

1st Semester Theory : Biomolecules

60 hrs
(2 hrs/week)

Unit-1 : Biophysical Concepts

12 hours

Basic Classification of biomolecules, Water as a biological solvent and its role in biological processes. Biological relevance of pH, measurement of pH, pKa of functional groups in biopolymers such as proteins and nucleic acids. Importance of buffers in biological systems, ion selective electrodes, and oxygen electrode. Donnan membrane equilibrium. Significance of osmotic pressure in biological systems,

Unit -II: Carbohydrates

12 hours

Carbohydrates: Classification. monosaccharides, D and L designation, open chain and cyclic structures, epimers and anomers, mutarotation, reactions of carbohydrates (due to functional groups - hydroxyl, aldehyde and ketone). Amino sugars, Glycosides. Structure and biological importance of disaccharides (sucrose, lactose, maltose, isomaltose, trehalose), trisaccharides (raffinose, melezitose), structural polysaccharides (cellulose, chitin, pectin) and storage polysaccharides (starch, insulin, glycogen). Glycosaminoglycans, Bacterial cell wall polysaccharides. Outlines of glycoproteins, glycolipids and blood group substances.

Unit - III : Lipids

12 hours

Lipids: Classification, saturated and unsaturated fatty acids, structure and properties of fats and oils (acid, saponification and iodine values, rancidity). General properties and structures of phospholipids, sphingolipids and cholesterol. Prostaglandins - structure and biological role of PGD₂, PGE₂ and PGF₂, Lipoproteins: Types and functions.

Biomembranes: Behavior of amphipathic lipids in water - formation of micelles, bilayers, vesicles, liposomes. Membrane composition and organization - Fluid mosaic model.

Unit-IV: Amino Acids and Peptides

12 hours

Amino Acids: Classification, structure, stereochemistry, chemical reactions of amino acids due to carbonyl and amino groups. Titration curve of glycine and *pK* values. Essential and non-essential amino acids, non-protein amino acids, Peptide bond - nature and conformation, Naturally occurring peptides - glutathione, enkephalin.

Unit-V: Proteins

12 hours

Proteins: Classification based on solubility, shape and function. Determination of amino acid composition of proteins. General properties of proteins, denaturation and renaturation of proteins. Structural organization of proteins- primary, secondary, tertiary and quaternary structures (Eg. Hemoglobin and Myoglobin), forces stabilizing the structure of protein. Outlines of protein sequencing.

List of experiments:

45 hrs
(1½ hours/week)

1st Semester Practicals : Qualitative Analysis

1. Preparation of buffers (acidic, neutral and alkaline) and determination of pH.
2. Qualitative identification of carbohydrates - glucose, fructose, ribose/xylose, maltose, sucrose, lactose, starch/glycogen.
3. Qualitative identification of amino acids - histidine, tyrosine, tryptophan, cysteine, arginine.
4. Qualitative identification of lipids- solubility, saponification, acrolein test, Salkowski test, Lieberman-Burchard test.
5. Preparation of Osazones and their identification.
6. Absorption maxima of colored substances- *p*-Nitrophenol, Methyl orange.
7. Absorption spectra of protein-BSA, nucleic acids- Calf thymus DNA.

ACHARYA NAGARJUNA UNIVERSITY
Common Framework of CBCS for Colleges in Andhra Pradesh
 (A.P. State of Council of Higher Education)
B.Sc., BIOCHEMISTRY
Course Structure, Scheme of Instruction and Examination, 2015
Semester Pattern

| SEMESTER - II | Marks |
|--|--------------|
| Theory –BCT-201: Nucleic acids and Biochemical Techniques | 75 |
| Unit-I : Nucleic Acids | |
| Unit-II: Porphyrins | |
| Unit-III: Biochemical Techniques I | |
| Unit IV: Biochemical Techniques II | |
| Unit-V: Techniques employed in metabolic studies | |
| Practical – BCP-201 : Isolations and Biochemical Techniques | 50 |
| SEMESTER - III | Marks |
| Theory –BCT-301: Enzymology and Bioenergetics | 75 |
| Unit-I:Classification of Enzymes and Structure | |
| Unit-II: Influence of Physical factors and Inhibitors on Enzyme activity | |
| Unit- III: Mechanism of enzyme action | |
| Unit-IV: Bioenergetics | |
| Unit-V: Biological Oxidations in Mitochondria | |
| Practical – BCP-301: Enzymology | 50 |
| SEMESTER- IV | Marks |
| Theory – BCT-401: Intermediary Metabolism | 75 |
| Unit -I:Carbohydrates Metabolism | |
| Unit-II:Lipid Metabolism | |
| Unit-III: Metabolism of Amino acids | |
| Unit-IV: Nitrogen Fixation | |
| Unit-V: Metabolism of Nucleic acids and heme | |
| Practical – BCP-401 : Quantitative Analysis | 50 |

3rd Year:

Semester-V: Skill Development Course-1 (University's Choice)
 Skill Development Course- 2 (University's Choice)

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Semester-II B.Sc., BIOCHEMISTRY

Theory: BCT-201 Nucleic acids and Biochemical Techniq **60 hrs**
(5 periods/week)

Unit-I : Nucleic Acids

12 hours

Nature of nucleic acids. Structure of purines and pyrimidines, nucleosides, nucleotides. Stability and formation of phosphodiester linkages. Effect of acids, alkali and nucleases on DNA and RNA. Structure of Nucleic acids- Watson-Crick DNA double helix structure, introduction to circular DNA, super coiling, helix to random coil transition, denaturation of nucleic acids- hyperchromic effect, T_m -values and their significance. Reassociation kinetics, cot curves and their significance. Types of RNA and DNA.

Unit-II: Porphyrins

9 hours

Structure of porphyrins; Protoporphyrin, porphobilinogen properties Identification of Porphyrins. Structure of metalloporphyrins – Heme, cytochromes and chlorophylls.

Unit-III: Biochemical Techniques I

15 hours

Methods of tissue homogenization: (Potter-Elvehjem, mechanical blender, sonicator and enzymatic). Principle and applications of centrifugation techniques- differential, density gradient. Ultra-centrifugation- preparative and analytical.. Principle and applications of chromatographic techniques- paper, thin layer, gel filtration, ion- exchange and affinity chromatography. Elementary treatment of an enzyme purification. Electrophoresis- principles and applications of paper, polyacrylamide (native and SDS) and agarose gel electrophoresis.

Unit-IV: Biochemical Techniques II

12 hours

Colorimetry and Spectrophotometry- Laws of light absorption- Beer-Lambert law. UV and visible absorption spectra, molar extinction coefficient, biochemical applications of spectrophotometer. Principle of fluorimetry. Tracer techniques: Radio isotopes, units of radio activity, half life, β and γ - emitters, use of radioactive isotopes in biology.

Unit- V: Techniques employed in metabolic studies

12 hours

Broad outlines of Intermediary metabolism, methods of investigation, Intermediary metabolism in vivo studies such as analysis of excretion, Respiratory exchange, Removal of organs and perfusion studies, in vitro studies such as tissue slice techniques; Homogenates and purified enzyme systems; isotope tracer studies, use of inhibitors and antimetabolites.

Practical BCP- 201 : Nucleic acids and Biochemical Techniques **45 hrs**

List of Experiments: **(3 periods/week)**

1. Isolation of RNA and DNA from tissue/culture.
2. Qualitative Identification of DNA, RNA and Nitrogen Bases
3. Isolation of egg albumin from egg white.
4. Isolation of cholesterol from egg yolk.
5. Isolation of starch from potatoes.
6. Isolation of casein from milk.
7. Separation of amino acids by paper chromatography.
8. Determination of exchange capacity of resin by titrimetry.
9. Separation of serum proteins by paper electrophoresis.
10. Separation of plant pigments by TLC.

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B.Sc., BIOCHEMISTRY

Semester III

Theory : BCT-301 Enzymology and Bioenergetics

60 hrs
(5 periods/week)
(5 periods/week)

Unit-I: Classification of Enzymes and Structure

12 hours

Introduction to biocatalysis, differences between chemical and biological catalysis. Nomenclature and classification of enzymes. Enzyme specificity. Active site. Principles of energy of activation, transition state. Interaction between enzyme and substrate- lock and key, induced fit models. Definition of holo-enzyme, apo-enzyme, coenzyme, cofactor. Fundamentals of enzyme assay, enzyme units.

Unit II: Influence of Physical factors and Inhibitors on Enzyme activity.

12 hours

Factors affecting the catalysis- substrate concentration, pH, temperature. Michaelis - Menten equation for uni-substrate reaction (derivation not necessary), significance of K_M and V_{max} . Enzyme inhibition- irreversible and reversible, types of reversible inhibitions- competitive and non-competitive.

Unit-III: Mechanism of enzyme action

12 hours

Outline of mechanism of enzyme action- acid-base catalysis, covalent catalysis, electrostatic catalysis, and metal ion catalysis. Regulation of enzyme activity- allosterism and cooperativity, ATCase as an allosteric enzyme, covalent modulation- covalent phosphorylation of phosphorylase, zymogen activation- activation of trypsinogen and chymotrypsinogen. Isoenzymes (LDH). Multienzyme complexes (PDH). Ribozyme .

Unit- IV: Bioenergetics

12 hours

Bioenergetics: Thermodynamic principles – Chemical equilibria; free energy, enthalpy (H), entropy (S). Free energy change in biological transformations in living systems; High energy compounds. Energy, change, oxidation-reduction reactions.

Unit V : Biological Oxidations in Mitochondria

12 hours

Organization of electron carriers and enzymes in mitochondria. Classes of electron-transferring enzymes, inhibitors of electron transport. Oxidative phosphorylation. Uncouplers and inhibitors of oxidative phosphorylation. Mechanism of oxidative phosphorylation.

Practical – BCP-301: Enzymology

List of Experiments:

45 hrs
(3 periods/week)

1. Assay of amylase
2. Assay of urease
3. Assay of catalase.
4. Assay of phosphatase
5. Determination of optimum temperature for amylase.
6. Determination of optimum pH for phosphatase.

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B.Sc., BIOCHEMISTRY

Semester - IV

Theory: BCT- 401 Intermediary Metabolism

60 hrs
(5 periods/week)

60 hrs
(5 periods/week)

Unit- I : Carbohydrate Metabolism

12 hours

Concept of anabolism and catabolism. Glycolytic pathway, energy yield. Fate of pyruvate- formation of lactate and ethanol, Pasteur effect. Citric acid cycle, regulation, energy yield, amphipathic role. Anaplerotic reactions. Glycogenolysis and glycogenesis. Pentose phosphate pathway. Gluconeogenesis. Photosynthesis- Light and Dark reactions, Calvin cycle, C₄ Pathway. Disorders of carbohydrate metabolism- Diabetes Mellitus.

Unit- II: Lipid Metabolism

12 hours

Catabolism of fatty acids (β - oxidation) with even and odd number of carbon atoms, Ketogenesis, *de novo* synthesis of fatty acids, elongation of fatty acids in mitochondria and microsomes, Biosynthesis and degradation of triacylglycerol and lecithin. Biosynthesis of cholesterol. Disorders of lipid metabolism.

Unit- III: Metabolism of Amino acids

12 hours

General reactions of amino acid metabolism- transamination, decarboxylation and deamination, Urea cycle and regulation, Catabolism of carbon skeleton of amino acids- glycolytic and ketogenic amino acids. Metabolism of glycine, serine, aspartic acid, methionine, phenylalanine and leucine. Biosynthesis of creatine. Inborn errors of aromatic and branched chain amino acid metabolism.

Unit- IV: Nitrogen Fixation

12 hours

Nitrogen cycle, Non-biological and biological nitrogen fixation, Nitrogenase system. Utilization of nitrate ion, Ammonia incorporation into organic compounds. Synthesis of glutamine and regulatory mechanism of glutamine synthase.

Unit- V: Metabolism of Nucleic acid and heme:

12 hours

Biosynthesis and regulation of purine and pyrimidine nucleotides, *de novo* and salvage pathways. Catabolism of purines and pyrimidines. Biosynthesis of deoxyribonucleotides- ribonucleotide reductase and thymidylate synthase and their significance. Disorders of nucleotide metabolism- Gout, Lesch-Nyhan syndrome. Biosynthesis and degradation of heme.

Practical – BCP-401: Quantitative Analysis

45 hrs
(3 periods/week)

List of Experiments:

1. Estimation of amino acid by Ninhydrin method.
2. Estimation of protein by Biuret method.
3. Estimation of protein by Lowry method.
4. Estimation of glucose by DNS method.
5. Estimation of glucose by Benedict's titrimetric method.
6. Estimation of total carbohydrates by Anthrone method.