

Pt. Ravishankar Shukla University, Raipur				
M. Sc. Bioscience (Program code-M. Sc. 0405)				
Scheme and Syllabi of Examination for SESSION 2022-2024				
July 2022 – December 2022				
Paper	Title of Paper (Course code)	Marks		Credit
		(External)	(Internal*)	
I	Cell Biology (BS-22101)	80	20	4
II	Biomolecules (BS-22102)	80	20	4
III	Instrumentation and Techniques (BS-22103)	80	20	4
IV	Biometry, Computer Application and Scientometry (BS-22104)	80	20	4
LC-I	Lab Course I (Based on Theory papers I & II) (BSLC-22105)	80	20	2
LC-II	Lab Course II (Based on Theory papers III & IV) (BSLC-22106)	80	20	2
Total		600		20
January 2023– June 2023				
Paper	Title of Paper (Course code)	Marks		Credit
		(External)	(Internal)	
I	Genetics and Molecular Biology (BS-22201)	80	20	4
II	Bioenergetics & Metabolism(BS-22202)	80	20	4
III	Microbiology(BS-22203)	80	20	4
IV	Immunology(BS-22204)	80	20	4
LC-I	Lab Course I (Based on Theory papers I & II) (BSLC-22205)	80	20	2
LC-II	Lab Course II (Based on Theory papers III & IV) (BSLC-22206)	80	20	2
Total		600		20
July 2023 – December 2023				
Paper	Title of Paper (Course code)	Marks		Credit
		(External)	(Internal)	
I	Plant Physiology(BS-22301)	80	20	4
II	Ecology and Environmental Biology(BS-22302)	80	20	4
III	Animal Physiology(BS-22303)	80	20	4
IV	Developmental Biology and Evolution(BS-22304)	80	20	4
LC-I	Lab Course I (Based on Theory papers I & II) (BSLC-22305)	80	20	2
LC-II	Lab Course I (Based on Theory papers III & IV) (BSLC-22306)	80	20	2
Total		600		20
January 2024 – June 2024				
Paper	Title of Paper (Course code)	Marks		Credit
		(External)	(Internal)	
I	Molecular Endocrinology(BS-22401)	80	20	4

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II	Genetic Engineering (BS-22402)	80	20	4	
III (Special paper)	(A) Parasitology (BS-22403-A) / (B) Basic Chronobiology (BS-22403-B) / (C) Ethnobotany (BS-22403-C)	80	20	4	
IV (Special paper)	(A) Applied Immunology (BS-22404-A) / (B) Applied Chronobiology (BS-22404-B) / (C) Secondary Metabolites (BS-22404-C)	80	20	4	
LC-I	Lab Course I (Based on Theory papers I & II) (BSLC-22405)	80	20	2	
LC-II	Lab Course II (Based on Theory papers III & IV) (BSLC-22405)	80	20	2	
Total		600		20	
OR					
Project Work**					
Distribution of Marks		Dissertation	240	60	11
		Seminar based on project	160	40	6
		Viva-voce	80	20	3
		Total	600		20
Grand total [Semester I + II + III + IV]			2400		80

Important Note:

Each theory paper will have questions divided into four sections, A, B, C & D. Section A will have 20 MCQ of 1 mark each covering whole syllabus. Section B will have 8 very short answer questions, two from each unit, of 2 marks each to be answered in two to three lines. Section C will have 8 questions, two from each unit, of 3 marks each. The question has to be answered in about 75 words. Section D will have 4 questions, one from each unit with internal choice, of 5 marks each. The question has to be answered in about 150 words.

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 20 marks allocated for internal Assessment for each paper

- 10 marks are to be assigned for class test.
- 5 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

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(iv)	80% or more but less than 85%	4 Marks
(v)	85% and above	5 Marks

Scheme for Lab Course (for each Semester)		Maximum Marks	100
External/Internal			
1-	Major exercise based on paper I	20	
2-	Minor exercise based on paper I	10	
3-	Major exercise based on paper II	20	
4-	Minor exercise based on paper II	10	
5-	Spotting/ Interpretation•	10	
6-	Viva-voce	10	
Internal			
1-	Sessional	20	
Total		100	

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

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

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M. Sc. Bioscience (Program code-M. Sc. 0405)
FIRST SEMESTER (July 2022 – December 2022)
PAPER - I: CELL BIOLOGY (Course code: BS-22101)
[Credit: 4 and Maximum Marks: 80]

(Each theory paper will have questions divided into four sections, A, B, C & D. Section A will have 20 MCQ of 1 mark each covering whole syllabus. Section B will have 8 very short answer questions, two from each unit, of 2 marks each to be answered in two to three lines. Section C will have 8 questions, two from each unit, of 3 marks each. The question has to be answered in about 75 words. Section D will have 4 questions, one from each unit with internal choice, of 5 marks each. The question has to be answered in about 150 words).

- UNIT-I:** Molecular organization of membranes - Asymmetrical organization of lipids, proteins and carbohydrates. Membrane transport: Passive transport, Osmosis, ion channels, membrane pumps and, Active transport: ATP-powered pumps-types, properties and mechanisms, electrical properties of membranes.
- UNIT-II:** Protein trafficking: Transport of proteins into mitochondria, chloroplast, endoplasmic reticulum and nucleus [in and out]. Transport by vesicle formation: exocytosis, endocytosis and its molecular mechanism.
- UNIT-III:** Cell signaling: Signaling via G-protein linked and enzyme linked cell surface receptors, MAP kinase pathways.
Eukaryotic cell division cycle: different phases and molecular events, regulation and control of cell cycle. Oncogenes: retinoblastoma, E2F and p53 proteins.
Apoptosis: regulation by CASPases and formation of apoptosome. Pro- and anti-apoptotic factors.
- UNIT-IV:** States of chromosomes during cell cycle. Mitotic chromosome. Organization of genes in chromosomes. Banding pattern of chromosomes. Lampbrush and Polytene chromosomes. DNA packaging: Chromatin, nucleosomes, heterochromatin and euchromatin.

Lab Course:

1. Study of chromosome behaviour during Mitosis and meiosis (Onion / Garlic root tips, Onion buds, human lymphocytes, rat or bird testis /grass hopper 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 insect.
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 chromosomes plant cells.
14. Isolation of protoplast, measurement of cell density plating efficiency.
15. Preparation of Karyotype of 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.

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Books Recommended:

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

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FIRST SEMESTER (July 2022 – December 2022)

PAPER – II: Biomolecules (Course code: BS-22102)

[Credit: 4 and Maximum Marks: 80]

(Each theory paper will have questions divided into four sections, A, B, C & D. Section A will have 20 MCQ of 1 mark each covering whole syllabus. Section B will have 8 very short answer questions, two from each unit, of 2 marks each to be answered in two to three lines. Section C will have 8 questions, two from each unit, of 3 marks each. The question has to be answered in about 75 words. Section D will have 4 questions, one from each unit with internal choice, of 5 marks each. The question has to be answered in about 150 words).

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

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

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

UNIT-IV Structure and biological role of: Porphyrins in biology, structure of hemoglobin and chlorophyll
Animal hormones: protein, peptide and steroid hormones. Vitamins: fat and water soluble.

Lab Course:

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

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

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FIRST SEMESTER (July 2022 – December 2022)

PAPER- III: Instrumentation and Techniques

(Course code: BS-22103)

[Credit: 4 and Maximum Marks: 80]

(Each theory paper will have questions divided into four sections, A, B, C & D. Section A will have 20 MCQ of 1 mark each covering whole syllabus. Section B will have 8 very short answer questions, two from each unit, of 2 marks each to be answered in two to three lines. Section C will have 8 questions, two from each unit, of 3 marks each. The question has to be answered in about 75 words. Section D will have 4 questions, one from each unit with internal choice, of 5 marks each. The question has to be answered in about 150 words).

- UNIT-I** Centrifugation: Principle, techniques and applications. Preparative, analytical and ultracentrifuges, factors affecting sedimentation coefficient. Photometry: principles of colorimetry, UV- visible spectrophotometry & IR- spectrophotometry. Atomic absorption spectroscopy: Principle, Instrumentation and applications.
- UNIT-II** Chromatography: Paper, thin Layer, Gas and HPLC. Gel filtration, Ion exchange and Affinity chromatography. Electrophoresis: Agarose, PAGE, *Lyophilization*: Principle and applications. Microtomy and its applications.
- UNIT-III** Microscopic techniques: dark and bright field microscopy, confocal microscope, phase-contrast microscopy, scanning and transmission electron microscopy, atomic force microscope. Sample preparations, surface modifications and imaging in electron microscopy. Immobilization and functionalization techniques and their applications.
- UNIT-IV** Biosensor techniques: Cyclic voltammetry (CV), differential pulse voltammetry (DPV), electrochemical impedance spectroscopy (EIS) and surface plasmon resonance (SPR). Biosensor types, DNA biosensor, Immunosensors, biosensor for infectious diseases and food pathogens. Electrophoretic deposition and matrix fabrication.

Lab Course:

1. Verification of Beers Law
2. Determination of absorption maxima
3. Polyacralamide 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

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Books Recommended:

K Wilson and John Walker RF Boyer	Practical Biochemistry: Principles & Techniques 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 TA Jennings James M. Miller	An Introduction to Centrifugation Lyophilization: Introduction and Basic Principles Chromatography: Concepts and Contrasts
LR Synder, JJ Kirkland and JL Glajch Anna Pratima Nikalje & D. Bhosale Mark F. Vitha AGE Pearse PA Midgley DB Murphy & MW Davidson	Practical HPLC Method Development, 2nd Edition A Handbook of Chromatography Chromatography: Principles and Instrumentation Histology and Histochemical methods The principles of microscopy Fundamentals of Light Microscopy and Electronic Imaging, Second Edition
IW Watt RF Egerton	The Principles and Practice of Electron Microscopy Physical Principles of Electron Microscopy An Introduction to TEM, SEM, and AEM
Skoog. D. A, James Holler. F, Nieman. T. A Janos. H. Fenders (Ed)	Principles of Instrumental Analysis, Harcourt College, 2007 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

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FIRST SEMESTER (July 2022 – December 2022)
PAPER- IV: BIOMETRY, COMPUTER AND SCIENTOMETRY
(Course code: BS-22104)
[Credit: 4 and Maximum Marks: 80]

(Each theory paper will have questions divided into four sections, A, B, C & D. Section A will have 20 MCQ of 1 mark each covering whole syllabus. Section B will have 8 very short answer questions, two from each unit, of 2 marks each to be answered in two to three lines. Section C will have 8 questions, two from each unit, of 3 marks each. The question has to be answered in about 75 words. Section D will have 4 questions, one from each unit with internal choice, of 5 marks each. The question has to be answered in about 150 words).

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

Unit-II Statistical errors in hypothesis testing. Testing goodness of fit: Chi-square goodness of fit. Independence of attributes. Heterogeneity Chi-square. The 2 x 2 contingency table.

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One sample hypothesis. Two-sample hypothesis. Testing for difference between two means (t-test). Testing for difference between two variances (F-test). The paired sample t-test. Multiple-sample hypothesis (ANOVA): Single factor and two factors ANOVA. Multiple comparisons: Duncan's multiple-range tests. Simple linear regression. Regression vs. Correlation. Regression equation. Interpretations of regression functions. Simple linear correlation. The correlation coefficient.

Unit-III Introduction to MS-Office software: Word processing; creating 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/ graph. Presentation software; Working in PowerPoint, Creating new presentation, working with slides.

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

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 a 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,	Microsoft 2007: Introductory Concepts & Techniques
Cashman TJ	
Habraken J	Microsoft Office 2003 All in One
	Microsoft Office 2010 In Depth
Gilmore B	Plagiarism: Why it happens, How to prevent it?
Buranen L & Roy AM	Perspectives on Plagiarism & Intellectual Property in a Post-Modern World
Kumar Anupa P	Cyber Law
Sood V	Cyber Law Simplified

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SECOND SEMESTER (January 2023 – June 2023)
PAPER – I: Genetics and Molecular Biology
(Course code: BS-22201)
[Credit: 4 and Maximum Marks: 80]

(Each theory paper will have questions divided into four sections, A, B, C & D. Section A will have 20 MCQ of 1 mark each covering whole syllabus. Section B will have 8 very short answer questions, two from each unit, of 2 marks each to be answered in two to three lines. Section C will have 8 questions, two from each unit, of 3 marks each. The question has to be answered in about 75 words. Section D will have 4 questions, one from each unit with internal choice, of 5 marks each. The question has to be answered in about 150 words).

- UNIT-I** Gene mapping methods: Linkage maps, tetrad analysis, mapping with molecular markers, mapping by using somatic cell hybrids, development of mapping population in plants, complementation analysis.
Mutation: Types, mutagens and detection.
Mutant types – lethal, conditional, biochemical, loss of function, gain-of-function, germinal verses somatic mutants, insertional mutagenesis.
- UNIT-II** DNA replication in eukaryotes and prokaryotes : enzymes involved, replication origin and replication fork, fidelity of replication, extrachromosomal replicons. DNA damage and repair mechanisms: Repair of Base-excision, Nucleotide excisions, Mismatch and Double Strand. p_{53} and p_{21} .
- UNIT-III** RNA synthesis and processing: enzymes involved, formation of initiation complex, transcription activator and repressor, elongation, and termination, RNA processing, capping, RNA editing, splicing, and polyadenylation, RNA transport.
- UNIT-IV** Protein synthesis and processing: Ribosome, formation of initiation complex, initiation factors, elongation and elongation factors and their regulation, termination. Aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase, and translational proof-reading, translational inhibitors. Post Translational modification of proteins.

Lab Course:

1. Isolation, purification and estimation of RNA
2. Isolation, purification and estimation of DNA
3. Determination of T_m 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, and James Darnell.
Essential Cell Biology	B. Alberts, D. Bray, K. Hopkin and A. Johnson
Molecular Biology of the Cell	B. Alberts, A. Johnson, J. Lewis and M. Raff
Cell and Molecular Biology	Gerald Karp
: Concepts and experiments	
Molecular Biology of the Gene	JD Watson et al.
Molecular Biology of the Cell	John Wilson, Tim Hunt

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The Problems

Molecular Biology of the Cell

Bruce Albert's, Alexander Johnson, Julian Lewis,

Martin Raff, Keith Roberts, Peter Walter

Genes VIII

Benjamin Lewin

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SECOND SEMESTER (January 2023 – June 2023)

PAPER – II: Bioenergetics & Metabolism

(Course code: BS-22202)

[Credit: 4 and Maximum Marks: 80]

(Each theory paper will have questions divided into four sections, A, B, C & D. Section A will have 20 MCQ of 1 mark each covering whole syllabus. Section B will have 8 very short answer questions, two from each unit, of 2 marks each to be answered in two to three lines. Section C will have 8 questions, two from each unit, of 3 marks each. The question has to be answered in about 75 words. Section D will have 4 questions, one from each unit with internal choice, of 5 marks each. The question has to be answered in about 150 words).

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

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

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

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

Lab Course:

1. Protein estimation by Lowry, Bradford and Spectrophotometric method
2. Estimation blood cholesterol
3. Estimation of sugar by Nelson- Somogy and Benedict's reagent
4. Isolation and estimation of lipid 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
Biochemistry
Biochemistry
Biochemistry
Text book of biochemistry

Nelson, Cox and Lehninger
G. Zubay
Stryer
Garrett and Grosham
West, Tood, Mason & Bbruglen

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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

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SECOND SEMESTER (January 2023 – June 2023)

PAPER – III: Microbiology

(Course code: BS-22203)

[Credit: 4 and Maximum Marks: 80]

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

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

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

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

Lab Course:

1. Glassware preparation and sterilization techniques- wet heat- dry heat- filter types- laminar flow chamber types- CDC- safety levels.
2. Preparation of liquid & solid media, plating, pouring, inoculation and incubation for growth of microorganism

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3. Methods of obtaining pure culture of microorganisms (a) streak plate (b) Pour plate, and (c) spread plate methods
4. Identification and Microscopic examination of the microorganisms.
5. Motility of bacteria by hanging drop technique.
6. Bacterial genomic DNA isolation from *E-coli* culture.
7. Grams' staining for Gram positive and Gram's negative Bacteria.
8. Study of bacterial growth by turbidimetry/ spectrophotometry
9. Isolation and enumeration of microorganisms from soil by serial dilution agar plating method.
10. Enumeration of viruses by plaque assay technique.

Books Recommended:

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

M. Sc. Bioscience (Program code-M. Sc. 0405)

SECOND SEMESTER (January 2023 – June 2023)

PAPER – IV: Immunology

(Course code: BS-22204)

[Credit: 4 and Maximum Marks: 80]

(Each theory paper will have questions divided into four sections, A, B, C & D. Section A will have 20 MCQ of 1 mark each covering whole syllabus. Section B will have 8 very short answer questions, two from each unit, of 2 marks each to be answered in two to three lines. Section C will have 8 questions, two from each unit, of 3 marks each. The question has to be answered in about 75 words. Section D will have 4 questions, one from each unit with internal choice, of 5 marks each. The question has to be answered in about 150 words).

- UNIT-I** Innate and adaptive immune response. Cells of immune system: Hematopoiesis and differentiation, mononuclear cells and granulocytes, antigen presenting cells. Ontogeny and phylogeny of lymphocytes. Primary and Secondary lymphoid organs and tissues. Lymphocyte traffic. Major Histocompatibility Complex- types, structural organization, function and distribution. Complement system.
- UNIT-II** Antigen receptor molecules: B-cell receptor complex, Immunoglobulin- structure, types and function. Generation of diversity in BCR. Light and heavy chain gene recombination. Recombination Signal sequences. Class switching. Membrane and secreted immunoglobulins. T-cell receptor complex. Organization, arrangement of T-cell receptor genes and recombination.
- UNIT-III** Antigens: nature of antigens, factor affecting immunogenicity, Haptens and super antigens. Antigenic determinants. Recognition of antigens by T and B cell. Antigen processing. Role of MHC molecules in antigen presentation and co-stimulatory signals. Transplantation and Rejection. Antigen and antibody interaction: Precipitation, Agglutination, EIA, RIA and FIA.

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

Lab Course:

1. Identification of cells of 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 (Program code-M. Sc. 0405)	
Third Semester (July 2023 – December 2023)	
Paper I: Plant Physiology (Course code: BS-22301)	
[Credit: 4 and Maximum Marks: 80]	
Each theory paper will have questions divided into four sections, A, B, C & D. Section A will have 20 MCQ of 1 mark each covering whole syllabus. Section B will have 8 very short answer questions, two from each unit, of 2 marks each to be answered in two to three lines. Section C will have 8 questions, two from each unit, of 3 marks each. The question has to be answered in about 75 words. Section D will have 4 questions, one from each unit with internal choice, of 5 marks each. The question has to be answered in about 150 words	
Unit-I	Photosynthesis – Light harvesting complexes (LH-a and LH-II) Photosystem I and II (Electron Transport Chain) Carbon fixation- C3, C4 and CAM pathways Nitrogen Metabolism – Nitrate and ammonia assimilation
Unit-II	Photorespiration – Definition, process, significance and benefit in plants. Tricarboxylic acid cycle (TCA) in plant Mitochondrial electron transport chain (Components, steps involved and function) ATP synthesis and alternate oxidase in plants
Unit-III	Phytohormones: Introduction and types. Auxin: Structure, biosynthesis and function Cytokinin: Structure, biosynthesis and function Gibberellins: Structure, biosynthesis and function Abscisic acid: Structure, biosynthesis and function Ethylene and Brassinosteroids.
Unit-IV	Amino Acid Biosynthesis. Stress physiology in plant – Biotic and Abiotic stresses. Plant Secondary metabolites – Terpenes, phenols and nitrogenous compounds. Senescence and Programmed cell death and Phyto-remediation.

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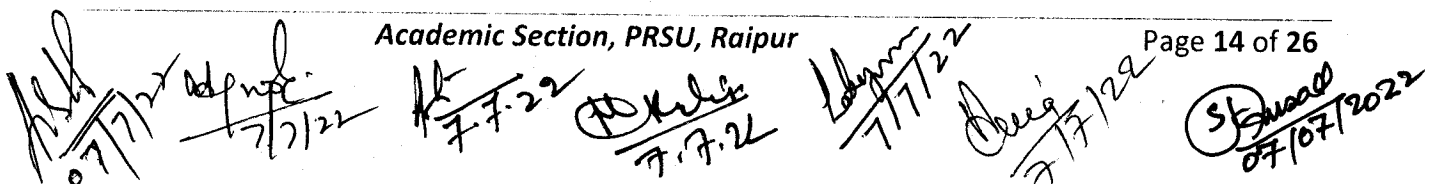
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Lab Course:	
1.	Estimation of Chlorophyll content in plant tissues (Spectrophotometric analysis).
2.	Separation of plant pigments (chlorophyll by chromatography).
3.	To demonstrate the evolution of oxygen during photosynthesis in aquatic plants.
4.	To study the different concentration of CO ₂ on the rate of photosynthesis.
5.	To study the effect of light intensity (by changing the distance) on the rate of photosynthesis using aquatic plant.
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 Salisbury & CW Ross	Plant Physiology
Dr. V.K. Jain	Fundamentals of Plant Physiology 19 Edition
S.S. Bhojwani and M.K. Razdan	Plant Tissue Culture: Theory and Practice, a Revised Edition
Arun Chandra Sahu	Plant Physiology and Metabolism
Fosket DF	Plant Growth & Development

M.Sc. Bioscience (Program code-M. Sc. 0405)	
Third Semester (July 2023 – December 2023)	
Paper II: Ecology and Environmental Biology	
(Course code: BS-22302)	
[Credit: 4 and Maximum Marks: 80]	
Each theory paper will have questions divided into four sections, A, B, C & D. Section A will have 20 MCQ of 1 mark each covering whole syllabus. Section B will have 8 very short answer questions, two from each unit, of 2 marks each to be answered in two to three lines. Section C will have 8 questions, two from each unit, of 3 marks each. The question has to be answered in about 75 words. Section D will have 4 questions, one from each unit with internal choice, of 5 marks each. The question has to be answered in about 150 words	
Unit-I	Ecosystem: Concept, Components and types. Productivity, Ecological energetics, Energy flow in ecosystem, Energy flow models, Ecological pyramids, Food chain, Food web. Ecological succession, Ecological niche.
Unit-II	Aquatic ecosystem: Biotic and abiotic components, lentic and lotic ecosystems, wetlands. Terrestrial ecosystems: Forest types of India with special reference to Chhattisgarh. Natural and plantation (artificial) forests, Agroforestry, Social forestry, National parks and Sanctuaries in Chhattisgarh.
Unit-III	Environmental pollution: Definition, types (air, water, soil, noise, thermal & radioactive), causes, effects and control. Solid waste management: Causes, effects and control measures of urban and industrial wastes. Disaster management: Floods, earthquake, cyclone and landslides.
Unit-IV	Biodiversity, ex-situ and in-situ conservation. Intellectual property right (IPR) with special reference to India. Natural resources: Water, Forest and Medicinal plants.
Lab Course:	
1.	To determine the minimum size of the quadrat by 'Specis -Area-Curve' method


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2.	To study the community by quadrat method by determining 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 (Program code-M. Sc. 0405)	
Third Semester (July 2023 – December 2023)	
Paper III: Animal Physiology (Course code: BS-22303)	
[Credit: 4 and Maximum Marks: 80]	
Each theory paper will have questions divided into four sections, A, B, C & D. Section A will have 20 MCQ of 1 mark each covering whole syllabus. Section B will have 8 very short answer questions, two from each unit, of 2 marks each to be answered in two to three lines. Section C will have 8 questions, two from each unit, of 3 marks each. The question has to be answered in about 75 words. Section D will have 4 questions, one from each unit with internal choice, of 5 marks each. The question has to be answered in about 150 words	
Unit-I	Blood and Circulation: Composition of blood, Cell types, Hemopoiesis, Structure and function of hemoglobin - Oxygen and carbon dioxide transport, Blood Coagulation. Blood volume and its regulation. Blood group. Respiration: Mechanism and regulation of breathing, Factors influencing oxygen uptake, Diving and high altitude adaptations. Measurement of metabolic rate and Q_{10}
Unit-II	Nervous system: Mechanisms of conduction along axon and across synapses, Nernst equation and measurement of action potential, Neurotransmitters, Types and physiology of reflexes. Myology: Types of muscles, Ultrastructure, mechanism and regulation of contraction of skeletal muscle.
Unit-III	Cardiovascular System: Anatomy of heart structure, ECG—its principle and significance, cardiac cycle, blood pressure and its neural and chemical regulation. Excretory system - Physiology of excretion, kidney, urine formation, urine concentration, waste elimination, regulation of water balance, electrolyte balance, acid-base balance.
Unit-IV	Digestive system - Digestion, absorption, energy balance, BMR. Thermoregulation - Comfort zone, body temperature – physical, chemical, neural regulation, acclimatization.
Lab Course:	
1.	Examination of RBC in Piscine/Avian/Human blood.
2.	Examination of WBC in Piscine/Avian/Human blood.
3.	Differential leukocyte counts in Human blood.
4.	Determination of Hb/Hct/ Absolute values in Piscine/Avian/Human blood.
5.	To determine prevalence of different types of polymorphs in human blood (Based on Arneht's classification).
6.	Demonstration of hemin crystal.
7.	To determine absolute Eosinophil count in Human blood

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8.	To determine blood pressure in different body position [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 function of age and gender
12.	To study different stages of melanophores in scales of the 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 (Program code-M. Sc. 0405)	
Third Semester (July 2023 – December 2023)	
Paper IV: Developmental Biology and Evolution	
(Course code: BS-22304)	
[Credit: 4 and Maximum Marks: 80]	
Each theory paper will have questions divided into four sections, A, B, C & D. Section A will have 20 MCQ of 1 mark each covering whole syllabus. Section B will have 8 very short answer questions, two from each unit, of 2 marks each to be answered in two to three lines. Section C will have 8 questions, two from each unit, of 3 marks each. The question has to be answered in about 75 words. Section D will have 4 questions, one from each unit with internal choice, of 5 marks each. The question has to be answered in about 150 words	
Unit-I	Gametogenesis in animals. Molecular events during fertilization. Activation of egg metabolism. Cleavage patterns and fat maps. Regulation of Cleavage cycle. Cleavage and nuclear activity.
Unit-II	Concepts of determination, competence, induction and differentiation. Determination in <i>Caenorhabditis elegans</i> . Germ cell determination, migration and differentiation. Totipotency and nuclear transfer experiments. Embryonic induction. Formation of vulva in <i>C. elegans</i> . Mechanism of differentiation in <i>Dictyostelium</i> .
Unit-III	Morphogenetic determinants in egg cytoplasm. Role of maternal contributions in early embryonic development. Genetic regulation of early embryonic development in <i>Drosophila</i> . Homeotic genes. Genetic interaction during differentiation. Hox genes and limb patterning.
Unit-IV	Concepts and theories of organic evolution. The processes of Evolutionary change-Genetic drift, Natural selection and the Hardy-Weinberg equilibrium. Speciation. Molecular evolution and origin of life. Evolution of Prokaryotes and Eukaryotes. A brief outline of the evolutionary history of Metazoans including-Evolution of tissue grade, coelomic body plans and Chordates. Evolution of Mankind.
Lab Course:	
1.	Study of developmental stages in Snail/Amphibian/Chick
2.	Study on <i>Drosophila</i> development
3.	Role of hormones in metamorphosis and development

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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 <i>et al.</i>	Molecular Biology of the Cell
SF Gilbert	Developmental Biology
Lewin Benjamin	Gene VIII
	Developmental Genetics
PO Moody	Introduction to Evolution, 1970, Harper and Row
Dobzhansky <i>et al.</i>	Evolution, W. H. Freeman. New York
SW Fox and K Dose	Molecular Evolution and the Origin of Life, 1972, W.H. Freeman & Co Ltd.
FJ Ayala and JW Valentine	Evolving: The theory and processes of Organic evolution, 1979, Benjamin/Cummings Pub. Co.
EO Dodson	Evolution: Process and Product
MW Strickberger	Evolution, 1979, James and Barlett International

M.Sc. Bioscience (Program code-M. Sc. 0405)	
Fourth Semester (January 2024 – June 2024)	
Paper I: Molecular Endocrinology	
(Course code: BS-22401)	
[Credit: 4 and Maximum Marks: 80]	
Each theory paper will have questions divided into four sections, A, B, C & D. Section A will have 20 MCQ of 1 mark each covering whole syllabus. Section B will have 8 very short answer questions, two from each unit, of 2 marks each to be answered in two to three lines. Section C will have 8 questions, two from each unit, of 3 marks each. The question has to be answered in about 75 words. Section D will have 4 questions, one from each unit with internal choice, of 5 marks each. The question has to be answered in about 150 words	
Unit-I	Definition and scope of molecular endocrinology. Chemical nature and general classes of hormones: Peptide, Amino acid derived, Steroid, Neurotransmitters, Neuropeptides, Chalcones, Eicosanoids and Pheromones. Hypothalamic octapeptide hormones: Oxytocin and Vasopressin. Purification and characterization of hormones. Hypothalamo-hypophyseal axis.
Unit-II	Genetic control of hormone synthesis: Structure and expression of protein hormone encoding gene. Molecular aspects of peptide hormone biosynthesis and secretion. Molecular aspects of synthesis and delivery of thyroid hormones, biogenic amines and steroid hormones. Production of protein hormones by recombinant DNA technology
Unit-III	Molecular mechanism of hormone action: Membrane, cytoplasmic and nuclear hormone receptors, Non-genomic mechanism of hormone action, Receptor-ligand interactions. Hormonal signal transduction: G-proteins and second messengers. Genomic mechanism of hormone action: Steroid and thyroid hormones.
Unit-IV	Molecular aspects of Reproductive endocrinology: Genetics of sex. Testicular and ovarian determining genes. Mullerian inhibiting substance genes. Stem cell renewal in testis. Molecular basis of male and female contraception. Endocrine disruptors. Neuroendocrine control of reproduction and feedback mechanism.
Lab Course:	
1.	Purification of any protein hormone.

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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 / Pregnanediol 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 (Program code-M. Sc. 0405)	
Fourth Semester (January 2024 – June 2024)	
Paper II: Genetic Engineering	
(Course code: BS-22402)	
[Credit: 4 and Maximum Marks: 80]	
Each theory paper will have questions divided into four sections, A, B, C & D. Section A will have 20 MCQ of 1 mark each covering whole syllabus. Section B will have 8 very short answer questions, two from each unit, of 2 marks each to be answered in two to three lines. Section C will have 8 questions, two from each unit, of 3 marks each. The question has to be answered in about 75 words. Section D will have 4 questions, one from each unit with internal choice, of 5 marks each. The question has to be answered in about 150 words	
Unit-I	Molecular tools and their applications: restriction enzymes, modification enzymes. Molecular techniques: polymerase chain reaction, DNA sequencing, DNA barcoding, protein sequencing.
Unit-II	Gene cloning vectors: plasmids, lambda phage as vector, M13 phage as vector, cosmids, artificial chromosomes (BAC, PAC, YAC). Genomic DNA library construction and screening methods, cDNA library construction and screening methods, DNA microarray.
Unit-III	Gene knockout technique: Site directed mutagenesis, Random mutagenesis and applications, Genome editing: CRISPR-Cas 9, Gene Knockdown, Gene Silencing. Study of gene regulation: reporter assays.
Unit-IV	Expression strategies for heterologous genes: vector engineering and codon optimization,

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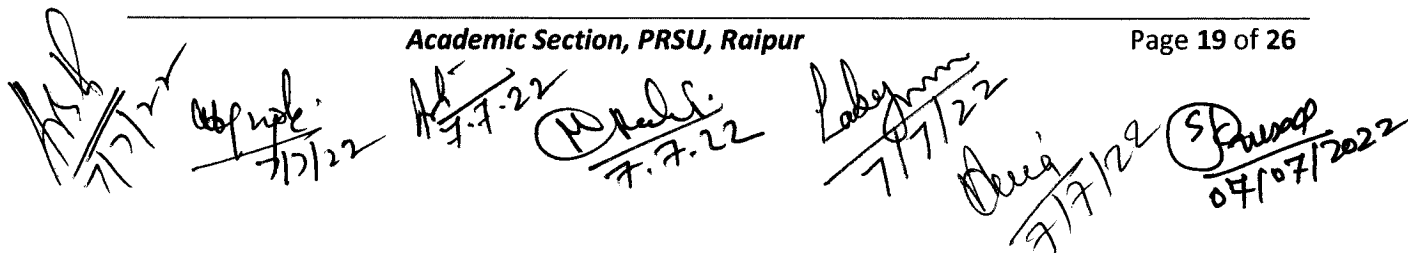
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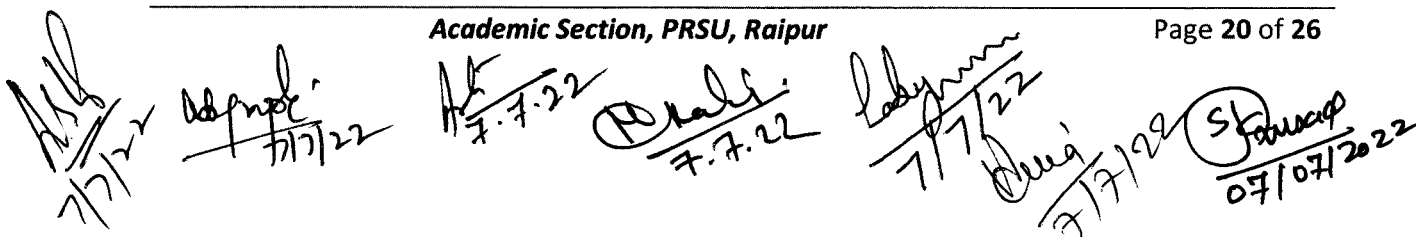
	host engineering, in vitro transcription and translation. Processing of recombinant proteins: recombinant proteins purification, refolding, characterization and stabilization, Applications of recombinant proteins.
Lab Course:	
<ol style="list-style-type: none"> 1. Antibiotic selection media and bacterial 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, 2 nd Edition
Paul Cutler	Protein Purification Protocol, 2 nd Edition
Jan-Christer Janson	Protein Purification, 3 rd Edition
<p>M.Sc. Bioscience (Program code-M. Sc. 0405) Fourth Semester (January 2024 – June 2024) Paper III: (A) Parasitology (Course code: BS-22403-A) [Credit: 4 and Maximum Marks: 80]</p>	
Each theory paper will have questions divided into four sections, A, B, C & D. Section A will have 20 MCQ of 1 mark each covering whole syllabus. Section B will have 8 very short answer questions, two from each unit, of 2 marks each to be answered in two to three lines. Section C will have 8 questions, two from each unit, of 3 marks each. The question has to be answered in about 75 words. Section D will have 4 questions, one from each unit with internal choice, of 5 marks each. The question has to be answered in about 150 words	
Unit-I	Parasites and parasitism. The Infection process: Modes of Parasite transmission, invasion, migration within host, maintaining station, obtaining nutrients and resisting host attack. Concept of Disease: Inflammation and Repair, Degeneration, Necrosis. Mechanism of Disease transmission with particular reference to vectors. Vector control measures.
Unit-II	General organization and life cycle patterns of Protozoa; Epidemiology, pathogenesis, diagnosis and control of major human diseases, such as- Malaria, Leishmaniasis and Trypanosomiasis.


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Unit-III	General organization and life cycle patterns of Trematodes and Cestodes; Epidemiology, pathogenesis, diagnosis and control of major human diseases, such as- Schistosomiasis and Hydatidosis. Arthropod- related ectoparasitic diseases: Ticks, mites and flies.
Unit-IV	General Organization and life cycle patterns of Acanthocephala and Nematoda; Epidemiology, pathogenesis, diagnosis and control of major nematode diseases, such as- Ascariasis, Ancylostomiasis and Filariasis. Biology of plant parasitic nematodes.
Lab Course:	
1.	Identification and comments on permanent mounts of parasitic organisms
2.	Host examination for parasites; preparation of permanent slides and identification
3.	Histology/Histopathology/Histochemistry by routine and differential staining
4.	Biochemistry of parasites and pathophysiology of the hosts
5.	Root knot nematodes: Extraction and isolation (Cobb's sieving and decantation method and Baerman's Funnel technique), preparation of perennial pattern mounts
6.	Detection of blood parasites: Malarial parasite
7.	Macroscopic and microscopic examination of stool samples, concentration methods
Recommended Books:	
KD Chatterjee	Parasitology (Protozoology and Helminthology) in Relation to Clinical Med.. 9 th 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.
DJWylar, Ed.	Modern Parasite Biology: Cellular, Immunological and Molecular Aspects.

M.Sc. Bioscience (Program code-M. Sc. 0405)	
Fourth Semester (January 2024 – June 2024)	
Paper III: (B) Basic Chronobiology (Course code: BS-22403-B)	
[Credit: 4 and Maximum Marks: 80]	
Each theory paper will have questions divided into four sections, A, B, C & D. Section A will have 20 MCQ of 1 mark each covering whole syllabus. Section B will have 8 very short answer questions, two from each unit, of 2 marks each to be answered in two to three lines. Section C will have 8 questions, two from each unit, of 3 marks each. The question has to be answered in about 75 words. Section D will have 4 questions, one from each unit with internal choice, of 5 marks each. The question has to be answered in about 150 words	
Unit-I	Historical developments in chronobiology. Different types of geophysical and biological cycles with examples of circadian rhythms. Quantification of biological rhythms - Average, amplitude, phase, and period. Brief introduction to time series analysis. Methods of time series analyses: cosinor, autocorrelation, chi-square, periodogram.
Unit-II	Characteristics of circadian rhythm: Free-run, Temperature and nutrition compensation, and Entrainment. Zeitgeber Time (ZT) and Circadian Time (CT). After-effects and Aschoff's rule. Aging and circadian clocks. Photoperiodism. Plant Rhythms
Unit-III	Synchronization (=Entrainment) and masking. Entrainment by single light pulse, complete and skeleton photoperiods. Zeitgebers for circadian clocks. Key properties of a Zeitgeber. Photic and non-photic zeitgebers. Mechanisms of entrainment. Phase response curves (PRC), phase transition curves, strong and weak PRC.
Unit-IV	Circadian pacemakers in insects with special reference to <i>Drosophila</i> . Suprachiasmatic nucleus as mammalian circadian clock. Multi-oscillatory organization: master and slave oscillators, morning and evening oscillators, pacemaker and peripheral oscillators. Adaptive significance of circadian rhythms. Social consequence of circadian rhythms.

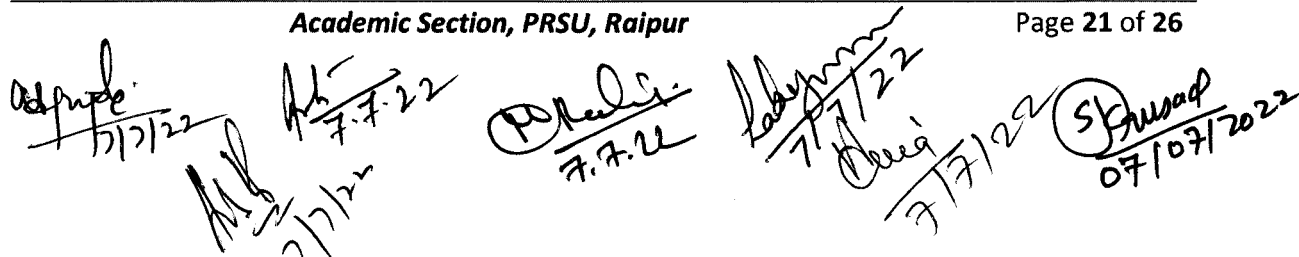

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Lab Course:	
1.	Terminology in Chronobiology
2.	Study of locomotor activity rhythm in suitable animal models
3.	Actogram construction of locomotor activity of suitable animal models
4.	Study of phase shift in circadian rhythm in a suitable variable, such as locomotor activity
5.	Construction of Cosinor Curves using Mesor (M), amplitude (A) and acrophase/ peak (\emptyset) of circadian, and other low and high frequency rhythms
6.	Computation of period (τ), phase angle (Ψ)
7.	Circadian changes in volume of nuclei in onion peel (<i>Allium cepa</i>) 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 <i>Drosophila</i> 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 Chandrashekar	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 (Program code-M. Sc. 0405)	
Fourth Semester (January 2024 – June 2024)	
Paper III: (C) Ethnobotany (Course code: BS-22403-C)	
[Credit: 4 and Maximum Marks: 80]	
Each theory paper will have questions divided into four sections, A, B, C & D. Section A will have 20 MCQ of 1 mark each covering whole syllabus. Section B will have 8 very short answer questions, two from each unit, of 2 marks each to be answered in two to three lines. Section C will have 8 questions, two from each unit, of 3 marks each. The question has to be answered in about 75 words. Section D will have 4 questions, one from each unit with internal choice, of 5 marks each. The question has to be answered in about 150 words	
Unit-I	Ethnobotany Introduction, Concept, Scope and objectives; Ethnobotany as an interdisciplinary science. The relevance of Ethnobotany in the present context; major and minor ethnic groups or tribals of India and their life styles. Plants used by the tribals as: (a) Food plants (b) Intoxicants and Beverages (c) Resins, oils and miscellaneous uses.
Unit-II	Methodology of Ethnobotanical studies Field work: collection and confirmation of tribal information; its documentation;



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	assessment of its valuation Herbarium: its role in confirmation of ethnic data; assessment of similarities of data across different habitats Ancient literature; Archaeo-ethnological findings; Sacred Grooves- their role in confirmation of ethnic data
Unit-III	Role of Ethnobotany in modern medicine Medico- Ethnobotanical sources in India. Significance of the following plants in ethno botanical practices (alongwith their habitat and morphology) (a) <i>Saussurea costus</i> (b) <i>Arnebia benthami</i> (c) <i>Fritillaria roylei</i> (d) <i>Rheum webbianum</i> (e) <i>Tribulus terrestris</i> (f) <i>Aconitum heterophyllum</i> (g) <i>Digitalis purpurea</i> (h) <i>Indigofera heterantha</i> . Role of Ethnobotany in modern medicine with special examples a) <i>Digitalis purpurea</i> b) <i>Atropa acuminata</i> c) <i>Artemisia</i> sp. d) <i>Withania</i> sp. Role of ethnic groups in conservation of plant genetic resources. Endangered taxa and forest management (participatory forest management).
Unit-IV	Ethnobotany and legal aspects Ethnobotany as a tool to protect interests of ethnic groups. Sharing of wealth concept with few examples from India. Biopiracy, Intellectual property rights and traditional knowledge.
Lab Course:	
1	Investigation of Food plants used by tribes.
2	Investigation of plants used as Beverages by tribes.
3	Preparation of herbarium of ethnomedicinal plants.
4	Ethnomedicinal investigation on plants .
5	Gardening rare plant Species.

Recommended Books:

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

M.Sc. Bioscience (Program code-M. Sc. 0405)	
Fourth Semester (January 2024 – June 2024)	
Paper IV: (A) Applied Immunology (Course code: BS-22404-A)	
[Credit: 4 and Maximum Marks: 80]	
Each theory paper will have questions divided into four sections, A, B, C & D. Section A will have 20 MCQ of 1 mark each covering whole syllabus. Section B will have 8 very short answer questions, two from each unit, of 2 marks each to be answered in two to three lines. Section C will have 8 questions, two from each unit, of 3 marks each. The question has to be answered in about 75 words. Section D will have 4 questions, one from each unit with internal choice, of 5 marks each. The question has to be answered in about 150 words	
Unit-I	Generation of diversity in BCR. Light and heavy chain gene recombination. Recombination Signal sequences. Class switching. Membrane and secreted immunoglobulins. Organization, arrangement of T-cell receptor genes and recombination. Regulation of immune response by antigen, antibody, immune complex, MHC and cytokines.
Unit-II	Immunoprophylaxis: Principles of Vaccination. Immunization practices. Vaccines against important bacterial and parasitic diseases. DNA vaccines; passive prophylactic measures.

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	Viral vaccines and antiviral agents. Vaccination schedules and safety. Production of vaccines.
Unit-III	Diagnosis of microbial diseases - Collection, transport and preliminary processing of Clinical pathogens. Clinical, microbiological, immunological and molecular diagnosis of diseases. Principles of immunodiagnosics. Antigen-antibody based diagnosis and the techniques involved – Enzyme, Radio and Fluorescence Immuno assays, Immunoblotting, Flow cytometry. Effector cell assays, Cytotoxic assays. Isolation of pure antibody. Monoclonal & Designer antibody and their application in immunodiagnosics.
Unit-IV	Modern methods of microbial diagnosis. Use of nanotechnology in diagnosis. Synthesis of Nanomaterials, Nanoparticle based drug delivery, Toxicity and environmental risks of nanomaterials. Biosensors: Biosensor-development, types and characteristics, DNA biosensors, application of biosensors in clinical diagnostics: detection of infectious diseases, food pathogen and environmental monitoring.
Lab Course:	
1.	Preparation of Parasite Antigen and analysis by PAGE
2.	Immunizations and production of antibody
3.	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. Kannagara, 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 (Program code-M. Sc. 0405)
Fourth Semester (January 2024 – June 2024)
Paper IV: (B) Applied Chronobiology (Course code: BS-22404-B)
[Credit: 4 and Maximum Marks: 80]
Each theory paper will have questions divided into four sections, A, B, C & D. Section A will have 20 MCQ of 1 mark each covering whole syllabus. Section B will have 8 very short answer questions, two from each unit, of 2 marks each to be answered in two to three lines. Section C will have 8 questions, two from each unit, of 3 marks each. The question has to be answered in about 75 words. Section D will have 4 questions, one from each unit with internal choice, of 5 marks each. The question has to be answered in about 150 words

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Unit-I	Molecular mechanisms underlying clock functions in organisms: Autoregulatory transcriptional feedback loops; Circadian clock mutant types in <i>Drosophila</i> (<i>per</i> , <i>tim</i> , <i>dbt</i> , <i>dclock</i> , <i>cycle</i> , <i>vriille</i> , <i>pdf</i> , <i>lark</i> , <i>takeout</i>), <i>Neurospora</i> , cyanobacteria, mouse, and humans. Temporal expression pattern of clock genes, Regulation of expression of clock genes, Expression patterns under constant light and darkness; Autonomous functions of clock genes in peripheral tissues.
Unit-II	Human circadian organization: Methods to study human circadian rhythm; Free-running rhythms in humans, Constant routine protocol, and Forced desynchronization protocol. Chronotypes and its assessment methods. Marker rhythms in humans: Core body temperature (CBT), melatonin, and cortisol. Sleep-wake alertness and performance rhythms in humans.
Unit-III	Circadian rhythms and human health: Chronopharmacology; Basics of chronopharmacology – clinical chronopharmacology – circadian dependence of drug pharmacokinetics. Chronotherapy; Application of chronotherapy in treatment of cancer, cardiovascular diseases, allergies, asthma, and circadian rhythm sleep disorders (for example, DSPS and ASPS) & mood disorders (SAD).
Unit-IV	Circadian rhythms in occupational and travel stresses: Shift work; Types of shift system, direction and frequency of shift rotation, Effect on rhythm parameters, Desynchronization of circadian rhythm, Consequences on sleep, Psychosocial problems, Clinical and non-clinical problems. Shift work tolerance/ intolerance. Shift optimization: Nap, Bright light therapy, Melatonin therapy. Jet lag: Consequences of jet lag; direction asymmetry & variable asymmetry; Approaches to jet lag alleviation.
Lab Course:	
1.	Study of circadian rhythms in objective variables in human subjects using autorhythmometry technique.
2.	Study of circadian rhythms in subjective variables in human subjects using autorhythmometry technique.
3.	Chronotyping in human population.
4.	Study of circadian rhythm in the rest-activity of humans by using wrist actigraphy.
5.	Study of circadian rhythm in blood pressure of humans by using Ambulatory Blood Pressure Monitor.
6.	Circadian variations in RBC and WBC in suitable animal models.
7.	Circadian rhythm in cortisol and melatonin by ELISA.
8.	Computation of mid-sleep and social jetlag
9.	Observation of functional status of in-built alarm clock in humans.
Recommended Books:	
JC Dunlap, JJ Loros & PJ DeCoursey	Chronobiology: Biological timekeeping
JC Hall	Genetics and molecular biology of rhythms in <i>Drosophila</i> 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 <i>et al.</i>	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

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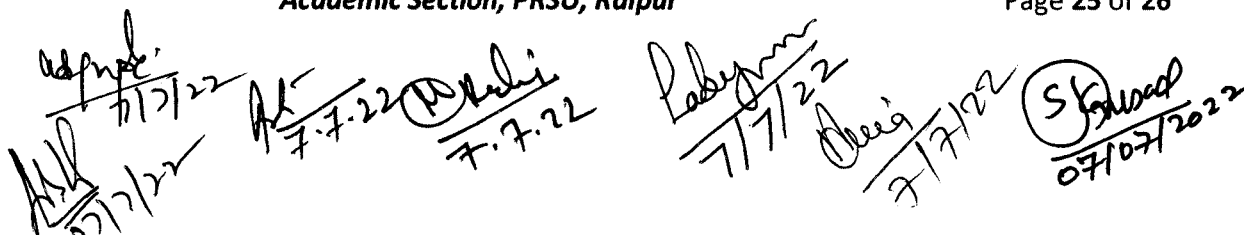
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A Sehgal	Molecular biology of circadian rhythms
LE Scheving	Chronobiotechnology and chronobiological engineering
Y Touitou <i>et al.</i>	Handbook of medical chronobiology

M.Sc. Bioscience (Program code-M. Sc. 0405)	
Fourth Semester (January 2024 – June 2024)	
Paper IV: (C) Secondary Metabolites (Course code: BS-22404-C)	
[Credit: 4 and Maximum Marks: 80]	
Each theory paper will have questions divided into four sections, A, B, C & D. Section A will have 20 MCQ of 1 mark each covering whole syllabus. Section B will have 8 very short answer questions, two from each unit, of 2 marks each to be answered in two to three lines. Section C will have 8 questions, two from each unit, of 3 marks each. The question has to be answered in about 75 words. Section D will have 4 questions, one from each unit with internal choice, of 5 marks each. The question has to be answered in about 150 words	
Unit-I	Introduction to secondary metabolites: Definition and systematic of secondary metabolites. Major classes of secondary metabolites i.e. alkaloids, terpenoids/ or isoprenoids, flavonoids and phenolics. Significance of secondary metabolites in plant's life. Roles in chemical defense system, taxonomical and ecological functions. Pharmacological and biological properties of secondary metabolites. Industrial and commercial significance of secondary metabolites
Unit-II	Biosynthesis and regulation of secondary metabolites: Biosynthesis of alkaloids derived from Shikimic acid pathway. Biosynthesis of isoprenoids via 3C-methyl-D-erythritol-4-phosphate (MEP) pathway. Biochemical pathways of flavonoids and polyphenol (lignin) biosynthesis. Integration of secondary metabolism with primary metabolic pathways. Regulation: Genetic, developmental, seasonal and geographical factors, roles of precursor feeding, metabolic channeling and compartmentalization. Cross-talk/exchange of intermediates between biochemical pathways. Use of specific enzyme inhibitors in regulation
Unit-III	Production of secondary metabolites: Methods of production of secondary metabolites: Tissue, organ and hairy root cultures. Roles of Endophytes in production of secondary metabolites. Production of secondary metabolites in bioreactors. Effects of precursors, co-factors and elicitors on production. Production of Taxol, Camptothecin, Berberine and rubber.
Unit-IV	Metabolic Engineering of secondary metabolic pathways: Cloning and characterization of enzymes of the Shikimate and MEP pathways. Functional genomics approaches for improvement of secondary metabolite production. Metabolic engineering of <i>Escherichia coli</i> and yeast for the production of flavonoids, terpenoids and alkaloids.
Lab Course:	
1	Isolation of essential oil and determination of the oil yield.
2	Qualitative test for determination of a- terpenoids b- alkaloids c- flavonoids d- saponins
3	Quantitative test for determination of: a- terpenoids b- alkaloids d- saponins e- phenolics


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4	Determination of antimicrobial activity of the plant extracts.
5	Demonstration of hairy root culture for production of secondary metabolites
6	RNA extraction and gene expression of key enzymes of Biosynthesis of alkaloid; <i>Strictosidine Synthase [STR1]</i> , <i>Strictosidine glucosidase (SG)</i> , <i>Acetylajmalan Esterase (AAE)</i> etc.

Recommended Books:

David S. Seigler Alan Crozier	Plant Secondary Metabolism, 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, Bell, E.A., Charlwood, B.V. (Eds.)	Fungal Secondary Metabolism
Petroski, Richard J., McCormick, Susan P. (Eds.)	Secondary Plant Products
Makkar, Harinder P.S., Sidhuraju, P., Becker, Klaus	Secondary-Metabolite Biosynthesis and Metabolism Plant Secondary Metabolites

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M.Sc. Syllabi of Bioscience: 2022-2024
Pt. Ravishankar Shukla University, Raipur
M. Sc. Bioscience (Program code-M. Sc. 0405)

Program learning outcome

- Bioscience is an integrated approach of biological sciences and inculcates the study of life and living organisms, their life cycles, physiological processes, adaptations and environment.
- Many different areas of study including biochemistry, microbiology and evolutionary biology etc. reside under Biosciences.
- Applied Bioscience includes studies on plants, animals and microorganisms and their functions at both the cellular and whole-organism level.
- Bioscience covers a fascinating range of topics, giving the modern biologist an insight into numerous disciplines of Life science.
- In view of the evolving natures of animal and plant sciences as a subject, the learning outcomes-based curriculum framework for a M.Sc. degree in Bioscience is designed to cater to the needs of students aspiring for higher education.
- Not only does it give a deeper insight into the knowledge of plant and animal worlds individually, but also provides an integrated vision about the various life processes involved in the fascinating world of living organisms in totality.
- A degree in biosciences can impart skills that will help students to stand out in a progressively competitive job market and propel him or her to academic success. It will not only help in development of a capability of appreciating the nature of living organisms and biological processes, but also inculcate an interest for research. Besides, being trained to use modern biological techniques, the student would also develop an aptitude to synthesize a range of biological concepts and ideas.
- Participation in projects will impart the ability to develop analytical and critical thinking skills, including hypothesis generation and testing, scientific writing and presentation skills. All these will be helpful not only to construct a strong base for higher studies in biological sciences but also prepare for a successful and productive career in teaching and research.
- Just as in some other parts of the world, the postgraduate program in Biosciences is the first level of university degree in the country.
- After obtaining this degree, a student may enter into the job market or choose for undertaking further higher studies in the subject.
- Options after post graduation include joining industries, academia, public health etc. Thus, the postgraduate will have an opportunity of contributing in the development in the welfare of society in a useful manner.

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Paper wise learning outcomes

SEMESTER-I
Paper-I: Cell Biology (Course code: BS-22101)
After completion of the course, students will gain clear understanding of: <ul style="list-style-type: none">• A thorough knowledge about cell structure and function, structure and organization of chromosomes and cell division in prokaryotes and eukaryotes and structure, types and function of DNA and RNA.• Cell structure, organelles and their roles.• Organization of DNA, its replication, damage and repair processes.• Cell-Cell communication and cell junctions present between the cells.• Cell division and regulation mechanisms.• Process of apoptosis and other types of cell death.
Paper-II: Biomolecules (Course code: BS-22102)
Students will have a knowledge base of <ul style="list-style-type: none">• Concepts of Biomolecules.• Structures, properties and functions of carbohydrates, lipids and proteins• Structure and role of different pigments and electron carriers.
Paper-III: Instrumentation and Techniques (Course code: BS-22103)
This is a very crucial paper which will be going to benefit students in further research in biological sciences. It will give in –depth understanding and knowledge base of <ul style="list-style-type: none">• Imaging techniques and instruments sample preparation procedure, operation of instruments, and data interpretation of different instruments in biological research.• Concept of the lights, different types of microscopes including confocal and atomicforce microscopy, optical tweezers.• Advanced and sophisticated instruments NMR technique. Students will be able to comprehend various concepts <ul style="list-style-type: none">• Nanotechnology in biology• Nanomaterial and Nanostructures• Biosensors and nanobiosensors.• Nanobiotechnological applications in health and disease and environment.
Paper-IV: Biometry, Computer Application and Scientometry (Course code: BS-22104)
After successfully completing this course, the students will be able to: <ul style="list-style-type: none">• Biostatistics and its significance in biology.• Understand the concept of research and different types of research in the context of biology.• Have basic awareness of data analysis and hypothesis testing procedures• Develop laboratory experiment related skills.• Have basic knowledge on qualitative research techniques• Develop competence on data collection and process of scientific documentation• Analyze the ethical aspects of research• Understand the concept of IPR• Develop skills in qualitative and quantitative statistical data analysis in biological studies• Know the applications and limitations of different statistical methods.• Understand the use of computers for various applications

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<ul style="list-style-type: none"> Recognize advanced resources for accessing scholarly literature from internet Utilize bibliography management software while typing and downloading citations Demonstrate knowledge and practical skills of using instruments in research <p>Apply the knowledge in future course of their career development in higher education and research.</p>
SEMESTER-II
Paper-I : Genetics and Molecular Biology (Course code: BS-22201)
<p>Students will be able to exhibit a knowledge base of</p> <ul style="list-style-type: none"> General principle, importance of genetics and interpretation of the various laws of genetic Hereditary nature of the gene and how it codes different proteins of the cells. Genetic diseases linked to gene/DNA. Relationship between gene and evolution. Basic concept of molecular biology. Central dogma and molecular mechanism in prokaryotes and eukaryotes. Synthesis and control the proteins synthesis, Gene expression in prokaryotes and eukaryotes. Mutation, its types, causes, and consequences. They would also possess the ability to develop a concept on Genetic code, Apoptosis, Molecular mechanism of recombination and basic concept of genetics including Mendelian genetics, mutations and transgenic animals and plants.
Paper-II : Bioenergetics & Metabolism (Course code: BS-22202)
<p>The aim of the course in Bioenergetics & Metabolism will enable the students to</p> <ul style="list-style-type: none"> Better understanding of different metabolic pathways related to synthesis and degradation of major macro molecules. Intricate biochemical reactions occurring in the biological systems. Concepts of enzymes and enzyme kinetics Protein structure, folding, and modification processes. Basics of photosynthesis process and electron carriers involved. Develop transferable quantitative skills Apply modern instrumentation theory and practice to biochemical problems Identify social and health-related dimensions of biochemical investigations.
Paper-III : Microbiology (Course code: BS-22203)
<p>Students will able to gain in –depth understanding of</p> <ul style="list-style-type: none"> Microscopic organisms unicellular, multicellular or acellular. Concepts of mycology, parasitology and bacteriology. Diseases mechanism associated with these microorganisms. Structure and classification of animal, plant viruses and bacteriophages. Replication mechanism and diseases caused by them. Development of vaccines for the viral epidemics and also about antiviral chemotherapy.
Paper-IV : Immunology (Course code: BS-22204)

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

- Demonstrate the basic knowledge of immunological processes at a cellular and molecular level and define central immunological principles and concepts.
- Outline, compare and contrast the key mechanisms and cellular players of innate and adaptive immunity and how they relate; the key players involved in the immune response, their identification and characteristics in the molecular and cellular levels.
- They would be able to decipher how the nature of the antigen shape the resulting effector responses, factors affecting antigen-antibody reactions and the role of the Major Histocompatibility Complex.
- 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.

SEMESTER-III

Paper-I: Plant Physiology (Course code: BS-22301)

Students will gain in-depth understanding of

- Fundamentals of Plant morphology, plant ecology
- Phytochemistry including the plant growth regulators
Phenomenon like photoperiodism, photomorphogenesis, circadian rhythms.

Paper-II: Ecology and Environmental Biology (Course code: BS-22302)

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

- Understand the importance of ecology, the factors affecting our ecosystem and gain knowledge on energy flow, food webs and food chains, ecological pyramids and ecological succession. This would not only help him/her conceptualize an important aspect of biology but also help develop an awareness and love for nature conservation.
- Gain knowledge on various types of pollutions their health hazards, management, impact assessment and environmental protection laws. In a world, facing the threat of a rapidly changing climate such students will act as Environmental volunteers for the creation of awareness among common masses, a need of the present hour:

Paper-III: Animal Physiology (Course code: BS-22303)

Students will be able to comprehend the basics of

- Organization and mechanism of working of various organ systems of the human body like nervous system, muscular system, and respiratory system.
- Process of nerve stimulation, neurotransmission, cardiac control, temperature control, blood pressure etc.
- Have an enhanced knowledge and appreciation of animal physiology;
- Understand the functions of important physiological systems including the cardio-respiratory, renal, reproductive and metabolic systems and comprehend how these separate systems interact to yield integrated physiological responses .
- Be able to perform, analyse and report on experiments and observations in physiology.
- Be able to recognise and identify principal tissue structures
- Gain a foundation to work in science, academia or medicine.

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- Develop critical thinking, analytical, communication and laboratory skills for pursuing careers in research, medical sales, healthcare, pharmaceuticals or teaching.

Paper-IV: Developmental Biology and Evolution (Course code: BS-22304)

Students will be able to comprehend

- Developmental processes in animals and plants.
- Biochemical and molecular regulation of development.
- Concepts of epigenetics and how environmental factors influence the development of plants and animals.
- Theories and evidences of organic evolution.
- Sources of variations and role in evolution.
- Population genetics, Evolution of man.
- Construction of phylogenetic trees, Multiple sequence alignment. Studying basic concepts of evolution and behavior would further corroborate in this mission.

SEMESTER-IV

Paper-I: Molecular Endocrinology (Course code: BS-22401)

Students should be able to:

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

Paper-II: Genetic Engineering (Course code: BS-22402)

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Students will have in –depth understanding

- Basic principles of genetic engineering.
- Animal cell culture.
- Types of cell culture media. Celllines, Stem cell research and gene transfer technology in animals
- Plant transformation techniques.
- Transgenics for increasing crop productivity.
- Transgenics for quality improvement.
- Chloroplast transformation.
- Plant Metabolic Engineering, Plant vaccines.
- Protein separation and identification techniques.
- Protein and Genome sequencing methods.
- Functional proteomics and its applications.
Human genome, Gene disease association and metagenomics.
- Transgenic animals, cloning and applications
- Development of transgenic plants and their applications.
- Medical biotechnology applications like tissue engineering.
Synthesis and application of nanoparticles.

Paper-III: (A) Parasitology (Course code: BS-22403-A)

Upon successful completion, students will have the knowledge of:

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

Paper-III: (B) Basic Chronobiology (Course code: BS-22403-B)

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

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

Paper-III: (C) Ethnobotany (Course code: BS-22403-C)

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Upon successful completion, students will have the knowledge of:

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

Paper-IV: (A) Applied Immunology (Course code: BS-22404-A)

Students will develop knowledge base in

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

Paper-IV: (B) Applied Chronobiology (Course code: BS-22404-B)

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

- Understand the molecular, cellular and system levels in various organisms, and the generation and coordination of internal timing.
- Understand the underlying mechanism of circadian rhythms in the human body
- Understand the various techniques which are helpful in investigating the endogenous nature of biological rhythms in humans
- Understand the consequence of the disruption of internal rhythms on work performance and health in the modern world.
- Acknowledge the role of Chronobiology and chronodisruption on several physiopathological events
- Experience a hands-on recording of own body rhythms in a basic class experiment
- Learn to understand the relationship between sleep and circadian biology by an analysis of students' own sleep rhythm
- Acknowledge the relevance of circadian rhythms on therapeutic interventions

Paper-IV: (C) Secondary Metabolites (Course code: BS-22404-C)

Students will develop understanding about

- Food crops Medicinal: Plant secondary metabolites.
- Knowledge of extraction, isolation, characterization and elicitation of bioactive metabolites.
- Nutraceuticals and functional foods.
- Plant-based biofuels.

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Project work

Project work will enable the student to

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

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