	30	70	100
		BS-22403-C	(C) Ethnobotany	T	5	5	30	70	100
	Elective - II	BS-22404-A	(A) Appliedimmunology	T	5	5	30	70	100
		BS-22404-B	(B) Applied Chronobiology	T	5	5	30	70	100

		BS-22404-C	(C) Secondary Metabolites	T	5	5	30	70	100
	LC-I Core	BSLC-22405	Lab Course I (Based on Core papers I & II)	P	6	3	30	70	100
	LC-II Elective	BSLC-22406	Lab Course II (Based on Elective papers I & II)	P	6	3	30	70	100
	Or Project Work								
		BS-22407	Dissertation			11	75	225	300
			Seminar based on project			5	30	70	100
			Viva-voce			5	30	70	100
		BS-22408	Bio-safety, Bio-ethics and IPR Or Can opt paper(s) from MOOC courses (Swayam portal)**	T		5	30	70	100

Note:

**Student can choose paper(s) from MOOC Courses (Swayam Portal) subject to the following conditions:

a. The chosen paper will be other than the papers offered in the current course structure.
b. The paper will be PG level with a minimum of 12 weeks' duration.
c. The list of courses on SWAYAM keeps changing; the departmental committee will finalize the list of MOOC courses for each semester.
d. The paper(s) may be chosen from Swayam Portal on the recommendation of Head of the Department.

1. **Project work**

(i) Any student of the IV Semester will have an option to opt for Project Work and a theory paper (taught in hybrid mode only)} in lieu of four theory papers and two lab courses.

(ii) The project work has to be carried out in any of the recognized national laboratories, UGC recognized universities, relevant teaching departments of the PRSU, colleges recognized as research centers by the RDC of PRSU. No student will be allowed to carry out project work in private laboratories/ college/ institutions, excluding the colleges recognized as research centers by the RDC of Pt. Ravishankar Shukla University, Raipur.

(iii) The valuation of all the projects will be carried out by the external examiner and HoD of UTD or its nominee at the UTD Centre. However, answer books of the online paper, Biosafety, Bioethics and IPR will be evaluated at the departmental level and its marks will be sent to the University Administration.

(iv) Fee Structure:
(a) For External Students (i.e., students from institutions other than the School of Studies in Life Science): Rs. 30,000.00

(b) For Internal Students (i.e., students of the School of Studies in Life Science): Rs. 15,000.00

(As approved by the Executive Council in its 96th meeting, Ref. No. 580/Acad./EC/2025 dated 24.03.2025.)

Students of the School of Studies in Life Science who undertake their project work within the School are required to pay the Project Fee in addition to the Course Fee. Please note that no exemption or relaxation from payment of the Project Fee will be granted under any circumstances, regardless of the student's category, domicile, locality, economic status (BPL/APL), gender, or any other criteria.

2. The candidates who have joined the PG Programme in School of Studies (University Teaching Department), shall undergo Generic Elective Courses (only qualifying in nature) offered by other departments/SoS in Semester II and Semester III.
3. The candidates who have joined the PG Programme in School of Studies (University Teaching Department), shall undergo Skill Enhancement Course/Value Added Course (only qualifying in nature) in Semester III.
4. The candidates who have joined the PG Programme in School of Studies (University Teaching Department), shall undergo Indian Knowledge System in Life Science Course (only qualifying in nature) in Semester I.

Generic Elective Courses: (Offered to PG students of Life Science and other Departments/SoS only)

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

Skill Enhancement/Value Added Courses*: (Offered to the PG students of M.Sc. Bioscience)

Semester	Course Code	Course Title	Course Type (T/P)	Hrs/ Week	Credits	Marks		
						CIA	ESE	Total
III	LS-VAC-1	Survival Skills vs Wilderness and Metropolitan Challenges	T	2	2	30	70	100
III	LS-VAC-2	Research Skill	T	2	2	30	70	100

*Offer any one of the VACs in a particular year.

Course on Indian Knowledge System: (Offered to the PG students of M.Sc. Bioscience)

Semester	Course Code	Course Title	Course Type (T/P)	Hrs/ Week	Credits	Marks		
						CIA	ESE	Total
I	IKS-1	Indian Knowledge System in Life Science	T	2	2	30	70	100

Internship

Semester	Course Code	Course Title	Course Type (T/P)	Hrs/ Week	Credits	Marks		
						CIA	ESE	Total
II	-	-	T/P	*	2	30	70	100

*Total duration- 60 hours after examination of 2nd Semester

[Guidelines for Internship for the students of Pt. Ravishankar Shukla University, Raipur (E.C. under 12.6.2024), Notification No. 3591/Acad./2024 dated 21.6.2024]

Students may undertake their Internship either within the School of Studies in Life Science, in other Schools within the University campus, or outside PRSU (e.g., in academic institutions, industries, research organizations, or social sector entities), based on their interest and subject to the recommendation of the Head of the Department. Students opting to complete their Internship in the School are required to pay an Internship Fee of Rs. 2,000.00. The total duration of the Internship shall be 60 hours. Upon completion, each student must submit a detailed Internship Report, duly signed by the Supervisor and forwarded by the Head of the Host Institution, to the Office of the SoS in Life Science.

Continuous Evaluation of Performance

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

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

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

The marks for attendance shall be as follows-

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

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

External

1.	Major exercise based on paper I	15
2.	Minor exercise based on paper I	10
3.	Major exercise based on paper II	15
4.	Minor exercise based on paper II	10
5.	Spotting/ Interpretation*	10
6.	Viva-voce	10
Internal (Sessional)		30
Total		**100**

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

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
BS-22101	√	×	√	√	√	√	√	√	√	√	√	√	√	√	√	√
BS-22102	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
BS-22103	√	√	√	√	√	×	√	√	×	√	√	×	√	√	√	√
BS-22104	√	√	√	√	√	×	√	×	×	√	√	×	√	√	√	√
BS-22201	√	√	√	√	√	×	√	√	√	√	√	√	√	√	√	√
BS-22202	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
BS-22203	√	√	√	√	√	√	√	√	×	√	√	√	√	√	√	√
BS-22204	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
BS-22301	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
BS-22302	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
BS-22303	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
BS-22304	√	√	√	√	×	√	√	×	√	√	√	√	√	√	√	√
BS-22401	√	√	√	√	√	×	√	√	√	√	√	√	√	√	√	√
BS-22402	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
BS-22403-A	√	√	√	√	√	×	√	√	×	√	√	×	√	√	√	√
BS-22403-B	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
BS-22403-C	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
BS-22404-A	√	√	√	√	√	×	√	√	√	√	√	√	√	√	√	√
BS-22404-B	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
BS-22404-C	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
No. of courses mapping the PO/PSO	20	19	20	20	19	14	20	18	16	20	20	17	20	20	20	20

M.Sc. (Bioscience) Semester-I

Program	Subject	Year	Semester
M.Sc. 0405	Bioscience	I	July 2025 – December 2025
Course Code	Course Title		Course Type
BS-22101	**Paper I - CELL BIOLOGY**		Core
Credit (L+T)	Hours Per Week (L-T-P)*		
	L	T	P
5	4	1	3.5
Maximum Marks	CIA		ESE
100	30		70

*L: Lecture, T: Tutorial, P: Practical

Learning Objective (LO):

The learning objectives of cell biology typically include the following:

1. Understanding Cell Structure and Function
2. Understanding Cellular Processes and Metabolism
3. To elucidate genetic information, protein synthesis and cell communication.
4. To determine various techniques in Cell Biology

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	Cell biology—the study of the structure and function of cells—has a wide range of applications in medicine, biotechnology, agriculture, and environmental science. Here are some of the key applications.	U
2	Studying the cell membrane is crucial because it plays a fundamental role in maintaining cellular integrity and functionality.	An
3	Studying protein trafficking is essential because it helps us understand how proteins are correctly synthesized, modified, and transported to their functional destinations within or outside the cell.	U
4	Cell signaling is fundamental because it allows us to understand how cells communicate and coordinate responses to various stimuli. Here's why cell signaling is essential: Cellular Communication and Coordination.	R
5	Chromosomes and DNA is fundamental to understanding the blueprint of life. Here's why this field of study is crucial: Understanding Heredity and Inheritance, Molecular Basis of Life.	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	2	2	3	1	1	3	3	3	3	3	3	3
CO2	3	3	3	2	2	2	3	1	1	3	3	3	3	3	3	3
CO3	3	3	3	2	2	1	3	2	1	3	3	3	3	3	3	3
CO4	3	3	3	2	2	2	3	1	1	3	3	3	3	3	3	3
CO5	3	3	3	2	2	2	2	2	2	3	3	3	3	3	3	3

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

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**Molecular organization of membranes:** Asymmetrical organization of lipids, proteins, and carbohydrates. Membrane transport: Passive transport, Osmosis, ion channels, membrane pumps, and Active transport: ATP-powered pumps-types, properties and mechanisms, electrical properties of membranes.	15	1
II	**Protein trafficking:** Transport of proteins into mitochondria, chloroplast, endoplasmic reticulum, and nucleus [in and out]. Transport by vesicle formation: exocytosis, endocytosis and its molecular mechanism.	15	2
III	**Cell signaling:** Signaling via G-protein linked and enzyme-linked cell surface receptors, MAP kinase pathways. Eukaryotic cell division cycle: different phases and molecular events, regulation and control of cell cycle. Oncogenes: retinoblastoma, E2F, and p53 proteins. Apoptosis: regulation by CASPases and formation of apoptosome. Pro- and anti-apoptotic factors.	15	3
IV	**States of chromosomes during cell cycle**. Mitotic chromosome. Organization of genes in chromosomes. Banding pattern of chromosomes. Lampbrush and Polytene chromosomes. DNA packaging: Chromatin, nucleosomes, heterochromatin, and euchromatin.	15	4
V	**Cellular communication:** Regulation of hematopoiesis, general principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, neurotransmission and its regulation.	15	5

Lab Course:

1. Study of chromosome behaviour during Mitosis and meiosis (Onion / Garlic root tips, Onion buds, human lymphocytes, rat or bird testis /grasshopper testis or any other materials).
2. Calculation of mitotic index in growing Onion / Garlic root tips

3. Squash preparation: Polytene chromosome (in Chironomus/ Drosophila or other insect salivary gland) and Barr body (in buccal epithelial cells).
4. Demonstration of secretory granules in the salivary gland cells of insects.
5. Demonstration of mitochondria by vital staining.
6. Study of permanent slides.
7. Estimation of DNA
8. Estimation of RNA
9. Sub-cellular fractionation and marker enzymes
10. Identification of biomolecules in different tissues by histochemical techniques
11. Preparation of mitotic plate by carmine squashing method and phase identification.
12. Demonstration of the nuclear matrix networks in onion cells.
13. Study of the effect of chemical agents on chromosome plant cells.
14. Isolation of protoplast, measurement of cell density plating efficiency.
15. Preparation of Karyotype of the metaphase plate.
16. Preparation of Meiotic plate and determination of phases.
17. Computation of Chiasma frequency and Terminalization of phases.
18. Micrometry and Camera Lucida drawings.

Books Recommended:

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

M.Sc. (Bioscience) Semester-I

Program	Subject	Year	Semester
M.Sc. 0405	Bioscience	I	July 2025 – December 2025
Course Code	Course Title		Course Type
BS-22102	**Paper II - BIOMOLECULES**		Core
Credit (L+T)	Hours Per Week (L-T-P)		
	L	T	P
5	4	1	3.5
Maximum Marks	CIA		ESE
100	30		70

Learning Objective (LO):

The learning objectives of studying biomolecules focus on understanding the molecular basis of life, including how biomolecules function, interact, and regulate biological processes. Here are the key objectives:

1. Understanding the biomolecular structure and function.
2. Metabolic pathways and bioenergetics
3. Signal transduction and regulation
4. Integration and Regulation of Metabolism

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	Gain a deep understanding of the molecular structure of carbohydrates, including their chemical properties and biological significance	**Ap**
2	Students will develop an understanding of the molecular structure of lipids, including their classification, chemical properties, and roles in biological membranes, energy storage, signalling and biological significance	**Ap**
3	Students will gain a thorough understanding of nucleic acid structure, including DNA and RNA composition, and their roles in genetic information storage and expression.	**An**
4	Analyse the classification, structure, and properties of amino acids and proteins including protein folding, denaturation, and interactions.	**An**
5	Analyse the structural and functional roles of enzymes, also learning enzyme kinetics and inhibition mechanisms,	**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	2	1	3	1	1	3	3	3	3	2	3	3
CO2	3	3	3	3	2	1	3	1	1	3	3	3	3	2	3	3
CO3	3	3	3	3	1	1	3	2	1	3	3	3	3	2	3	3
CO4	3	3	3	3	2	1	3	1	1	3	3	3	3	2	3	3
CO5	3	3	3	3	2	2	2	2	1	3	3	3	3	2	3	3

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

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**Carbohydrates** - Structure of Monosaccharide, Isomerism of sugars, Reactions of aldehyde and ketone groups, Ring structure and anomeric forms, mutarotation, structure, importance of monosaccharide, oligosaccharides and polysaccharides e.g., cellulose, chitin, agar, alginic acid, occurrence and biological pectins, proteoglycans, sialic acids, glycogen and starch. Bacterial cell wall polysaccharides.	15	1
II	**Lipid:** Classification, Structure and properties of saturated and unsaturated fatty acids. Essential fatty acids, prostaglandins, Triacylglycerols – nomenclature, physical and chemical properties of fats. Vitamins: fat and water soluble.	10	2
III	**Nucleic Acid:** Structure of purine and pyrimidine bases, nucleoside and nucleotide; DNA structure and conformation; RNA – Structure, types and functions. Structure and biological role of: Porphyrins in biology, structure of hemoglobin, chlorophyll and cytochromes.	15	3
IV	**Amino Acids and Proteins** - Classification and structures of standard amino acids, physical and chemical properties of amino acids. Level of organization of protein - primary, secondary, tertiary structure of protein. Forces stabilizing the tertiary and quaternary structure of protein. Denaturation and renaturation of proteins. Salting in and salting out of proteins. Structure and biological function of fibrous protein, globular proteins, lipoprotein, metalloprotein, glycoprotein and nucleoproteins.	19	4
V	**Enzyme:** apoenzymes, cofactors, coenzymes, active site, factors contributing to the catalytic efficiency of enzyme; enzyme kinetics-Michaelis-Menten equation, determination of Km, enzyme inhibition, allosteric enzymes, isoenzymes, multienzyme complexes.	19	5

Lab Course:

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

Books Recommended:

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

M.Sc. (Bioscience) Semester-I

Program	Subject	Year	Semester
M.Sc. 0405	Bioscience	I	July 2025 – December 2025
Course Code	Course Title		Course Type
BS-22103	**Paper III - INSTRUMENTATION AND TECHNIQUES**		Core
Credit (L+T)	Hours Per Week (L-T-P)		
	L	T	P
5	4	1	3.5
Maximum Marks	CIA		ESE
100	30		70

Learning Outcomes: Here are some clear learning objectives for Instrumentation and Techniques in Biology:

1. Understand the Principles of Biological Instruments.
2. Develop Practical Skills in Using Laboratory Instruments.
3. Develop Analytical and Problem-Solving Skills.
4. Emphasize Safety and Ethical Practices.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	Analyse the principles, techniques, and applications of centrifugation and photometry in biochemical and analytical research.	**An/ Ap**
2	Analyse and apply different separation and analytical techniques in various fields of biological sciences.	**An/ Ap**
3	Analyse and apply various microscopic techniques, and learn methods to evaluate their applications in scientific imaging and material characterization.	**An/ Ap**
4	Students will analyse and apply electrochemical and biosensing techniques, to evaluate their principles, methodologies, and applications in diagnostics and biomedical sciences.	**An/ Ap**
5	Analyse and apply principles of radioactivity detection and advanced spectroscopic methods and implement its applications in scientific research and diagnostics.	**An/ 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	2	3	3	2	1	3	1	2	3	3	3	2	-	3	3
CO2	3	2	3	3	2	1	3	1	2	3	3	3	2	-	3	3
CO3	3	2	3	3	2	1	3	1	1	3	3	3	2	-	3	3
CO4	3	2	3	3	2	1	3	1	1	3	3	3	2	-	3	3
CO5	3	2	3	3	2	1	3	1	2	3	3	3	2	-	3	3

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

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**Centrifugation and photometry:** Principle, techniques, and applications. Preparative, analytical, and ultracentrifuges, factors affecting sedimentation coefficient. Photometry: principles of colorimetry, UV- visible spectrophotometry & IR- spectrophotometry. Atomic absorption spectroscopy: Principle, Instrumentation, and Applications. Optical rotator dispersion and circular dichroism	15	1
II	**Chromatography**: Paper, thin Layer, Gas, and HPLC. Gel filtration, Ion exchange, and Affinity chromatography. Electrophoresis: Agarose, PAGE, *Lyophilization*: Principle and applications. Microtomy and its applications. PCR: Types, principle and applications.	19	2
III	**Microscopic techniques**: Dark and bright field microscopy, confocal microscope, phase-contrast microscopy, scanning and transmission electron microscopy, atomic force microscope. Sample preparations, surface modifications, and imaging in electron microscopy. Immobilization and functionalization techniques and their applications.	19	3
IV	**Biosensor techniques:** Cyclic voltammetry (CV), differential pulse voltammetry (DPV), electrochemical impedance spectroscopy (EIS), and surface plasmon resonance (SPR). Biosensor types, DNA biosensors, Immunosensors, biosensors for infectious diseases and food pathogens. Electrophoretic deposition and matrix fabrication.	11	4
V	**Radioactivity:** GM counter, liquid Scintillation counter, solid Scintillation counter, gamma counters. RIA and Autoradiography: applications: Principles, instrumentation and applications. NMR, Principles, instrumentation and applications: GC-MS, LC-MS	11	5

Lab Course:

1. Verification of Beers Law
2. Determination of absorption maxima
3. Polyacrylamide Gel Electrophoresis
4. Separation of biomolecules by chromatography
5. Ion exchange and gel filtration chromatography
6. Agarose gel Electrophoresis of genomic DNA

7. Identification and characterization of nanomaterials
8. Electrophoretic deposition and matrix fabrication
9. Identification of analyte for biosensing applications
10. Biosensor development using CV, DPV, and EIS techniques.

Books Recommended:

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

M.Sc. (Bioscience) Semester-I

Program	Subject	Year	Semester
M.Sc. 0405	Bioscience	I	July 2025 – December 2025
Course Code	Course Title		Course Type
BS-22104	**Paper IV - BIOMETRY, COMPUTER, AND SCIENTOMETRY**		Core
Credit (L+T)	Hours Per Week (L-T-P)		
	L	T	P
5	4	1	3.5
Maximum Marks	CIA		ESE
100	30		70

Learning Objective (LO):

1. The objective of this course is to equip students with a comprehensive understanding of biostatistical methods and their applications in biological research.
2. Students will learn to manage and analyze biological data using appropriate statistical tools.
3. The course will also develop competency in using computer applications.
4. Furthermore, students will gain knowledge of internet-based scientific resources, scientometric indicators, plagiarism awareness, and cyber laws etc.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	Classify biological data, compute and interpret descriptive statistics, perform data transformations, and apply random sampling techniques using real datasets to gain practical insight into biostatistical analysis.	**U/ Ap/ An**
2	Gain hands-on experience in applying probability laws, working with probability distributions (binomial and normal), and conducting hypothesis tests (chi-square, t-test, F-test) on biological data to draw meaningful conclusions using statistical software.	**U/A p/ An**
3	Develop practical skills in performing parametric tests (t-test, F-test, ANOVA), interpreting regression and correlation analyses, and conducting statistical evaluations on biological data using appropriate software tools.	**U/ Ap/ An**
4	Students will acquire practical proficiency in using MS Word for document creation, MS Excel for statistical data analysis (including Excel ToolPak), and MS PowerPoint for creating effective presentations, all with a focus on scientific data handling and presentation.	**U/ Ap/ An**
5	Students will learn how to effectively use online scientific resources, databases (e.g., PubMed, Scopus), and citation tools for research, and will understand the practical applications of bioinformatics, plagiarism detection, and cyber laws in scientific work.	**U/ Ap/ 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	3	-	3	3	3	-	3	2	3	3
CO2	-	3	3	3	2	3	3	-	3	3	3	-	3	2	3	3
CO3	-	1	2	3	3	-	3	-	1	3	3	-	-	2	3	2
CO4	-	1	1	2	-	-	2	-	3	2	2	-	-	1	2	2
CO5	3	2	3	3	1	1	3	-	3	3	3	-	2	2	3	3

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

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**Introduction to Biostatistics and Data Handling:** Definition and scope of biostatistics; Types of biological data: nominal, ordinal, interval, and ratio scales; Data presentation: frequency distributions and cumulative frequency distributions; Measures of central tendency: Mean, Median, Mode; Measures of dispersion: Range, Variance, Standard Deviation, Coefficient of Variation; Parameters and statistics; Random sampling and its importance in biological research; Effects of coding data; Data transformations: Log, Square-root, and Arcsine transformations	15	1
II	**Probability, Distributions, and Hypothesis Testing:** Probability: basic concepts and laws (addition and multiplication laws); Probability distributions: Binomial and Normal distributions; Hypothesis testing: concepts, null and alternative hypotheses; Statistical errors: Type I and Type II errors; Chi-square tests: goodness of fit, test of independence, and heterogeneity Chi-square; 2 x 2 contingency tables; One-sample and two-sample hypothesis testing	15	2
III	**Parametric Tests, ANOVA, and Regression Analysis:** Testing difference between two means: t-test (independent and paired samples); Testing difference between two variances: F-test; ANOVA (Analysis of Variance): one-way and two-way ANOVA; Post-hoc comparisons: Duncan's multiple-range test; Simple linear regression: regression equation, interpretation of regression functions; Regression vs. correlation; Simple linear correlation and calculation of correlation coefficient.	16	3
IV	**Introduction to MS Office software:** Word processing; creating a new document, editing documents, adding graphics to documents, Word tables. Management of Workbook & Worksheets; Applications, Features, Using formulas and functions, Features for Statistical data analysis, Excel ToolPak for data analysis, Generating charts/graphs. Presentation software; Working in PowerPoint, Creating new presentations, and working with slides.	12	4

V	**Introduction to Internet and Applications:** Basics of internet, e-mailing, Search engines – Google and Yahoo; PubMed, Scopus, Web of Science, Google Scholar, Indian Citation Index, Science Citation Index (SCI), h-index, i-10-index. Journal Impact Factor (JIF). Introduction to Plagiarism and Cyber laws; Basics of Bioinformatics	14	5

Lab Course:

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

Books Recommended:

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

M.Sc. (Bioscience) Semester-II

Program	Subject	Year	Semester
M.Sc. 0405	Bioscience	I	January 2026 – June 2026
Course Code	Course Title		Course Type
BS-22201	**Paper I - GENETICS AND MOLECULAR BIOLOGY**		Core
Credit (L+T)	Hours Per Week (L-T-P)		
	L	T	P
5	4	1	2
Maximum Marks	CIA		ESE
100	30		70

Learning Objective (LO): Students will be able to understand:

1. Fundamental Concepts: Understand the basic principles of genetics.
2. Genetic Material and Inheritance
3. Gene Expression and Regulation
4. Molecular Techniques and Applications
5. Genetic Variation and Evolution

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	Explain the role of mutations, recombination, and natural selection in genetic diversity. Describe population genetics concepts, including allele frequency and genetic drift. Understand the molecular basis of evolution and speciation.	**Ap**
2	Describe the structure and function of DNA, RNA, and proteins. Explain the central dogma of molecular biology.	**Ap**
3	Explain how mutations can affect gene expression and function. Discuss epigenetic modifications and their role in gene regulation.	**U/An**
4	Understand transcription, translation, and gene regulation mechanisms.	**U/An**
5	Explain how mutations can affect gene expression and function. Discuss epigenetic modifications and their role in gene regulation.	**U/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	2	1	3	3	3	3	2	3	3
CO2	3	3	3	3	3	3	3	2	1	3	3	3	3	2	3	3
CO3	3	3	3	3	3	3	3	2	1	3	3	3	3	2	3	3
CO4	3	3	3	3	3	3	3	2	1	3	3	3	3	2	3	3
CO5	3	3	3	3	3	3	3	2	1	3	3	3	3	2	3	3

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

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**Gene mapping methods:** Linkage maps, tetrad analysis, mapping with molecular markers, mapping by using somatic cell hybrids, development of mapping population in plants, complementation analysis. Mutation: Types, mutagens, and detection. Mutant types – lethal, conditional, biochemical, loss of function, gain-of-function, germinal versus somatic mutants, insertional mutagenesis.	15	1
II	**DNA replication in eukaryotes and prokaryotes:** enzymes involved, replication origin and replication fork, fidelity of replication, extrachromosomal replicons. DNA damage and repair mechanisms: Repair of Base-excision, Nucleotide excisions, Mismatch, and Double Strand. p_{53} and p_{21}.	15	2
III	**RNA synthesis and processing:** enzymes involved, formation of initiation complex, transcription activator and repressor, elongation, and termination, RNA processing, capping, RNA editing, splicing, polyadenylation, RNA transport.	18	3
IV	**Protein synthesis and processing:** Ribosome, formation of initiation complex, initiation factors, elongation and elongation factors and their regulation, termination. Aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase, and translational proof-reading, translational inhibitors. Post-translational modification of proteins.	17	4
V	**Gene regulation:** Transcriptional regulation in prokaryotes (inducible and repressible system, positive regulation and negative regulation); Operon concept – lac, trp and Ara operons.	10	5

Lab Course:

1. Isolation, purification, and estimation of RNA
2. Isolation, purification, and estimation of DNA
3. Determination of Tm of nucleic acid
4. Fraction of poly (A) RNA
5. Restriction Mapping
6. Restriction Digestion
7. Ligation
8. DNA molecular size determination

Books Recommended:

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

M.Sc. (Bioscience) Semester-II

Program	Subject	Year	Semester
M.Sc. 0405	Bioscience	I	January 2026 – June 2026
Course Code	Course Title		Course Type
BS-22202	**Paper II - BIOENERGETICS AND METABOLISM**		Core
Credit (L+T)	Hours Per Week (L-T-P)		
	L	T	P
5	4	1	2.5
Maximum Marks	CIA		ESE
100	30		70

Learning Objective (LO): The aim of the course in Bioenergetics & Metabolism will enable the students to:

1. Understanding the bioenergetic principles
2. To elucidate the metabolic pathways and energy production
3. To understand the mechanisms of regulation of metabolism
4. Integration and coordination of metabolic pathways
5. Awareness regarding bioenergetic disorders and clinical relevance
6. Skill development through experimental techniques in Bioenergetics

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 thermodynamics and learn their significance in biochemical processes and metabolic reactions.	U
2	Learn key biochemical pathways of carbohydrate metabolism and their significance in cellular energy production and metabolic balance.	U
3	Analyse and apply biochemical processes in lipid metabolism and regulation, to evaluate their significance in energy balance and physiological functions.	U/An
4	Understand biochemical processes of amino acid metabolism/nucleotide biosynthesis and their significance in nitrogen balance, energy metabolism, and genetic regulation.	U/An
5	Understand principles of electron transport and oxidative phosphorylation and their significance in cellular respiration and energy metabolism.	U

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

CO-PO/PSO Mapping for the course:

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

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

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**laws of thermodynamics.** Gibbs free energy G, free energy change ΔG, endergonic & exergonic reactions. Standard state free energy changes-ΔG, ΔG^0 and $\Delta G'^0$, Relationship between equilibrium constant and $\Delta G'^\circ$, Feasibility of reactions. Structure, properties, and energy currency of the cell, Importance of Coupled reactions, and other high-energy compounds.	15	1
II	**Carbohydrate metabolism:** Aerobic and anaerobic pathways, Glycolysis, Kreb's cycle, glycogenolysis, glycogenesis, pentose phosphate pathway, gluconeogenesis, and glyoxylate pathway. Regulation of carbohydrate metabolism.	15	2
III	**Lipid Metabolism**: Biosynthesis of Lipids. Acetyl-CoA carboxylase reaction, Fatty acid synthase complex, polyketide biosynthesis. Degradation of Lipids, Hydrolysis, Beta – oxidation of saturated & unsaturated fatty acids. Ketone bodies. Regulation of lipid metabolism	18	3
IV	**Amino acid Metabolism:** General reactions of amino acid metabolism: transamination, oxidative, Deamination and decarboxylation. Urea cycle. Degradation and biosynthesis of Amino acids. Glycogenic and ketogenic amino acids. Biosynthesis and Degradation of purines and pyrimidines Nucleotides.	17	4
V	**Electron transport chain and oxidative phosphorylation:** Electron carriers, complexes I to IV, substrate level phosphorylation, mechanism of oxidative phosphorylation. Inhibitors of electron transport chain. Shuttle system for entry of electrons.	10	5

Lab Course:

1. Protein estimation by Lowry, Bradford, and Spectrophotometric method
2. Estimation of blood cholesterol
3. Estimation of sugar by Nelson-Somogyi and Benedict's reagent
4. Isolation and estimation of lipids from seeds and egg.
5. Estimation of inorganic and total phosphorus by Fiske-Subba Rao method

6. Assay of phosphatases in blood and seeds
7. Urease estimation in plant tissues

Books Recommended:

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

M.Sc. (Bioscience) Semester-II

Program	Subject	Year	Semester
M.Sc.0405	Bioscience	I	January 2026 – June 2026
Course Code	Course Title		Course Type
BS-22203	**Paper III - GENERAL MICROBIOLOGY**		Core
Credit (L+T)	Hours Per Week (L-T-P)		
	L	T	P
5	4	1	2·5
Maximum Marks	CIA		ESE
100	30		70

Learning Objective (LO): Here are the key learning objectives for a module on Basic Microbiology.

1. Fundamental Concepts of Microbiology.
2. Microbial Structure and Function.
3. Microbial Growth and Metabolism:
4. Microbial Genetics and Evolution:
5. Microbial Interactions and Ecology:
6. Applied Microbiology and Biotechnology:
7. Microbial Pathogenesis and Immunity:

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	Understand the morphological, cellular, and reproductive diversity among algal groups. Classify algae based on pigmentation, storage products, and cell wall composition.	Ap
2	To explain the taxonomic classification and evolutionary relationships among fungal groups. Distinguish between molds, yeasts, mushrooms, and lichens based on morphological and reproductive features.	Ap
3	Understand the phylogenetic relationships between bacterial groups, including major phyla like Proteobacteria, Firmicutes, Actinobacteria, and others. Describe the differences between Gram-positive and Gram-negative bacteria.	U
4	Explain the essential nutrients required by different living organisms, including carbohydrates, proteins, lipids, vitamins, and minerals. Understand the role of macro and micronutrients in metabolic processes and overall health. Differentiate between autotrophic and heterotrophic modes of nutrition.	An
5	Describing the fundamental characteristics that define viruses as obligate intracellular parasites. The structure of viruses, Classify viruses. To Understand the taxonomy of viruses as outlined by the International Committee on Taxonomy of Viruses.	U

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

CO-PO/PSO Mapping for the course:

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

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

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**Algae**: Distribution, classification, reproduction, Nutrition and economic importance, Pigmentation of algae, Life cycle patterns in algae, Lichens: classification, structure and economic importance.	15	1
II	**Fungi:** Classification of fungi, life cycle of selected fungal genus (Aspergillus, Penicillium). Economic importance of fungi. Symbiosis: symbiosis association with plants and animals. Mycorrhiza, VAM.	15	2
III	**Morphology and ultra-structure of bacteria:** Morphology and ultra-structure of bacteria, gram negative and gram-positive bacteria. Cell membranes - structure, composition and properties. Structure and function of flagella. Cyanobacteria and mycoplasma. Gene transfer mechanisms: transformation, transduction, conjugation and transfection.	18	3
IV	**Nutritional types:** autotrophs, heterotrophs, phototrophs, chemotrophs, Bacterial growth curves, measurement of growth, factors affecting growth, generation time, growth kinetics. Classification: Bergey's manual of determinative bacteriology.	17	4
V	**Viruses:** Structure and classification of viruses; General Concepts: Viral genome, capsids, envelopes, viroids and prions). Virus reproductions: Lysogeny and Lytic phase, Bacteriophages and their types. Plant and animal viruses (TMV, HIV, Corona, Ebola and Monkey pox virus), Route of transmission of viruses, Laboratory diagnosis and treatment, Biosensor for pathogen detection.	10	5

Lab Course:

1. Glassware preparation and sterilization techniques: wet heat, dry heat, filters types, laminar flow chamber types, and Biosafety levels.
2. Preparation of liquid & solid media, plating, pouring, inoculation and incubation for growth of microorganism
3. Methods of obtaining pure culture of microorganisms (a) streak plate (b) Pour plate, and (c) spread plate methods
4. Microscopic examination of the microorganisms, identification and staining methods
5. Study of bacterial growth by turbiditimetry/ spectrophotometry
6. Isolation and enumeration of microorganisms from soil by serial dilution agar plating method.
7. Enumeration of viruses by plaque assay technique.
8. Biosensor based detection for microorganisms.

Books Recommended:

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

M.Sc. (Bioscience) Semester-II

Program	Subject	Year	Semester
M.Sc. 0405	Bioscience	I	January 2026 – June 2026
Course Code	Course Title		Course Type
BS-22204	**Paper IV - IMMUNOLOGY**		Core
Credit (L+T)	Hours Per Week (L-T-P)		
	L	T	P
5	4	1	2.5
Maximum Marks	CIA		ESE
100	30		70

Learning Objective (LO): After completing the course, the student should be able to-

1. Outline, compare, and contrast the key mechanisms and cellular players of innate and adaptive immunity.
2. Understanding, how cells and organelles are involved in the immune response, their identification, and characteristics at the molecular and cellular levels.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	Explain how central and peripheral tolerance are maintained in the immune system. Understand the roles of T cells, B cells, autoantibodies, and antigen-presenting cells in autoimmune responses.	Ap
2	Besides, they would also develop concepts about humoral immune response, immunoglobulin structure, properties and their types, monoclonal antibodies, complements and their biological importance, characterization and types of T cells, macrophage activation, cytokines, Antibody-Dependent Cell-Mediated Cytotoxicity; Hypersensitivity: types; Autoimmunity; Immunodeficiency diseases.	Ap
3	They would be able to decipher how the nature of the antigen shapes the resulting effector responses, factors affecting antigen-antibody reactions, and the role of the Major Histocompatibility Complex.	U
4	Define autoimmunity and explain the mechanisms that lead to the loss of self-tolerance. Understand the difference between organ-specific and systemic autoimmune disorders. Describe the role of genetic, environmental, and immunological factors in the development of autoimmune diseases. Analyze the genetic predisposition and environmental triggers associated with specific autoimmune conditions.	An
5	Demonstrate the basic knowledge of immunological processes at a cellular and molecular level and define central immunological principles and concepts. Discuss the challenges of long-term management, including medication side effects and quality-of-life issues.	U

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

23/5/25 23.5.25 23/5/25 23.5.25 23/05/2025

CO-PO/PSO Mapping for the course:

CO \ PO	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	2	2	3	3	3	3	3	2	3	2
CO2	3	3	3	3	2	2	2	2	3	3	3	3	3	2	3	2
CO3	3	3	3	3	2	2	2	2	3	3	3	3	3	2	3	2
CO4	3	3	3	3	2	2	2	1	3	3	3	3	3	2	3	2
CO5	3	3	3	3	2	2	3	2	3	3	3	3	3	2	3	2

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

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**Innate and adaptive immune response:** Cells of the immune system: Haematopoiesis and differentiation, mononuclear cells and granulocytes, antigen-presenting cells. Ontogeny and phylogeny of lymphocytes. Primary and Secondary lymphoid organs and tissues. Lymphocyte traffic.	15	1
II	**Antigens:** nature of antigens, factor affecting immunogenicity, Haptens and super antigens. Antigenic determinants. Recognition of antigens by T and B cell. Antigen processing. Major Histocompatibility Complex-types, structural organization, function, and distribution. Complement system.	15	2
III	**Antigen receptor molecules:** B-cell receptor complex, Immunoglobulin- structure, types and function. Generation of diversity in BCR. Light and heavy chain gene recombination. Recombination Signal sequences. Class switching. Membrane and secreted immunoglobulins. T-cell receptor complex. Organization, arrangement of T-cell receptor genes, and recombination.	18	3
IV	**Cell-mediated immune response:** Cytokines and interleukins- structure and function. Immunity to infections. Hypersensitive reactions and their types. Immunodeficiency disorders. Autoimmunity and autoimmune disorder. Immunological tolerance. Principles of Vaccination. Immunization practices.	17	4
V	**Immunological techniques: Principles, methodology and applications:** Transplantation and Rejection. Antigen and antibody interaction: Precipitation, Agglutination, Enzyme Immunoassay (EIA), (Radio immunoassay) RIA, Fluorescence Immunoassay (FIA) and Enzyme linked immunosorbent Essay (ELISA).	10	5

23/5/25 23.5.25 23/05/25 23/5/25 23.5.25 23/5/25 23/05/2025

Lab Course:

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

Books Recommended:

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

M.Sc. (Bioscience) Semester-III

Program	Subject	Year	Semester
M.Sc. 0405	Bioscience	II	July 2026 – December 2026
Course Code	Course Title		Course Type
BS-22301	**Paper I - PLANT PHYSIOLOGY**		Core
Credit (L+T)	Hours Per Week (L-T-P)		
	L	T	P
5	4	1	2.5
Maximum Marks	CIA		ESE
100	30		70

Learning Objective (LO): Here are the key learning objectives for a module on Plant Physiology:

1. To clarify the fundamental concepts of plant physiology.
2. To understand water relations and transport mechanisms.
3. To learn about plant nutrition and mineral absorption.
4. Knowledge of photosynthesis and carbon assimilation in plants.
5. To understand the mechanism o plant growth and development.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	Explain the basic concept of photosynthesis as the process by which green plants, algae, and some bacteria convert light energy into chemical energy. Understanding the significance of photosynthesis in sustaining life.	U
2	Explain the process of photorespiration as a pathway that consumes oxygen and releases carbon dioxide in plants. Describe the photorespiratory pathway, including key organelles involved (chloroplasts, peroxisomes, mitochondria).	U
3	Identify the major classes of plant hormones, including auxins, gibberellins, cytokinins, ethylene, abscisic acid, and others. Understand the concept of hormone signaling and cross-talk among different phytohormones.	U/An
4	Explain the importance of amino acids as building blocks of proteins and their role in cellular metabolism.	U
5	Define abiotic and biotic stress factors affecting plant growth and development. Understand the physiological and biochemical basis of plant responses to stress.	U/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	2	2	2	2	1	1	3	3	3	2	3	2
CO2	3	3	3	2	2	2	2	2	1	1	3	3	3	2	3	2
CO3	3	3	3	2	2	2	2	2	1	1	3	3	3	2	3	2
CO4	3	3	3	2	2	2	2	2	1	1	3	3	3	2	3	2
CO5	3	3	3	2	2	2	3	2	1	1	3	3	3	2	3	2

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

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**Photosynthesis** – Light-harvesting complexes (LH-a and LH-II). Photosystems I and II (Electron Transport Chain) Carbon fixation- C3, C4 and CAM pathways Nitrogen Metabolism – Nitrate and ammonia assimilation	15	1
II	**Photorespiration** – Definition, process, significance, and benefit in plants. Tricarboxylic acid cycle (TCA) in plant Mitochondrial electron transport chain (Components, steps involved and function) ATP synthesis and alternate oxidase in plants	15	2
III	**Phytohormones:** Introduction and types. Auxin: Structure, biosynthesis and function. Cytokinin: Structure, biosynthesis, and function; Gibberellins: Structure, biosynthesis, and function. Abscisic acid: Structure, biosynthesis, and function. Ethylene and Brassinosteroids.	18	3
IV	**Amino Acid Biosynthesis:** Biosynthesis of alkaloids derived from Shikimic acid and 3C-methyl-D-erythritol-4-phosphate (MEP) pathway. Plant Secondary metabolites – Terpenes, phenols, and nitrogenous	17	4
V	**Stress physiology in plant** – Biotic and Abiotic stresses. Antioxidative defense system in plants. Senescence and Programmed Cell Death, Phyto-remediation.	10	5

Lab Course:

1. Estimation of Chlorophyll content in plant tissues (Spectrophotometric analysis).
2. Separation of plant pigments (chlorophyll by chromatography).
3. To demonstrate the evolution of oxygen during photosynthesis in aquatic plants.

4. To study the different concentrations of CO2 on the rate of photosynthesis.
5. To study the effect of light intensity (by changing the distance) on the rate of photosynthesis using aquatic plants.
6. To demonstrate the process of plasmolysis in onion cells.
7. To demonstrate osmosis in living plant cells by potato osmoscope.
8. Measurement of Relative Water Content (RWC) in plant tissues.
9. Measurement of Stomatal density, Stomatal index, and perimeter of stomata in different leaves.

Recommended Books:

JA Hopkins	Introduction to Plant Physiology
BB Buchanan, W Gruissem & RL Jones	Biochemistry & Molecular Biology of Plants
MB Wilkins	Advanced Plant Physiology
Leopold AC & Kriedemann PE	Plant Growth & Development
Moore TC	Biochemistry & Physiology of Hormones
FB Salisburry & CW Ross	Plant Physiology
Dr. V.K. Jain	Fundamentals of Plant Physiology 19 Edition
SS Bhojwani and MK Razdan	Plant Tissue Culture: Theory and Practice, a Revised Edition

M.Sc. (Bioscience) Semester-III

Program	Subject	Year	Semester
M.Sc.0405	Bioscience	II	July 2026 – December 2026
Course Code	Course Title		Course Type
BS-22302	**Paper II - ECOLOGY AND ENVIRONMENTAL BIOLOGY**		Core
Credit (L+T)	Hours Per Week (L-T-P)		
	L	T	P
5	4	1	2.5
Maximum Marks	CIA		ESE
100	30		70

Learning Objective (LO): Here are the key learning objectives for a module on Ecology and Environmental Biology:

1. Understanding Basic Ecological Principles: Population Ecology; Community Ecology etc.
2. Ecosystem Structure and Function; Biodiversity and Conservation Biology:
3. Awareness regarding environmental pollution and global challenges.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Define ecology and explain its importance in understanding the interactions among organisms and their environment. Describe the levels of ecological organization: individual, population, community, ecosystem, biome, and biosphere. Understand biotic and abiotic components of ecosystems and their roles.	**U**
2	Explain the concept of aquatic ecosystems and their classification into freshwater (lentic and lotic) and marine systems. To understand the structural components and functional processes within aquatic and terrestrial environments. Also Identifying major types of aquatic habitats.	**U**
3	Identify types of pollution (air, water, soil, noise) and their sources and effects on ecosystems and human health. Understand principles of waste management, pollution control technologies, and environmental laws and policies. Discuss sustainable development and the role of environmental impact assessments.	**An/ Ap**
4	Understand the importance of biodiversity at genetic, species, and ecosystem levels. Describe threats to biodiversity such as habitat loss, pollution, invasive species, and climate change. Explore conservation strategies including protected areas, restoration ecology, and sustainable resource management.	**An/ Ap**
5	Explain the causes and consequences of climate change and global warming. Understand the role of greenhouse gases, ozone depletion, and deforestation. Analyze international efforts and agreements to mitigate environmental problems.	**An/ 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	3	3	3	3	3	3
CO2	3	3	3	2	3	3	3	3	2	3	3	3	3	3	3	3
CO3	3	3	3	2	3	3	3	3	2	3	3	3	3	3	3	3
CO4	3	3	3	2	3	3	3	3	2	3	3	3	3	3	3	3
CO5	3	3	3	2	3	3	3	3	2	3	3	3	3	3	3	3

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

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**Ecosystem:** Concept, Components and Types. Productivity, Ecological energetics, Energy flow in an ecosystem, Energy flow models, Ecological pyramids, Food chain, Food web. Ecological succession, Ecological niche.	18	1
II	**Aquatic ecosystem:** Biotic and abiotic components, lentic and lotic ecosystems, wetlands. **Terrestrial ecosystems:** Forest types of India with special reference to Chhattisgarh. Natural and plantation (artificial) forests, Agroforestry, Social forestry, National parks and Sanctuaries in Chhattisgarh.	12	2
III	**Environmental pollution:** Definition, types (air, water, soil, noise, thermal & radioactive), causes, effects, and control. **Solid waste management:** Causes, effects, and control measures of urban and industrial wastes.	15	3
IV	**Biodiversity:** ex-situ, and in-situ conservation. Intellectual property rights (IPR) with special reference to India. Natural resources: Water, Forest, and Medicinal plants.	12	4
V	**Disaster management:** **Natural Disaster:** Floods, earthquakes, cyclones, and landslides. **Man Made Disaster:** Deep water Horizon oil spills – super bug, Industrial accident. **Biological Disaster:** Covid 19 and Cholera	18	5

Lab Course:

1. To determine the minimum size of the quadrate by 'Species–Area-Curve' method
2. To study the community by quadrate method by determining the frequency, density, and abundance of different species present in the community
3. Chromatographic separation of chlorophyll pigments in leaf
4. Measurement of pH and Total alkalinity in water
5. Measurement of Free carbon dioxide and dissolved oxygen in given water

6. Identification and drawing of at least 15 medicinal plants.

Recommended Books:

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

M.Sc. (Bioscience) Semester-III

Program	Subject	Year	Semester
M.Sc. 0405	Bioscience	II	July 2026 – December 2026
Course Code	Course Title		Course Type
BS-22303	**Paper III - ANIMAL PHYSIOLOGY**		Core
Credit (L+T)	Hours Per Week (L-T-P)		
	L	T	P
5	4	1	2·5
Maximum Marks	CIA		ESE
100	30		70

Learning Objective (LO): Here are the key learning objectives for a module on Animal Physiology:

1. This course aims to provide students with a comprehensive understanding of the physiological processes that sustain animal life, focusing on major organ systems and their functions.
2. Students will explore the composition and roles of blood, mechanisms of respiration, and circulatory dynamics including heart function and blood pressure regulation.
3. By the end of the course, students will be equipped to analyze and interpret physiological mechanisms and their regulatory controls in vertebrates.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	Explain the composition and physiological functions of blood, mechanisms of gas transport and blood coagulation, and describe respiratory adaptations, breathing regulation, and metabolic rate assessment.	**U/ AP/ An**
2	Understand the principles of nerve impulse conduction, synaptic transmission, and muscle physiology, including the molecular mechanisms underlying skeletal muscle contraction.	**U/ AP/ An**
3	Describe the anatomical and functional organization of the heart, interpret ECG data, and explain the cardiac cycle and blood pressure regulation through neural and chemical mechanisms.	**U/ AP/ An**
4	Demonstrate knowledge of the structure and function of digestive organs, mechanisms of digestion and absorption, energy metabolism, and regulation of body temperature and acclimatization.	**U/ AP/ An**
5	Analyze the physiology of kidney function and urine formation, and explain the regulation of water, electrolyte, and acid-base balance in maintaining homeostasis.	**U/ AP/ 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	2	2	2	1	1	3	1	1	2	1	3	2	2	2	2
CO2	3	2	3	3	1	1	3	1	1	2	1	3	2	3	3	3
CO3	3	3	3	3	2	2	3	2	1	3	2	3	3	3	3	3
CO4	3	2	2	2	1	1	3	1	1	2	1	3	2	2	2	2
CO5	3	3	3	2	1	2	3	1	1	2	2	3	3	3	2	3

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

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**Blood and Circulation**: Composition of blood, Cell types, Hematopoiesis, Structure, and function of hemoglobin - Oxygen and carbon dioxide transport, Blood Coagulation. Blood volume and its regulation. Blood group. **Respiration**: Mechanism and regulation of breathing, Factors influencing oxygen uptake, Diving, and high-altitude adaptations. Measurement of metabolic rate and Q_{10}	18	1
II	**Nervous system**: Structure of Neurons, Mechanisms of conduction along axon and across synapses, Nernst equation and measurement of action potential, Neurotransmitters, Autonomic Nervous system, Types and physiology of reflexes. **Sleep physiology:** Sleep stages, Short-term and Long-term memory, Role of memory in sleep consolidation.	14	2
III	**Myology**: Types of muscles, Ultrastructure, mechanism, and regulation of contraction of skeletal muscle. **Cardiovascular System:** Anatomy of heart structure, ECG–its principle and significance, cardiac cycle, blood pressure, and its neural and chemical regulation.	12	3
IV	**Digestive system:** Organs of the digestive system, their Structure and function, Digestion, absorption, energy balance, BMR. **Thermoregulation**: Comfort zone, body temperature – physical, chemical, neural regulation, acclimatization.	14	4
V	**Excretory system:** Physiology of excretion, kidney, urine formation, urine concentration, waste elimination, regulation of water balance, electrolyte balance, acid-base balance.	14	5

Lab Course:

1. Examination of RBC in Human blood.
2. Examination of WBC in Human blood.

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

Books Recommended:

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

M.Sc. (Bioscience) Semester-III

Program	Subject	Year	Semester
M.Sc.0405	Bioscience	II	July 2026 – December 2026
Course Code	Course Title		Course Type
BS-22304	**Paper IV - DEVELOPMENTAL BIOLOGY**		Core
Credit (L+T)	Hours Per Week (L-T-P)		
	L	T	P
5	4	1	2·5
Maximum Marks	CIA		ESE
100	30		70

Learning Objective (LO): Here are the key course outcomes for a module on Animal Physiology:

1. Fundamental understanding of developmental biology:
2. To study about gametogenesis and fertilization.
3. Early embryonic development.
4. Organogenesis and tissue differentiation.
5. To learn about stem cells and regeneration in living organisms.
6. To understand the pattern of developmental genetics and molecular control.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	Describe the processes of gametogenesis (spermatogenesis and oogenesis) and their regulation. Understand the molecular and cellular mechanisms of fertilization, including gamete recognition and fusion. Explain the formation of the zygote and the initiation of embryogenesis.	**U/ An**
2	Describe key processes such as cell division, cell migration, and differentiation during early development.	**U/ An**
3	Understand the stages of early development, including cleavage, blastulation, gastrulation, and organogenesis. Explain the formation of the three germ layers and their derivatives. Describe key processes such as cell division, cell migration, and differentiation during early development.	**U/ An**
4	Explain the concept of morphogenetic determination and its significance in early embryonic development. Understand how the distribution of cytoplasmic determinants in the egg influences cell fate and patterning. Discuss the role of maternal gene products and their spatial localization in the egg cytoplasm.	**U/ An**
5	Explain the characteristics of stem cells, including pluripotency and differentiation potential. Understand the mechanisms of tissue regeneration and repair in various organisms. Discuss the therapeutic potential of stem cells in regenerative medicine.	**U/ An**

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

23/5/25 23.5.25 23/5/25 23/05/25 23.5.25 23/5/25 23/05/2025

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	2	3	3	3	2	3	3	3	3	2	3	3	3
CO2	3	3	2	2	3	3	3	2	3	3	3	3	2	3	3	3
CO3	3	3	1	2	3	3	3	2	3	3	3	3	3	3	3	3
CO4	3	3	2	2	3	3	3	2	3	3	3	3	2	3	3	3
CO5	3	3	1	2	3	3	3	2	3	3	3	3	3	3	3	3

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

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**Gametogenesis in animals:** Molecular events during fertilization. Activation of egg metabolism. Cleavage patterns and fat maps. Regulation of Cleavage cycle. Cleavage and nuclear activity.	15	1
II	**Concepts of determination, competence, induction, and differentiation:** Determination in *Caenorhabditis elegans*. Germ cell determination, migration, and differentiation. Totipotency and nuclear transfer experiments. Embryonic induction. Formation of vulva in *C. elegans*. Mechanism of differentiation in *Dictyostelium*.	15	2
III	**Morphogenetic determinants in egg cytoplasm:** Role of maternal contributions in early embryonic development. Genetic regulation of early embryonic development in Drosophila. Homeotic genes. Genetic interaction during differentiation. Hox genes and limb patterning.	15	3
IV	**Metamorphosis:** the hormonal reactivation of development. Multiple ovulation and Embryo transfer technology, Superovulation. Invitro fertilization. Cryopreservation. Stem cells. Transgenic and mutants in the analysis of development. Aging: the biology of senescence. Teratology.	15	4
V	**Morphogenesis and organogenesis in plants:** Organization of shoot and root apical meristem; shoot and root development; leaf development and phyllotaxy; transition to flowering, floral meristems and floral development in Arabidopsis and Antirrhinum	15	5

Lab Course:

1. Study of developmental stages in Snail/Amphibian/Chick
2. Study on Drosophila development
3. Role of hormones in metamorphosis and development
4. Effect of Vitamin A on tail regeneration in frog

5. Biochemical estimations in developing embryos
6. Structure of hen's egg and its vital staining
7. Demonstration of cell death by vital staining
8. Study of permanent slides of chick embryos
9. Histological studies of Gametogenesis
10. Induced breeding in fishes

Recommended Books

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

M.Sc. (Bioscience) Semester-IV

Program	Subject	Year	Semester
M.Sc. 0405	Bioscience	II	January 2027 – June 2027
Course Code	Course Title		Course Type
BS-22401	**Paper I - MOLECULAR ENDOCRINOLOGY**		Core
Credit (L+T)	Hours Per Week (L-T-P)		
	L	T	P
5	4	1	3.5
Maximum Marks	CIA		ESE
100	30		70

Learning Objective (LO): The learning objective of molecular endocrinology is to understand the molecular mechanisms through which hormones regulate physiological processes. Specifically, it aims to:

1. Understand how hormones interact with their receptors and trigger intracellular signaling pathways.
2. Learn how hormones influence gene expression and protein synthesis.
3. Identify molecular defects that lead to endocrine diseases.
4. Explore the role of hormones in metabolism, growth, reproduction, and homeostasis.
5. Use molecular biology tools to study hormone function and endocrine pathology.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Explain how hormones regulate physiological processes at the molecular level. Describe the mechanisms of hormone synthesis, secretion, transport, and action.	**U**
2	By identifying genetic mutations that affect hormone production, researchers can better understand disorders like diabetes, hypothyroidism, or growth deficiencies. Insights into gene regulation can help develop targeted therapies, tailoring treatments based on an individual's genetic makeup.	**U/An**
3	The outcome of the molecular mechanism of hormone action typically involves regulating physiological processes by altering the function of target cells. This can include changes in gene expression, enzyme activity, cellular metabolism, ion channel function, and overall cell signaling.	**U/An**
4	The outcome of studying molecular aspects of reproductive endocrinology generally includes a deeper understanding of the molecular mechanisms that regulate reproductive processes.	**U/An**

5	Identifying molecular defects leading to reproductive disorders such as polycystic ovary syndrome (PCOS), infertility, and hypogonadism.Using molecular insights to develop drugs targeting hormonal pathways, improving treatments for infertility and hormone-related conditions.	**U**

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

CO-PO/PSO Mapping for the course:

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

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

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**Definition and scope of molecular endocrinology:** Chemical nature and general classes of hormones: Peptide, Amino acid derived, Steroid, Neurotransmitters, Neuropeptides, Chalones, Eicosanoids, and Pheromones. Hypothalamic octapeptide hormones: Oxytocin and Vasopressin. Purification and characterization of hormones. Hypothalamo-hypophyseal axis.	15	1
II	**Genetic control of hormone synthesis:** Structure and expression of protein hormone encoding gene. Molecular aspects of peptide hormone biosynthesis and secretion. Molecular aspects of synthesis and delivery of thyroid hormones, biogenic amines, and steroid hormones. Production of protein hormones by recombinant DNA technology	15	2
III	**Molecular mechanism of hormone action:** Membrane, cytoplasmic and nuclear hormone receptors, Non-genomic mechanism of hormone action, Receptor-ligand interactions. Hormonal signal transduction: G-proteins and second messengers. Genomic mechanism of hormone action: Steroid and thyroid hormones.	15	3
IV	**Molecular aspects of reproductive endocrinology:** Genetics of sex. Testicular and ovarian determining genes. Mullerian inhibiting substance genes. Stem cell renewal in testis. Molecular basis of male and female contraception. Endocrine disruptors. Neuroendocrine control of reproduction and feedback mechanism.	15	4

V	**Hormonal regulation of Metabolism:** Role of Insulin & Glucagon in regulation of Carbohydrate metabolism. Metabolic regulatory hormones in Lipid & Protein metabolism. Gastrointestinal hormones and their role in regulation of metabolic activity. Endocrine regulation of calcium and phosphate homeostasis in mammals.	15	5

Lab Course:

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

Recommended Books

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

M.Sc. (Bioscience) Semester-IV

Program	Subject	Year	Semester
M.Sc.0405	Bioscience	II	January 2027 – June 2027
Course Code	Course Title		Course Type
BS-22402	**Paper II – GENETIC ENGINEERING**		Core
Credit (L+T)	Hours Per Week (L-T-P)		
	L	T	P
5	4	1	3.5
Maximum Marks	CIA		ESE
100	30		70

Learning Objective (LO): The primary learning objectives of genetic engineering are to:

1. Understand Genetic Modification Techniques:
2. Comprehend the Applications:
3. Evaluate Ethical and Social Implications:
4. Develop Problem-Solving Skills: Apply genetic engineering techniques to address real-world challenges, such as creating disease-resistant plants or developing personalized medicine.
5. Master Safety and Regulation Knowledge: Learn about biosafety protocols and regulatory frameworks governing genetic modification.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	Analyse and apply advanced molecular tools and techniques, to evaluate their applications in genetic research, biotechnology, and forensic science.	**An/ Ap**
2	Apply gene cloning techniques and screening methods to evaluate their significance in genetic engineering and molecular biology research.	**Ap**
3	Analyse and apply gene knockout and genome editing techniques to evaluate their role in genetic modification and gene regulation studies.	**An/ Ap**
4	Analyse and apply vector and host engineering in expression strategies for heterologous genes to evaluate their significance in recombinant protein production and genetic research.	**An/ Ap**
5	Analyse and apply bioprocessing techniques for recombinant protein production, purification and bioreactor engineering to evaluate their significance in biotechnology and industrial applications.	**Ap/ 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	2	2	2	2	2	2	3	3	2	3	2	2
CO2	3	3	3	3	2	1	2	2	2	2	3	3	2	3	2	2
CO3	3	3	3	3	2	2	2	2	2	2	3	3	3	3	2	2
CO4	3	3	3	3	2	1	2	2	2	2	3	3	2	3	2	1
CO5	3	3	3	3	2	1	2	2	2	2	3	3	3	3	2	2

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

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**Molecular tools and their applications**: restriction enzymes, modification enzymes. Molecular techniques: polymerase chain reaction, DNA sequencing, DNA barcoding, protein sequencing.	18	1
II	**Gene cloning vectors:** plasmids, lambda phage as a vector, M13 phage as a vector, cosmids, artificial chromosomes (BAC, PAC, YAC). Genomic DNA library and cDNA library construction and screening methods, DNA microarray.	12	2
III	**Gene knockout technique:** Site-directed mutagenesis, Random mutagenesis, and applications, Genome editing: CRISPR-Cas 9, Gene Knockdown, Gene Silencing. Study of gene regulation: reporter assays.	15	3
IV	**Expression strategies for heterologous genes:** vector engineering and codon optimization, host engineering, in vitro transcription and translation. Post-Translational Modification Optimization	18	4
V	**Bioprocessing of recombinant proteins:** recombinant proteins purification, refolding, characterization and stabilization, Bioreactor engineering for recombinant protein production. Applications of recombinant proteins.	18	5

Lab Course:

1. Antibiotic selection media and bacterial culture
2. Preparation of competent cells
3. Isolation of plasmid DNA.
4. Isolation of Genomic DNA.
5. Quantitation of nucleic acids.
6. Agarose gel electrophoresis and restriction mapping of DNA.
7. Construction of restriction map of plasmid DNA.
8. Cloning in plasmid/phagemid vectors.
9. Isolation of RNA.

10. Synthesis of cDNA.
11. RAPD analysis by PCR.
12. Protein purification.

Recommended Books:

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

M.Sc. (Bioscience) Semester-IV

Program	Subject	Year	Semester
M.Sc.0405	Bioscience	II	January 2027 – June 2027
Course Code	Course Title		Course Type
BS-22403-A	**Paper III -(A) PARASITOLOGY**		Elective
Credit (L+T)	Hours Per Week (L-T-P)		
	L	T	P
5	4	1	3.5
Maximum Marks	CIA		ESE
100	30		70

Learning Objective (LO): The learning objective of Parasitology generally includes:

1. Understanding the biology, life cycles, and morphology of parasites.
2. Identifying various types of parasites (protozoa, helminths, ectoparasites) and their hosts.
3. Comprehending the mechanisms of parasite transmission and infection.
4. Recognizing the clinical manifestations and pathology caused by parasitic infections.
5. Learning diagnostic methods for parasitic diseases.
6. Understanding prevention, control, and treatment strategies for parasitic infections.
7. Appreciating the epidemiology and public health significance of parasitic diseases.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Gain comprehensive knowledge of the biology, life cycles, morphology, and classification of various parasites including protozoa, helminths, and ectoparasites.	**U**
2	Understand the complex interactions between parasites and their hosts, including modes of transmission, pathogenesis, and immune responses.	**U**
3	Knowledge about the basic biology, morphology, and classification of protozoa. Understanding the different stages in the life cycle of protozoa, Adaptations and Survival.	**U/An**
4	Identifying and classify the major species of trematodes (flukes) and cestodes (tapeworms) based on their morphological and anatomical features.	**An**
5	Understand the general characteristics and classification,describe the taxonomy, morphology, and distinguishing features of Acanthocephala and Nematoda. Explain the complex life cycles of acanthocephalans and nematodes, including intermediate and definitive hosts.	**An**

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	2	2	1	1	2	3	3	2	3	3	1
CO2	3	3	3	3	2	2	2	1	1	2	3	3	2	3	3	1
CO3	3	3	3	3	2	2	1	1	1	2	3	3	3	3	3	1
CO4	3	3	3	3	2	2	2	1	1	2	3	3	2	3	3	1
CO5	3	3	3	3	2	2	2	1	1	2	3	3	3	3	3	1

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

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	Parasites and parasitism. The Infection process: Modes of Parasite transmission, invasion, migration within the host, maintaining the station, obtaining nutrients, and resisting host attack.	18	1
II	Concept of Disease: Inflammation and Repair, Degeneration, Necrosis. Mechanism of Disease transmission with particular reference to vectors. Vector control measures.	12	2
III	General organization and life cycle patterns of Protozoa; Epidemiology, pathogenesis, diagnosis, and control of major human diseases, such as Malaria, Leishmaniasis, and Trypanosomiasis.	15	3
IV	General organization and life cycle patterns of Trematodes and Cestodes; Epidemiology, pathogenesis, diagnosis, and control of major human diseases, such as Schistosomiasis and Hydatidosis. Arthropod-related ectoparasitic diseases: Ticks, mites, and flies.	12	4
V	General Organization and life cycle patterns of Acanthocephala and Nematoda; Epidemiology, pathogenesis, diagnosis, and control of major nematode diseases, such as Ascariasis, Ancylostomiasis, and Filariasis. Biology of plant parasitic nematodes.	18	5

Lab Course:

1. Identification and comments on permanent mounts of parasitic organisms
2. Host examination for parasites; preparation of permanent slides and identification
3. Histology/Histopathology/Histochemistry by routine and differential staining
4. Biochemistry of parasites and pathophysiology of the hosts
5. Root-knot nematodes: Extraction and isolation (Cobb's sieving and decantation

method and Baerman's Funnel technique), preparation of perennial pattern mounts

6. Detection of blood parasites: Malarial parasite
7. Macroscopic and microscopic examination of stool samples, concentration methods

Recommended Books:

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

M.Sc. (Bioscience) Semester-IV

Program	Subject	Year	Semester
M.Sc.0405	Bioscience	II	January 2027 – June 2027
Course Code	Course Title		Course Type
BS-22403-B	**Paper III -(B) BASIC CHRONOBIOLOGY**		Elective
Credit (L+T)	Hours Per Week (L-T-P)		
	L	T	P
5	4	1	3.5
Maximum Marks	CIA		ESE
100	30		70

Learning Objective (LO):

1. This course introduces students to the foundational concepts and historical development of chronobiology, focusing on the nature and quantification of biological rhythms, particularly circadian rhythms.
2. Students will learn about key features of circadian clocks such as entrainment, compensation, masking, and the influence of environmental cues known as zeitgebers.
3. The course also covers methods of time series analysis for rhythm quantification, mechanisms of synchronization, and the anatomical and functional organization of circadian pacemakers in model organisms like Drosophila and mammals.
4. Additionally, students will explore multi-oscillatory systems, including master and peripheral oscillators, and evaluate the adaptive and social significance of circadian rhythms in living organisms.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	Describe biological rhythms and perform basic time series analyses to quantify rhythmic parameters using statistical methods.	**U/ Ap/**
2	Analyze the adaptive properties of circadian rhythms under varying physiological and environmental conditions, including entrainment and compensation mechanisms.	**U/ An**
3	Evaluate the role of different zeitgebers in the entrainment of biological clocks and interpret phase response curves to assess entrainment dynamics.	**U/An**
4	Explain the anatomical and molecular basis of circadian pacemakers in model organisms like *Drosophila* and mammals, including the function of the SCN.	**U**
5	Discuss the functional organization of multi-oscillatory circadian systems and assess their adaptive and social significance in biological systems.	**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	2	3	1	2	2	1	1	3	2	3	2	3	3	3
CO2	3	3	3	2	1	2	2	1	1	3	2	3	3	3	2	3
CO3	3	3	3	2	1	3	2	2	1	3	2	3	3	3	2	3
CO4	3	2	2	2	1	2	2	1	1	3	2	3	2	3	2	3
CO5	3	2	2	2	2	2	2	2	1	3	3	3	3	3	2	3

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

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**Historical developments in chronobiology:** Different types of geophysical and biological cycles with examples of circadian rhythms. Quantification of biological rhythms - Average, amplitude, phase, and period. Characteristics and properties of circadian rhythm: Free-run, temperature and nutrition compensation, and Entrainment. Zeitgeber Time (ZT) and Circadian Time (CT).	16	1
II	**Zeitgebers for circadian clocks:** Key properties of a Zeitgeber. Photic and non-photic zeitgebers. After-effects and Aschoff's rule. A brief introduction to time series analysis. Methods of time series analyses: Cosinor, autocorrelation, chi-square periodogram.	16	2
III	**Synchronization (Entrainment) and masking:** Entrainment by single light pulse, complete and skeleton photoperiods. Mechanisms of entrainment. Phase response curves (PRC), strong and weak PRC, phase transition curves (PTC).	15	3
IV	**Circadian pacemakers:**Circadian pacemakers in insects with special reference to *Drosophila*. Suprachiasmatic nucleus as mammalian circadian clock. Photoperiodism. Plant Rhythms.	14	4
V	**Multi-oscillatory organization:** Central pacemaker and peripheral oscillators. morning and evening oscillators. Adaptive significance of circadian rhythms. Social consequence of circadian rhythms. Aging and circadian clocks	12	5

Lab Course:

1. Terminology in Chronobiology
2. Study of locomotor activity rhythm in suitable animal models
3. Actogram construction of locomotor activity of suitable animal models

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

Recommended Books:

MJ Berridge	Biochemical oscillations and cellular rhythms. The molecular bases of periodic and chaotic behaviour
E Bunning	The physiological clock
FH Columbus	Trends in chronobiology
G Cornelissen & F Halberg	Introduction to chronobiology
JC Dunlap, JJ Loros& PJ DeCoursey	Chronobiology: Biological timekeeping
JC Hall	Genetics and molecular biology of rhythms in *Drosophila* and other insects
PJ Lumsden& AJ Millar	Biological rhythms and photoperiodism in plants
JD Palmer	The living clock
AK Pati	Chronobiology: The dimension of time in biology and medicine; PINSA (Biological Sciences), December 2001
AK Pati (Ed.)	Chronobiology
DS Saunders	An introduction to biological rhythms
B Thomas & D Vince-Prue	Photoperiodism in plants
V Kumar (Ed.)	Biological rhythms
MK Chandrashekaran	Time in the Living World
AT Winfree	The Geometry of Biological Time
MC Moore, FM Sulzman, & CA Fuller	The Clocks That Time Us, Harvard University Press,1982
DS Saunders	Insect clocks, Pergamon, 2002

M.Sc. (Bioscience) Semester-IV

Program	Subject	Year	Semester
M.Sc.0405	Bioscience	II	January 2027 – June 2027
Course Code	**Course Title**		**Course Type**
BS-22403-C	**Paper III -(C) ETHNOBOTANY**		Elective
Credit (L+T)	Hours Per Week (L-T-P)		
	L	T	P
5	4	1	3.5
Maximum Marks	CIA		ESE
100	30		70

Learning Objective (LO):

1. Identify and classify various plant species that would provide the correct direction for their grouping and categorization and preparation of phylogenetic relationship.
2. Improve existing knowledge of plant biodiversity thus strengthening the list of rare, endangered, vulnerable, and extinct species.
3. Understate the importance of plants in human and animal life and identify new food crops and plants with ethnomedicinal potential.
4. Understand the economic and pathological importance of plants, bacteria, and viruses.
5. Understand the complexity of biological systems in a simple manner after exploring the world of fungi, and pathogens of plants.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Ethnobotany is the study of the relationship between people and plants, focusing on how different cultures use and perceive plants for medicine, food, rituals, and other purposes.	**U**
2	Students will learn how various indigenous and local communities use plants in their daily lives, traditions, and medicine.Ability to identify important medicinal, nutritional, and economically valuable plants used by different cultures.	**U/ Ap**
3	Appreciation of how traditional ecological knowledge about plants is passed down through generations and its relevance today.	**U**
4	Understanding the importance of conserving both plant biodiversity and cultural heritage related to plant use.	**U/ Ap**
5	Insight into how ethnobotanical knowledge can contribute to fields like pharmacology, agriculture, and sustainable development.	**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	2	2	2	2	3	3	2	3	3	3
CO2	3	3	3	3	2	2	2	2	2	2	3	3	2	3	3	3
CO3	3	3	3	3	2	2	3	2	2	2	3	3	3	3	3	3
CO4	3	3	3	3	2	2	2	2	2	2	3	3	2	3	3	3
CO5	3	3	3	3	2	2	2	2	2	2	3	3	3	3	3	3

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

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**Ethnobotany:** Introduction, Concept, Scope, and Objectives; Ethnobotany as an interdisciplinary science. The relevance of Ethnobotany in the present context; major and minor ethnic groups or tribals of India and their lifestyles. Plants used by the tribals as (a) Food plants (b) Intoxicants and Beverages (c) Resins, oils, and miscellaneous uses.	18	1
II	**Methodology of Ethnobotanical studies:** Fieldwork: collection and confirmation of tribal information; its documentation; assessment of its valuation Herbarium: its role in the confirmation of ethnic data; assessment of similarities of data across different habitats ancient literature; Archaeo-ethnological findings; Sacred Grooves-their role in the confirmation of ethnic data.	12	2
III	**Role of Ethnobotany in modern medicine:** Medico-Ethnobotanical sources in India. Significance of the following plants in ethnobotanical practices (along with their habitat and morphology) (a) *Saussureacostus*(b) *Arnebiabenthamii*(c) *Fritillaria roylei*(d) *Rheum webbianum*(e) *Tribulus terrestris*(f) *Aconitum heterophyllum*(g) *Digitalis purpurea* (h) *Indigofera heterantha.*	15	3
IV	**Role of Ethnobotany in modern medicine with special examples:** a) *Digitalis purpurea* b) *Atropa acuminata* c) *Artemisia* sp. d) *Withania*sp. Role of ethnic groups in the conservation of plant genetic resources. Endangered taxa and forest management (participatory forest management).	12	4
V	**Ethnobotany and legal aspects:**Ethnobotany as a tool to protect the interests of ethnic groups. Sharing of wealth concept with a few examples from India. Biopiracy, Intellectual property rights, and traditional knowledge.	18	5

Lab Course:

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

Recommended Books:

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

M.Sc. (Bioscience) Semester-IV

Program	Subject	Year	Semester
M.Sc.0405	Bioscience	II	January 2027 – June 2027
Course Code	Course Title		Course Type
BS-22404-A	**Paper IV -(A) Applied Immunology**		Elective
Credit (L+T)	Hours Per Week (L-T-P)		
	L	T	P
5	4	1	3.5
Maximum Marks	CIA		ESE
100	30		70

Learning Objective (LO):

1. Conceptsofthe immunesystemandtypesofimmunity
2. Mechanismofactivationofimmunesystemcomponents
3. Concepts of immune deficiency,allergies, autoimmune disorders, transplantimmunology,immunotherapy,developmentofvaccines,etc.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Studying Applied Immunology equips students with both theoretical knowledge and practical skills related to the immune system and its applications in health and disease.	**U/Ap**
2	Comprehend the structure, function, and regulation of the immune system. Understand innate and adaptive immunity, immune responses, and immune regulation.	**U/Ap**
3	Analyze the role of immunity in infectious diseases, autoimmune disorders, allergies, and cancer. Understand how immune dysfunctions contribute to disease pathology.	**U/Ap**
4	Learn techniques used in diagnosing immune-related diseases (e.g., ELISA, flow cytometry). Understand therapeutic approaches, including vaccines, immunotherapies, and monoclonal antibodies.Materials like silver nanoparticles improve electrical and thermal conductivity. Nanomaterials can respond to external stimuli, useful in sensors and adaptive systems.	**Ap**
5	The outcome of a biosensor technique is the detection, quantification, and analysis of a specific biological or chemical substance. Biosensors convert a biological response into an electrical, optical, or thermal signal, allowing for rapid and accurate measurements.	**Ap**

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

CO-PO/PSO Mapping for the course:

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

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

Detailed Syllabus

Unit No.	Topics	No. of Lectures	CO No.
I	**Generation of diversity in BCR:** Light and heavy chain gene recombination. Recombination Signal sequences. Class switching. Membrane and secreted immunoglobulins. Organization, arrangement of T-cell receptor genes, and recombination. Regulation of immune response by antigen, antibody, immune complex, MHC, and cytokines.	18	1
II	**Immuno-prophylaxis:**Principles of Vaccination. Immunization practices. Vaccines against important bacterial and parasitic diseases. DNA vaccines; passive prophylactic measures. Viral vaccines and antiviral agents. Vaccination schedules and safety. Production of vaccines.	12	2
III	**Diagnosis of microbial diseases:** Collection, transport, and preliminary processing of Clinical pathogens. Clinical, microbiological, immunological, and molecular diagnosis of diseases. Principles of immunodiagnostics. Antigen-antibody-based diagnosis and the techniques involved – Enzyme, Radio, and Fluorescence Immunoassays, Immunoblotting, and Flow cytometry. Effector cell assays, Cytotoxic assays. Isolation of pure antibody. Monoclonal & Designer antibody and their application in immunodiagnostics.	15	3
IV	**Modern methods of microbial diagnosis:** Use of nanotechnology in diagnosis. Synthesis of Nanomaterials, Nanoparticle-based drug delivery, Toxicity, and environmental risks of nanomaterials.	12	4
V	**Biosensors:** Biosensor development, types, and characteristics, DNA biosensors, application of biosensors in clinical diagnostics: detection of infectious diseases, food pathogen, and environmental monitoring.	18	5

Lab Course:

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

Recommended Books:

RA Goldsby, TJ Kindt and BA Osborne	Kuby's Immunology
E Benjamini, R Coico and G Sunshine	Immunology-A Short Course
Roitt, Brostoff and Male	Immunology
William Paul	Fundamentals of Immunology
Stewart Snell	Immunology, Immunopathology and Immunity
Elgert	Understanding Immune System
M. Wilson, K. Kannangara, G Smith, M. Simmons, B. Raguse	Nanotechnology: Basic Science and Emerging Technologies
G. Cao	Nanostructures and Nanomaterials: Synthesis, properties and applications
Challa S.S.R. Kumar	Nanomaterials for medical diagnosis and therapy
Charles P. Poole Jr. and Franks. J. Qwens	Introduction to Nanotechnology
C. M. Niemeyer, C. A. Mirkin (Editor)	Nanobiotechnology: Concepts, Applications and Perspectives

M.Sc. (Bioscience) Semester-IV

Program	Subject	Year	Semester
M.Sc.0405	Bioscience	II	January 2027 – June 2027
Course Code	Course Title		Course Type
BS-22404-B	**Paper IV -(B) APPLIED CHRONOBIOLOGY**		Elective
Credit (L+T)	Hours Per Week (L-T-P)		
	L	T	P
5	4	1	3.5
Maximum Marks	CIA		ESE
100	30		70

Learning Objective (LO):

1. This course aims to provide students with an in-depth understanding of the molecular and physiological mechanisms underlying biological clocks across diverse organisms.
2. Students will gain insights into the clinical applications of chronobiology, particularly in chronopharmacology and chronotherapy, addressing circadian influences on drug efficacy and treatment strategies for various diseases.
3. Students will acquire both theoretical and applied knowledge relevant to health, performance, and daily biological timing.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	Analyze the genetic and molecular basis of circadian clocks in various model organisms and explain the transcriptional feedback loops that regulate rhythmic gene expression under different environmental conditions.	**U/An**
2	Describe the structure and function of the pineal gland, explain the synthesis and circadian regulation of melatonin, and evaluate its role as an input and output component of vertebrate biological clocks.	**U**
3	Assess human circadian rhythms using various experimental protocols and biological markers, and differentiate chronotypes to understand their implications on sleep, alertness, and performance.	**U/ Ap/ An**
4	Apply the principles of chronopharmacology and chronotherapy in understanding how circadian timing affects drug action and in developing time-based treatment strategies for major health disorders.	**U/ Ap**
5	Evaluate the effects of shift work and jet lag on circadian rhythms and human health, and recommend effective coping strategies such as shift optimization, light therapy, and melatonin intervention.	**U/ 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	2	3	2	2	1	3	2	3	3	3	3	3
CO2	3	2	2	2	2	2	2	2	1	3	2	3	2	2	2	3
CO3	3	3	3	3	2	3	3	2	1	3	3	3	3	3	3	3
CO4	3	3	3	3	2	3	3	3	2	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	2	3	3	3	3	3	3	3

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

Detailed Syllabus

Unit No.	Topics	No. of Lectures	CO No.
I	**Molecular mechanisms underlying clock functions in organisms:***Drosophila* (*per*, *tim*, *dbt*, *clock*, *cycle*, *vrille*, *pdf*, *lark*, *takeout*), *Neurospora,* cyanobacteria, mouse, and humans. Temporal expression patternand regulation of clock genes, Expression patterns under constant light and darkness.	16	1
II	**Pineal gland structure and function, Melatonin:** synthesis and release, Melatonin: essential elements of vertebrate Timekeeping, Input or output signal of the clock system.	12	5
III	**Human circadian organization:** Methods to study human circadian rhythm; Free-running rhythms in humans, Constant routine protocol, and Forced desynchronization protocol. Chronotypes and their assessment methods. Marker rhythms in humans: Core body temperature (CBT), melatonin, and cortisol. Sleep-wake alertness and performance rhythms in humans.	14	2
IV	**Circadian rhythms and human health:** Chronotherapy; Application of chronotherapy in the treatment of cancer, cardiovascular diseases, allergies, asthma, and circadian rhythm sleep disorders (for example, DSPS and ASPS) & mood disorders (SAD).Chrononutrition.	16	3
V	**Circadian rhythms in occupational and travel stresses:** Shift work; Types of shift system, direction and frequency of shift rotation, Effect on rhythm parameters, Desynchronization of circadian rhythm, Consequences on sleep, Psychosocial problems, Clinical and non-clinical problems. Shift work tolerance/ intolerance. Shift optimization: Nap, Bright light therapy, Melatonin therapy.Jet lag: Consequences of jet lag; direction asymmetry & variable asymmetry; Approaches to jet lag alleviation.	16	4

Lab Course:

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

Recommended Books:

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

M.Sc. (Bioscience) Semester-IV

Program	Subject	Year	Semester
M.Sc.0405	Bioscience	II	January 2027 – June 2027
Course Code	Course Title		Course Type
BS-22404-C	**Paper IV-(C) SECONDARY METABOLITES**		Elective
Credit (L+T)	Hours Per Week (L-T-P)		
	L	T	P
5	4	1	३·५
Maximum Marks	CIA		ESE
100	30		70

Learning Objective (LO): Students will develop an understanding of-

1. Understand what plant secondary metabolites are and how they differ from primary metabolites. Knowledge of extraction, isolation, characterization, and elicitation of bioactive metabolites.
2. Explain the biosynthetic pathways involved in the production of secondary metabolites. Plant-based biofuels.
3. Learn methods of extraction, purification, and qualitative/quantitative analysis of secondary metabolites.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	Gain insights into how plants protect themselves from herbivores, pathogens, and environmental stress through the production of compounds like alkaloids, flavonoids, and terpenoids.	**U**
2	Explore how genetic engineering and biotechnology can enhance the production of valuable secondary metabolites in plants.	**U**
3	Develop skills in identifying and analyzing the chemical structures and biosynthetic pathways of diverse secondary metabolites.	**U**
4	Learn about the medicinal potential of secondary metabolites, including their roles as antioxidants, antimicrobials, and anticancer agents, which are crucial for drug development.	**Ap/ U**
5	To realize the commercial value of secondary metabolites in industries such as pharmaceuticals, cosmetics, and food additives.	**Ap/ 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	2	2	2	2	2	2	2	3	2	3	2	2
CO2	3	3	3	2	2	2	2	2	2	2	2	3	2	3	2	2
CO3	3	3	3	2	2	2	3	2	2	2	2	3	3	3	2	2
CO4	3	3	3	2	2	2	2	2	2	2	2	3	2	3	2	2
CO5	3	3	3	2	2	2	2	2	2	2	2	3	3	3	2	2

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

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**Introduction to secondary metabolites**: Definition and systematic of secondary metabolites. Major classes of secondary metabolites i.e. alkaloids, terpenoids/ or isoprenoids, flavonoids, and phenolics. Significance of secondary metabolites in plant life. Roles in chemical defence system, taxonomical and ecological functions.	18	1
II	**Biosynthesis and regulation of secondary metabolites:** Biosynthesis of alkaloids derived from Shikimic acid pathway. Biosynthesis of isoprenoids via 3C-methyl-D-erythritol-4-phosphate (MEP) pathway. Biochemical pathways of flavonoids and polyphenol (lignin) biosynthesis. Integration of secondary metabolism with primary metabolic pathways.	12	2
III	**Production of secondary metabolites:** Methods of production of secondary metabolites: Tissue, organ, and hairy root cultures. Roles of Endophytes in the production of secondary metabolites.	15	3
IV	**Industrial Production of secondary metabolites:** Bioreactors. Effects of precursors, co-factors, and elicitors on production. Production of Taxol, Camptothecin, Berberine, and rubber.	12	4
V	**Metabolic Engineering of secondary metabolic pathways:** Cloning and characterization of enzymes of the Shikimate and MEP pathways. Functional genomics approaches for improvement of secondary metabolite production. Metabolic engineering of *Escherichia coli* and yeast for the production of flavonoids, terpenoids, and alkaloids.	18	5

Lab Course:

1. Isolation of essential oil and determination of the oil yield.
2. Qualitative test for determination of
   a- terpenoids b- alkaloidsc- flavonoidsd- saponins

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

4 Determination of the antimicrobial activity of the plant extracts.

5 Demonstration of hairy root culture for production of secondary metabolites

Recommended Books:

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

PROJECT WORK

Learning Outcomes:

Project work will enable the student to:

a. Develop an inquisitive mind and be methodical in his approach to solving the research problem.
b. Demonstrate skill and knowledge of current information and technological tools and techniques specific to the professional field of study.
c. Develop scientific temperament, work ethics, creativity, collaboration, and communication skills increasing their chances of employability.
d. Build an important network of future partners, mentors, and/or collaborators that will be helpful in their future endeavors.
e. Open a window to career opportunities hitherto undiscovered by them.
f. Gain experience in their field of interest through learning activities giving them a competitive edge.
g. Refine their interests and gain confidence in moving forward.
h. The main objective of such projects is to develop research aptitude in students at an early age.
i. Thisisthesecondphasewherethestudentswillundertakesomeresearchproblems andsolve themthroughexperiments.
j. Furtherareport will be submittedandpresentedfordiscussion.

M.Sc. (Bioscience) Semester-IV

Program	Subject	Year	Semester
M.Sc.0405	Bioscience	II	January 2027 – June 2027
Course Code	Course Title		Course Type
BS - 22408	**PAPER – BIOSAFETY, BIOETHICS AND IPR**		Theory withProject
Credit	Hours Per Week (L-T-P)		
	L	T	P
5	5	-	--
Maximum Marks	CIA		ESE
100	30		70

Learning Objective (LO):

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

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Gain Knowledge of working principles in a laboratory taking a, safety measures, Handling of live cultures, disposal of infectious waste, and care of the equipment requiring	**U**
2	Get an insight into Biosafety guidelines. Analyze and Manage the Risks involved with GMOs.	**An**
3	Understand the international Agreements and Regulations with respect to Biosafety, Gain Knowledge about intellectual property Rights.	**U/ Ap**
4	Understand guidelines to protect biological inventions. Understand different treaties, rights, and duties of patent owners.	**U/A p**
5	Understand the process of filing a patent.	**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	2	2	2	1	2	2	2	2	3	2	1	1	1
CO2	3	3	2	2	2	2	1	2	2	2	2	3	2	1	1	1
CO3	3	3	2	2	2	2	1	2	2	2	2	3	2	1	1	1
CO4	3	3	2	2	2	2	1	2	2	2	2	3	2	1	1	1
CO5	3	3	2	2	2	2	1	2	2	2	2	3	2	1	1	1

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

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**BIOSAFETY INTRODUCTION** Introduction: Biosafety issues; Biological safety, cabinets & their Types; primary containment for Biohazards; Biosafety Levels of specific Microorganisms.	18	1
II	**GUIDELINES:** Biosafety guidelines and regulations (National and International); Role of institutional biosafety committees (IBSC).	12	2
III	**RISK ANALYSIS AND GUIDELINES** Genetically modified organisms (GMOs), GMo applications in food and agriculture, Risk Analysis; Risk Assessment and Risk Management; Experimental models: Use of Animals in Research and its Alternatives, Animal cloning, and their Ethical Aspects. Testing of drugs on Human volunteers.	15	3
IV	**INTRODUCTION TO INTEILECTUAL PROPERTY** Introduction to intellectual property and History Patents, Trademarks, Copyright, Trade secrets, industrial Design and Rights, Traditional Knowledge, importance of IPR-patentable and non-patentable; World intellectual Rights Organization, WTPO, pros and Cons of IP protection.	12	4
V	**PATENT FILING AND GRANT** Types of patent applications: ordinary, Patent PCT, conventional, An introduction to patent Filing procedures; licensing and agreement; Agreements and Treaties: GATT, TRIPS Agreement; WIPO Treaties; Budapest Treaty; Indian Patent Act 1970 & recent amendments. patenting of Living organisms.	18	5

Recommended books:

H S Chawla.	Introduction to plant Biotechnology,
M K Sateesh.	Bioethics and Biosafety.
Shomini Parashar, Deepa Goel	IPR, Biosafety and Bioethics pearson India 2013.
Susan K	Private Power, Public Law: The Globalization of Intellectual Property Rights
Alexander, Poltroack; Paul J. Lerner Wiley, 2011 (2nd edition).	Essential of Intellectual Property: Law, Economics and Strategy
Diane o' Fleming Debra L' Hunt	Biological safety: principles and practices, 4th Edition. ASM 200G.

M.Sc. (Bioscience) Semester-I
Course on Indian Knowledge System

Program	Subject	Year	Semester
M.Sc.0405	Bioscience	I	July 2025 – December2025
Course Code	Course Title		Course Type
IKS - 1	**PAPER – INDIAN KNOWLEDGE IN LIFE SICENCE**		IKS
Credit	Hours Per Week (L-T-P)		
	L	T	P
2	2	-	--
Maximum Marks	CIA		ESE
100	30		70

Learning Objective (LO):

1. Creating awareness amongst the youths about the true history and rich culture of the country;
2. Understanding the scientific value of the traditional knowledge of Bhārata;
3. Promoting the youths to do research in the various fields of Bhāratīya knowledge system;
4. Converting the Bhāratīya wisdom into the applied aspect of the modern scientific paradigm;
5. Adding career, professional and business opportunities to the youths.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	Provide an overview of the concept of the Indian Knowledge System and its importance.	**U**
2	Appreciate the need and importance of protecting traditional knowledge.	**U/ Ap**
3	Recognize the relevance of Traditional knowledge in different domains.	**U/ Ap**
4	Establish the significance of Indian Knowledge systems in the contemporary world.	**U/ Ap**
5	To gain insights into the concept of traditional knowledge and its relevance' They will also be able to understand and connect the basics of Indian traditional knowledge with a modern perspective.	**U/ 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	3	2	3	3	2	3	2	2
CO2	3	3	3	3	3	3	3	3	3	2	3	3	2	3	2	2
CO3	3	3	3	3	3	3	3	3	3	2	3	3	3	3	2	2
CO4	3	3	3	3	3	3	3	3	3	2	3	3	2	3	2	2
CO5	3	3	3	3	3	3	3	3	3	2	3	3	3	3	2	2

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

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**Introduction to Indian Knowledge Systems (IKS):** Overview, Vedic Corpus, Philosophy, Character scope and importance, traditional knowledge vis-a-vis indigenous knowledge, traditional knowledge vs. western knowledge.	4	1
II	**Indian Knowledge System:** Tribal and ethnic communities in India: communication and knowledge sharing method. Ethnic groups in India, understanding and application of Ethnic studies, Tattoos, and Magico religious beliefs.	5	2
III	**Life sciences:** The historicalevolution of medicinal tradition in ancient India: • Survey and inventory of plant usages, search for newer plant resources, and conservation practices. • Agriculture, Social forestry, Shift cultivation, and Edible plants.	5	3
IV	**Life sciences: Ayurveda for life, health and well-being:** • Various aspects of how Ayurveda is a holistic studyand practice that balances the inner environment with the external. • Appraise the concept of good health and explore the role of dietary and behavioral changes in restoring health.	5	4
V	**Traditional Knowledge:** • Traditional music, beverages and ethno-veterinary. • Edible mushrooms and their importance. • Opportunities and challenges for the life sciences in India.	5	5

Recommended books:

1. A Handbook of Ethnobotany. S K Jain, V. Mudgal 1999 Dehradun, India
2. Textbook on The Knowledge System of Bhārata by Bhag Chand Chauhan,
3. History of Science in India Volume-1, Part-I, Part-II, Volume VIII, by Sibaji Raha, et al. National Academy of Sciences, India and The Ramkrishan Mission Institute of Culture, Kolkata (2014).

M.Sc. (Bioscience) Semester-III

Skill Enhancement/Value Added Courses

Program	Subject	Year	Semester
M.Sc.0405	Bioscience	II	July 2026 - December 2026
Course Code	Course Title		Course Type
LS-VAC-1	**PAPER – SURVIVAL SKILLS VS WIRDERNESS AND METROPOLITAN CHALLENGES**		Skill development/Value-Added Course
Credit	Hours Per Week (L-T-P)		
	L	T	P
2	2	-	--
Maximum Marks	CIA		ESE
100	30		70

Learning Objective (LO):

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

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	Understanding the role of biological information for life survival in an ecosystem. Helps to recognize the basic necessity of life in various conditions.	**U**
2	To understand the precautionary approaches/s unde4r low or minimal limiting factors of life.	**U/Ap**
3	Understanding the importance of survival techniques for human existence.	**U/Ap**
4	Acquire the skills necessary to become independent productive and satisfied adults.	**U/ Ap**
5	Learn to access, navigate, and contribute to the community.	**U/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	3	2	2	2	3	3	2	2	2	1
CO2	3	3	3	3	2	3	3	2	2	2	3	3	2	2	2	1
CO3	3	3	3	3	2	3	3	2	2	2	3	3	3	2	2	1
CO4	3	3	3	3	2	3	3	2	2	2	3	3	2	2	2	1
CO5	3	3	3	3	2	3	3	2	2	2	3	3	3	2	2	1

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

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**Basic principle of Life Survival** 1. Basic necessities of life (Wilderness and Metropolitan) 2. Understanding and arrangement of tools for survival ship using natural resources.	4	1
II	**Basic Survival Skills:** 1. Types of survival ships: Wilderness and Metropolitan 2. Importance of mobility in Wilderness and Metropolitan environment.	5	2
III	**Preliminary Survival Skills:** 1. Management of health in wilderness and metropolitan environment: Challenges of food and nutrition under unfavourable conditions. 2. Sources of medicines and health care in absence of high technology and resources.	5	3
IV	**Secondary Survival Skills** 1. Challenges of safety: Shelter and Fire 2. Self awareness with special reference to wilderness and metropolitan ecosystem. 3. Communication skills understanding signs and marks.	5	4
V	**Special survival skills and value added approaches to life survival.** 1. Use of waste for life survival. 2. Real life stories and examples of survival skills/techniques. 3. Importance and opportunities for survival experts.	5	5

Recommended books:

Cody Lundin	When All Hell Breaks Loose: Stuff You Need to Survive When Disaster Strikes
Tom Brown Jr.	Field Guide to Wilderness Survival
Mors Kochanski	Outdoor Skills and Wilderness Survival
Larry Dean Olsen	Outdoor Survival Skills
C. Spike Trotman	Poorcraft: The Funnybook Fundamentals of Living Well on Less

M.Sc. (Bioscience) Semester-III

Skill Enhancement/Value Added Courses

Program	Subject	Year	Semester
M.Sc.0405	Bioscience	II	July 2026- December 2026
Course Code	Course Title		Course Type
LS-VAC-02	**PAPER – RESEARCH SKILL**		Skill development/value-added course
Credit	Hours Per Week (L-T-P)		
	L	T	P
2	2	-	--
Maximum Marks	CIA		ESE
100	30		70

Learning Objective (LO: Explain the scientific method, research ethics, and the process of inquiry. To develop clear, concise, and researchable questions or hypotheses.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Develop clear, concise, and researchable questions or hypotheses.	**U/ An**
2	Conduct a comprehensive literature review to identify gaps, trends, and relevant studies in the chosen field.	**U/ An**
3	Choose appropriate qualitative, quantitative, or mixed-method approaches based on the research objectives.	**U/ An**
4	Use reliable and valid methods for gathering data, such as surveys, experiments, observations, or archival research. Analyze quantitative data using statistical tools and qualitative data using thematic analysis or coding.	**U/ An/ Ap**
5	Present research findings in a clear, structured, and well-documented format, adhering to academic standards.	**U/ An/ 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	2	3	3	2	2	2	2	3	3	3	2	2	2
CO2	3	3	2	2	3	3	2	2	2	2	3	3	3	2	2	2
CO3	3	3	2	2	3	3	2	2	2	2	3	3	3	2	2	2
CO4	3	3	2	2	3	3	2	2	2	2	3	3	3	2	2	2
CO5	3	3	2	2	3	3	2	2	2	2	3	3	3	2	2	2

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

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**SKILL OF IDENTIFYING A RESEARCHPROBLEM** Specifying a Problem - Justifying it - Suggesting the need to study it for audiences.	5	1
II	**RESOURCE SEARCHING:** Skill of reviewing the literature Locating Resources - Selecting Resources - Summarizing Resources.	4	2
III	**SKILL OF SPECIFYING A PURPOSE FOR RESEARCH** Identifying the purpose statement - Narrowing the purpose statement to research - Questions or hypotheses.	5	3
IV	**SKILL OF COLLECTING DATA** Selecting individuals to study - Obtaining permissions - Gathering information. Skill of analyzing and interpreting DATA Breaking down the data - Representing the data - Explaining the data.	6	4
V	**SKILL OF REPORTING AND EVALUATING RESEARCH** Deciding on audience - Structuring the report - Writing the report sensitivity.	6	5

Recommended books:

R. Murray Thomas; Dale L. Brubaker	Theses and Dissertations
Stella Cottrell	Dissertations and Project Reports

M.Sc. (Bioscience) Semester-II
Generic Elective Courses

Program	Subject	Year	Semester
M.Sc. 0405	Bioscience	I	January 2026 – June 2026
Course Code	Course Title		Course Type
LS-CBCS-1	**Paper I -Astrobiology**		Generic Elective
Credit	Hours Per Week (L-T-P)		
	L	T	P
2	2	-	-
Maximum Marks	CIA		ESE
100	30		70

Learning Objective (LO):

The learning objectives of studyingastrobiology provides insights into the origins, evolution, and potential existence of life beyond Earth. Here are some key learning objectives:

1. Integrate principles of biology, chemistry, physics, and planetary science to learn astro-biological phenomena.
2. Understand the significance of organic molecules in early life formation
3. Examine techniques used in space missions for detecting biosignatures.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	Explain historical development of astrobiology, understand evolution of life on Earth	**Ap**
2	Analyze the formation of the solar system and interpret evidence of early life and its adaptation to extreme environments	**An**
3	Analyze the conditions that determine planetary habitability within the Solar System	**An**
4	Learn various types of biosignature for identifying and interpreting signs of life, both past and present	**Ap**
5	Explain and apply advanced techniques for biosignature detection,and critically assess their roles in the identification of biological molecules	**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	2	2	3	2	2	3	3	3	3	2	3	3
CO2	3	3	3	3	2	2	3	1	2	3	3	3	3	2	3	3
CO3	3	3	3	3	1	2	3	2	2	3	3	3	3	2	3	3
CO4	3	3	3	3	1	2	3	1	2	3	3	3	3	2	3	3
CO5	3	3	3	3	1	2	2	2	2	3	3	3	3	2	3	3

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

Unit No.	Topics	No. of Lectures	CO No.
I	**Life and its origin** History of Astrobiology, Life on Earth, Current hypotheses of origin of life. Structure of Life: Building blocks and cells	6	1
II	**Life on Earth** Formation of the Solar System, Conditions on early Earth, Evidence of early life and its survival in extreme environments, Evolution of multicellularity	6	2
III	**Planetary Habitability in the Solar System** Biotic and abiotic conditions for Habitable planet, Search of life on planetary bodies such as Mars, Europa, Enceladus and other icy bodies	6	3
IV	**Biosignatures of Life** Types of biosignatures: Chemical (Molecular biosignatures, Isotopic biosignatures, minerals and gases biosignatures), Physical (Macroscopic and Microscopic biosignatures).	6	4
V	**Biosignature Detection** GasChromatography and Capillary electrophoresis method, Raman spectroscopy and Next generation sequencing method.	6	5

Books Recommended:

1. Keith Cooper — Origins of the Universe
2. Pekka Teerikorpi, Mauri Valtonen K. Lehto, Harry Lehto, Gene Byrd Arthur Chernin — The Evolving Universe and the Origin of Life
3. Andrew May — Astrobiology: The Search for Life Elsewhere in the Universe
4. Alan Longstaff — Astrobiology
5. Vera M. Kolb — Handbook of Astrobiology
6. Charles S. Cockell — Astrobiology: Understanding Life in the Universe
7. Jonathon Stone, Paul Higgs, Ralph Pudritz — Planetary Systems and the Origins of Life
8. Barbara Cavalazzi Frances Westall — Biosignatures for Astrobiology

M.Sc. (Bioscience) Semester-II

Generic Elective Courses

Program	Subject	Year	Semester
M.Sc.0405	Bioscience	I	January 2026 - June 2026
Course Code	Course Title		Course Type
LS-CBCS - 2	**PAPER – Applied Biology**		Generic Elective
Credit	Hours Per Week (L-T-P)		
	L	T	P
2	2	-	--
Maximum Marks	CIA		ESE
100	30		70

Learning Objective (LO: Grasp the foundational biological principles and their applications in real-world contexts.

1. Develop hands-on experience with laboratory techniques and fieldwork relevant to applied biology.
2. Collect, analyze, and interpret biological data using quantitative and qualitative methods.
3. Apply biological knowledge to address practical challenges in agriculture, healthcare, biotechnology, and environmental management.
4. Design and conduct experiments to investigate applied biological questions.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Explain the taxonomy, physiology, and life cycle of edible and medicinal mushrooms. Demonstrate the ability to cultivate mushrooms using different substrates and methods.	**U/ Ap**
2	Demonstrate proficiency in classical and modern plant breeding methods, including hybridization, mutation breeding, and marker-assisted selection	**U/ Ap**
3	Explain the principles of animal breeding, nutrition, health care, and management. Apply effective practices for rearing and managing various livestock species, including cattle, poultry, sheep, goats, and pigs.	**U/ Ap**
4	Articulate the ethical implications and responsibilities associated with the use of animals and plants for human purposes.	**U/ Ap**
5	Evaluate how policies affect research, innovation, and commercialization in biotechnology, agriculture, healthcare, and environmental management.	**U**

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

CO-PO/PSO Mapping for the course:

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

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

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**MUSHROOM:** Structure and its parts (Anatomy and morphology). Mushroom Farming: Introduction, Process and economic importance.Edible Mushrooms: Wild and Cultivated varieties with special reference to Chhattisgarh. Mushrooms of medicinal importance.	6	1
II	**PLANT BREEDING** Plant Breeding Technique: Traditional methods and Modern techniques. Indoor and Rooftop plant cultivation. Plant Nursery establishment.Hydroponics and Aquaponics.	6	2
III	**ANIMAL HUSBANDRY:** Poultry and Dairy farming: Introduction, Technique and importance. Apiculture and sericulture: introduction, Technique and importance. Aquaculture: Introduction, Technique and importance.	6	3
IV	**SOCIAL IMPACT** Animals used in sports, pleasure and research. Edible Vaccines, Harvest festivals in India	6	4
V	**GOVERNMENT POLICY** Role of government in applied bioscience with special reference to India: NLM, NMSA, PMFBY, PMKSY, PKVY and Micro irrigation fund scheme, others scheme and government Support.	6	5

Recommended books:

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

M.Sc. (Bioscience) Semester-III

Generic Elective Courses

Program	Subject	Year	Semester
M.Sc.0405	Bioscience	II	July 2026 - December 2026
Course Code	Course Title		Course Type
LS-CBCS - 3	**PAPER – Nano Biology**		Generic Elective
Credit	Hours Per Week (L-T-P)		
	L	T	P
2	2	-	--
Maximum Marks	CIA		ESE
100	30		70

Learning Objective (LO): The learning objectives of nanobiology are to equip students with the knowledge and skills to

1. Understand Core Concepts: Explain the fundamental principles of nanobiology, including the interaction between nanoscale materials and biological systems.
2. Identify and describe the properties and functions of various nanomaterials (e.g., nanoparticles, nanofibers, nanotubes) used in biological applications.
3. Demonstrate knowledge of synthesizing and characterizing bio-nanomaterials using methods such as sol-gel, self-assembly, and electrospinning.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand the basic principles of nanoscience, including the unique physical, chemical, and biological properties at the nanoscale. Develop nanomaterials with tailored properties for specific applications.	**U**
2	Explain the unique physical, chemical, and mechanical properties of nanomaterials compared to their bulk counterparts.	**U/ An**
3	Utilize advanced analytical techniques like scanning electron microscopy (SEM), atomic force microscopy (AFM), and X-ray diffraction (XRD) to analyze nanomaterials.	**U/ An**
4	Propose innovative applications and improvements in existing nanomaterial technologies.	**U/ An**
5	Address challenges related to stability, toxicity, and scalability in the production and application of nanomaterials.	**U**

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

CO-PO/PSO Mapping for the course:

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

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

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**Nanobiology:** Introduction and history of nanobiology, Application of Nanobiology in biological science: tissue Engineering and cancer diagnosis.	4	1
II	**Nanomaterials:** Metal oxides and carbon nanomaterials, nanocomposites, Synthesis of nanomaterials and biomaterials, Quantum Dots (QDs) for Biological Applications, Toxicity and environmental risks of nanomaterials.	5	2
III	**Characterization Techniques:** Fourier transform infrared (FTIR), spectroscopy, X-ray diffraction (XRD), Atomic Force Microscopy (AFM), Field Emission Scanning, Electron microscope (FESEM), High-Resolution Transmission electron microscopy (HR-TEM).	5	3
IV	**Biosensor:** Types of biosensors and its characteristics, Nanobiosensors fabrication: genosensors and lab-on-a-chip devices. Applications of biosensors in healthcare.	5	4
V	**Biosensors Techniques**: Electrochemistry, Cyclic voltammetry (CV), Difference purse vortammetry (DPV), and Electrochemical impedance spectroscopy (EIS).Electrophoretic deposition (EPD).	4	5

Recommended books:

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

M.Sc. (Bioscience) Semester-III

Generic Elective Courses

Program	Subject	Year	Semester
M.Sc.0405	Bioscience	II	July 2026 - December 2026
Course Code	Course Title		Course Type
LS-CBCS - 4	**PAPER – Rhythms inLife**		Generic Elective
Credit	Hours Per Week (L-T-P)		
	L	T	P
2	2	-	--
Maximum Marks	CIA		ESE
100	30		70

Learning Objective:

1. This course introduces students to the origin, evolution, and diversity of biological rhythms.
2. Students will learn methodologies to study biological rhythms.
3. The course emphasizes the quantification of biological rhythms and their universality from microbes to humans.
4. It will also highlight the relevance of circadian timing in human health, addressing its application in managing diseases and lifestyle-related challenges.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to:	CL
1	Explain the evolutionary basis and classification of biological rhythms and relate different geophysical cycles to biological timing mechanisms.	**U**
2	Demonstrate an understanding of experimental methods such as autorhythmometry to monitor human rhythms, and evaluate key circadian characteristics such as free-running, entrainment, and temperature compensation.	**U/ An**
3	Quantify biological rhythms using parameters like average, amplitude, phase, and period, and differentiate between Zeitgeber Time (ZT) and Circadian Time (CT) across biological systems.	**U/ An**
4	Identify and compare circadian rhythms in a wide range of organisms, including plants, cyanobacteria, fungi, *Drosophila*, fish, and mammals, recognizing the conserved nature of circadian regulation.	**U/ An**
5	Apply chronobiological principles to assess and propose timing-based strategies for the management of health issues such as cancer, sleep disorders, shift work fatigue, and jet lag.	**U/ 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	2	3	2	3	3	2	2	2	2
CO2	3	3	3	3	3	3	2	2	3	2	3	3	2	2	2	2
CO3	3	3	3	3	3	3	2	2	3	2	3	3	2	2	2	2
CO4	3	3	3	3	3	3	2	2	3	2	3	3	2	2	2	2
CO5	3	3	2	3	3	3	2	2	3	2	3	3	2	2	2	2

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

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**Origin and evolution of rhythms; Types of rhythms:** Historical developments in chronobiology. Different types of geophysical and biological cycles with examples of circadian, ultradian, and infradian rhythms.	6	1
II	**How to study rhythms?** Autorhythmometry – Study of behavioral and physiological rhythms in humans (Self). Characteristics of circadian rhythm: Free-run, Temperature compensation, and Entrainment.	6	2
III	**Rhythms are ubiquitous from microbe to man:** Zeitgeber Time (ZT) and Circadian Time (CT). Quantification of biological rhythms - Average, amplitude, phase, and period.	6	3
IV	**Circadian rhythms in organisms:** Examples of circadian rhythms in plants, cyanobacteria, fungi, *Drosophila*, fish and mammals.	6	4
V	**Chronobiology and Human Health:** Application of principles of Chronobiology in the management of diseases with specific examples based on cancer, sleep disorders, shift work and jet lag.	6	5

Recommended Books/Reading Materials:

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