

GOVT. NAGARJUN P. G. COLLEGE OF SCIENCE RAIPUR (C.G.)

Department of Chemistry & Biochemistry

B.Sc. Part I
BIOCHEMISTRY

Syllabus – 2018-19

Structure of B.Sc. Part I Biochemistry Syllabus:-

1. Paper I : Biomolecules
2. Paper II: Bio-physical & Biochemical Technique
3. Laboratory Course:

1. Theory Papers:-

Paper	Course	Duration	Marks
I.	Biomolecules	03 Hrs.	50
II.	Bio-physical & Biochemical Technique Minimum Passing Marks 33% In each Paper	03 Hrs.	50

2. Laboratory course:- Duration – 05 Hrs., Maximum Marks – 50

Distribution of Marks

1. Experiment No. 01	15
2. Experiment No. 02	15
3. Viva / Project	10
4. Sessional	10
Minimum Passing Marks 33 %	

B.Sc. Part I
Paper I
BIOMOLECULES

M.M. 50 Marks

Unit – I : Introduction

Introduction to biochemistry, water as a biological solvent, weak acids and bases pH buffers, Henderson-Hasselbalch equation, physiological Buffers, fitness of the aqueous environment for living organisms.

Carbohydrates: Structure of monosaccharide, stereoisomerism and optical isomerism of sugars, Reactions of aldehyde and ketone groups. Ring structure and Anomeric forms, mutarotation. Reactions of sugar due to hydroxyl Group. Important derivatives of monosaccharides, disaccharides and Trisaccharides (structure, occurrence and function of important ones). Structure occurrence and biological importance of monosaccharides, Oligosaccharides and polysaccharides e.g. Cellulose, chitin, agar, algenic Acids, pectins, proteoglycans, sialic acids, blood Group polysaccharides, Glycogen and starch. Bacterial cell wall polysaccharides etc. glycoproteins.

Unit –II :Lipids

Definition and classification, fatty acids, introduction, classification Nomenclature, structure and properties of saturated and unsaturated fatty Acids, prostaglandins, triacylglycerols, nomenclature, physical properties Chemical properties and characterization of fats-hydrolysis saponification Value, rancidity of fats, Raichert-Meissel number and reaction of glycerol Biological significance of fats, glycerophospholipid (lecithins, lysolecithins Cephalin, phosphatidyl, serine, phosphatidyl, inositol plasmalogen) Sphingomyelins glycolipids- cerebrosides, gangliosides, properties and Functions of phospholipids, isoprenoids and sterols.

Unit – III :Proteins

Introduction, classification based on solubility, shape, composition and Functions, Amino acids, common structural features, stereo-isomerism and RS system of designation optical-isomers, classification and structures of Standard amino acids as zwitterions in aqueous solutions, physical and Chemical properties, titration of amino acids, separations of amino acids, Essential amino acids.

Peptides

Structure of peptide bond, chemical synthesis of polypeptides-protection and deprotection of N-terminal and C-terminal ends and functional groups in the side chains formation of peptide bonds condensing agents, strategy of chemical synthesis, Merrifield solid phase peptide synthesis. Determination of the amino acid sequence of a polypeptide chain, specific chemical and enzymatic cleavage of a polypeptide chains and separation of peptides, protein structure; levels of structure in protein architecture, primary structure of proteins, secondary structure of proteins-helix and pleated sheets, tertiary structure of proteins, forces stabilizing the tertiary structure and quaternary structure of proteins denaturation and renaturation of proteins. Behaviour of proteins in solutions, salting in and salting out of proteins. Structure and biological Functions of fibrous proteins (Keratins, collagen and elastin) globular Proteins hemoglobin, myoglobin, lipoprotein, metalloproteins, glycoproteins and nucleoproteins.

Unit –IV : Nucleic acids

Nature of genetic material, evidence that DNA is the genetic material ,Composition of RNA and DNA , generalized structure plan of nucleic Acids . nomenclature used in writing structure of nucleic acids, features of DNA double helix. Denaturation and annealing of DNA structure and Roles Of different types of RNA . Size of DNA in procaryotic and eucaryotic Cells , central dogma of molecular biology, gene , genome , chromosome.

Unit –V: Porphyrins

Porphyrin nucleus and classification of porphurins. Important Metalloporphyrins occurring in nature detection of porphyrins spectrophotometrically and by fluorescence Bile pigments-chemical and their physiological significance.

B.Sc. Part I

Paper II

BIOPHYSICAL & BIOCHEMICAL TECHNIQUES

M.M. 50 Marks

Unit – I : Concepts of Bioenergetics

Principles of thermodynamics and their applications in biochemistry-Introduction thermodynamics system , thermodynamics state functions, First and second laws of thermodynamics concept of free energy , standard Free energy , determination of ΔG for a reaction , relation between equilibrium constant and standard free energy change, biological standard state and standard free energy change in coupled reactions. Biological oxidation Reduction reactions-introduction potentials, relation between standard reduction potentials and free energy change redox derivatives and numerical included, high energy phosphate compounds-introduction, phosphate groups transfer free energy of hydrolysis of ATP and sugar phosphate along with reasons for ΔG .

Unit – II : Hydrodynamic Methods

Sedimentation-sedimentation velocity and analytical ultracentrifugation Technique determination of molecular weight by hydrodynamic methods. (derivations excluded and numerical included)

Measurement of pH: Principles of glass and reference electrodes, types of electrodes, complications of pH measurement (dependence of pH on ionic strength , electrode contamination and sodium error) and use of pH paper. Electrophoresis Basic principles of agarose electrophoresis , PAGE and SDS-PAGE , two dimensional electrophoresis , its importance isoelectrofocussing.

Unit – III: Chromatography

General principles and applications of

- (1) Adsorption chromatography
- (2) Ion exchange chromatography
- (3) Thin layer chromatography
- (4) Molecular-sieve chromatography
- (5) Hydrophobic chromatography
- (6) Gas liquid chromatography
- (7) HPLC
- (8) Affinity chromatography
- (9) Paper chromatography

Unit – IV: Spectroscopic Techniques

Beer-Lambert law , light absorption and its transmittance , determination and application of extinction coefficient , application of visible and UV spectroscopic techniques (structure elucidation and numericals excluded) Principle and application of NMR , ESR , Mass spectroscopy. Fluorescent and emission spectroscopy.

Unit – V: Radioisotopic Techniques :

Types of radioisotopes used in Biochemistry , units of radioactivity Measurement, technique used to measure radioactivity (gas ionization and liquid scintillation counting) nuclearemulson used in biological studies (pre-mounted, liquid and stripping) isotopes

commonly used in biological studies – ^{32}P , ^{35}S , ^{14}C and ^3H) autoradiography. Biological hazards of radiation safety measures in handling radioisotopes Biological applications.

Immunological Techniques :

Immunodiffusion, immunoelectrophoresis , radioimmunoassay , ELISA , Immunofluorescence.

B.Sc. Part – I

PRACTICAL

M.M. 50 Marks

1. Preparation of standard buffers and determination of pH of a solution.
2. Qualitative tests for :
 - a. Carbohydrates
 - b. Proteins and amino acids
 - c. Lipids
3. Determination of saponification value and iodine number of fats.
4. Estimation of ascorbic acid.
5. Titration curve for amino acids and determination of pKa value.
6. Verification of Beer-Lambert's law.
7. Estimation of
 - i) Carbohydrate by anthrone method.
 - ii) Blood glucose by the methods (a) Folin-Wu (b) Nelson-Somogyi
8. Estimation of amino acids by ninhydrin method.
9. Isolation and assay of glycogen from rat liver.
10.
 - i) Extraction of total lipids by Folch method.
 - ii) Estimation of food adulterant.
11. Estimation of DNA and RNA .
12. Separation of sugars using paper chromatography.

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Department of Chemistry & Biochemistry

B.Sc.-II

BIOCHEMISTRY

Syllabus – 2012-13

Structure of B.Sc. Part II Biochemistry Syllabus:-

1. Paper I : Enzymology
2. Paper II: Intermediary Metabolism
3. Laboratory Course:

1. Theory Papers:-

Paper	Course	Duration	Marks
I.	Enzymology	03 Hrs.	50
II.	Intermediary Metabolism Minimum Passing Marks 33% In each Paper	03 Hrs.	50

2. Laboratory course:- Duration – 05 Hrs., Maximum Marks – 50

Distribution of Marks

1. Experiment No. 01	15
2. Experiment No. 02	15
3. Viva / Project	10
4. Sessional	10
Minimum Passing Marks 33 %	

B. Sc. Part II
Paper I
ENZYMOLOGY

M.M. 50 Marks

Unit – I Introduction

History, general characteristics, nomenclature, IUB enzyme classification (Rationale, overview and specific examples), significance of numbering system. Definitions with examples of holoenzyme, apoenzyme, coenzymes, cofactors, Activators, inhibitors, active site (identification of groups excluded), metallo-Enzymes, units of enzyme activity, specific enzymes, isoenzymes, monomeric Enzymes, oligomeric enzymes and multi-enzyme complexes. Enzyme specificity. Historical perspective, nature of non-enzyme activity-enzyme assays. Definition of IU, Katal, enzyme turn over number and specific activity.

Unit – II Enzyme catalysis

Role of cofactors in enzyme catalysis: NAD/NADP, FMN/FAD, coenzyme A, Biocytin, cobamide, lipoamide, TPP pyridoxal phosphate, tetrahydrofolate and Metal ions with special emphasis on coenzyme functions. Acid-base catalysis, Proximity and orientation effects, strain and distortion theory.

Unit – III Enzyme Purification

Methods for isolation, purification and characterization of enzymes. Role of non-Protein organic molecules and inorganic ions-coenzyme, prosthetic groups. Role of Vitamins as coenzymes precursors (general treatment) Mechanism of action of chymotrypsin carboxypeptidase, ribonuclease and lysozyme.

Unit-VI Enzyme Kinetics

Factors affecting enzyme activity: enzyme concentration, substrata concentration, pH and temperature. Derivation of Michaelis-Menten equation for uni-substrate reactions. K_m and its significance. Lineweaver-Burk plot and its limitations.

Importance of K_{cm}/K_m Bi-substrate reactions-brief introduction to sequential and Ping-pong mechanism with examples. Kinetics of zero and first order reactions. Significance and evaluation of energy of Activation and free energy. Reversible and irreversible inhibition, competitive, non-competitive and Uncompetitive inhibitions, determination of K_m & V_{max} in presence and Absence of inhibitor: Allosteric enzymes.

Unit – V Industrial and Clinical Application of Enzymes

Immobilization of enzymes and their industrial applications. Production Of glucose, starch, cellulose and dextran; use of lactase in dairy industry Production of glucose syrup from sucrose; Use of Proteases in food, detergent And leather industry application of enzymes; Use of glucose oxidase in Electrodes.

B.Sc. Part II

Paper II

INTERMEDIARY METABOLISM

M.M. 50 Marks

Unit – I Introduction to Metabolism

General features of metabolism, experimental approaches to study metabolism: Use of intact organism, bacterial mutants, tissue slices, stable and radioactive Isotopes.

Carbohydrate Metabolism

Reactions and energetics of glycolysis. Alcoholic and lactic acid fermentations. Entry of fructose, galactose, mannose etc. Reactions and energetic of TCA Cycle. Gluconeogenesis, glycogenesis and glycogenolysis. Reaction and Physiological significance of pentose phosphate pathway. Regulation of Glycolysis and TCA cycle Photosynthesis a brief review.

Unit – II Electron Transport Chain and Oxidative Phosphorylation

Structure of mitochondria, sequence of electron carriers, sites of ATP production, inhibitors of electron transport chain. Hypothesis of mitochondrial Oxidative phosphorylation . Transport of reducing potentials into mitochondria.

Unit – III Lipid Metabolism

Introduction, hydrolysis of triacylglycerols, transport of fatty acids into Mitochondria, B oxidation saturated fatty acids, ATP yield from fatty acid Oxidation. Biosynthesis of saturated and unsaturated fatty acids. Metabolism of Ketone bodies, oxidation of unsaturated and odd chain fatty acids. Biosynthesis of triglycerides and important phospholipids, glycolipids, sphingolipids and cholesterol. Regulation of cholesterol metabolism.

Unit – IV Amino acid Metabolism

General reactions of amino acid metabolism : transamination, oxidative Deamination and decarboxylation. Urea cycle. Degradation and biosynthesis of Amino acids. Glycogenic and ketogenic amino acids.

Unit – V Nucleotide Metabolism

Sources of the atoms in the purine and pyrimidine molecules. Biosynthesis and Degradation of purines and pyrimidines biosynthesis.

Porphyrin Metabolism

Biosynthesis and degradation of porphyrins. Production of bile pigments

B.Sc. Part – II

PRACTICAL

MM 50 Marks

1. Separation of Blood Plasma and Serum
 - a. Estimation of proteins from serum by biuret and Lowry methods.
 - b. Determination of albumin and A/G ratio in serum.
2. Estimation of bilirubin (conjugated and unconjugated) in serum.
3.
 - i) Estimation of total lipids in serum by vanillin method.
 - ii) Estimation of cholesterol in serum.
4. Estimation of lipoproteins in plasma.
5. Estimation of lactic acid in blood before and after exercise.
6. Estimation of blood urea nitrogen from plasma.
7. Separation and identification of amino acids by
 - (a) paper chromatography and
 - (b) thin chromatography.
8. Separation of polar and non-polar lipids by thin-layer chromatography.
9. Estimation of SGPT and SGOT in serum.
10.
 - a. Assay of serum alkaline phosphatase activity.
 - b. Inhibition of alkaline phosphatase activity by EDTA
 - c. Effect of substrate concentration on alkaline phosphatase activity and determine of its K_m value.
11.
 - a. Effect of temperature of enzyme activity and determination of activation energy.
 - b. Effect of pH on enzyme activity and determination of optimum pH.
 - c. Effect of enzyme concentration on enzyme activity.
12.
 - a. Preparation of starch from potato and its hydrolysis by salivary amylase.
 - b. Determination of achromatic point in salivary amylase.
 - c. Effect of sodium chloride on amylases.

GOVT. NAGARJUN PG COLLEGE OF SCIENCE RAIPUR (C.G.)

Department of Chemistry & Biochemistry

B.Sc.-III

BIOCHEMISTRY

Syllabus – 2012-13

Structure of B.Sc. Part III Biochemistry Syllabus:-

1. Paper I : Molecular Biology
2. Paper II: Nutritional, Clinical & Environmental Biochemistry
3. Laboratory Course:

1. Theory Papers:-

Paper	Course	Duration	Marks
I.	Molecular Biology	03 Hrs.	50
II.	Nutritional, Clinical & Environmental Biochemistry Minimum Passing Marks 33% In each Paper	03 Hrs.	50

2. Laboratory course:- Duration – 05 Hrs., Maximum Marks – 50

Distribution of Marks

1. Experiment No. 01	15
2. Experiment No. 02	15
3. Viva / Project	10
4. Sessional	10
Minimum Passing Marks 33 %	

B.Sc. Part III
Paper I
MOLECULAR BIOLOGY

M.M. 50 Marks

Unit – I Basic Concepts of Genetic Information

Nucleic acids as genetic information carriers, experimental, TMV reconstitution experiment. Central dogma of molecular genetics-current version, reverse transcription and retroviruses. Primary structure of nucleic acids and their properties, salient features of Eukaryotic, prokaryotic and viral genomes; highly repetitive, moderately repetitive and unique DNA sequences. Basic concepts about the secondary structure of nucleic acids, 5' ---> 3' direction antiparallel strands, base composition, base equivalence, base pairing and base-stacking in DNA molecule. T_m and buoyant density and their relationship with G-C content in DNA.

Unit – II Structure Levels of Nucleic Acids and Sequencing

Secondary and Tertiary structure of DNA; Watson and Crick model, A, B and Z types of DNA, major and minor grooves, chirality's of DNA, tertiary Structure of DNA. Structure and properties of RNA: secondary and tertiary structures. Nucleic acid hybridization: Cot value and satellite DNA. Sequencing: Restriction and modification system, sequencing of DNA and RNA.

Unit – III DNA Replication

DNA replication in prokaryotes-conservative, semiconservative and Dispersive types, experimental evidence for semiconservative replication. DNA polymerases, other enzymes and protein factors involved in replication.

Transcription: Transcription in prokaryotes. RNA polymerase, promoters, initiation, Elongation and termination of RNA synthesis, inhibitors of transcription. Reverse transcriptase, post-transcriptional processing of RNA in eukaryotes.

Unit – IV Translation and Regulation of Gene Expression

Genetic code: Basic features of genetic code, biological significance of degeneracy. Wobble hypothesis, gene within genes and overlapping genes. Mechanisms of translation: Ribosome structure, A and P sites, charged tRNA f-met-tRNA, initiator codon, Shine-Dalgarno consensus sequence (AGGA), formation of 70S initiation complex, role of EF-Ts, EF-G and GTP, non-sense codons and release factors, RF1 and RF2. Regulation of Gene Expression in prokaryotes: Enzyme induction and repression, operon concept, Lac operon, Try operon.

Unit – V Mutation and Repair

Mutation: Molecular basis of mutation, types of mutation, e.g. transition, frame shift, insertion, deletion, suppresser sensitive, germinal and somatic, backward and forward mutations, true reversion and suppression, dominant and recessive mutations, spontaneous and induced mutations – Lederberg's replica plating experiment. Mutagenicity testing: Correlation of mutagenicity and carcinogenicity: Ames testing, Random and site-directed mutagenesis. DNA Repair: UV repair system in E. coli, significance of thymine in DNA.

Recombinant DNA Technology

Restriction endonucleases, brief discussion of steps in DNA cloning. Applications of recombinant DNA technology.

B.Sc. Part – III
Paper - II
NUTRITIONAL, CLINICAL & ENVIRONMENTAL BIOCHEMISTRY

M.M. 50 Marks

Unit -1 Nutritional Biochemistry

Introduction and definition of foods and nutrition. Factors determining food acceptance, physiological, energy, body building (growth and development). Regulation of body temperature. Physiology and nutrition of carbohydrates, fats, proteins and water. Vitamins A, D, E, K, Vit. B-complex and Vit. C and minerals like Ca, Fe and Iodine and their biological functions. Basic food groups: energy giving foods, body building foods and protective Foods. Composition of balance diet, recommended dietary allowances (RDA) for average Indian, Locally available foods, inexpensive quality foods stuffs rich in more than one nutrients. Balanced vegetarian and non-vegetarian diets, emphasis on nutritional adequacy.

Unit – II Nutritive and calorific value of foods

Basic concepts of energy expenditure, units of energy, measurement of energy expenditure by direct or indirect calorimetry, calculation of non-protein RQ with respect to carbohydrate and lipids. Determination of heat production of the diet. The basal metabolic rate (BMR) ; energy requirements during growth pregnancy, lactation and various physical activities. Calculation of energy expenditure of average man and woman .Specific dynamic action (SDA) of foods, nutritive value of various kinds of foods generally used by Indian population. Planning of dietary regimes for infants, during pregnancy and old age. Malnutrition, its implications and relationship with dietary habits and prevention of malnutrition specially protein-calorie malnutrition (Kwashiorkor and Marasmus) by improvement of diets. Human milk and its virtues, breast vs formulated milk feeding. Food preservation standards, food adulterations and precautions, government regulations on preservation and quality of food .

Unit – III Clinical Biochemistry

Basic concept of clinical biochemistry

- a. Definition and scope of clinical biochemistry in diagnosis, a brief review of units and abbreviations used in expressing concentrations and standard solutions. Quality control. Manual vs automation in clinical laboratory.
- b. Collection and preservation of biological fluids (blood, serum, plasma, urine and CSF). Chemical analysis of blood, urine and CSF. Normal values for important constituents (in SI units) in food (plasma / serum), CSF and urine, clearance test for urea.

Unit –IV Clinical enzymology

- a. Definition of functional and non-functional plasma enzymes and diagnostic tests. Enzyme pattern in health and diseases with special mention of plasma lipase, amylase, cholinesterase, alkaline and acid phosphatase, SGOT , SGPT,LDH and CPK .
- b. Functional tests of kidney, liver, and gastric fluids.

Disease related to metabolism

Hypo and Hyper-glycemia, glycogen storage diseases; lipid mal-absorption And steatorrhea, sphingolipidosis; role of lipoproteins. Inborn errors of amino Acid metabolism-alkaptonuria, phenyl-ketonuria , albinism , gout and hyper-uricemia.

Unit – V Environmental Biochemistry

Air pollution: Particulate matter, compounds of carbon, sulphur, Nitrogen and their inter-reactions, methods of their estimation, their effect on atmosphere.

Water pollution: Types of water bodies and their general characteristics, major pollutants in Domestic, agricultural and industrial wastes, methods of their estimation, Effects of pollutants on plants and animals, treatment of domestic and Industrial wastes, solid-wastes, and their treatment.

B.Sc. Part III

PRACTICAL

M.M. 50 Marks

1. Estimation of DNA by diphenylamine method.
2. Effect of temperature on the viscosity of DNA using Oswald's viscometer.
3. Extraction of RNA and its estimation by Orcinol method.
4. Estimation of hemoglobin by measuring total iron in blood.
5. Estimation of calcium and phosphorus in serum & urine.
6. Estimation of creatine and creatinine in urine .
7. Estimation of immunoglobulin by precipitation with saturated ammonium sulphate.
8. Denaturation of enzyme, studies on DNA.
9. A. Separation of proteins by column chromatography.
B. Determination of proteins by dye binding assay.
10. Separation of protein by SDS-polyacrylamide gel electrophoresis.
