Departmental Copy

DEPARTMENT OF BIOCHEMISTRY

Govt. Nagarjuna PG Autonomous College of Science,Raipur

M. Sc. BIOCHEMISTRY
Scheme and Syllabi of Examination
For
Session 2020-21 & 2021-22

The syllabus for M.Sc. Bio-Chemistry is hereby approved for the session 2020-21 & 2021-22. In case any change or modification is prescribed by Central Board of Studies or Higher Education Department, Govt. of Chhattisgarh with respect to content or distribution of marks for Postgraduate syllabi, it will be implemented accordingly.

Name and Signature	(Professor Science Faculty Other Dept.)
Chairperson /H.O.D 27/01/2021	1. 27/1/21
Subject Expert ..... (University Nominee) 27/01/21	2. Sadhana
Subject Expert (Academic Council) 1. ..... 27/1/21 2.	3.
Representative..... (Industry) 27/1/21	
Representative..... (Alumni)	

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Program Educational Objective:

PEO1. The graduating student shall become a professional in the area of biochemistry.

PEO2. The graduating student shall become a researcher in the field of biochemistry.

PEO3. The graduating student shall become a consultant or an entrepreneur or a freelancer in the area of biochemistry.

Program Outcome:

On successful completion of this program the graduates shall have:

PO1. Ability to apply the fundamental knowledge of molecules of life, molecular techniques, toxicology in the area of biochemistry.

PO2. Ability to design experiment and interpret the results.

PO3. An ability to design a system, or process to meet desired need within realistic constraints.

PO4. Ability to function in a multidisciplinary team.

PO5. An ability to identify, formulate and solve professional problems in the area of biochemistry.

PO6. An understanding of professional and ethical responsibility in the area of biochemistry.

PO7. An ability to communicate effectively in scientific reasoning and data analysis in both written and oral forms.

PO8. The broad education necessary to understand the impact of solutions in a global, economic, environmental and societal context.

PO9.A recognition of the needed for and an ability to engage in lifelong learning in the area of biochemistry.

PO 10. A knowledge of contemporary issues related to biochemistry

PO11. Ability to think critically and apply the same to update scientific knowledge.

PO12. An ability to use the techniques, skills and modern professional tools necessary for professional practice and for research.

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Program Specific Objectives:

PSO1. Students shall be able to identify, formulate and solve the problems of biological metabolisms, protein biochemistry and molecular biology.

PSO2. Students shall be able to conduct the experiments in the field of medicine, toxicology and immunology as well as to analyses and interpret the results.

PSO3. Students shall be able to use the biochemical techniques, bioinformatics tools, biostatistics, skills and modern pathological tools necessary for professional practice and for research.

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Representative..... (Industry)	
Representative..... (Alumni)	

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First Semester
(July 2020-December 2020)

		Marks			Credit
		(External)	(Internal)*	Total	
I	Cell Biology	80	20	100	4
II	Biomolecules	80	20	100	4
III	Microbiology	80	20	100	4
IV	Biology of Immune System	80	20	100	4
LC-I	Lab Course I (Based on paper I & II)	80	20	100	2
LC-II	Lab Course II (Based on paper III & IV)	80	20	100	2
Total		**480**	**120**	**600**	**20**

Second Semester
(January 2021-June-2021)

		Marks			Credit
		(External)	(Internal)*	Total	
I	Genetics and Molecular Biology	80	20	100	4
II	Bioenergetics & Metabolism	80	20	100	4
III	Instrumentation and Molecular Techniques	80	20	100	4
IV	Biometry, Computer and Scientometry	80	20	100	4
LC-I	Lab Course I (Based on paper I & II)	80	20	100	2
LC-II	Lab Course II (Based on paper III & IV)	80	20	100	2
Total		**480**	**120**	**600**	**20**

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Third Semester
(July 2021-December 2021)

		Marks			Credit
		(External)	(Internal)*	Total	
I	Genetic Engineering	80	20	100	4
II	Plant Physiology and Biochemistry	80	20	100	4
III	Nutritional and Environmental Biochemistry	80	20	100	4
IV	Enzymology	80	20	100	4
LC-I	Lab Course I (Based on paper I & II)	80	20	100	2
LC-II	Lab Course II (Based on paper III & IV)	80	20	100	2
	Total	**480**	**120**	**600**	**20**

Fourth Semester
(January 2022 -June 2022)

		Marks			Credit
		(External)	(Internal)*	Total	
I	Plant Biotechnology	80	20	100	4
II	Nutraceuticals and Functional Foods	80	20	100	4
III	**Special Paper-A:** Clinical Biochemistry and Endocrinology **Special Paper-B:** Seed Science Technology	80	20	100	4
IV	**Special Paper-A:** Advanced Immunology, diagnostics and Prophylaxis **Special Paper-B:** Bioinformatics	80	20	100	4
LC-I	Lab Course I (Based on paper I & II)	80	20	100	2
LC-II	Lab Course I (Based on paper III & IV)	80	20	100	2
	Total	**480**	**120**	**600**	**20**

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Pattern of Question Paper

Each theory paper will have questions divided into four sections, A, B, & C. Section A will have 8 MCQ of 1 mark each covering whole syllabus. Section B will have 4 short answer questions, one from each unit with internal choice, of 6 marks each to be answered about 75 words. Section C will have 4 questions, one from each unit with internal choice, of 12 marks each. The question has to be answered in about 150 words.

Section	Type of Question	Word Limit	No. of Questions	Marks in each question	Marks in Question
Section A	Objective Type/MCQ	-	8 (Two From Each Unit)	1	8
Section B	Short Answer Type	75-100 words	4 (From Each Unit with internal Choice)	6	24
Section C	Long Answer Type	250- 300 Words.	4 (From Each Unit with internal Choice)	12	48
Total Marks					**80**

Examination Scheme for Lab Course (for each Semester) Max. Marks 100

	Exercises	Max. Marks
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 I I	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

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Continuous evaluation of Performance* (Continuous Comprehensive Evaluation (CCE))

Each student will be evaluated continuously throughout the semester. There will be a **class test based on each theory paper in I and III semester and Course based seminar/ poster presentation in II and IV semester.** Each student will be required to submit a brief write-up (not more than 15-20 pages) on his/her poster/Seminar presentation. Maximum marks for Continuous evaluation of performance will be classified as follows.

I. Theory courses (Division of Sessional/Internal)

Semester I and III		**Semester II and IV**	
Category	**Marks**	**Category**	**Marks**
Class Test I	05	Seminar/Poster Presentation	05
Class Test II	05	Seminar/Poster Report	05
Assignment	05	Assignment	05
Attendance	02	Attendance	02
Class Participation	03	Class Participation	03
Total	**20**		**20**

II. Lab Course in all semesters (Division of Sessional/Internal)

Category	**Marks**
Record Note Book	5
Viva Voce	5
Lab (Practical) participation during semester	10
Total	**20**

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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 secure at least **65%** or more marks in aggregate in semester I and II. The project has to be carried out in recognized national 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. RavishankarShukla University, Raipur. The valuation of all the projects will be carried out by an external examiner and HOD of Biochemistry or its nominee at the College.

Evaluation of Project Work

		Marks					Credit
		(External)		(Internal)*		Total	
		Max.	Min	Max.	Min		
I	DESSERTATION	240	48	60	12	300	11
II	SEMINAR BASED ON PROJECTS	160	32	40	08	200	06
III	VIVA VOCE	80	16	20	04	100	03
	Total					**600**	**20**

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M. Sc. Biochemistry
FIRST SEMESTER (July 2020 – December 2020)
PAPER - I: CELL BIOLOGY
[Credit: 4 and Maximum Marks: 80]

Course Objective: This module is a general introduction to cell biology, its importance in pathology body functioning.

Course Outcomes (COs)

On successful completion of the course, the student shall be able to:

CO.1 –Describe the chemical and molecular foundations of cell and the role in biological systems.
CO.2 – Define the structure, properties and roles of nucleus.
CO.3 – Explain the protein sorting and its transport in biological system.
CO.4 – Discuss cell signaling mechanism through various pathways.
CO.5 – Classify the cell cycle, its regulation and development.

UNIT-I Molecular organization of membranes - asymmetrical organization of lipids, proteins and carbohydrates.Osmosis, ion channels, membrane pumps and electrical properties of membranes. Active transport by ATP-powered pumps: types, properties and mechanisms.

UNIT-II Transport of proteins into mitochondria, chloroplast and endoplasmic reticulum. Transport of proteins into and out of 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. Apoptosis. Oncogenes and tumor suppressor genes: viral and cellular Oncogenes, retinoblastoma, E2F and p53 proteins.

UNIT-IV Organization of chromosomes: Structure of chromosomes, centromere and telomere. States of chromosomes during cell cycle.Mitotic chromosome.Organization of genes in chromosomes.Banding pattern of chromosomes.Lampbrush and Polytene chromosomes.Chromatin, nucleosomes, DNA packaging, heterochromatin and euchromatin.

Pattern of Question Paper

Section	Type of Question	Word Limit	No. of Questions	Marks in each question	Marks in Question
Section A	Objective Type/MCQ	-	8 (Two From Each Unit)	1	8
Section B	Short Answer Type	75-100 words	4 (From Each Unit with internal Choice)	6	24
Section C	Long Answer Type	250- 300 Words	4 (From Each Unit with internal Choice)	12	48
Total Marks					**80**

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Lab Course

Course Outcomes (COs)

On successful completion of the course, the student shall be able to:

CO.1 – Describe the basic lab requirements and their uses.
CO.2 – Examine various cell organelles through micrograph techniques.
CO.3 – Analyse various nucleic acids through staining techniques.
CO.4 – Examine plolyploidy through onion root with various treatments.
CO.5 – Examine cancer cell by photomicrography.
CO.6 – Analyse various stages of mitosis.
CO.7 – Examine various stages of meiosis cell division.

Exercises:

1. Study of chromosome behavior during Mitosis and meiosis (Onion / Garlic root tips, Onion buds, humanlymphocytes, 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) andBarr body (in buccal epithelial cells).
4. Demonstration of secretary 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.
13. Study of the effect of chemical agents on chromosomes plant cells.
15. Preparation of Karyotype of metaphase plate.
16. Preparation of Meiotic plate and determination of phases.

Books Recommended:

A. Lodish, A. Berk, S L Zipursky, P. Matsudaira Molecular Cell Biology
C. Alberts, D. Bray, K. Hopkin, A. Johnson Essential of Cell Biology
D. Lodish, A. Berk, C. A. Kaiser & M. Krieger Molecular cell Biology
F. Gerald Karp Cell and Molecular Biology Concepts and experiments

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PROGRAMME: M.Sc. (BIOCHEMISTRY)SESSION 2020-21 & 21-22

M. Sc. Biochemistry

FIRST SEMESTER (July 2020 – December 2020)

PAPER – II: Biomolecules [Credit: 4 and Maximum Marks: 80]

Course Objective: The module is designed to provide introduction & detailed information on the molecules of life.

Course Outcome:

On successful completion of the course, the student shall be able to:

CO1: Explain the importance of the four biomolecules of our life.
CO2: Illustrate the detailed structure and functions cellular components.
CO3: Understand the structure and biological importance of carbohydrate and lipids.
CO4: Understand the structure and synthesis of protein and nucleic acids.
CO5: Differentiate the role of cell suicide in maintaining the cellular balance.

UNIT-I Carbohydrates: Structure, classification, properties and function; derivatives of monosaccharides, homo and hetero-polysaccharides, Peptidoglycan glycoproteins and liposaccharide. Lipids: - Classification, structure and function. Nucleic Acid: - Structure of purine and pyrimidine bases, nucleoside and nucleotide; DNA- structure and conformation; RNA - Structure, types and functions.

UNIT-II Amino acids; - structure, classification and functions; Synthesis of peptides and protein sequencing; Proteins- properties, covalent structure; secondary, tertiary and quaternary structure of proteins, Ramchandran plot

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

UNIT-IV Chemistry of porphyrins: Importance of porphyrins in biology; structure of hemoglobin and chlorophyll porphyrins, structure and biological role of animal hormones, structure and biological role of water soluble and fat soluble vitamins.

Pattern of Question Paper

Section	Type of Question	Word Limit	No. of Questions	Marks in each question	Marks in Question
Section A	Objective Type/MCQ	-	8 (Two From Each Unit)	1	8
Section B	Short Answer Type	75-100 words	4 (From Each Unit with internal Choice)	6	24
Section C	Long Answer Type	250- 300 Words	4 (From Each Unit with internal Choice)	12	48
Total Marks					**80**

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Lab Course

Course Objective: The module is designed to provide introduction to basics of reagent preparation and quantification of biomolecules.

Course Outcome:

On successful completion of the course, the student shall be able to:

CO1: Apply the knowledge to prepare buffer solution

CO2: Apply the knowledge to prepare normal and molar solution

CO3: Apply the techniques for identification of pKa value CO4: Determine the different properties of solutions

CO4: Determine the proteins content in different sample.

Experiments:

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

Books Recommended:

Nelson, Cox and Lehninger Principles of Biochemistry

G. Zubay Biochemistry

Stryer Biochemistry

Garrett and Grosham Biochemistry

West, Tood, Mason &Bbruglen Text book of biochemistry

White, Handler & Smith Biochemistry-clinical application

D. Voet and J C Voet Biochemistry

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M. Sc. Biochemistry

FIRST SEMESTER (July 2020– December 2020)

PAPER – III: Microbiology [Credit: 4 and Maximum Marks: 80]

Course Objectives: The module is designed to provide introduction to the biochemistry of micro-organisms and give a general description of the basic recombinant DNA Techniques.

Course Outcome:

On successful completion of the course, the student shall be able to:

CO1: Explain the structure of bacteria and their microscopic examinations.
CO2: Analyze the types bacterial toxins and the toxicology.
CO3: Apply the plant genetic engineering techniques in environment.
CO4: Analyze the production of monoclonal antibodies and its applications.
CO5: Apply the knowledge of fermentation technology in production of antibiotics, enzymes etc.
CO6: Apply the knowledge of enzyme technology in enzymes-based production in industry.

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, 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, eukaryotes. 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; morphology and ultra-structure; capsids and their arrangements, types of envelopes, viral genome, their types and structure, virus related agents (viroids, prions). General feature of virus reproductions, early events in virus multiplication, virus restriction and modification of host, virus mRNA.General overview of bacterial viruses, RNA and DNA bacteriophages (MS2, □X174, M13, T3, T4).Lysogeny and Lytic phase. General account of plant and animal viruses (TMV, HIV and other oncogenic virus, Hepatitis virus).

Pattern of Question Paper

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Section B	Short Answer Type	75-100 words	4 (From Each Unit with Internal Choice)	6	24
Section C	Long Answer Type	250- 300 Words .	4 (From Each Unit with Internal Choice)	12	48
Total Marks					**80**

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Lab Course

Course Objectives: The module is designed to provide detailed techniques about biochemical analysis, antibiotic sensitivity and morphological analysis of some microbes.

Course outcome:

On successful completion of the course, the student shall be able to:

CO1: Demonstrate the techniques of pure culture of bacteria or fungi.

CO2: Interpret the motility of the microbes.

CO3: Interpret the biochemical activities of microbes by various tests

CO4: Understand about the impact of antibiotics on microbial survival

Experiments:

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. Micrometery and camera lucida drawings
6. Study of bacterial growth by turbiditimetry/ 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.

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

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M. Sc. Biochemistry
FIRST SEMESTER (July 2020 – December 2020)
PAPER – IV: Biology of Immune System [Credit: 4 and Maximum Marks: 80]

Course Objective: The module is designed to provide introduction & detailed information on the principles of body's defense mechanism.

Course Outcome:

On successful completion of the course, the student shall be able to:

CO1: Differentiate between innate and adaptive immunity and also between humoral and cell mediated immunity.

CO2: Explain the primary and secondary responses and their relevance to immunizations.

CO3: Identify the role of antigen presenting cells, lymphocytes, and phagocytic cells in immune responses.

CO4: Apply immunochemical techniques used in pathological laboratories.

CO5: Discriminate the nature of antigens and antibodies.

UNIT-I Innate immune mechanism and characteristics of adaptive immune response. Cells of immune system: Hematopoisis 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.Complements in immune function.

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

Pattern of Question Paper

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Section A	Objective Type/MCQ	-	8 (Two From Each Unit)	1	8
Section B	Short Answer Type	75-100 words	4 (From Each Unit with internal Choice)	6	24
Section C	Long Answer Type	250-300 Words	4 (From Each Unit with internal Choice)	12	48
Total Marks					**80**

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Lab Course

Course Objective: The module is designed to provide introduction & detailed information on some basic immunodiagnostic techniques and quantification of blood proteins.

Course Outcome:

On successful completion of the course, the student shall be able to:

CO1: Apply the techniques to test various clinical conditions.

CO2: Perform immunological techniques

CO3: Analyze the different blood cell counting.

CO4: Perform qualitative and quantitative test for proteins

Experiments:

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

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

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M. Sc. Biochemistry
SECOND SEMESTER (January 2021 – June 2021)
PAPER – I: Genetics and Molecular Biology [Credit: 4 and Maximum Marks: 80]

Course Objective: The module is designed to provide introduction the molecular mechanisms of life together with its advancements.

Course Outcome:

On successful completion of the course, the student shall be able to:

CO1: Interpret the cell cycling and signaling mechanisms.
CO2: Interpret the replication and transcriptional processes of a cell.
CO3: Analyze the process of translation and post translational modifications.
CO4: Evaluate the gene regulatory mechanisms in a eukaryotic cell.
CO5: Apply the recombinant DNA methods in designing new recombinants.

UNIT- I Mendelian principles: Dominance, segregation, independent assortment. Concept of gene: Allele, multiple alleles, pseudoallele, complementation tests Extensions of Mendelian principles: Codominance, incomplete dominance, gene interactions. Gene mapping methods: Linkage maps, tetrad analysis, mapping with molecular markers, mapping by using somatic cell hybrids, development of mapping population in plants

Mutation: Types, causes and detection, mutant types – lethal, conditional, biochemical, loss of function, gain of function, germinal verses somatic mutants, insertional mutagenesis

UNIT-II DNA replication, repair and recombination: Mechanism of replication, 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. Guardian of DNA; *p53* and *p21*.Homologous and site-specific recombination.

UNIT-III RNA synthesis and processing: transcription factors and machinery, formation of initiation complex, transcription activator and repressor, RNA polymerases, elongation, and termination, RNA processing, capping, RNA editing, splicing, and polyadenylation, structure and function of different types of RNA, RNA transport.

UNIT-IV Protein synthesis and processing: Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, aminoacylation of tRNA, tRNA-identity, aminoacyltRNAsynthetase, and translational proof-reading, translational inhibitors, Post Translational modification of proteins. Protein targeting.

Pattern of Question Paper

Section	Type of Question	Word Limit	No. of Questions	Marks in each question	Marks in Question
Section A	Objective Type/MCQ	-	8 (Two From Each Unit)	1	8
Section B	Short Answer Type	75-100 words	4 (From Each Unit with internal Choice)	6	24
Section C	Long Answer Type	250-300 Words	4 (From Each Unit with internal Choice)	12	48
Total Marks					80

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Lab Course

Course Objectives: The module is designed to provide detailed knowledge about isolation, transformation and quantification of nucleic acids.

Course Outcome:

On successful completion of the course, the student shall be able to:

CO1: Apply the knowledge of DNA isolation.
CO2: Apply the techniques of gene cloning in bacteria.
CO3: Apply the technique of differential staining in bacterial chromosomes.
CO4: Apply the process of gel electrophoresis in separation of DNA.
CO5: Apply the technique of DNA quantification by spectrometry.

Experiments:

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

Books Recommended:

Molecular Cell Biology H. Lodish, A. Berk, SL Zipursky, P. Matsudaira, D. Baltimore, andJames 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
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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M. Sc. Biochemistry

SECOND SEMESTER (January 2021 – June 2021)

PAPER – II: Bioenergetics & Metabolism [Credit: 4 and Maximum Marks: 80]

Course Objective: This module is a general introduction to the metabolism of biomolecules (Carbohydrates, Lipids andthe basic energetics).

Course Outcomes (COs)

On successful completion of the course, the student shall be able to:

CO.1 – Describe the fundamentals of thermodynamics in biochemical processes.

CO.2 – Acquire the knowledge of energy production in living systems by the degradation of fatty acids.

CO.3 – Explain the various pathways of fatty acid synthesis in living systems.

CO.4 – Describe the energy generated from the carbohydrate metabolism.

CO.5 – Explain the mechanism of the machinery system involved in carbohydrate metabolism.

UNIT-I First and second laws of thermodynamics.Concept of free energy. High – energy compounds, ATP cycle, structural basis of free energy change during hydrolysis of ATP. Other high- energy biological compounds

UNIT-II Basic concepts of intermediary metabolism. Carbohydrate metabolism: Glycolysis, Kreb's cycle, glycogenolysis, glycogenesis, pentose phosphate pathway, gluconeogenesis, and glyoxylate pathway, inborn errors of carbohydrate metabolism. 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 Biosynthesis of amino acids Degradation of amino acids Regulation of amino acid metabolismBiosynthesis and degradation of purine and pyrimidine nucleotides.

Pattern of Question Paper

Section	Type of Question	Word Limit	No. of Questions	Marks in each question	Marks in Question
Section A	Objective Type/MCQ	-	8 (Two From Each Unit)	1	8
Section B	Short Answer Type	75-100 words	4 (From Each Unit with internal Choice)	6	24
Section C	Long Answer Type	250-300 Words	4 (From Each Unit with internal Choice)	12	48
Total Marks					80

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Lab Course

Course Outcomes (COs)

On successful completion of the course, the student shall be able to:

CO.1 Explain biochemical parameter of biological sample.
CO.2- Explain fermentation process by microorganism.
CO.3- Explain enzyme assay of salivary enzyme.
CO.4- Apply the various techniques for isolation of lipids.
CO.5- Practice the biochemical parameters in biological system.
CO.6- Practice the estimation of plasma sugar.
CO.7- Demonstrate the cholesterol level from known sources.

Experiments:

1. Protein estimation by Lowry, Bradford and Spectrophotometric method
2. Estimation blood cholesterol
3. Estimation of sugar by Nelson- Somagy and Benedict's reagent
4. Isolation and estimation of lipid from seeds and egg.
5. Estimation of inorganic and total phosphorus by Fiske-SubbaRao method
6. Assay of phosphatases in blood and seeds
7. Urease estimation in plant tissues

Books Recommended:

Principles of Biochemistry Nelson, Cox and Lehninger
Biochemistry G. Zubay
Biochemistry Stryer
Biochemistry Garrett and Grosham
Text book of biochemistry West, Tood, Mason &Bbruglen
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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PROGRAMME: M.Sc. (BIOCHEMISTRY)SESSION 2020-21 & 21-22

M. Sc. Biochemistry

SECOND SEMESTER (January 2021 – June 2021)

PAPER- III: Instrumentation and Molecular Techniques

[Credit: 4 and Maximum Marks: 80]

Course Objectives: This module is a general introduction to different types of techniques. It includes the DNA isolation Technique, PCR, RFLP etc.

Course Outcome:

On successful completion of the course, the student shall be able to:

CO1: Apply the principle, methodology and applications of Spectroscopic techniques.
CO2: Apply the principle, methodology and applications of Centrifugation techniques.
CO3: Employ the principle, methodology and applications of Electrophoretic techniques.
CO4: Apply the principle, methodology and applications of Chromatography techniques.
CO5: Interpret the principle, methodology and applications of PCR techniques.
CO6: Outline the principle, methodology and applications of Radioisotope techniques.

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 Electrophoresis: Paper electrophoresis, Starch gel, agarose, PAGE-type, 2D-E.

UNIT-II Microscopic techniques: light microscopy, microscopy of living cells, scanning and transmission microscopes, different fixation and staining techniques for EM, freeze-etch and freeze-fracture methods for EM, image processing methods in microscopy.

Microtomy: types, principle and applications *Lyophilization*: Principle, instrumentation and applications

UNIT-III Chromatography: Paper and Thin Layer Chromatography. Gel filtration, Ion exchange chromatography and Affinity chromatography. Gas-liquid chromatography and HPLC.

Histochemical and immunotechniques: Antibody generation, 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. Radioactivity: GM counter, liquid Scintillation counter, solid Scintillation counter, gamma counters

UNIT-IV Molecular techniques: Isolation and purification of RNA, DNA (genomic and plasmid) and proteins, separation methods; RNA, DNA and proteins; 1-D and 2-D, isoelectric focusing gels; Molecular cloning of DNA and RNA fragments in bacterial systems; Expression of recombinant DNA; DNA sequencing. Gene expression;. mRNA, cDNA using PCR and qRT-PCR. Micro array based techniques. Molecular Markers for diversity analysis: RFLP, RAPD, AFLP, VNTR, SSR, ISSR, SNP, DArT.

Pattern of Question Paper

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Total Marks					80

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Lab Course

Course Objective: This module is a general introduction to different types of techniques involved in quantification of some biomolecules like glucose, vitamins, hemoglobin, chlorophyll and lipids.

Course Outcome:

On successful completion of the course, the student shall be able to:

CO1: Apply the estimation techniques for different blood components
CO2: Illustrate the technique of hemoglobin level determination
CO3: Analyze various enzymes related to organ disorders
CO4: Illustrate the techniques of paper chromatography
CO5: Analyze plant pigments by calorimetric method.

Exercise:

A. Verification of Beers Law
B. Determination of absorption maxima
C. Quantitative determination, Enzyme kinetics
D. Amino acid and carbohydrate separation by paper and TLC
E. Ion exchange and gel filtration chromatography
F. SDS Polyacralamide Gel Electrophoresis DNA electrophoresis
G. Isoenzymes
H. Separation of sub-cellular organelles by differential centrifugation.
I. Isolation of DNA and Agarose gel Electrophoresis
J. Isolation of RNA and Electrophoresis of RNA on denaturing gels.
K. Isolation of Protein and SDS-PAGE

Books Recommended:

K Wilson and John Walker Practical Biochemistry: Principles & Techniques
RF Boyer Biochemistry Laboratory: Modern Theory & Techniques
S Carson, H Miller and D Scott Molecular Biology Techniques: A Classroom Laboratory Manual
TC Ford and J. M. Graham An Introduction to Centrifugation
R Baserga and D Malamud Autoradiography: techniques and application
T Chard An Introduction to Radioimmunoassay and Related Techniques , Volume 6
MD Bruch NMR Spectroscopy Techniques

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M. Sc. Biochemistry

SECOND SEMESTER (January 2021– June 2021)

PAPER- IV: BIOMETRY, COMPUTER AND SCIENTOMETRY

[Credit: 4 and Maximum Marks: 80]

Course Objectives: The module is designed to provide introduction to Graphs. It also gives insight about Data and result interpretation. The student will be taught how to design a research project and finally how to present his research work.

Course Outcome:

On successful completion of the course, the student shall be able to:

CO1: Explain the concept of the sampling distribution in statistics and the behavior of the sample.

CO2: Demonstrate an appreciation of one- way analysis of variance (ANOVA).

CO3: Understand the method of regression analysis in statistics.

CO4: Interpret the results of Bivariate Regression and Multivariate Regression.

CO5: Analyze the concept of research methodology and skills of scientific writing.

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. 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, 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.Scientific Writing: Interpretation and Report Writing. Meaning of Interpretation, Techniques of interpretation, Precaution of interpretation.Significance of Report Writing. Step in Report Writing. Types of Report Writing.Component of a Research Report.

Pattern of Question Paper

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Total Marks					**80**

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Lab Course

Course Objective: This module provides basic information on collection, sampling, calculations, interpretations and presentations of various biological data.

Course Outcome:

On successful completion of this program the graduates shall have:

CO1: Apply the knowledge of sampling techniques.
CO2: Calculate the measures of central tendencies with the help of online software
CO3: Illustrate various data presentation styles for a good presentation
CO4: Test the significance of data

Experiments:

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. Review Writing.

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
Shelly GB, Vermaat ME, Microsoft 2007: Introductory Concepts & Techniques
Cashman TJ, Habraken J Microsoft Office 2003 All in One Microsoft Office 2010 In Depth
Kumar Anupa P Cyber Law
Sood V Cyber Law Simplified

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PROGRAMME: M.Sc. (BIOCHEMISTRY)SESSION 2020-21 & 21-22

M. Sc. Biochemistry

THIRD SEMESTER (July 2021 – December 2021)

PAPER – I: Genetic Engineering [Credit: 4 and Maximum Marks: 80]

Course Objective: This module is a general introduction of both the principles and application of molecular and geneticengineering. The module aims to understand the mechanisms of living, from the molecular basis of cell function to theintegrated behavior of the whole body.

Course Outcomes (COs)

On successful completion of the course, the student shall be able to:

CO.1 – Compute the basic steps of genetic engineering according to the species.
CO.2 – Modify the DNA recombinant molecules according to the target cell.
CO.3 – Apply the knowledge of DNA sequencing while genetic engineering.
CO.4 – Convert the genetic information into cDNA library and genomic library that would be beneficial for thepreparation of transgenic organisms.
CO.5 – Choose the appropriate gene delivery system for the target cell.

UNIT- I Milestones of genetic engineering: isolation of enzymes, DNA sequencing, synthesis and mutation, detection and separation of clones, cloning and patenting of life forms, genetic engineering guide lines. Molecular tools and their applications: restriction enzymes, modification enzymes. Molecular techniques: gel electrophoresis, polymerase chain reaction, DNA sequencing, DNA microarray.

UNIT-II Gene cloning vectors: plasmids and transformation, bacteriophages and in vitro packaging, cosmids, artificial chromosomes. Genomic library: strategies of genomic DNA library construction, transformation, construction of eukaryotic genomic library, screening methods. cDNA library: isolation and purification of mRNA, first strand synthesis, second strand synthesis, cDNA library construction. Study of gene regulation: reporter assays Expression strategies for heterologous genes: vector engineering and codon optimization, host engineering, in vitro transcription and translation.

UNIT-III Processing of recombinant proteins: recombinant proteins purification, refolding, characterization and stabilization Site directed mutagenesis, protein engineering Gene knockout technique

UNIT-IV Plant transformation technology: basis of tumor formation, hairy root, features of Ti and Ri plasmids, mechanism of DNA transfer, role of virulence genes, use Ti and Ri as vectors, binary vectors, use of 35S and other promoters, genetic markers, use of reporter genes. Vector-less or direct DNA transfer: particle bombardment, electroporation, microinjection. Application of plant transformation for productivity and performance, herbicide resistance, insect resistance, virus resistance, long shelf-life of fruits

Pattern of Question Paper

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Section C	Long Answer Type	250-300 Words	4 (From Each Unit with internal Choice)	12	48
Total Marks					**80**

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Lab Course

Course Outcomes (COs)

On successful completion of the course, the student shall be able to:

CO. 1- Demonstrate isolation of nucleic acid from microorganisms.

CO. 2- Demonstrate digestion reaction in nucleic acids of various samples.

CO. 3- Illustrate PCR methods.

CO. 4- Sketch Complementation by various techniques.

CO. 5- Illustrate hyper expression of poly histidine-tagged recombinant protein and purification.

Exercises:

1. Bacterial culture and antibiotic selection media. Preparation of competent cells
2. Isolation of plasmid DNA.
3. Isolation of Lambda phage DNA.
4. Quantitation of nucleic acids.
5. Agarose gel electrophoresis and restriction mapping of DNA.
6. Construction of restriction map of plasmid DNA.
7. Cloning in plasmid/phagemid vectors.
8. Isolation of RNA.
9. Synthesis of cDNA.
10. RAPD analysis by PCR.

Books Recommended:

1. Genes VIII Benjamin Lewin
2. An Introduction to Genetic Engineering DST Nicholl
3. Principles of Gene Manipulation and Genomics SB Primrose and Richard
4. Gene Cloning and Manipulation CJ Howe
5. Genetic Engineering (Genetics and Evolution) R Hodge
6. Introduction to Biotechnology & AJ Nair
7. Genetic Engineering
8. Genetic Engineering A Kumar & N Garg
9. Biotechnology & Genetic Engineering L Yount
10. DNA Microarrays & Gene Expression: from P Baldi& G Wesley

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M. Sc. Biochemistry
THIRD SEMESTER (July 2021 – December 2021)
PAPER- II: Plant Physiology and Biochemistry [Credit: 4 and Maximum Marks: 80]

Course Objective: The module is designed to provide introduction & detailed information on the basics of plant biochemistry and latest development in plant biotechnology.

Course Outcome:

On successful completion of the course, the student shall be able to:

CO1: Differentiate between photosynthesis and respiration in a plant cell.
CO2: Acquire the knowledge about nitrogen fixation and plant hormones.
CO3: Understand the plant stress management.
CO4: Apply tissue culture techniques in production of hybrid plants.
CO5: Apply the knowledge of transgenics in production of transgenic plants.

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 C3, C4 and CAM pathways, Photorespiration

UNIT-III Phytohormones: Structure, biosynthesis, molecular mechanisms of Auxin, Gibberellins, Cytokinin, Abscisic 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

Pattern of Question Paper

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Section C	Long Answer Type	250-300 Words	4 (From Each Unit with internal Choice)	12	48
Total Marks					**80**

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Lab Course

Course Objective: The module is designed to provide an experimental background on analysis of plant metabolites and learn the basic plant tissue culture techniques.

Course Outcome:

On successful completion of the course, the student shall be able to:

CO1: Estimate the chlorophyll contents in various leaf sources.

CO2: Analyze the various metabolites present in plant.

CO3: Isolate the plant genomic material.

CO4: Learn the plant tissue culture techniques

Exercise:

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 *de-novo* 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.

Books Recommended:

Fosket DF Plant Growth & Development
Foyer CH Photosynthesis
Bacon KE Photosynthesis: Photobiochem. &Photobiophysics
Leopold AC &Kriedemann PE Plant Growth & Development
Moore TC Biochemistry & Physiology of Hormones
L Taiz& E Zeiger Plant Physiology
BB Buchanan, W Gruissem& Biochemistry and Molecular Biology of Plants
RL Jones MB Wilkins Advanced Plant Physiology
JA Hopkins Introduction to Plant Physiology
FB Salisburry& CW Ross Plant Physiology
Hans-Walter Heldt Plant Biochemistry & Molecular Biology

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PROGRAMME: M.Sc. (BIOCHEMISTRY)SESSION 2020-21 & 21-22

M. Sc. Biochemistry

THIRD SEMESTER (July 2021 – December 2021)

PAPER- III: Nutritional and Environmental Biochemistry

[Credit: 4 and Maximum Marks: 80]

Course Objectives:1. The module is designed to provide information on organic and inorganic content of food stuffs, food preservation techniques and some knowledge on various nutritional disorders.

2. This module will be helpful to develop understanding of Human-environment interactions and consequences of disturbance of the environment.

Course Outcome:

On successful completion of the course, the student shall be able to:

CO1: Explain the basic components of food stuff and balance diet.

CO2: Summarize the dietary component and body electrolytes.

CO3: Recognize the food vitamins and minerals with nutritional disorder.

CO4: Distinguish the effect of toxic substances on environment.

CO5: Interpret the effect of toxic chemicals on body parts and their cure.

UNIT-I Composition of balanced vegetarian and non-vegetarian diets; recommended dietary allowance (RDA) for different categories of the human beings.Food preservation standards, food adulterations and precautions, government regulations on preservation and quality of food.Food processing and loss of nutrients during processing and cooking.

Basal metabolism and methods of measuring basal metabolic rate (BMR); energy requirements during growth, pregnancy, lactation and various physical activities.

UNIT- II Nutritional aspects of the carbohydrates, lipids and protein: nutritive value, requirements, and functions.

Nutritional aspects of the vitamins and minerals: requirement and functions Malnutrition, its implications, relationship with dietary habits and prevention. Disorders related to the nutrition: Protein energy malnutrition, Starvation, Obesity.

UNIT- III

Environmental Pollution: Types, Outdoor and indoor Air pollution, sources, structure and control strategies. Water and Soil Pollution.Eco–toxicology and its environmental significance.Xenobiotic metabolism, Phase I reaction – oxidation – reduction, hydrolysis and hydration. Phase II reaction – conjugation and methylation.

UNIT- IV

Pesticide toxicity – insecticides, fungicides, herbicides and biopesticides.Toxicology of food additives.Metal toxicity – arsenic, mercury, lead and cadmium. Toxicity testing – Test control, genetic toxicity testing. Occupational toxicology: Occupational hazards and their assessment.

Pattern of Question Paper

Section	Type of Question	Word Limit	No. of Questions	Marks in each question	Marks in Question
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Section B	Short Answer Type	75-100 words	4 (From Each Unit with internal Choice)	6	24
Section C	Long Answer Type	250- 300 Words	4 (From Each Unit with internal Choice)	12	48
Total Marks					**80**

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PROGRAMME: M.Sc. (BIOCHEMISTRY)SESSION 2020-21 & 21-22

Lab Course

Course Objectives: The module is designed to provide detailed techniques about estimation of vitamins and minerals in food products and also to analyze the microbial content of domestic and industrial effluents.

Course Outcome: On successful completion of the course, the student shall be able to:

CO1: Analyze the contents of mineral and vitamin in food samples.

CO2: Analyze the chemical and microbial contents in various effluents.

CO3: Demonstrate TLC for different food components.

CO4: Analyze the adulterants present in food samples.

Exercises:

1. Separation and purification of sub-cellular organelles and assay of marker enzymes.
2. Protein fractionation - salt, solvent and isoelectric precipitation.
3. Identification and assay of certain toxicants.
4. Effect of various toxicants on serum enzymes and proteins
5. Effect of various toxicants on liver and kidney metabolism
6. Estimation of carbohydrate, protein and fat in food materials.
7. Titrimetric method of ascorbic acid estimation in fruit.
8. Separation of casein protein from milk

Books Recommended:

LG Corkerhem and BSS Shane Basic Environmental Toxicology

T Shibamato& L F Bzeidanes Introduction to Food Technology

M. Stipanuk Biochemical, Phys. & Mol. Aspects of Human Nutrition

Tom Brody Nutritional Biochemistry

DA Bender Nutritional Biochemistry of the Vitamins

R.L. Pike and M.L. Brown Nutrition: An integrated approach -

G.P. Talwar Text book of Biochemistry and Human Biology

DWS Wong Mechanism and theory in food chemistry

M.S. Banji N P. Rao& V. Reddy Text book of Human Nutrition

Linten Nutritional Biochemistry and Metabolism

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PROGRAMME: M.Sc. (BIOCHEMISTRY)SESSION 2020-21 & 21-22

M. Sc. Biochemistry

THIRD SEMESTER (July 2021 – December 2021)

PAPER - IV: Enzymology [Credit: 4 and Maximum Marks: 80]

Course Objectives: The module is designed to provide introduction & detailed information on structure, biosynthesis and engineering of proteins.

Course Outcome:

On successful completion of the course, the student shall be able to:

CO1: Explain the enzyme classification.
CO2: Interpret the mechanisms of enzyme actions.
CO3: Acquire knowledge of allosteric enzymes and their kinetics.
CO4: Analyze the thermodynamics of enzyme substrate reactions.
CO5: Outline the knowledge of enzyme action, isolation and purification techniques.

UNIT-I Isolation and purification of enzymes. General properties and effects of pH, substrate and temperature on enzyme catalyzed reactions. Kinetics of catalyzed reaction: Single substrate reactions, bisubstrate reactions, concept of Michaelis - Menten, Briggs Haldane relationship, Determination and significance of kinetic constants, Limitations of Michaelis-Menten Kinetics, Concept of convergent and divergent evolution of enzyme. Methods of examining enzyme – substrate complexes

UNIT-II Enzyme Turnover and methods employed to measure turnover of enzymes, significance of enzyme turnover.

Protein – ligand binding, including measurement, analysis of binding isotherms, cooperativity phenomenon, Hill and Scatchard plots. Multienzymesystem : occurrence , isolation & their properties , mechanism of action &regulation;Pyruvate dehydrogenase complex, fatty acid synthetase complexes. Mechanism of action of lysozyme, chymotrypsin, carboxypeptidase and DNA polymease

UNIT-III General mechanisms of enzyme regulation, Allosteric enzymes, sigmoidal kinetics and their physiological significance, symmetrical and sequential modes for action of allosteric enzymes and their significance.Water soluble enzymes and their coenzymes.Metallo enzymes.Immobilized enzymes and their industrial applications. Enzyme modeling; WHATIF, Verify3d, PROSA and DOPE score

UNIT-IV Enzymes of Industrial Importance; their source, characteristic properties, functions and uses. Enzymes used in leather, paper, and textile industries. Enzymes in baking, brewing, Alcohol products; enzymes in detergents, starch and animal feeds. Amylases, cellulases, catalase, pectinase, lipase, protease, xylanase, laccase, beta glucanase.

Pattern of Question Paper

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			Total Marks		**80**

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Lab Course

Course Objective: This module is a general introduction to different analytical techniques involved in assessment of some specific enzymes of our body.

Course Outcome:

On successful completion of the course, the student shall be able to:

CO1: Illustrate the kinetics of a specific enzyme involved in a metabolic activity of human body
CO2: Identify the optimum pH and temperature of an enzyme
CO3: Interpret the enzyme inhibition by various factors
CO4: Illustrate the enzymatic activity

Exercise:

1. Estimation of enzymes
2. Separation, purification of sub-cellular organelles & assay of marker enzymes.
3. Methods of purification of an enzyme - ion-exchange, gel filtration
4. Test of homogeneity by SDS-PAG E
5. Kinetics of an enzymatic reaction
6. Effect of various toxicants on serum enzymes and proteins
7. Enzyme modeling: Validation Criteria by WHATIF, Verify3d, PROSA and DOPE score
8. Verification of Ramachandran Plot: Estimation of interaction energy per residue by PROSA and Verify3D.
9. Enzyme packing quality: Assessed by WHATIF.

Books Recommended:

Brandon and Tooze Introduction to Protein Structure
Campell Discovering Genomics, Proteomics and Bioinformatics,
Dan Gusfield Algorithms on Strings Trees and Sequences
Lesk, A.M Introduction to Protein Architecture
Mcpherson, A. Introduction of Molecular Crystallography
Pennington Proteomics from Protein Sequence to Function
Durbin, Eddy, Anders & Graeme Biological Seq. Analysis: Probabilistic Models of Proteins & Nucleic Acids
S.A. Bbernhard The structure and function of enzymes
J. Palmer Enzymes: biochemistry, Biotechnology, Clinical chemistry

Name and Signature	(Professor Science Faculty Other Dept.)
Chairperson /H.O.D 27/01/21	
Subject Expert ..... (University Nominee) 27/01/21	Sadhana
Subject Expert (Academic Council) 1. ..... 27/1/21 2.	Deepak
Representative..... (Industry)	
Representative..... (Alumni) Thakur	

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M. Sc. Biochemistry
FOURTH SEMESTER (January 2022 – June 2022)
PAPER – I: Plant Biotechnology [Credit: 4 and Maximum Marks: 80]

Course Objective: This module will help to understand production of plats in the lab, production of high quality seeds, plants and plant products, engineering with plant genome.

Course Outcomes (COs)

On successful completion of the course, the student shall be able to:

CO.1 – Requirement and essentials of a plant tissue culture laboratory.
CO.2 –Skilled with plant tissue culture laboratory.
CO.3 – Socially aware with hybrid and indigenous verity and quality of plant based foods.
CO.4 – understand research area and research possibility towards plant science.
CO.5 – Apply plant tissue culture and its importance in various fields for development of new crops.

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 & establishment of 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 & homozygous lines.Protoplast isolation, culture and fusion; selection of hybrid cells and regeneration of hybrid plants; symmetric and asymmetric hybrids, cybrids.Germplasm conservation: Cryopreservation & slow growth cultures. Chloroplast Transformation: Advantages, vectors, success; tobacco & 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.

Pattern of Question Paper

Section	Type of Question	Word Limit	No. of Questions	Marks in each question	Marks in Question
Section A	Objective Type/MCQ	-	8 (Two From Each Unit)	1	8
Section B	Short Answer Type	75-100 words	4 (From Each Unit with internal Choice)	6	24
Section C	Long Answer Type	250-300 Words	4 (From Each Unit with internal Choice)	12	48
				Total Marks	80

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PROGRAMME: M.Sc. (BIOCHEMISTRY)SESSION 2020-21 & 21-22

Lab Course

Course Objective: This module will help to understand production of plats in the lab, production of high quality seeds, plants and plant products, engineering with plant genome.

Course Outcomes (COs)

On successful completion of the course, the student shall be able to:

CO.1 – Skilled with plant tissue culture laboratory.

Experiments:

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 another culture development.
8. Study of molecular markers.
9. Extraction of DNA from plant cultures.
10. Estimation & separation of DNA: Agarose gel electrophoresis & spectrophotometer.

Books Recommended:

Razdan MK Introduction to Plant Tissue Culture

Vasil IK Plant Cell and Tissue Culture

Bhojwani SS and Razdan MK Plant Tissue Culture

Singh BD Biotechnology: Expanding Horizons

RH Smith Plant Tissue Culture Techniques and Experiments

L Kyte and J Kleyn Plants from Test Tubes: An Introduction to Micropropagation

M Smith Plant Propagator's Bible

MR AhujaMicropropagation of Woody Plants

YPS Bajaj Trees III

YPS Bajaj Trees IV

Name and Signature	(Professor Science Faculty Other Dept.)
Chairperson /H.O.D 24/01/2021	
Subject Expert ..... (University Nominee) 27/01/21	Sadhana
Subject Expert (Academic Council) . 1. ..... 27/1/21 2.	
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Representative..... (Alumni)	

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M. Sc. Biochemistry

FOURTH SEMESTER (January 2022 – June 2022)

PAPER- II: Nutraceutical Biochemistry and Functional Foods

[Credit: 4 and Maximum Marks: 80]

Course objectives:

i) provide basic knowledge on nutraceuticals/bioactive compounds (e.g. carotenoids, glucosinolates, and polyphenols);

ii) Familiarize students with the scientific evidence about the role of diet and dietary components in the modulation of risk factors associated with chronic diseases (e.g cardiovascular diseases) and human health;

iii) Enable students to understand the concept of functional foods and their role in the human health and well-being.

Course outcomes:

On successful completion of the course, the student shall be able to:

CO1: basic knowledge on the nutraceuticals in the context of the human well-being.

CO2: Equipped with knowledge necessary to understand the diet-health relationships and the importance of human evidence-based nutrition.

CO3: Learn the regulatory aspects of functional foods and the requirements for safety and efficacy assessment of nutraceutical and functional food.

CO4: Perspectives about the application of biotechnology for improving the formulation of potential functional ingredients/foods will be mastered.

Unit-I: Introduction to Nutraceuticals as Science:

Historical perspective, classification, scope and future prospects.Scrutinising the term 'nutraceutical', Regulation of various countries. Medicinal Plants: Ethnomedicine in India, Applied aspects of the Nutraceutical Science. Sources of Nutraceuticals. Relation of Nutraceutical Science with other Sciences: Medicine, Human physiology, genetics, food technology, chemistry and nutrition

Unit-II: Properties, structure and functions of various Nutraceuticals:

Glucosamine, Octacosanol, Lycopene, Falvanoids, Carnitine, Melatonin and Ornithine alpha, ketoglutarate.Use of proanthocyanidins, grape products, flaxseed oil as Nutraceuticals.Nutraceutical Industry and Market Information, New technologies in development of Nutraceuticals and functional foods Functional Foods, Scope of Genetic engineering, Nutritional Genomics

Unit-III: Food as remedies

Nutraceuticals bridging the gap between food and drug, Special Dietary Needs, Disease and Nutrition; Nutraceuticals in treatment for cognitive decline, Nutraceutical remedies for common disorders like Arthritis, Bronchitis, circulatory problems, hypoglycemia, Nephrological disorders, Liver disorders, Osteoporosis, Psoriasis and Ulcers etc. Brief idea about some Nutraceutical rich supplements e.g. Bee pollen, Caffeine, Green tea, Lecithin, Mushroom extract, Chlorophyll, Kelp and Spirulina etc.

Unit-IV: Anti-nutritional Factors present in Foods

Types of inhibitors present in various foods and how they can be inactivated. General idea about role of Probiotics and Prebiotics as nutraceuticals. Recent advances in techniques & feeding of substrates. Assessment of nutritional status and Recommended Daily allowances.

Pattern of Question Paper

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Section C	Long Answer Type	250- 300 Words	4 (From Each Unit with internal Choice)	12	48
Total Marks					**80**

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PROGRAMME: M.Sc. (BIOCHEMISTRY)SESSION 2020-21 & 21-22

Lab Course

Course outcomes:

On successful completion of the course, the student shall be able to:

CO1: Student will be skilled with basic Research on bioactive compounds.

Experiments:

Identification using characteristic features of nutracuetically important plants like; *Phyllanthusemblica, Curcuma longa, Zinziberofficinalis*, Solanaceae (*Withanlasomnifera), Aloe vera*, Lilliaceae (*Aliumsativum*), Lamiaceae (*Ocimum sanctum*), Apiaceae (*Coriandrumsps*) and Liliaceae (*Asparagus sps.*), *Centellaasiatica*.

Study of following Parasites/ Vectors/ pests: Identification, Habits and control measures (museum Specimens / slides): *Entamoebahistolytica, Taeniasps, Ascarislumbricoides, Ancylostomadueodenaei, Trichinellaspiralis, Trichuratrichuris,* Mosquito (*Culex and Anopheles*), House fly, Green bottle fly, Head Louse, Cockroach (*Periplanata&Blatta*), bed bug, *Mussps.* (Mouse) and *Rattus*sps. (House rat)

Reactions of mono, di and polysaccharides and their identification in unknown mixtures

Determination of Acid value, Saponification and Iodine number of natural fats & oils.

Estimation of proteins with Bradford's and other methods.

Extraction and estimation of total sugars from food products (dairy product, fruit juices, bread).

TLC separation of Plant pigments – Curcumin and carotene.

To isolate DNA and RNA from given plant/ animal material and estimate DNA by Diphenylamine (DPA) method and RNA by Orcinol reagent

Extraction, purification and evaluation of activity of any one digestive enzyme (e.g. Beta amylase from sweet potato)

Estimation of ascorbic acid from lemon &amla juice by titration method

Estimation of total Nitrogen of foods by Kjeldahl and Micro Kjeldahl methods.

Chromatography: Paper, TLC, adsorption, ion exchange, gel filtration, affinity, GC & HPLC.

Separation of Milk proteins on Native and SDS gels.

Books Recommended:

1. Stryer E.A., Biochemistry
2. Zubay, Geoffrey L. Biochemistry,
3. Greenberg David M. Metabolic Pathways, Vol 3 Todd and others, Clinical Diagnosis and Management, 17th Ed,
4. Gopalan C., et al Dietary Allowances for Indians, NIH, Hyderabad.
5. Anita F.P. Clinical Dietetics and Nutrition, 4th Ed, 1997,
6. Devlin, T.M. Text Book of Biochemistry with Clinical Correlation,
7. Mahan, L.K. &Ecott- Stump, S. [Ed.] Krause's Food, Nutrition and Diet Therapy
8. Lehninger Nutrition Concepts & Controversies,
9. W. Jeffrey, Hursts Methods of Analysis for Functional Foods and Nutraceuticals

Name and Signature	(Professor Science Faculty Other Dept.)
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Subject Expert (Academic Council) 1.	
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Representative (Alumni).....	

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PROGRAMME: M.Sc. (BIOCHEMISTRY)SESSION 2020-21 & 21-22

M. Sc. Biochemistry

FOURTH SEMESTER (January 2022 – June 2022)

Special Paper PAPER - III (A): Clinical Biochemistry and Endocrinology

[Credit: 4 and Maximum Marks: 80]

Course Objective: The module is designed to provide introduction & detailed information on the basics of pathological conditions arising in body and the basic concepts of hormones and their functions.

Course Outcome:

On successful completion of the course, the student shall be able to

CO1: Infer the inheritance pattern of several genetic disorder

CO2: Explain pathophysiology of disease processes and their correlation in the study of body functions.

CO3: Analyze the importance of clinically significant enzymes in disease

CO.4 – Explain the PTH, Vitamin D, calcitonin, mechanism of Ca2+ regulation and pathway as well as thepathophysiology of the parathyroid gland:

CO.5 – Describe the regulations, physiological and biochemical actions as well as the pathophysiology of pancreatic and GI tract hormones.

CO.6 – Describe the physiological and biochemical actions as well as endocrine disorders of hypothalamic hormones and pituitary hormones.

UNIT-I Plasma proteins – Properties, functions and their variations in diseases, Plasma lipids and lipoproteins, Interrelationship of lipids, lipoproteins and apolipoproteins.Erythropoiesis, abnormalities in blood formation.Anemias.Heamoglobinopathies.Cerebrospinal fluid – composition in health and diseases. Clinical enzymology - Plasma enzymes in diagnosis and prognosis, Isoenzymes in health and diseases (Liver, cardiac and skeletal muscle enzymes)

UNIT-II Liver function tests, their significance, Liver diseases – Jaundice, hepatitis, gall stones, cirrhosis and fatty liver. Free radical mechanism and role of reactive oxygen species in diseases. Role of liver in metabolic regulation and drug metabolism.Clinical chemistry of new born.Kidney – Renal hormones –Renin, erythropoietin and angiotensin.Investigations of renal functions, biochemical investigation of renal disorders.Nephritis, nephrotic syndrome and urolithiasis.Compensatory mechanism for acidosis and alkalosis.Gastrointestinal hormones - Gastrin, secretin and cholecystokinin.Disorders of gastric function, methods of evaluation.Pancreatic exocrine secretions, pancreatic diseases, steatorrhoea.Malabsorption syndrome – tests for their evaluation and significance.

UNIT-III Pancreatic hormones – Biosynthesis of insulin, regulation of secretion of insulin and glucagon, their role in carbohydrate ,lipid and protein metabolism. Endocrine disorders of pancreas – Diabetes mellitus, melliturias, hypoglycemia.Glucose tolerance test.Thyroidal hormones – Chemistry, function and metabolism. Hypo and hyper thyroidism, tests for thyroid function. Parathyroid hormones – Parathormone and calcitonin, their role in calcium and phosphate metabolism, abnormalities of parathyroid functions and methods of evaluation. Adrenals - Chemistry and biosynthesis of adrenal medullary and adrenal cortical hormones .Disorders of adrenal cortex and adrenal medulla, tests for the evaluation of adrenal functions. Biochemical effects of tumours.

UNIT-IV Synthesis, secretion, transport and biological actions of hypothalamic, adenohypophysial and neurohypophysial hormones. Hypothalamic disorders. Pituitary - Clinical syndromes and their evaluation. Penial hormones – Melatonin and serotonin.Chemistry, biosynthesis and role of androgens, estrogens and progesterone.Hormonal regulation of menstrual cycle, Hormonal contraception.Placental hormones.Biochemistry of reproductive disorders, pregnancy toxemia, pregnancy tests.

Pattern of Question Paper

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Section B	Short Answer Type	75-100 words	4 (From Each Unit with internal Choice)	6	24
Section C	Long Answer Type	250- 300 Words	4 (From Each Unit with internal Choice)	12	48
				Total Marks	80

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Lab Course

Course Objective: The module is designed to provide introduction & detailed information on some basic diagnostic techniques and quantification of biochemical and physiological effects of all hormones and factors on cells and tissues.

Course Outcomes (COs)

On successful completion of the course, the student shall be able to:

CO1: Analyze the protein content in normal and diseased samples
CO2: Analyze the sugar content in normal and diseased samples
CO3: Analyze the various metabolites present in human.
CO. 4- Demonstrate glucose tolerance test.
CO. 5- Illustrate various important ions of different samples.
CO. 6- Illustrate thyroid hormones in blood sample.

Exercises:

1. Assay of Alkaline and Acid Phosphates
2. Estimation of blood glucose by GOD and POD method
3. Various types of glucose tolerance tests.
4. Estimation of SGOT, SGPT, LDH and CPK, Serum Amylase enzymes
5. Estimation of HDL- cholesterol, LDL- cholesterol.
6. Estimation of uric acid and creatinine in plasma.
7. Estimation of urine and blood billurubin.
8.. Histological / Histochemical / Cytological study of Endocrine gland

Books Recommended:

1. Experimental Endocrinology: Zarrow, M.X; Yochin, J.M and Machrth, J.I
2. Essential techniques in reproductive physiology and Endocrinology: Chinoy, N.J, Rao, M.V, Desarai, K.J and High land, H.N
3. Biochemistry: L. Stryer
4. Textbook of Biochemistry with Clinical Correlations: T.M. Devlin
5. Lippincott's Illustrated Reviews in Biochemistry: P.C.Champe, R.A.Harvey and D.R.Ferrier
6. Harper's Biochemistry: R.K.Murray, D.K.Granner, P.A. Mayes and V.W.Rodwell.
7. Clinical Laboratory Science Review: Robert R. Harr
8. Fundamentals of Clinical Chemistry: C.A. Burtis, E.R. AshwoodTietz
9. Notes on Clinical Chemistry- Principles of Internal Medicines: Whitby, Smith, Beckett, Walker, Harrison

Name and Signature	(Professor Science Faculty Other Dept.)
Chairperson /H.O.D 27/01/2021	
Subject Expert ..... (University Nominee) 27/01/21	Sadhana
Subject Expert (Academic Council) 1. ..... 27/1/21 2.	Deepa
Representative..... (Industry)	
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PROGRAMME: M.Sc. (BIOCHEMISTRY)SESSION 2020-21 & 21-22

M. Sc. Biochemistry

FOURTH SEMESTER (January 2022 – June 2022)

Special Paper: PAPER- III (B): Seed Science Technology [Credit: 4 and Maximum Marks: 80]

Course Objective:

1. To impart basic knowledge of seed development and its structures.
2. To appraise students with its relevance to production of quality seed.

Course Outcomes (COs)

On successful completion of the course, the student shall be able to:

CO1: Learn the meaning of seed, its structure, development and maturation and their importance in crop production.

CO2: students will acquire knowledge and basic principles related to quality seedproduction of varieties and hybrids in agricultural and horticultural crops.

CO3: To promulgate knowledge about mechanism involved in dormancy and stressmanagement for quality seed production.

CO4: To initiate basic methods and principle related to seed quality testing and seedstandardsCO5: To disseminate the knowledge on seed laws related to quality control programme forthe needy fast growing seed sector.

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, Vitrification, Encapsulation and Drying.Synthetic seeds.

Pattern of Question Paper

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Total Marks					80

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Lab Course

Course Objective:
To appraise students with its relevance to production of quality seed.

Course Outcomes (COs)
On successful completion of the course, the student shall be able to:
CO1: To set forth basic knowledge on various processing operations and principles involved in successful seed storage.
CO2: To encourage the students to become an entrepreneurship in seed production & seed business.

Exercise:
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) triphenyltetrazolium 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.

Books Recommended:
J.D. Bewley& M. Black Physiology & Biochemistry of Seeds
J.D. Bewley& M. Black Seeds: Physiology of Development & Germination
Black et al. Desiccation and Survival of Plants: Dying without Drying
P.K. Agrawal& M. Dadlani Techniques in Seed Science & Technology
FAO Report 113 Ex-situ storage of seeds, pollen & in-vitro cultures
Copeland & McDonald Seed Science & Technology
R.L. Agrawal Seed Technology

Name and Signature	(Professor Science Faculty Other Dept.)
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M. Sc. Biochemistry

FOURTH SEMESTER (January 2022 – June 2022)

Special Paper: PAPER- IV (A): Advanced Immunology, diagnostics and prophylaxis

[Credit: 4 and Maximum Marks: 80]

Course Objective: This module is a general introduction to the basic concepts of immunity of the body and how itworks. The module also gives insight to importance of immunity.

Course Outcomes (COs):

On successful completion of the course, the student shall be able to:

CO.1 – Describe cells and organs of the immune system.

CO.2 – Explain innate immunity, cell adhesion molecules, cytokines and complement system.

CO.3 – Describe the structure of antibody, B-cell development, receptor diversity and humoral immune response.

CO.4 – Explain the T-cell biology and MHC restriction.

CO.5 – Describe mucosal immune system.

UNIT- I Clonal selection theory- concept of antigen specific receptor.Organization and expression of immunoglobulin genes.Generation of antibody diversity.Light and heavy chain gene recombination. Recombination Signal Sequences. Heavy chain constant region genes.Class switching.T-cell receptor diversity.

UNIT-II Membrane and secreted immunoglobulins. Production of polyclonal and monoclonal antibodies- principle, technique and applications.Antibody engineering.Regulation of immune response by antigen, antibody, immune complex, MHC and cytokines. Immune response to infectious diseases: viral, bacterial and protozoal. Cancer and immune system.Nutrition and Immune response.

UNIT-III Principles of Immunodiagnosis.Antigen-antibody interactions.Precipitation reactions.Haemagglutination.Complement fixation test. Immunofluorescence assay: Fluorescence activated cell sorter (FACS) technique. Radio Immuno and Enzyme Immuno assays. Immunoblotting.Isolation of pure antibodies.Isolation of leucocyte population on density gradient. Effector cell assays. Plaque forming cell assay, ELISPOT assay, leucocyte migration inhibition technique, cytotoxicity assay.

UNIT-IV Active immunization (immunoprophylaxis): Principles of vaccination. Immunization practices. Passive immunization (immunotherapy). Role of vaccine in prevention of diseases: vaccines against important viral, bacterial, protozoan and parasitic diseases. DNA vaccines; Antiviral, antibacterial agents.

Pattern of Question Paper

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Section C	Long Answer Type	250- 300 Words	4 (From Each Unit with internal Choice)	12	48
Total Marks					**80**

27/1/21 41

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PROGRAMME: M.Sc. (BIOCHEMISTRY)SESSION 2020-21 & 21-22

Lab Course

Course Outcomes (COs)

On successful completion of the course, the student shall be able to:

CO.1 – Apply the isolation of blood cells from various samples or tissues.
CO.2 – Demonstrate purification process of antibodies from various types of sample.
CO.3 – Analyze precipitation reaction by different methods.
CO.4 – Examine the agglutination reactions by different methods.
CO.5 – Examine the reaction of antigen –antibody.
CO.6 – Analyze Immunodiffusion reaction by various methods.

Experiments:-

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 & EIA
4. Western Blot Analysis
5. Immunodiagnosis using commercial kits

Books Recommended:

R.A. Goldsby, T.J Kindt& B. A. 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

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M. Sc. Biochemistry
FOURTH SEMESTER (January 2022 – June 2022)
Special Paper: PAPER- IV (B): Bioinformatics
[Credit: 4 and Maximum Marks: 80]

Course Objectives: The module is designed to provide introduction & detailed information on storing, retrieving, analyzing biological data in silico.

Course Outcomes (COs)

On successful completion of the course, the student shall be able to:

CO1: Discuss the various databases and GenBank used in storing biological data.
CO2: Identify the basic concepts of sequence similarity by BLAST and FASTA algorithms.
CO3: Explain the phylogenetic analysis and various genome projects.
CO4: Apply the techniques for the protein structure prediction.
CO5: Summarize the cheminformatics and medicinal chemistry.

Unit I Introduction to bioinformatics and data generation

Bioinformatics and its relation with molecular biology. Examples of related tools (FASTA, BLAST, BLAT, RASMOL), databases (GENBANK, Pub med, PDB) and software (RASMOL, Ligand Explorer). Data generation; Generation of large scale molecular biology data. (Through Genome sequencing, Protein sequencing, Gel electrophoresis, NMR Spectroscopy, X-Ray Diffraction, and microarray). Applications of Bioinformatics.

Unit II Biological Database and its Types

Introduction to data types and Source.Population and sample.Classification and Presentation of Data.Quality of data, private and public data sources.General Introduction of Biological Databases; Nucleic acid databases (NCBI, DDBJ, and EMBL). Protein databases (Primary, Composite, and Secondary). Specialized Genome databases: (SGD, TIGR, and ACeDB). Structure databases (CATH, SCOP, and PDB sum)

Unit III Data storage and retrieval and Interoperability

Flat files, relational, object oriented databases and controlled vocabularies. File Format (Genbank, DDBJ, FASTA, PDB, SwissProt). Introduction to Metadata and search; Indices, Boolean, Fuzzy, Neighboring search.Data exchange and integration. Ontologies, interchange languages and standardization efforts. General Introduction to XML, UMLS, CORBA, PYTHON and OMG/LIFESCIENCE.

Unit IV Gene Expression and Representation of patterns and relationship

General introduction to Gene expression in prokaryotes and eukaryotes, transcription factors binding sites. SNP, EST, STS. Regular Expression, Hierarchies, and Graphical models (including Marcov chain and Bayes notes).Genetic variability and connections to clinical data.

Pattern of Question Paper

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Lab Course

Course Objectives: The module is designed to provide a detailed knowledge of online databases available and functioning of all the software to study the bio molecules of life.

Course Outcomes (COs):

On successful completion of the course, the student shall be able to:

CO1: Demonstrate the use of databases.
CO2: Demonstrate the gene and protein sequence retrieval techniques.
CO3: Produce novel DNA and protein structures to be used in therapeutics.
CO4: Perform phylogenetic studies to establish the relationship between two genomes.

Exercises:

01. Retrieval of sequences from NCBI, EBI and EMBL databases.
02. Retrieval of sequences from NBRF-PIR, SWISSPROT and P databases.
03. Transition and Translation of sequences.
04. Retrieval of genome from genome databases.
05. Exploring DIP and PPI.
06. Exploring BIND and PIM.
07. Exploring MINT and GRID.
08. Analysis of phylogenetic tree
09. Exploring PDB file.
10. Analysis of active site by pymol

Books Recommended:

BAXEVANIS, AD & OUELLETTE, BFF : Bioinformatics: a practical guide to the analysis of genes and proteins. 2nd Ed.. 2002.
BAXEVANIS, AD, DAVISON, DB, PAGE: Current protocols in bioinformatics. 2004.
RDM & PETSKO, GA ORENGO, C, JONES, D & : Bioinformatics: genes, proteins and computers. 2003
THORNTON, J Ingvar Eidhammer, Ingejonassen, : Protein Bioinformatics. 2003
William R Taylor HIGGINS, D & TAYLOR, W : Bioinformatics: sequence, structure, and databank. 2000.
David Mount: Bioinformatics: sequence and genome analysis. 2004

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