Bharatiya Vidya Bhavan

BHAVAN'S VIVEKANANDA COLLEGE
OF SCIENCE, HUMANITIES & COMMERCE
Sainikpuri, Secunderabad – 500094
Autonomous College - Affiliated to Osmania University
(Reaccredited with 'A' grade by NAAC)

Department of Biochemistry & Nutrition

PROGRAM NAME: M.Sc. BIOCHEMISTRY (Academic year 2023-24)

		SEMESTER I						
PAPERS	Code	TITLE	Course Type	Teaching hrs/week	Credits	Internal marks	Final exam marks	Total
			Theory					
1	BI101	Chemistry of Biomolecules	DSC	3	3	30	70	100
2	BI102	Endocrine biochemistry, Vitamins and Nucleic Acids	DSC	3	3	30	70	100
3	BI103	Cell biology and Bioenergetics	DSC	3	3	30	70	100
4	BI104	Basic Bio-Analytical Techniques	DSC	3	3	30	70	100
			Practicals					
5	BI 101P	Chemistry of Biomolecules		4	2	--	50	50
6	BI 102P	Endocrine biochemistry, Vitamins and Nucleic Acids		4	2	--	50	50
7	BI103P	Cell biology and Bioenergetics		4	2	--	50	50
8	BI104P	Basic Bio-Analytical Techniques		4	2	--	50	50
	Total			**28**	**20**	**120**	**480**	**600**

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Department of Biochemistry& Nutrition

PROGRAM NAME: M.Sc. BIOCHEMISTRY (Academic year 2023-24)

COURSE NAME: CHEMISTRY OF BIOMOLECULES

PAPER CODE: BI101 **PPW: 3**
YEAR/SEMESTER: I/I **NO OF CREDITS: 3**

COURSE OBJECTIVE: To explain the chemistry of proteins, lipids and porphyrins.

CREDITWISE COURSE OBJECTIVES:

COb1 To describe the structure, classification and properties of amino acids and proteins.
COb2 To describe structure, classification and properties of carbohydrates.
COb3 To explain the structure, classification and properties of lipids and porphyrins.

CREDIT 1 Aminoacids and Proteins **15h**

1. Classification and structure of aminoacids
2. Essential, non - essential, and non - protein or unusual amino acid.
3. General Properties and Acid- Base Reactions of AA, (pKa Values)
4. Peptide bond - stability and formation, polypeptides.
5. Methods for determining amino and carboxy terminal and molecular weight
6. Primary structure of protein
7. Secondary structure α helix, βsheet, 3_{10}helix
8. GN Ramachandran plots. *Phi, Psi and omega angle*
9. Tertiary & Quarternary structure (myoglobin, hemoglobin)
10. Small peptides (glutathione, peptide hormones)
11. Cyclic peptides (Gramicidin)
12. Classification of proteins - globular, fibrous,
13. Membrane, Metallo - proteins, SCOP,CATH
14. Denaturation (pH, temperature, chaotropic agents), Renaturation
15. Protein folding, role of Chaperons in folding

A. Lai Das
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CREDIT 2 Carbohydrates **15h**

1. Classifications and structure of Carbohydrates
2. Configurations and conformations
3. Reactions of Monosaccharides
4. Stability and formations of glycosidic bonds
5. Disaccharides and Oligosaccharides
6. Structural Polysaccharides (Cellulose, Chitin, Chitosan)
7. Storage polysaccharides (Starch, Glycogen, Inulin)
8. Hemicelluloses- Lignins, Pectins,
9. Hetero-Polysaccharides /acidic Muco Polysaacharides Glycosaminoglycan
10. Chemistry and biological role of Hyaluronic acids, Chondroitin sulphate,
11. Keratan sulphate, dermatan sulphate, heparin
12. Glycoproteins and Proteoglycans
13. Bacterial cell wall Polysaccharides- Peptidoglycans
14. Blood group substances
15. Structural determinations of polysaccharides

CREDIT 3 Lipids & Porphyrins **15h**

1. Classification of lipids & fatty acids
2. Biological significance of lipids & fatty acids
3. Steroids, Sterols, relation to vitamin D
4. Steroid hormones
5. Bile acids and salts
6. Phospholipids
7. Oils, waxes, isoprene units
8. Lipoproteins
9. Glycolipids
10. Sphingolipids
11. Structure &function of porphyrins: Heme
12. Structure &function of porphyrins: Chlorophyll
13. Cerebrosides, Gangliosides
14. Prostaglandins, Prostacyclins, Eicosanoids
15. Thromboxanes, Leukotrienes

REFERENCES:

1.Lehninger's Principles of Biochemistry, David L. Nelson, Michael M Cox Publisher:W H Freeman.

2.Biochemistry-Jeremy M Berg, John L Tymoczko, and LubertStryer.: W H Freeman

3.Biochemistry,4thEdition-Donald Voet, Judith G. Voet. –Publisher John Wiley & Sons.

COURSE OUTCOMES:

At the end of the course students will be able to:

BI101.CO1 Relate structural organization of aminoacids and proteins with their properties and functions.

BI101.CO2 Differentiate the structural features and properties of various carbohydrates.

BI101.CO3 Associate the different classes of lipids with their tissue distribution.

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PROGRAM NAME: M.Sc. BIOCHEMISTRY (Academic year 2023-24)

COURSE NAME: CHEMISTRY OF BIOMOLECULES

PAPER CODE: BI101P **PPW: 4**
YEAR/SEMESTER: I/I **NO OF CREDITS: 2**

CREDIT WISE COURSE OBJECTIVES
Cob4 To explain the qualitative and quantitative methods for the analysis of amino acids.
Cob5 To describe qualitative and quantitative methods for analysis of lipids

CREDIT 4 Aminoacid analysis **30h**

1. Qualitative analysis of amino acids.
2. Determine pKa and pI of acidic, basic, and neutral amino acids.
3. Estimation of amino acids by Ninhydrin method.
4. Quantification of glycine by formal titration.
5. Estimation of tryptophan by Spies and Chambers method

CREDIT 5 Lipid analysis **30h**

1. Qualitative analysis of lipids.
2. Saponification value of fats.
3. Iodine number of oil.
4. Peroxide value of fats.
5. Acid value of fats.

At the end of the course students will be able to:

BI101P.CO4 Analyze amino acids and proteins qualitatively and quantitatively in research labs/industries.
BI101P.CO5 Apply the knowledge of qualitative and quantitative analysis of lipids from various samples in research/industry.

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Department of Biochemistry & Nutrition

PROGRAM NAME: M.Sc. BIOCHEMISTRY (Academic year 2023-24)

COURSE NAME: ENDOCRINE BIOCHEMISTRY, VITAMINS AND NUCLEIC ACIDS

PAPER CODE: BI102 **PPW: 3**
YEAR/SEMESTER: I/I **NO.OF CREDITS: 3**

COURSE OBJECTIVE: To understand the physiology of endocrine system, structural features, types and properties of carbohydrates, nucleic acids and vitamins.

CREDIT-WISE COURSE OBJECTIVES:
COb1 To outline the organization, chemistry, mechanism of action and physiological functions of endocrine system.
COb2 To explain the importance of vitamins in human health.
COb3 To discuss the structural features of nucleic acids.

CREDIT 1 Endocrine system **15h**

1. Endocrine glands Types and secretion of hormones
2. Control of hormone secretion
3. Mechanism of hormone action
4. Pituitary gland: Structure, Anterior Pituitary: hormones secreted and functions
5. Posterior Pituitary- Hormones secreted and their functions
6. Disorders related to pituitary hormones
7. Thyroid gland and Parathyroid gland: Structure and functions
8. Disorders: hypothyroidism, hyperthyroidism
9. Parathormone and associated disorders
10. Adrenal gland: Structure
11. Secretions of adrenal cortex and their functions, hypoadrenalism, hyperadrenalism
12. Secretions of adrenal medulla and their functions
13. Pancreas: Islets of Langerhans, alpha and beta cells
14. Functions of Insulin and glucagon, deficiency of insulin
15. Testes and Ovaries Structure, Functions of testosterone, estrogens and progesterone

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CREDIT 2: Vitamins **15h**

1. Water Soluble Vitamins; Structure and Classifications
2. Water Soluble Vitamins: Chemistry, Biological Source and physiological significance
3. Fat Soluble Vitamins: Structure and Classification
4. Fat Soluble Vitamins: Chemistry, Biological Source and Significance
5. Structure, function and the deficiency disorder of Vit Bl (Thiamine), B2 (Riboflavin)
6. Structure, function and the deficiency disorder of B3 (Niacin) and Vit B5 (Pantothenic acid)
7. Structure, function and the deficiency disorder of B6 (Pyridoxine) and B7(Biotin)
8. Structure, function and the deficiency disorder of Vit B9 (Folic acid) and B 12 (Cobalamins)
9. Structure, function and the deficiency disorder of Vit C (Ascorbic acid)
10. Structure, function and the deficiency disorder of Vit A (Retinol)
11. Structure, function and the deficiency disorder of Vit D (Calciferol)
12. Structure, function and the deficiency disorder of Vit E (Tocopherol)
13. Structure, function and the deficiency disorder of Vit K (Phytonadione)
14. Recommended daily allowance of vitamins
15. Vitamin supplementation

CREDIT 3 Chemistry of Nucleic Acids

15h

1. Purines: structure and functions
2. Pyrimidines- structure and functions,
3. Nucleosides, nucleotides, phosphodiester bond
4. Unusual bases, Modified bases: Structure and properties.
5. Structure of DNA – Watson Crick Model, A- and Z- forms.
6. Supercoiling of DNA – negative and positive, linking number.
7. Properties of DNA – denaturation and renaturation
8. T_m (factors affecting T_m) and Cot curves.
9. Structure of mRNA, tRNA
10. Structure of rRNA, siRNA / miRNA.
11. Properties of RNA-denaturation and renaturation
12. Difference between DNA and RNA.
13. Hetero duplex mapping
14. D loops and R loops.
15. Catalytic RNA.

REFERENCES:

1. Lehninger Principles of Biochemistry, David L. Nelson, Michael M. Cox Publisher: W. H. Freeman.
2. Biochemistry-Jeremy M Berg, John L Tymoczko, and LubertStryer.: W H Freeman.
3. Biochemistry, 4th Edition - Donald Voet, Judith G. Voet – Publisher John Wiley & Sons.
4. Principles of Biochemistry: Mammalian Biochemistry: Smith EL, Hill RL, White A, McGraw Hill

COURSE OUTCOMES:

At the end of the course students will be able to:

BI102.CO1 Categorize the types of hormones with their physiology and analyse the process of endocrine regulation.
BI102.CO2 Implement the importance of vitamins in daily health.
BI102.CO3 Distinguish the structural features and properties of nucleic acids.

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PROGRAM NAME: M.Sc. BIOCHEMISTRY (Academic year 2023-24)

COURSE NAME: ENDOCRINE BIOCHEMISTRY, VITAMINS AND NUCLEIC ACIDS

PAPER CODE: BI102P **PPW: 4**
YEAR/SEMESTER: I/I **NO OF CREDITS: 2**

CREDIT WISE COURSE OBJECTIVES
COb4 To explain the qualitative and quantitative methods for the analysis of carbohydrates.
COb5 To explain the qualitative and quantitative methods for analysis of nucleic acids.

CREDIT 4 Carbohydrate analysis **30 h**
1. Qualitative analysis of carbohydrates
2. Quantitative analysis of carbohydrates
3. Estimation of Fructose
4. Estimation of total sugars by phenol sulfuric acid method
5. Estimation of reducing sugars by DNS

CREDIT 5 Nucleic acid analysis **30 h**
1. Estimation of DNA by DPA
2. Assessment of DNA purity by A260/A280 method
3. Estimation of RNA by Orcinol method
4. Separation of purines by paper chromatography
5. Separation of pyrimidines by paper chromatography

COURSE OUTCOMES:
At the end of the course students will be able to:

BI102P.CO4 Apply the knowledge of qualitative and quantitative analysis of carbohydrates from various samples in research/industry.
BI02P.CO5 Identify and analyse nucleic acids qualitatively and quantitatively in molecular biology/ biotech labs or industry.

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PROGRAM NAME: M.Sc. BIOCHEMISTRY (Academic year2023-24)

COURSE NAME: CELL BIOLOGY AND BIOENERGETICS

PAPER CODE: BI103 **PPW: 3**
YEAR/SEMESTER: I/I **NO OF CREDITS: 3**

COURSE OBJECTIVE: To familiarize the students with the concepts of Cell biology, Biomembranes and Bioenergetics.

CREDIT-WISE COURSE OBJECTIVES:

COb1 To describe the structural organization of cells and the process of Cell cycle and apoptosis
COb2 To describe the composition and organization of biomembranes.
COb3 To explain the concepts of thermodynamics and its relevance to biological energy production

CREDIT I Structure of Prokaryotic & Eukaryotic cells **15 h**

l. Classification of prokaryotes and eukaryotes (systems of classification)
2. Ultrastructure of eubacteria, cyanobacteria, mycoplasma
3. Ultra structure of plant cell
4. Ultrastructure of animal cell
5. Composition of cytoskeleton: microfilaments, microtubules, intermediate filaments
6. Function of cytoskeleton
7. Nuclear skeleton: lamina, scaffold
8. Structure of Chromosomes (centromere, telomere, kinetochore)
9. Euchromatins, heterochromatin
10. Formation and structure of special chromosomes (polytene and lampbrush)
11. Cell cycle
12. Mitosis and meiosis
13. Cell cycle check points and regulation
14. Apoptosis
15. Regulation of Apoptosis

CREDIT 2 Biomembranes **l5h**

1. Composition and Structure of Cell membrane
2. Membrane Dynamics

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3. Membrane Lipids: Composition distribution and Functions
4. Membrane Proteins: Composition distribution and Functions
5. Trans - membrane proteins and their classification
6. Methods of detecting Trans membrane proteins, Hydropathy plots
7. Membrane Asymmetry
8. Fluid Mosaic Model of Membrane
9. Membrane fluidity and its regulations, Flip flop.
10. RBC membrane structure.
11. Membrane transport: active and passive transport, symport and antiport; Na^+-K^+ ATPase
12. Transport channels: voltage gated, ion gated and ligand-gated channels
13. Aquaporin, Glucose transporters, Valinomycin: structure and mechanism
14. Artificial membranes; Reconstitution of functional membrane system from purified components
15. Liposomes , Micelles and vesicles

CREDIT 3 Bioenergetics **15 h**

1. Elements of importance in biochemistry (H,C,N,O,P,S), types and energy of bonds and interactions (ionic, covalent, coordinate, H-bonds, van der Waals, hydrophobic interactions).
2. Laws of thermodynamics, Gibbs free energy, relevance of entropy and enthalpy in biological systems and reactions.
3. Thermodynamically coupled reactions
4. Order of the reactions: first and second order reactions
5. Log and lnscales in biological processes (exponential growth curves, radioactive decay)
6. Biological oxidation, Redox potential, Nernst equation
7. Enzymes involved in biological oxidation
8. High energy compounds
9. Oxidative phosphorylation
10. High energy bonds, phosphate potential, Forces stabilizing membrane
11. ETC in mitochondria
12. ETC in Chloroplasts
13. Uncouplers and inhibitors of energy transfer.
14. Shuttle pathways- Glycerol phosphate shuttle, Malate- Aspartate shuttle
15. Biological Fluorescence (GFP and derivatives), Bioluminescence.

REFERENCES:

1. Lehninger Principles of Biochemistry, David L. Nelson, Michael M. Cox Publisher: W. H. Freeman.
2. Biochemistry, 4th Edition - Donald Voet, Judith G. Voet – Publisher John Wiley & Sons
3. Molecular Cell Biology, 4th edition. Harvey Lodish, Arnold Berk, S Lawrence Zipursky, Paul Matsudaira, David Baltimore, and James Darnell. New York: W. H Freeman

COURSE OUTCOMES:

At the end of the course students will be able to:

BI103.CO1 Illustrate the structural organisation of cell
BI103.CO2 Differentiate the structural organization of various biomembranes and membrane transport mechanisms with their functions.
BI103.CO3 Relate the concepts of Thermodynamics to biological oxidation and energy production

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PROGRAM NAME: M.Sc. BIOCHEMISTRY (Academic year 2023-24)

COURSE NAME: CELL BIOLOGY AND BIOENERGETICS

PAPER CODE: BI103P **PPW: 4**
YEAR/SEMESTER: I/I **NO OF CREDITS: 2**

CREDIT- WISE COURSE OBJECTIVES:

COb4 To explain the importance of good laboratory practices, preparation of buffers and titrimetric methods
COb5 To demonstrate bioanalytical techniques for separation of proteins, nucleic acids and subcellular organelles

CREDIT 4 Laboratory maintenance, safety and basic methods **30 h**

1. GLP; Use of balance and pH meter, Lab safety,
2. Calculations and preparation of standard solutions (primary, working standard)
3. Preparation of buffers: Phosphate, Citrate and Tris-buffer
4. Titration: Estimation of Calcium in milk
5. Titration: Estimation of vitamin C in lemon juice

CREDIT 5 Separation and identification of biomolecules **30 h**

1. SDS PAGE for protein
2. Agarose gel for DNA
3. Desalting proteins by dialysis
4. Gel filtration (size exclusion)
5. Cell fractionation (centrifuge)

COURSE OUTCOMES:

At the end of the course students will be able to:
BI103P.CO4 Implement the knowledge of good laboratory practices and select suitable buffers for biochemical experiments and also carry out titrimetric procedures.
BI103P.CO5 Apply different techniques for analysis of biomolecules and cell organelles in biological samples.

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PROGRAM NAME: M.Sc. BIOCHEMISTRY (Academic year 2023-24)

COURSE NAME: BASIC BIOANALYTICAL TECHNIQUES

PAPER CODE: BI104 **PPW: 3**
YEAR/SEMESTER: I/I **NO OF CREDITS: 3**

COURSE OBJECTIVE: To explain the principle, instrumentation and applications of various bio-analytical and cell study techniques.

CREDIT- WISE COURSE OBJECTIVES:

COb1 To familiarize with principle, instrumentation and applications of various spectroscopic techniques and chromatographic techniques
COb2 To explain centrifugation, electrophoresis and tracer techniques with their applications in biology.
COb3 To explain the principles and working of various analytical tools to study cell structure and function.

CREDIT 1 Spectroscopy and Chromatography **15 h**

1. Colorimetry, Beer Lambert's Law-application and limitation, Molar extinction coefficient, Absorption maximum
2. UV - Vis Spectrophotometer - Instrumentation, application
3. Fluorescence Spectroscopy - principle, instrumentation, application
4. Infrared (IR) spectroscopy - principle, instrumentation, application
5. Raman spectroscopy - principle, instrumentation, application
6. CD - and ORD - principle, instrumentation, application
7. Partitioning and counter current distribution;
8. PC and TLC -principle, instrumentation, application
9. GC - principle, instrumentation, application
10. Ion – exchange chromatography - principle, instrumentation, application
11. Gel filtration (Gel exclusion chromatography) - principle, application
12. Affinity chromatography -principle instrumentation, application; immunoprecipitation
13. HPLC and RP-HPLC - principle, instrumentation, application
14. FPLC, LC - principle, instrumentation, application
15. Peptide mapping and N-Terminal sequencing of proteins

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CREDIT 2 Centrifugation, Electrophoresis and Tracer techniques 15h

1. Centrifugation, RCF and types of rotors. Ultra centrifugation - principle, instrumentation, application
2. CsCl density gradient and sucrose gradient centrifugation - principle, application
3. Electrophoresis - moving boundary and zonal electrophoresis, Native and SDS PAGE
4. IEF and 2D PAGE, PAGE for DNA sequencing
5. Agarose Gels, PFGE, Zymography
6. Denaturing gels for RNA, Southern and Northern Blots
7. Western Blot
8. Stable and radioactive isotopes, theory of radioactivity
9. Half life and emission spectra of biologically useful isotopes:^{2}H, ^{3}H, ^{14}C, ^{18}O, ^{32}P, ^{35}S, ^{125}I;
10. Detection of radio activity by Scintillation counting. Autoradiography Isotopes used for labelling proteins, (^{3}H, ^{14}C,^{35}S , ^{125}I) and nucleic acids (^{3}H, ^{32}P)
11. GM counter, gamma counter
12. Fluorography, applications of Phosphor -imaging, luxmetry and chemiluminescence as alternative to radioactivity.
13. Radiation hazards and safe disposal of radioactivity waste
14. Isotope dilution method pulse chase
15. Historic examples -^{14}C and ^{18}O to study photosynthesis: ^{32}P and ^{35}S to study viral replication (Hershey - Chase experiment ^{16}N and ^{15}N in DNA replication Meselson and Stahl experiment)

CREDIT 3 Microscopy and Cell Study 15h

1. Simple and compound microscope.
2. Phase contrast,
3. Dark field and polarization microscopy.
4. Electron microscopy: SEM, freeze fracture.
5. Electron microscopy: TEM
6. Fluorescence microscopy
7. Confocal microscopy, imaging live cells.
8. FRET
9. FRAP
10. Flow-Cytometry and cell sorting (FACS).
11. Cell counting- hemocytometer
12. Plant tissue culture.
13. Animal tissue culture
14. Insect tissue culture.
15. Methods of cell disruption and fractionation, isolation of organelles.

REFERENCES:

1. Principles and Techniques of Practical Biochemistry- Wilson. K. And Walker. J. Pub: Cambridge Press
2. Physical Biochemistry- Friefelder, Publisher D. W.H. Freeman Press
3. Biophysical Chemistry: Principles and Techniques, 2nd edition by A. Upadhyay, K. Upadhyay and N. Nath. Himalaya Publishing House, Delhi.

COURSE OUTCOMES:

At the end of the course students will be able to:

BI104.CO1 Apply relevant spectroscopic and chromatographic methods to study of molecular mass physical and chemical properties biomolecules.
BI104.CO2 design protocol for separating and identifying proteins or nucleic acids using centrifugation, electrophoresis and tracer technique methods.
BI104.CO3 identify suitable methods to study cells.

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PROGRAM NAME: M.Sc. BIOCHEMISTRY (Academic year 2023-24)

COURSE NAME: BASIC BIOANALYTICAL TECHNIQUES

PAPER CODE:BI104P **PPW: 4**
YEAR/SEMESTER: I/I **NO OF CREDITS: 2**

CREDIT WISE COURSE OBJECTIVES

COb4 To explain the quantitative methods for the analysis of amino acids, minerals and proteins.
COb5 To demonstrate chromatographic techniques for separation of biomolecules

CREDIT 4 Quantitation of Biomolecules by Spectroscopy **30 h**
1. Absorption spectrum of tyrosine, determination of molar extinction coefficient
2. Estimation of concentration of biomolecules based on Beer Lambert's Law
3. Estimation of inorganic phosphate by Fiske-Subbarow method
4. Estimation of protein by Biuret method
5. Estimation of protein by Lowry method

CREDIT 5 Separation of Biomolecules by Chromatography **30 h**
1 Separation of plant pigments by paper Chromatography
2. l-D and 2-D paper chromatography of amino acids
3 TLC of plant pigments and lipids
4 Anion/ Cation-exchange capacity of resin
5 Separation of amino acids by ion-exchange chromatography

COURSE OUTCOMES:

At the end of the course students will be able to:

BI104P.CO4 analyse amino acids and proteins quantitatively in research lab and industries.
BI104P.CO5 apply different chromatographic techniques for separation of biomolecules in biological samples in industries and research labs

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