

Scheme of Semester Examination & Syllabus, 2018-2020				
M. Sc. Bioscience (Semester I to IV)				
Pt. Ravishankar Shukla University, Raipur				
First Semester [July 2018 – December 2018]				
Paper	Title of Paper	Marks		
		(External)	(Internal [*])	Credit
I	Cell Biology	80	20	4
II	Biomolecules	80	20	4
III	Microbiology	80	20	4
IV	Biology of Immune System	80	20	4
LC-I	Lab Course I (Based on Theory papers I & II)	80	20	2
LC-II	Lab Course II (Based on Theory papers III & IV)	80	20	2
	Total	600		20
Second Semester [January 2019– June 2019]				
Paper	Title of Paper	(External)	(Internal)	Credit
I	Genetics and Molecular Biology	80	20	4
II	Bioenergetics & Metabolism	80	20	4
III	Instrumentation and Molecular Techniques	80	20	4
IV	Biometry, Computer and Scientometry	80	20	4
LC-I	Lab Course I (Based on Theory papers I & II)	80	20	2
LC-II	Lab Course II (Based on Theory papers III & IV)	80	20	2
	Total	600		20
Third Semester [July 2020 – December 2020]				
Paper	Title of Paper	(External)	(Internal)	Credit
I	Molecular Plant Physiology	80	20	4
II	Ecology and Environmental Biology	80	20	4
III	Animal Physiology	80	20	4
IV	Developmental Biology and Evolution	80	20	4
LC-I	Lab Course I (Based on Theory papers I & II)	80	20	2
LC-II	Lab Course I (Based on Theory papers III & IV)	80	20	2
		600		20
Fourth Semester [January 2020 – June 2020]				
Paper	Title of Paper	(External)	(Internal)	Credit
I	Seed Science	80	20	4
II	Plant Biotechnology	80	20	4
III	Special Paper A: Parasitology/ Special Paper B: Basic Chronobiology	80	20	4
IV	Special Paper A: Immunology/ Special Paper B: Applied Chronobiology	80	20	4

LC-I	Lab Course I (Based on Theory papers I & II)		80	20	2
LC-II	Lab Course II (Based on Theory papers III & IV)		80	20	2
	Total		600		20
	OR				
	Project Work**			600	
	Distribution of Marks	Dissertation	240	60	11
		Seminar based on project	160	40	6
		Viva-voce	80	20	3
				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.
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Continuous evaluation of Performance*

	Each student will be evaluated continuously throughout the semester.
	There will be a class test based on each theory paper. The full marks will be 10 for each paper.
	There will be a poster/oral presentation based on each theory paper. The full marks will be 10 for each presentation.
	Each student will be required to submit a brief write-up (not more than 15-20 pages) on his/her poster/oral presentation.

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 75% 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.

Scheme for Lab Course (LC) Examination (Applicable for each LC in each Semester)

	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	

	7.	Sessional [Internal]	20
		Total	100
	*** A student will be required to interpret on the displayed item/ material		
July 2018 – December 2018			
M.Sc. Bioscience			
First Semester			
Paper I: Cell Biology			
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. 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.
Recommended Books	
H Lodish <i>et al.</i>	Molecular Cell Biology
B Alberts <i>et al.</i>	Essential Cell Biology
H Lodish <i>et al.</i>	Molecular Cell Biology (Lodish, Molecular Cell Biology)
B Alberts <i>et al.</i>	Molecular Biology of the Cell
G Karp	Cell and Molecular Biology: Concepts and experiments

July 2018 – December 2018	
M.Sc. Bioscience	
First Semester	
Paper II: Biomolecules	
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 and function of Carbohydrates, Lipid and Nucleic acid: Carbohydrate: Monosaccharides, homo and hetero-polysaccharides, Peptidoglycan glycoproteins and liposaccharide. Lipids: Simple; cholesterol and complex; phospholipids and TAG
Unit-II	Classification and functions of amino acids, Synthesis of peptides, Proteins-properties, secondary, tertiary and quaternary structure of proteins, Ramchandranplot. Nucleic Acid: 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)
Recommended Books:	
Nelson, Cox and Lehninger	Principles of Biochemistry

G Zubay	Biochemistry
Stryer	Biochemistry
Garrett and Grosham	Biochemistry
West, Tood, Mason and Bbruglen	Text book of biochemistry
White, Handler and Smith	Biochemistry
D Voet and JC Voet	Biochemistry

July 2018 – December 2018	
M.Sc. Bioscience	
First Semester	
Paper III: Microbiology	
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	General characteristics of fungi, classification of fungi, life cycle of selected fungal genus (<i>Aspergillus</i> , <i>Pencillium</i> , <i>Fusarium</i> and <i>Mucor</i>).Economic importance of fungi. Fungi and bioremediation, parasitism, mutualism and symbiosis with plants and animals.Heterothallism, sex hormone in fungi, Mycorrhiza, VAM. Algae: Distribution, classification, reproduction, ecology and importance.
Unit-II	Morphology and ultra structure of bacteria: Morphological types, cell wall of archaebacteria, gram negative, gram positive eubacteria. 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: F- factors, colicins and col factors, plasmids as a 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, asynchronous, synchronous culture. Basis of microbial classification, classification and salient feature of bacteria according to Bergey's manual of determinative bacteriology, cyanobacteria, prochlorons and cyanelles.
Unit-IV	Viruses: Structure and classification of viruses; General Concepts: Viral genome, capsids, envelopes, viroids and prions). Virus reproductions: Lysogeny and Lytic phase, Bacteriophages and their types. General Introduction to Plant and animal viruses (TMV, HIV, Hepatitis virus, H1N1 virus, Small Pox virus), hemorrhagic viral fever, 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
3.	Methods of obtaining pure culture of microorganisms (a) streak plate (b) Pour plate, and (c) spread plate methods
4.	Microscopic examination of the microorganisms, identification and staining methods
5.	Micrometry and camera lucida drawings
6.	Study of bacterial growth by turbidimetry/ spectrophotometry
7.	Biomass measurement for fungi
8.	Isolation and enumeration of microorganisms from soil by serial dilution agar plating method
9.	Enumeration of viruses by plaque assay technique
10.	Motility of bacteria by hanging drop technique
Recommended Books:	
LM Prescott, JP Harley and DA Klein	Microbiology, McGraw Hill Publication
RY Stanier et al.	General Microbiology, Mac Millan Press
RM Atlas	Principles of Microbiology
Peleczar, Chan and Krieg	Microbiology
Luria, Darnell, Baltimore and Campbell	General Virology
CJ Alexopoulos and CW Mims	Introduction to Mycology, Wiley Eastern Ltd, New Delhi
S. J. Flint, V. R. Racaniello, L. W. Enquist, V. R. Rancaniello, A. M. Skalka	Principles of Virology: Molecular Biology, Pathogenesis, and Control of Animal Viruses.

July 2018 – December 2018	
M.Sc. Bioscience	
First Semester	
Paper IV: Biology of Immune System	
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 immune mechanism and characteristics of adaptive immune response. Cells of immune system: Hematopoiesis and differentiation, mononuclear cells and granulocytes, antigen presenting cells. Primary and Secondary lymphoid organs and tissues. Ontogeny and phylogeny of lymphocytes. Lymphocyte traffic.
Unit-II	Antigen receptor molecules: B-cell receptor complex, Immunoglobulin-structure, types and function. T-cell receptor complex. Major Histocompatibility Complex- types, structural organization, function and distribution. Transplantation and Rejection. Complement system.
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. Antigen and antibody interaction.
Unit-IV	Cell mediated immune response. Cytokines and interleukins- structure and

	function. Immunity to infections. Hypersensitive reactions and their types. Immunodeficiency disorders. Autoimmunity
Lab Course:	
1.	Identification of cells of immune system
2.	Separation of mononuclear cells by Ficoll-Hypaque
3.	Identification of Lymphocytes and their subsets
4.	Lymphoid organs and their microscopic organization
5.	Isolation and purification of Antigens
6.	Purification of IgG from serum
7.	Estimation of Levels of gamma globulins and A/G ratio in blood
8.	Antigen antibody interaction
Recommended Books:	
RA Goldsby <i>et al.</i>	Kuby's Immunology
E Benjamini, R Coico and G Sunshine	Immunology- A short Course
Roitt, Brostoff and Male	Immunology
William Paul	Fundamentals of Immunology
Tizard	Immunology
Abbas <i>et al.</i>	Immunology

January 2019 – June 2019	
M.Sc. Bioscience	
Second Semester	
Paper I: Genetics and Molecular Biology	
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 versus somatic mutants, insertional mutagenesis.
Unit-II	DNA replication in eukaryotes and prokaryotes : enzymes involved, replication origin and replication fork, fidelity of replication, extrachromosomal replicons. DNA damage and repair mechanisms: Repair of Base-excision, Nucleotide excisions, Mismatch and Double Strand. p53 and p21.
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
Recommended Books	
H Lodish <i>et al.</i>	Molecular Cell Biology
B Alberts <i>et al.</i>	Essential Cell Biology
B Alberts <i>et al.</i>	Molecular Biology of the Cell
G Karp	Cell and Molecular Biology: Concepts and experiments
JD Watson <i>et al.</i>	Molecular Biology of the Gene
J Wilson and T Hunt	Molecular Biology of the Cell: The Problems
B Lewin	Genes VIII
JE Krebs <i>et al.</i> (Ed.)	Genes X (Lewin's), Jones and Bartlett Publishers, Sudbury, Massachusetts, (2011)

January 2019 – June 2019	
M.Sc. Bioscience	
Second Semester	
Paper II: Bioenergetics and Metabolism	
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- ΔG , ΔG^0 and $\Delta G'^0$, Relationship between equilibrium constant and $\Delta G'^0$, 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, Kreb'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-Sompgy 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

Recommended Books:

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

January 2019 – June 2019

M.Sc. Bioscience

Second Semester

Paper III: Instrumentation and Molecular Techniques

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. Preparative, analytical and ultracentrifuges, sedimentation coefficient and factors affecting sedimentation coefficient. Application of centrifugation. Photometry: Basic principles of colorimetry, UV- visible spectrophotometry & IR- spectrophotometry. Spectroflurometry Atomic absorption spectroscopy: Principle, Instrumentation and applications
Unit-II	Microscopic techniques: light microscopy, phase-contrast microscopy, scanning and transmission electron microscopy, different fixation and staining techniques for EM, freeze-etch and freeze-fracture methods for EM, image processing methods in microscopy.
Unit-III	Chromatography: Paper and Thin Layer Chromatography. Gel filtration, Ion exchange chromatography and Affinity chromatography. Gas-liquid chromatography and HPLC. Histochemical and immunotechniques: Detection of molecules using ELISA, RIA, western blot, immunoprecipitation, flow cytometry and immunofluorescence microscopy, detection of molecules in living cells, In situ localization; FISH and GISH.
Unit-IV	Electrophoresis: Agarose, PAGE, 2D-E. Radioactivity: GM counter, liquid Scintillation counter, solid Scintillation

	counter, gamma counters. Lyophilization: Principle, instrumentation and applications. Microtomy: types, principle and applications
Lab Course:	
	• Verification of Beers Law • Determination of absorption maxima • Quantitative determination, Enzyme kinetics • Amino acid and carbohydrate separation by paper and TLC • Ion exchange and gel filtration chromatography • SDS Polyacralamide Gel Electrophoresis • DNA electrophoresis • Isoenzymes • Separation of sub-cellular organelles by differential centrifugation. • Isolation of DNA and Agarose gel Electrophoresis • Amplification of RAPD and AFLP markers. • Isolation of RNA and Electrophoresis of RNA on denaturing gels. • cDNA synthesis and cloning • Isolation of Protein and SDS-PAGE • In vitro DNA ligation, transformation of E. coli • Characterization of transformants: DNA gel electrophoresis, Restriction map analysis
Recommended Books:	
• K Wilson and John Walker • RF Boyer • S Carson, H Miller and D Scott • TC Ford and J. M. Graham • R Baserga and D Malamud • T Chard • MD Bruch • BA Wallace and R William • J Sambrook, EF Rritsch and I Maniatis • PD Dabre • JD Watson, NH Hopkins, JW Roberts, JA Steitz and AM Weiner • J Darnell, H Lodish and D Baltimore • B Alberts, D Bray, J Lewis, M Raff, K Roberts and JD Watson • Benjamin Lewin • JM Walker and R Rapley • SB Primrose	- Practical Biochemistry: Principles & Techniques - Biochemistry Laboratory: Modern Theory & Techniques - Molecular Biology Techniques: A Classroom Laboratory Manual - An Introduction to Centrifugation - Autoradiography: techniques and application - An Introduction to Radioimmunoassay and Related Techniques , Volume 6 - NMR Spectroscopy Techniques - Modern Techniques for Circular Dichroism and Synchrotron Radiation, Volume 1 - Molecular cloning: A Laboratory Manual - Introduction to Practical Molecular Biology - Molecular Biology of Gene (4th Edition) - Molecular Cell Biology (2nd Edition) - Molecular Biology of the Cell (2nd Edition) - Gene VII - Molecular Biology and Biotechnology - Molecular Biotechnology
January 2019 – June 2019	
M.Sc. Bioscience	
Second Semester	
PAPER IV: BIOMETRY, COMPUTER AND SCIENTOMETRY	

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 and binomial. Probability: Basic laws of probability, addition law, multiplication law. Probability and frequency.

Unit-II Statistical errors in hypothesis testing. Testing goodness of fit: Chi-square goodness of fit. Heterogeneity Chi-square. The 2 x 2 contingency table. 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-Tool Pack 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; Pubmed, Scopus, Web of Science, Google Scholar, Indian Citation Index, Science Citation Index (SCI), h-index, i-10-index. Journal Impact Factor (JIF). Introduction to Plagiarism and Cyber laws.

Lab Course

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|-----|---|
| 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, <i>r</i> , and regression constants |
| 5. | Data analysis by ANOVA and multiple-range tests |
| 6. | Hypothesis testing by <i>t</i> -test, <i>F</i> -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) for article 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 <i>et al.</i>	Inside Microsoft Office Professional
Coleman P and Dyson P	Mastering Internets
Gralla P	How the Internet Works
Shelly GB, Vermaat ME, Cashman TJ	Microsoft® 2007: Introductory Concepts and Techniques
Habraken J	Microsoft® Office 2003 All in One
	Microsoft® Office 2010 In Depth
Gilmore B	Plagiarism: Why it happens, How to prevent it?
Buranen L and Roy AM	Perspectives on Plagiarism and Intellectual Property in a Post-Modern World
Kumar Anupa P	Cyber Law
Sood V	Cyber Law Simplified

July 2019 – December 2019	
M.Sc. Bioscience	
Third Semester	
Paper I: Molecular Plant Physiology	
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	Membrane transport : Pumps; F-type H^+ -ATPase mitochondria, P-type PM H^+ -ATPase, V Type H^+ -ATPase, and ABC type. Ion Channels; Voltage gated channels of K and Ca. Water transport through Aquaporins. Physiology of Mineral Nutrition: Molecular mechanism and regulation of K, Fe and Zn transport. Phosphorous nutrition and transport. Phytoremediation. Mineral toxicity
Unit-II	Photosynthesis: Light absorption and energy conversion, photosystems I and II, ATP synthesis, Assimilation of carbon in C_3 , C_4 and CAM pathways, Photorespiration
Unit-III	Phytohormones: Structure, biosynthesis, molecular mechanisms of Auxin, Gibberellins, Cytokinin, Absciscic acid and Ethylene, Brassinosteroids
Unit-IV	Senescence and Programmed cell death: Senescence; Metabolism and regulation of pigment and nucleic acid, PGR regulation, SAG. PCD; Formation of TE and mobilization of cereal endosperm, Formation of aerenchyma. Signal transduction and PCD
Lab Course:	
1.	Spectrophotometric determination of chlorophyll-a, chlorophyll-b and total chlorophyll in young, mature and senescent leaves
2.	Kinetin estimation by cucumber cotyledons expansion bioassay
3.	Auxin bioassay using wheat coleoptiles

4.	GA bioassay by inducing <i>de-novo</i> synthesis of Amylase in de-embryonated seeds of wheat
5.	Estimation of mono, di and total phenols in the young and aged leaves
6.	Estimation of Guaiacol peroxidase activity in fresh and aged seeds
7.	Determination of Superoxide dismutase levels in the healthy and deteriorated seeds
8.	Estimation of metal toxicity induced changes in the AOS levels in leaf tissues
9.	Determination of Nitrate reductase activity in leaf tissues
10.	Separation of isozymes of SOD and GPX
Recommended Books:	
Fosket DF	Plant Growth & Development
Foyer CH	Photosynthesis
Bacon Ke	Photosynthesis: Photobiochemistry & Photobiophysics
Leopold AC & Kriedemann PE	Plant Growth & Development
Moore TC	Biochemistry & Physiology of Hormones
L Taiz & E Zeiger	Plant Physiology
BB Buchanan, W Gruissem & RL Jones	Biochemistry & Molecular Biology of Plants
MB Wilkins	Advanced Plant Physiology
JA Hopkins	Introduction to Plant Physiology
FB Salisbury & CW Ross	Plant Physiology
Hans-Walter Heldt	Plant biochemistry & Molecular Biology

July 2019 – December 2019	
M.Sc. Bioscience	
Third Semester	
Paper II: Ecology and Environmental Biology	
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 'Species –Area-Curve' method
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

July 2018 – December 2018	
M.Sc. Bioscience	
Third Semester	
Paper III: Animal Physiology	
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	Circulation: Composition of blood, Cell types, Hemopoiesis, Structure and function of hemoglobin - Oxygen and carbon dioxide transport, Cardiac cycle and its regulation. Blood pressure, Blood Coagulation, 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	Endocrinology: Communication (autocrine, paracrine, neuroendocrine and endocrine) between cells and within the cells, Classification of hormones, General principles of nature and molecular aspects of hormone action, Hormone receptors, Structure and physiology of following endocrine glands: hypothalamus, pituitary, thyroid and parathyroid, pancreas, adrenal, and pineal.
Unit-IV	Hormones, Reproduction and Pheromones: Hormones in reproduction, Structure and function of testis and ovary, sexual cycles, Mechanism of action of

	gonadotropins; Types of pheromones, primer pheromone, releaser pheromone, imprinting pheromone, Lee-Boot effect, Bruce effect, Whitten effect, Human pheromones, Sex pheromones in insect control.
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Lab Course (8-10 out of the following):

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 Arneth's classification).
6.	Demonstration of hemin crystal.
7.	To determine absolute Eosinophil count in Human blood
8.	To determine blood pressure in different body 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.	Assessment of short interval time perception as function of gender
13.	Assessment of reaction time using suitable method
14.	Study of histology of endocrine glands
15.	ELISA/ RIA for T4, T3 & TSH
16.	ELISA/ RIA for Cortisol and Melatonin
17.	Effects of surfacing prevention on opercular activity in <i>C. batrachus</i> / <i>H. fossilis</i>
18.	To study phototactic behavior of fishes
19.	To study different stages of melanophores in scales of the live fish
20.	To study the effect of temperature on melanophores in scales of live fish
21.	To observe the effect of adrenalin [neurotransmitter] on melanophores
22.	To study chemotactic behavior of organisms present in natural habitat

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
D McFarland	Animal behaviour, psychobiology, ethology & evolution
CL Prosser	Adaptational biology: molecules to organisms
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
TD Wyatt	Pheromones and animal behavior: Communication by smell and taste
G Litwack	Pheromones

July 2019 – December 2019

M.Sc. Bioscience

Third Semester

Paper IV: Developmental Biology and Evolution

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
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 et al.	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

January 2020 – June 2020

M.Sc. Bioscience

Fourth Semester	
Paper I: Seed Science	
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	Seed development: Phases of development, Maturation; accumulation of desiccation related compounds, ABA regulation. Seed Dormancy: Physiological and molecular basis, Testa, Endosperm, Aleurone layers & Hormonal cross talk in dormancy. Alleviation of dormancy; Protein oxidation. Dormancy breaking chemicals and mechanism.
Unit-II	Seed Germination: Pre-germination, Germination and post germination Metabolism. Reactivation of the metabolic pathway. Cellular repair. Hormonal regulation and metabolism; GA & ABA, ROS metabolism.
Unit-III	Seed Ageing: Seed storage physiology: Orthodox & Recalcitrant; ROS metabolism, Mechanism of desiccation tolerance, dehydrins/LEA/peroxiredoxin, HSPs, Sugars. Longevity markers; β - mercaptopyruvatesulfurtransferase (MST), L-isoaspartyl O-methyltransferase (PIMT).
Unit-IV	Seed Technology: Priming technology; biochemical and molecular aspects. Cryobanks, Cryopreservation of seed and embryo; Cryoprotective molecules, Vittrification, Encapsulation and Drying. Synthetic seeds.
Lab Course:	
1.	Hydro and chemical priming effect on seed germination.
2.	To perform accelerated ageing in seeds and its comparison with the control.
3.	Testing seed viability and vigour by :
	(a) germination
	(b) triphenyl tetrazolium test
	(c) Specific conductance of leachates and
	(d) Germination Index
4.	Lipid peroxidation in ageing seeds.
5.	Extraction and estimation of seed proteins, carbohydrates and lipids.
6.	Quantitative and qualitative estimation of antioxidant enzymes in seeds:
	(a) SOD
	(b) Peroxidase and
	(c) catalase
7.	Peroxidase assay by tissue printing method.
8.	Seed cryopreservation technique and post-cryopreservation recovery.
9.	Separation and determination of Molecular weight of seed proteins by SDS-PAGE.
Recommended Books	
JD Bewley& M Black	Physiology & Biochemistry of Seeds, Vol. I & II
JD Bewley& M Black	Seeds : Physiology of Development & Germination
Black <i>et al.</i>	Desiccation and Survival of Plants : Dying without Drying
PK Agrawal & M Dadlani	Techniques in Seed Science & Technology
FAO Report 113	Ex-situ storage of seeds, pollen & <i>in vitro</i> cultures
Copeland & McDonald	Seed Science & Technology

RL Agrawal	Seed Technology
J Kigel & G Galili	Seed Development & Germination
W Ayad et al.	Molecular Genetic Techniques for Plant Genetic resources
EE Benson	Plant Conservation Biotechnology
DE Fosket	Plant Growth & Development
RB Taylorson	Recent Advances in the Development & Germination of Seeds
McDonald & Copeland	Seed Technology Laboratory Manual
Khullar & RC Thapliyal	Forest Seed
L Schmidt	Guide to Handling of Tropical & Sub-tropical Forest Seed

January 2020 – June 2020	
M.Sc. Bioscience	
Fourth Semester	
Paper II: Plant Biotechnology	
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 cell and tissue culture, tissue culture as a technique to produce novel plants and hybrids Tissue culture media (composition and preparation) Initiation and maintenance of callus and suspension culture; single cell clones Organogenesis; somatic embryogenesis; transfer and establishment of whole plants in soil Shoot tip culture: Rapid clonal propagation and production of virus free plant.
Unit-II	Embryo culture and embryo rescue. Anther, pollen and ovary culture for production of haploid plants and homozygous lines. Protoplast isolation, culture and fusion; selection of hybrid cells and regeneration of hybrid plants; symmetric and asymmetric hybrids, cybrids. Germplasm conservation: Cryopreservation and slow growth cultures. Chloroplast Transformation: Advantages, vectors, success with tobacco and potato.
Unit-III	Plant transformation technology: Basis of tumor formation, Mechanism of DNA transfer, Features of Ti and Ri plasmids, role of virulence genes, use of Ti and Ri as vectors, binary vectors, markers, use of reporter genes, 35S and other promoters, use of scaffold attachment regions, multiple gene transfers, particle bombardment, electroporation, microinjection Applications of plant transformation for productivity and performance: herbicide resistance, insect resistance, Bt genes, Non-Bt like protease inhibitors & amylase inhibitors,

	virus resistance, nucleocapsid gene, disease resistance, PR (Pathogenesis Related) proteins, nematode resistance, abiotic stress, male sterile lines.
Unit-IV	Metabolic Engineering and Industrial Products: plant secondary metabolites, control mechanisms and manipulation of phenylpropanoid pathway, shikimate pathway, biodegradable plastics, therapeutic proteins, antibodies, edible vaccines Molecular Markers– RFLP maps, linkage analysis, RAPD markers, STS (Sequence Tagged Strands), microsatellites, SCAR (Sequence characterized amplified regions), SSCP (Single strand conformational polymorphism), AFLP, map based cloning, molecular marker assisted selection.
Lab Course:	
1.	Preparation of culture media
2.	To perform meristem/ bud culture, shoot multiplication & rooting phenomenon
3.	To study organogenesis
4.	To perform somatic embryogenesis
5.	To study the process of plantlet acclimatization
6.	To perform embryo culture
7.	To study the process of anther culture development
8.	Study of molecular markers
9.	Extraction of DNA from plant cultures
10.	Estimation and separation of DNA using agarose gel electrophoresis and spectrophotometer
Recommended Books:	
MK Razdan	Introduction to Plant Tissue Culture, 2 nd Edition, Oxford & IBH Publishing Co. Pvt Ltd, 2010
IK Vasil	Plant Cell and Tissue Culture; Springer Publication, 1994
SS Bhojwani and MK Razdan	Plant Tissue Culture; Elsevier
TJ Fu, G Singh and WR Curtis	Plant Cell and Tissue Culture for the production of Food Ingredients. Kluwer Academic/ Plenum Press, 1999
J Hammond, P McGarvey and V Yusibov	Plant Biotechnology, Springer Verlag, 2000
HS Chawla	Biotechnology in Crop Improvement, International Book Distributing Co., 1998
HS Chawla	Introduction to plant biotechnology. Oxford & IBH Publishing Co. Pvt. Ltd., 2000
BD Singh	Biotechnology- Expanding Horizons. 1 st Edition, Kalyani Publisher, Ludhiana, 2004
Roberta H Smith	Plant Tissue Culture: Techniques and Experiments, 2 nd Edition: Academic Press, 2000
Kyte L http://www.amazon.com/Plants-Test-Tubes-Introduction-Micropropagation/dp/0881923613/ref=pd_sim_b_1/184-6352969-4068647 and Kley J	Plants from Test Tubes: An Introduction to Micropropagation, 3 rd Edition, Timber Press, 1996
M Smith	Plant Propagator's Bible, 1 st Edition, Rodale

	Books, 2007
MR Ahuja	Micropropagation of Woody Plants, Springer, 1993
YPS Bajaj	Trees III, Springer, 1991
YPS Bajaj	Trees IV, Springer, 1996

January 2020 – June 2020	
M.Sc. Bioscience	
Fourth Semester	
Paper III (Special Paper-A) Parasitology	
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.
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 Medicine. 9 th Ed. KD Chatterjee, 236 pages, 1973
TC Cheng	General Parasitology. Second Ed., Academic Press College Division, University of California, 827 pages, 1986

CKJ Panicker	Textbook of Medical Parasitology. Jaypee Brothers, Medical Publishers, 248 pages, 2007
TV Rajan	Textbook of Medical Parasitology. BI Publications, New Delhi, 2009
D Rollinson, and SI Hay, Ed.	Advances in Parasitology; Volumes 1 to 78, Elsevier, 1963-2012.
JD Smyth and DW Halton	The Physiology of Trematodes. Academic Press, Second Edition, 446 pages, 1983
DJ Wyler, Ed.	Modern Parasite Biology: Cellular, Immunological and Molecular Aspects. WH Freeman and Company, New York, 2003

January 2020 – June 2020	
M.Sc. Bioscience	
Fourth Semester	
Paper III (Special Paper-B) Basic Chronobiology	
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, FOURIER, MESA, 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.
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 (Ø) 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-Ede, FM Sulzman, & CA Fuller	The clocks that time us, Harvard University Press, 1982
DS Saunders	Insect clocks, Pergamon, 2002

January 2020 – June 2020	
M.Sc. Bioscience	
Fourth Semester	
Paper IV (Special Paper-A) Immunology	
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 and TCR. Light and heavy chain gene recombination. Recombination Signal sequences. Heavy chain constant region genes. Class switching. Membrane and secreted immunoglobulins. Organization and arrangement of T-cell receptor genes.
Unit-II	Synthesis and production of immunoglobulins. Monoclonal antibody. Designer antibody. Regulation of immune response by antigen, antibody, immune complex, MHC and cytokines. Immunity to infections. Immunological tolerance. Nutrition and Immune response.
Unit-III	Principles of Immunodiagnosis. Antigen-antibody interactions. Precipitation reactions. Haemagglutination. Complement fixation test. Direct and Indirect immunofluorescence. Radio labeled and Enzyme linked assays. Immunoblotting. Isolation of pure antibodies. Assay for complement. Isolation of lymphocyte

	population. Effector cell assays. Flow cytometry. Plaque forming cell assay, ELISPOT assay, lymphocyte stimulation test, migration inhibition assays, cytotoxic assay. Immunodiagnosis of parasitic diseases.
Unit-IV	Immunoprophylaxis: Principles of vaccination. Immunization practices. Vaccines against important bacterial, protozoan and parasitic diseases. DNA vaccines; passive prophylactic measures. Viral vaccines and antiviral agents. Parasite vaccines.
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
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

January 2020 – June 2020	
M.Sc. Bioscience	
Fourth Semester	
Paper IV (Special Paper-B) Applied Chronobiology	
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 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. Techniques involve in molecular mechanism of clock functions.
Unit-II	Human circadian organization: Methods to study human circadian rhythm; Free-running rhythms in humans, Constant routine protocol, and Forced desynchronization protocol. Cronotypes and its assiment 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. Sports Chronobiology.
Lab Course:	
1.	Study of circadian rhythms in objective/subjective variables in human subjects.
2.	Chronotyping in human population.
3.	Study of circadian rhythm in the rest-activity of humans by using wrist actigraphy.
4.	Study of circadian rhythm in blood pressure of humans by using Ambulatory Blood Pressure Monitor.
5.	Circadian variations in RBC and WBC in suitable animal models.
6.	Circadian rhythm in cortisol and melatonin by ELISA
7.	Computation of mid-sleep and social jetlag
8.	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
A Sehgal	Molecular biology of circadian rhythms
LE Scheving	Chronobiotechnology and chronobiological engineering
Y Touitou <i>et al.</i>	Handbook of medical chronobiology