Department of Biochemistry, UCS, Osmania University

Approved MSc. Biochemistry CBCS Syllabus

(Effective from 2022-23 admitted batch)

SEMESTER-I

PAPER	TITLE	Credits*	hrs/ week	Internal marks(Theory)	Final exam marks(Theory)	Practical exam marks
I	**BI101:** Chemistry of Biomolecules (core)	**5 (3T+2P)**	**7**	**30**	**70**	**50**
II	**BI102:** Endocrine Biochemistry, Vitamins and Nucleic acids (core)	**5 (3T+2P)**	**7**	**30**	**70**	**50**
III	**BI103:** Cell Biology and Bioenergetics (core)	**5 (3T+2P)**	**7**	**30**	**70**	**50**
IV	**BI 104:** Basic Bioanalytical Techniques (core)	**5 (3T+2P)**	**7**	**30**	**70**	**50**
TOTAL		**20**	**28**	**400**		**200**

***One credit means the standard methodology of calculating one hour of theory or one hour of tutorial or two hours of laboratory work, per week for a duration of a semester (13-15 weeks)**

PAPER-I BI 101: CHEMISTRY OF BIOMOLECULES

(5 credits: theory credits= 3+ practical credits= 2)

THEORY	
CREDIT 1	**Amino Acids, & Proteins (15h)**
	1. Classification and structure of amino acids, 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 proteins 7. Secondary structure α helix, β sheet, 310 helix 8. GN Ramachandran plots: *Phi, Psi* and *omega* angle 9. Tertiary & Quaternary 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, chaotropicagents), renaturation 15. Protein folding, role of chaperones in folding
CREDIT 2	**Carbohydrates (15h)**
	1. Classifications and structure of Carbohydrates 2. Configurations and conformations 3. Reactions of Monosaccharides 4. Stability and formations of glycosidic bond 5. Disaccharides and Oligosaccharides 6. Polysaccharides Structural (Cellulose, Chitin) 7. Storage (Starch, Glycogen, Inulin) 8. Hemicelluloses- Lignin, Pectin 9. Hetero-Polysacharides/ acidic Mucopolysaccharides Glycosaminoglycan 10. Chemistry and biological role of Hyaluronic acids, Chondroitin sulphate, 11. Keratansulphate, dermatansulphate, heparin 12. Glycoproteins and Proteoglycans 13. Bacterial cell wall Polysaccharides, Peptidoglycans 14. Blood group glycoproteins 15. Structural determination 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

PRACTICAL (Each practical topic consists of 3 Experiments, Total 15 Expts)	
CREDIT 4	**Amino acid analysis (30 h)**
	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 methods 4. Quantification of glycine by formal titration 5. Estimation of tryptophan by Spies and Chambers method
CREDIT 5	**Lipid analysis (30 h)**
	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

PAPER-II BI 102 : ENDOCRINE BIOCHEMISTRY, VITAMINS AND NUCLEIC ACIDS

(5 credits: theory credits= 3+ practical credits= 2)

THEORY	
CREDIT 1	**Endocrine System (15h)**
	1.Endocrine glands and their hormones 2. Control of hormone secretion 3. Mechanism of hormone action 4. Pituitary gland: Structure, Anterior Pituitary : hormones and their functions 5. Posterior Pituitary- Hormones 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
CREDIT 2	**Vitamins (15h)**
	1. Water Soluble Vitamins: Structure and Classification 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 disorders of Vit B1 (Thiamine), B2 (Riboflavin) 6. Structure, function and the deficiency disorders of and B3 (Niacin) and Vit B5 (Pantothenic acid) 7. Structure, function and the deficiency disorders of B6 (Pyridoxine) andB7(Biotin) 8. Structure, function and the deficiency disorders of Vit B9(Folic acid) and B12 (Cobalmins) 9. Structure, function and the deficiency disorders of Vit C (Ascorbic acid) 10. Structure, function and the deficiency disorders of Vit A (Retinol) 11. Structure, function and the deficiency disorders of Vit D (Calciferol) 12. Structure, function and the deficiency disorders of Vit E (Tocopherol) 13. Structure, function and the deficiency disorders of Vit K (Phytonadione) 14. Recommended daily allowance of vitamins 15. Vitamin supplementation
CREDIT 3	**Chemistry of Nucleic acids (15h)**
	1. Purines: structure and function 2. Pyrimidines: structure and function 3. Nucleosides, nucleotides, phospho-diester 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. Tm (factors affecting T_m) and $C_o t$ curves 9. Structure of RNA: mRNA, tRNA 10. Structure of RNA: rRNA, siRNA and miRNA 11. Properties of RNA denaturation and renaturation 12. Difference between DNA and RNA 13. Heteroduplexmapping 14. D loops and R loops 15. Catalytic RNA

PRACTICAL (Each practical topic consists of 3 Experiments, Total 15 Expts)	
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

PAPER-III BI 103 : CELL BIOLOGY AND BIOENERGETICS

(5 credits: theory credits= 3+ practical credits= 2)

THEORY	
CREDIT 1	**Structure of Prokaryotic & Eukaryotic cells (15 h)**
	1. 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 (transport and cell division) 7. Nuclear skeleton : lamina scaffold 8. Structure of chromosome (centromere, telomere, kinetochore) 9. Euchromatin & 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	**Bio Membranes (15 h)**
	1. Composition and Structure of Cell membrane 2. Membrane Dynamics 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; NaK ATPase 12. Transport channels: voltage gated, ion gated and ligand-gated channels 13. Aquaporin, Glucose transporters, valinomycin: structure and mechanism of action 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 lnscalesin biological processes (exponential growth curves, radioactivedecay) 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. Un–couplers and inhibitors of energy transfer. 14. Shuttle pathways: Glycerol phosphate shuttle, Malate-Aspartate shuttle 15. Biological fluorescence (GFP and derivatives), Bioluminescence

PRACTICAL (Each practical topic consists of 3 Experiments, Total l5 Expts)	
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 of proteins by dialysis 4. Gel filtration (size exclusion) 5. Cell fractionation (centrifuge)

PAPER-IV BI 104 : BASIC BIOANALYTICAL TECHNIQUES

(5 credits: theory credits= 3+ practical credits= 2)

THEORY	
CREDIT 1	**Spectroscopy and Chromatography (15h)**
	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. Infra red(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
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. AgaroseGels, 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; Isotopes used for labelling proteins (^{3}H ^{14}C ,^{35}S ,^{125}I) and nucleic acids (^{3}H, ^{32}P) 10. Detection of radioactivity by Scintillation counting Autoradiography 11. GM counter, gamma counter 12. Fluorography, applications of Phosphorimaging, luxometry and chemiluminescence as alternative to radioactivity 13. Radiation hazards and safe disposal of radio activity waste 14. Isotope dilution method – pulsechase 15. Historic examples -^{14}C and ^{18}O to study photosynthesis; ^{32}P and ^{35}S to study viral replication (Hershey – Chase experiment), ^{14}N and ^{15}N in DNA replication (Meselson and Stahl experiment)
CREDIT 3	**Microscopy and Methods of Cell Study (15h)**
	1. Light Microscopy: Simple and compound microscope 2. Phase contrast microscopy 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 Fluorescence assisted 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 and isolation of organelles

PRACTICAL (Each practical topic consists of 3 Experiments, Total 15 Expts)	
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 1-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

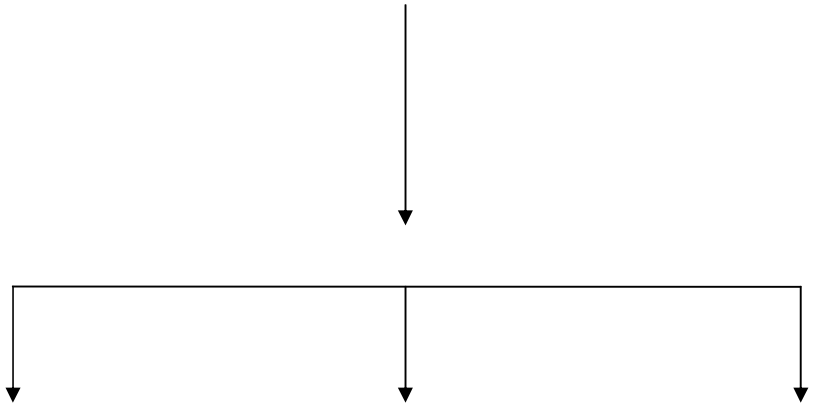
SCHEME OF EVALUATION

Each paper - Theory = 100 marks, Practical = 50 Marks.

Theory: Internal assessment=30 Marks + Semester end examination = 70 Marks

THEORY

INTERNAL ASSESSMENT= 30 Marks



SEMESTER END EXAMINATION =70 Marks

70 Marks - 3 UNITS

PART – A

Answer all questions 5 x 5 = 25 Marks

1.

2.

3.

4.

5.

PART- B

Answer All Questions 3 X 15=45 Marks

6 A

or

B

7 A

or

B

8 A

or

B