

# 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

<b>SEMESTER- I</b>	<b>Marks</b>
<b>Theory- BCT-101: Biomolecules</b>	<b>75</b>
Unit-I : Biophysical concepts	
Unit-II : Carbohydrates	
Unit-III: Lipids	
Unit-IV: Amino acids and Peptides	
Unit-V : Proteins	
<b>Practical – BCP- 101: Qualitative Analysis</b>	<b>50</b>
<b>SEMESTER - II</b>	<b>Marks</b>
<b>Theory –BCT-201: Nucleic acids and Biochemical Techniques</b>	<b>75</b>
Unit-I : Nucleic Acids	
Unit-II: Porphyrins	
Unit-III: Biochemical Techniques I	
Unit IV: Biochemical Techniques II	
Unit-V: Techniques employed in metabolic studies	
<b>Practical – BCP-201 : Isolations and Biochemical Techniques</b>	<b>50</b>
<b>SEMESTER - III</b>	<b>Marks</b>
<b>Theory –BCT-301: Enzymology and Bioenergetics</b>	<b>75</b>
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	
<b>Practical – BCP-301: Enzymology</b>	<b>50</b>
<b>SEMESTER- IV</b>	<b>Marks</b>
<b>Theory – BCT-401: Intermediary Metabolism</b>	<b>75</b>
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	
<b>Practical – BCP-401 : Quantitative Analysis</b>	<b>50</b>

<b>SEMESTER - V</b>	<b>Marks</b>
<b>Theory – BCT-501: Physiology, Clinical Biochemistry and Immunology</b>	<b>75</b>
Unit-I: Physiology	
Unit II: Endocrinology	
Unit-III: Nutritional Biochemistry	
Unit-IV: Clinical Biochemistry	
Unit-V: Immunology	
<b>Practical – BCP-501 : Nutritional and Clinical Biochemistry</b>	<b>50</b>
<b>Elective Theory - BCT-502: Basic Microbiology</b>	<b>75</b>
Unit-I: History of Development of Microbiology	
Unit II: Diversity of Microbial world	
Unit-III: Viruses, Bacteria and Protozoa	
Unit-IV: Algae	
Unit-V: Fungi	
<b>Elective Practical – BCP-502 : Basic Microbiology</b>	<b>50</b>
<b>Elective Theory - BCT-503: Molecular Basis of Infectious Diseases</b>	<b>75</b>
Unit-I: Classification of infectious agents	
Unit II: Overview of diseases caused by bacteria	
Unit-III: Overview of diseases caused by Viruses	
Unit-IV: Overview of diseases caused by Parasites	
Unit-V: Overview of diseases caused by other organisms	
<b>Elective Practical – BCP-503 : Molecular Basis of Infectious Diseases</b>	<b>50</b>
<b>SEMESTER – VI</b>	
<b>Theory – BCT-601 Microbiology and Molecular Biology</b>	<b>75</b>
Unit-I: Microbiology	
Unit -II: Applied Biochemistry	
Unit-III: DNA Replication and Transcription	
Unit-IV: Protein Synthesis and Regulation of Gene Expression	
Unit-V: Recombinant-DNA Technology	
<b>Practical – BCP-601 : Microbiology and Molecular Biology</b>	<b>50</b>
<b>Elective Theory - BCT-602: Biochemistry of Cell</b>	<b>75</b>
Unit-I: Biomolecules in their cellular environment	
Unit II: Amino acids and Lipids	
Unit-III: Sugars and Nucleic Acids	
Unit-IV: Vitamins, coenzymes and metal ions	
Unit-V: Signaling molecules	
<b>Elective Practical – BCP-602 : Biochemistry of Cell</b>	<b>50</b>
<b>Elective Theory - BCT-603: Biochemical Correlations in Diseases</b>	<b>75</b>

Unit-I: Inborn errors of metabolism	
Unit II: Nutritional Deficiency and Life style diseases	
Unit-III: Hormonal Imbalances and Autoimmune diseases	
Unit-IV: Diseases caused due to misfolded proteins	
Unit-V: Infectious diseases	
<b>Elective Practical – BCP-603 : Biochemical Correlations in Diseases</b>	<b>50</b>

### FOUNDATION COURSES

#### 1<sup>st</sup> Year:

**Semester-I:** Foundation Course- 1 HVPE (Human Values & Professional Ethics),  
Foundation Course-2 Communication & Soft Skills-1

**Semester-II:** Foundation Course-3 Environmental Sciences  
Foundation Course-4A ICT-1 (Information & Communication Technology)

#### 2<sup>nd</sup> Year:

**Semester-III:** Foundation Course- 5 Entrepreneurship  
Foundation Course-2B Communication & Soft Skills-2

**Semester-IV:** Foundation Course-2C Communication & Soft Skills-3  
Foundation Course- 6 Analytical Skills  
Foundation Course- 7 CE (Citizenship Education)  
Foundation Course- 4 B ICT-2 (Information & Communication Technology)

#### 3<sup>rd</sup> Year:

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

# **B.Sc -BIOCHEMISTRY ( CBCS) SYLLABUS, 2015**

## **SEMESTER- I**

### **Theory BCT-101: Biomolecules**

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

#### **Unit – I : Biophysical Concepts**

**12 hours**

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, inulin, 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 PGD<sub>2</sub>, PGE<sub>2</sub> and PGF<sub>2</sub> α. 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.

### **Practical : BCP-101: Qualitative Analysis**

**45 hrs**  
**(3 periods/week)**

#### **List of Experiments:**

1. Preparation of buffers (acidic, neutral and alkaline) and determination of pH.
2. Titration curve of glycine and determination of pK and pI values.

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

## Semester-II

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

### Theory: BCT-201 Nucleic acids and Biochemical Techniques

#### **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,  $\beta$  and  $\gamma$ - 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.

**Semester III**

**Theory : BCT-301 Enzymology and Bioenergetics**

**60 hrs**  
**(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:**

1. Assay of amylase
2. Assay of urease
3. Assay of catalase.

**45 hrs**  
**(3 periods/week)**

4. Assay of phosphatase
5. Determination of optimum temperature for amylase.
6. Determination of optimum pH for phosphatase.

### Semester - IV

### Theory: BCT- 401 Intermediary Metabolism

**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, C<sub>4</sub> Pathway. Disorders of carbohydrate metabolism- Diabetes Mellitus.

#### **Unit- II: Lipid Metabolism**

**12 hours**

Catabolism of fatty acids ( $\beta$ - 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.

### **Semester-V**

## **Theory: BCT-501-Physiology, Clinical Biochemistry and Immunology**

60 hrs

(5 periods/  
week)

### **Unit- I : Physiology**

12 hours

Digestion and absorption of carbohydrates, lipids and proteins. Composition of blood and coagulation blood. Hemoglobin and transport of gases in blood (oxygen and CO<sub>2</sub>).  
Muscle- kinds of muscles and mechanism of muscle contraction.

### **Unit II: Endocrinology**

12 hours

Endocrinology- organization of endocrine system. Classification of hormones. Outlines of chemistry, physiological role and disorders of hormones of thyroid, parathyroid, pituitary and hypothalamus. Introduction of gastrointestinal hormones. Mechanism of hormonal action- signal transduction pathways for glucocorticoids and insulin. Adrenalin, estrogen and progesterone.

### **Unit- III : Nutritional Biochemistry**

12 hours

Balanced diet. Calorific values of foods and their determination by bomb calorimeter. BMR and factors affecting it. Specific dynamic action of foods. Energy requirements and recommended dietary allowance (RDA) for children, adults, pregnant and lactating women. Sources of complete and incomplete proteins. Biological value of proteins. Malnutrition- Kwashiorkor, Marasmus and PEM.  
Vitamins- sources, structure, biochemical roles, deficiency disorders of water and fat soluble vitamins. Introduction to nutraceutical and functional foods. Bulk and trace elements-Ca, Mg, Fe, I, Cu, Mo, Zn, Se and F. Obesity and starvation.

### **Unit- IV : Clinical Biochemistry**

12 hours

Plasma proteins in health and disease. Disorders of blood coagulation (haemophilia). Types of anemias, haemoglobinopathies-sickle cell anemia.  
Liver diseases-jaundice. Liver function tests- conjugated and total bilirubin in serum, albumin: globulin ratio, Serum enzymes in liver diseases- SGPT, GGT and alkaline phosphatase.  
Kidneys-structure of nephron, urine formation, normal and abnormal constituents of urine. Biological buffers. Role of kidneys in maintaining acid-base and electrolyte balance in the body. Renal function test- creatinine.

### **Unit- V : Immunology**

12 hours

Organization of immune system. Organs and cells of immune system. Innate and acquired immunity. Cell mediated and humoral immunity (T- and B- cells). Classification of immunoglobulins, structure of IgG. Epitopes / antigenic determinants. Concept of haptens. Adjuvants. Monoclonal antibodies. Antigen-antibody reactions- agglutination, immunoprecipitation, immunodiffusion. Blood group antigens. Immunodiagnosics- ELISA. Vaccines and their classification. Traditional vaccines-live and attenuated. Modern vaccines- recombinant and peptide vaccines. Outlines of hypersensitivity reactions.

## **Practical: BCP-501-Nutritional and Clinical Biochemistry**

45 hrs

(3 periods/week)

### **List of Experiments:**

1. Estimation of calcium by titrimetry
2. Estimation of iron by Wong's method.
3. Estimation of vitamin C by 2, 6 -dichlorophenol indophenol method.
4. Determination of iodine value of an oil.
5. Estimation of hemoglobin in blood.



6. Total count - RBC and WBC. Differential count.
7. Determination of blood group and Rh typing.
8. Visualization of antigen antibody reactions (Ouchterlony technique).
9. Urine analysis for albumin, sugars and ketone bodies.
10. Estimation of urinary creatinine.
11. Estimation of blood Glucose.
12. Estimation of serum total cholesterol.

### **Elective Theory BCT-502: Basic Microbiology**

**60 hrs**  
**(5 periods/weeks)**

#### **Unit –I : History of Development of Microbiology**

**12hrs**

Development of microbiology as a discipline, Spontaneous generation vs. biogenesis. Contributions of Anton von Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Alexander Fleming. Role of microorganisms in fermentation, Germ theory of disease, Development of various microbiological techniques. Establishment of fields of medical microbiology and immunology through the work of Paul Ehrlich, Elie Metchnikoff, Edward Jenner

#### **Unit-II: Diversity of Microbial world**

**12hrs**

Binomial Nomenclature, Whittaker's five kingdom and Carl Woese's three kingdom classification systems and their utility. Difference between prokaryotic and eukaryotic microorganisms. General characteristics of different groups: acellular microorganisms (Viruses, Viroids, Prions) and Cellular microorganisms (Bacteria, Algae, Fungi and Protozoa) with emphasis on distribution and occurrence and mode of reproduction.

#### **Unit-III : Viruses, Bacteria and Protozoa**

**12hrs**

An introduction to viruses with special reference to the structure and replication of the following: Poxvirus and Poliovirus. Bacterial Diseases- Cholera and Typhoid. TMV and T<sub>4</sub> . Protozoan Diseases- Amebiasis and Malaria.

#### **Unit- IV: Algae**

**12hrs**

History of phycology; General characteristics of algae: occurrence, thallus organization, algae cell ultra structure, pigments, flagella, eyespot food reserves and vegetative, asexual and sexual reproduction. Applications of Algae in agriculture, industry, environment and food.

#### **Unit- V: Fungi**

**12hrs**

General characteristics of fungi - habitat, distribution, nutritional requirements, fungal cell ultra-structure, thallus organization and aggregation, fungal wall structure and synthesis, asexual reproduction, sexual reproduction, heterokaryosis, heterothallism and parasexual mechanism. Economic Importance of Fungi in Agriculture, environment, Industry, medicine, food, biodeterioration, mycotoxins

### **ELECTIVE PRACTICAL BCP-502: BASIC MICROBIOLOGY**

**45 hrs**  
**(3 per/week)**

#### **List of Experiments:**

1. Microbiology Laboratory Practices and Biosafety.
2. To study the principle and applications of important instruments (biological safety cabinets, autoclave, incubator, BOD incubator, hot air oven, light microscope, pH meter)

3. Preparation and sterilization of culture media for bacterial cultivation
4. Study of different shapes of bacteria, fungi, algae, protozoa using permanent slides/pictographs
5. Staining of bacteria using Gram stain
6. Isolation of pure cultures of bacteria by streaking method.
7. Estimation of CFU count.

### **SUGGESTED READINGS**

1. Atlas RM. (1997). Principles of Microbiology. 2nd edition. W M.T.Brown Publishers.
2. Pelczar MJ, Chan ECS and Krieg NR. (1993). Microbiology. 5th edition. McGraw Hill Book Company

## **Elective Theory BCT-503: Molecular Basis of Infectious Diseases**

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

### **Unit-I : Classification of infectious agents**

**No. of Hours : 12**

Bacteria, Viruses, protozoa and fungi. Past and present emerging and re-emerging infectious diseases and pathogens. Source, reservoir and transmission of pathogens, Antigenic shift and antigenic drift. Host parasite relationship, types of infections associated with parasitic organisms. Overview of viral and bacterial pathogenesis. Infection and evasion.

### **Unit-II: Overview of diseases caused by bacteria**

**No. of Hours : 12**

Detailed study of tuberculosis: History, causative agent, molecular basis of host specificity, infection and pathogenicity, Diagnostics, Therapeutics, inhibitors and vaccines. Drug resistance and implications on public health. Other bacterial diseases including Typhoid, Diphtheria, Pertussis, Tetanus and Pneumonia.

### **Unit –III: Overview of diseases caused by Viruses**

**No. of Hours : 12**

Detailed study of AIDS, history, causative agent, pathogenesis, Diagnostics, Drugs and inhibitors. Other viral diseases including hepatitis, influenza, rabies, chikungunya and polio.

### **Unit-IV: Overview of diseases caused by Parasites**

**No. of Hours : 12**

Detailed study of Malaria, history, causative agents, Vectors, life cycle, Host parasite interactions, Diagnostics, Drugs and Inhibitors, Resistance, Vaccine development. Other diseases including leishmaniasis, amoebiasis.

### **Unit-V: Overview of diseases caused by other organisms**

**No. of Hours : 12**

Fungal diseases, General characteristics. Medical importance of major groups, pathogenesis, treatment.

### **Elective Practical BCP-503: MOLECULAR BASIS OF INFECTIOUS DISEASES**

**45 hrs  
3 periods/ Week**

#### **List of Experiments:**

1. Permanent slides of pathogens. Mycobacterium tuberculosis, Leishmania, Plasmodium falciparum
2. WIDAL test
3. Gram staining
4. Acid fast staining

4. PCR based diagnosis
5. Dot Blot ELISA
6. Immunization Programme- Field visit.

#### **SUGGESTED READINGS**

1. Prescott, Harley, Klein's Microbiology (2008) 7<sup>th</sup> Ed., Willey, J.M., Sherwood, L.M., Woolverton, C.J. Mc Graw Hill International Edition (New York) ISBN: 978-007126727.
2. Mandell, Douglas and Bennett.S, Principles and practices of Infectious diseases, 7<sup>th</sup> edition, Volume, 2. Churchill Livingstone Elsevier.
3. Sherris Medical Microbiology: An Introduction to Infectious Diseases by Kenneth J.Ryan, C. George Ray, Publisher: McGraw-Hill
4. Medical Microbiology by Patrick R. Murray, Ken S. Rosenthal, Michael A. Pfaller, Elsevier Health Sciences

### **Semester – VI** **60 hrs** **(5 periods/week)**

#### **Theory: BCT-601-Microbiology and Molecular Biology**

#### **Unit- I : Microbiology**

**12 hours**

Introduction to brief history of microbiology. Classification of microorganisms- prokaryotic and eukaryotic microorganisms. Isolation and cultivation of bacteria. Selective media and enriched media. Bacterial growth curve and kinetics of growth. Gram's staining- Gram positive and Gram negative bacteria, motility and sporulation. Structure and composition of viruses. Isolation and cultivation of bacterial plaques. Lytic and lysogenic life cycle of  $\lambda$  phage. Retro viruses- HIV.

#### **Unit II-Applied Biochemistry**

**12 hours**

Fermentation Technology: Batch, continuous culture techniques, principle types of fermentors. Industrial production of chemicals- alcohol, acids (citric acid), solvents (acetone), antibiotics (penicillin), Enzyme Technology: Immobilization of enzymes and cells, different methods. Industrial applications. Production of transgenic plants and their applications. Introduction to Bioinformatics- definitions of proteomics and genomics. Gene bank, NCBI, DDBJ, Swissprot, PDB. Sequence alignments- BLAST and FASTA.

#### **Unit- III : DNA Replication and Transcription**

**12 hours**

Nature and structure of the gene. DNA replication- models of replication, Meselson-Stahl's experimental proof for semi-conservative model. DNA polymerases I, II and III of *E.coli*, helicase, topoisomerases, primase, ligase. Bidirectional replication model. Okazaki fragments, leading and lagging strands of DNA synthesis. Inhibitors of DNA replication. Transcription - RNA synthesis, RNA polymerases of prokaryotes. Promoters, Initiation- sigma factors and their recognition sites. Elongation- role of core enzyme. Termination- rho dependent and rho independent.

#### **Unit- IV: Protein Synthesis and Regulation of Gene Expression**

**12 hours**

Introduction to protein synthesis- Genetic code, deciphering of genetic code, Nirenberg's and Khorana's experiments, wobble hypothesis, degeneracy of genetic code.

Protein synthesis- activation of amino acids (aminoacyl t-RNA synthetases). Ribosome structure. Initiation, elongation and termination of protein synthesis. Post- translational modifications- signal hypothesis. Inhibitors of protein synthesis.  
Regulation of prokaryotic gene expression- induction and repression. Lac operon.

#### **Unit- V: Recombinant DNA technology**

**12 hours**

Outlines of cloning strategies. DNA sequencing- Maxam Gilbert and Sanger's methods. Tools of r-DNA technology: Enzymes- Restriction endonucleases, ligase, phosphatases, reverse transcriptase, polynucleotide kinases, terminal transferase nucleases-S<sub>1</sub> and RNAase H. Restriction mapping. Cloning vectors- Plasmid, Expression vector - Host- *E.coli*.

Construction of c-DNA and genomic libraries. Isolation and sequencing of cloned genes- colony hybridization, nucleic acid hybridization.

Polymerase chain reaction- principle and applications. Outlines of blotting techniques-Southern, Northern and Western.

Applications of gene cloning- production of insulin and human growth hormone, production of Bt cotton and edible vaccines.

#### **Practical: BCP-601: Microbiology and Molecular Biology**

**45 hrs**

**(3 periods/week)**

#### **List of Experiments:**

1. Preparation of culture media and sterilization methods.
2. Isolation of pure cultures: (i) Streak plate method. (ii) Serial dilution method.
3. Gram staining.
4. Motility of bacteria by hanging drop method.
5. Antibiotic sensitivity by paper disc method.
6. Isolation of DNA from onion/liver/coconut endosperm.
7. Estimation of DNA by diphenylamine method.
8. Estimation of RNA by orcinol method..
9. Sequence alignments of insulin/BSA with other proteins using BLAST and FASTA.
10. Examination of milk quality by MBRT method.

#### **Elective Theory BCT-602: Biochemistry of Cell**

**60hrs**

**(5 periods/week)**

#### **Unit- I: Biomolecules in their cellular environment**

**No. of Hours : 12**

The cellular basis of life. Cellular structures – prokaryotes and eukaryotes. Chemical principles in biomolecular structure. Major classes of biomolecules. Role of water in design of biomolecules.

#### **Unit –II : Amino acids and Lipids**

**No. of Hours : 12**

Types of amino acids and their chemistry, derivatives of amino acids and their biological role. Introduction to biologically important peptides. Various classes of lipids and their distribution, storage lipids, structural lipids in membranes, lipids as signals, cofactors and pigments.

#### **Unit- III: 3 Sugars and Nucleic Acids**

**No. of Hours : 12**

Basic chemistry of sugars, optical activity. Disaccharides, trisaccharides and polysaccharides - their distribution and biological role. Structures and chemistry, DNA structures and their importance, different types of RNA. Unusual DNA structures, other functions of nucleotides.

**Unit- IV : Vitamins, coenzymes and metal ions****No. of Hours : 12**

Occurrence and nutritional role of vitamins. Coenzymes and their role in metabolism. Metal ion containing biomolecules - heme, porphyrins and cyanocobalamin; their biological significance.

**Unit- V: Signalling molecules****No. of Hours : 12**

Second messengers - cAMP, cGMP, IP<sub>3</sub>, diacyl glycerol, Ca<sup>2+</sup>, NO. Brief account of their importance and role in signalling and signal transduction.

**Elective Practical – 602 : Biochemistry of Cell****45 hrs****(3 periods/week)**

1. General safety procedures in a laboratory. Use of auto pipettes. Making solutions and buffer preparation - acetate and tris buffers.
2. Qualitative tests for biomolecules - carbohydrates, lipids, amino acids, proteins, bases and nucleic acids.
3. Separation of amino acids by paper chromatography.
4. Separation of sugars/bases by TLC and their identification.
5. Estimation of ascorbic acid in fruit juices.

**SUGGESTED READINGS**

1. Lehninger: Principles of Biochemistry (2013) 6<sup>th</sup> ed., Nelson, D.L. and Cox, M.M., W.H. Freeman and Company (New York), ISBN:13; 978-1-4641-0962-1 / ISBN:10-146410962-1.
2. Textbook of Biochemistry with Clinical Correlations (2011) 7<sup>th</sup> ed., Devlin, T.M., John Wiley & Sons, Inc. (New York), ISBN:978-0-470-28173-4.

**Elective Theory: BCT-603: Biochemical Correlations in Diseases****60 hrs****(5 periods/week)****Unit- I : Inborn errors of metabolism****No. of Hours : 12**

Alkaptonuria, Phenylketonuria, Glycogen and Lipid storage diseases, SCID, Clotting disorders.

**Unit- II: Nutritional Deficiency and Life style diseases****No. of Hours : 12**

Kwashiorkar, Marasmus, Beri-beri, Scurvy, Pellagra, Anaemia, Night blindness, Rickets, Osteomalacia, Osteoporosis, Wilson's disease. Obesity, Cardiovascular diseases, Atherosclerosis, Diabetes mellitus-II. Inflammatory Bowel Disease (IBD).

**Unit- III: Hormonal Imbalances and Autoimmune diseases****No. of Hours : 12**

Outline of hormone action and imbalances leading to disease - precocious puberty, hyper and hypopituitarism. Hyper and hypothyroidism. Concepts in immune recognition - self and non self discrimination, organ specific autoimmune diseases – Hashimoto's thyroiditis, Grave's disease, myasthenia gravis; Systemic diseases - SLE, rheumatoid arthritis; Diabetes Mellitus-I.

**Unit- IV : Diseases caused due to misfolded proteins****No. of Hours : 12**

Alzheimer's, Huntington's disease, Kuru, Creutzfeldt-Jakob disease, Sickle cell anaemia, Thalessemia.

**Unit- V: Infectious diseases****No. of Hours : 12**

Viral infection (polio, measles, mumps, influenza, HIV); Bacterial infections (tetanus, diphtheria, tuberculosis, typhoid, cholera); Protozoan (*Plasmodium* and *Trypanosoma*) and parasitic infections. Vaccines against diseases. General strategies in the design and development of vaccines.

**Elective Practical BCP- 603: Biochemical Correlations in Diseases****45 hrs  
(3 per/week)**

1. Glucose tolerance test.
2. Lipid profile: triglycerides and total cholesterol.
3. Obesity parameters.
4. RBC counting and haemoglobin estimation.
5. Blood pressure measurements.
6. Bone density measurements (visit to a nearby clinic).
7. T<sub>4</sub>/TSH assays.
8. Tridot Test/ Lateral flow test for viral diseases

**SUGGESTED READINGS**

1. Textbook of Biochemistry with Clinical Correlations (2011) Devlin, T.M. John Wiley & Sons, Inc. (New York), ISBN: 978-0-4710-28173-4.
2. Immunology: A Short Course (2009) 6<sup>th</sup> ed., Coico, R and Sunshine, G., John Wiley & sons, Inc (New Jersey), ISBN: 978-0-470-08158-7
3. Biochemistry (2012) 7<sup>th</sup> ed., Berg, J.M., Tymoczko, J.L. and Stryer, L., W.H Freeman and Company (New York), ISBN: 13:978-1-4292-7635-1.
4. Genetics (2012) 6<sup>th</sup> ed., Snustad, D.P. and Simmons, M.J., John Wiley & Sons. (Singapore), ISBN: 978-1-118-09242-2.

**Recommended Books for UG Course -Biochemistry****General Biochemistry**

1. Lehninger's Principles of Biochemistry – Nelson.D.L. and Cox.M.M., Freeman & Co.
2. Biochemistry – Berg.J.M., Tymoczko.J.L. and Stryer.L., Freeman & Co.
3. Biochemistry – Voet.D and Voet., J.G., John Wiley & Sons
4. Textbook of Biochemistry – West.E.S., Todd.W.R, Mason.H.S..and. Bruggen, J.T.V., Oxford & IBH Publishers.
5. Principles of Biochemistry: General Aspects-Smith, E. L., Hill, R.L. Lehman, I. R. Lefkowitz, R.J. Handler, P., and White, A. McGraw-Hill
6. Outlines of Biochemistry – Conn.E.E., Stumpf.P.K., Bruening, G and Doi.R.H., John Wiley & Sons .
7. Harper's Illustrated Biochemistry – Murray, R.K., Granner.D.K. & Rodwell,V.W., McGraw-Hill
8. Biochemistry-Lippincott's Illustrated Reviews. Champe, P.C. and Harvey, R. A. Lippincott
9. Fundamentals of Biochemistry –Jain, J.L., Jain, S., Jain, N. S. Chand & Co.
10. Biochemistry – Satyanarayana. U and Chakrapani. U, Books & Allied Pvt. Ltd.

11. Biochemistry – Rama Rao. A and Ratna Kumari. D, Kalyani Publishers.
12. Biochemistry- The Molecular Basis of Life – McKee. T and McKee, J. R, McGraw-Hill.

### **Enzymology**

1. Fundamentals of Enzymology – Price.N.C.and Stevens.L., Oxford University Press.
2. Understanding Enzymes – Palmer.T., Ellis Harwood.
3. Enzymes – Biochemistry, Biotechnology, Clinical Chemistry – Palmer.T., Affiliated East-West Press

### **Biochemical Techniques**

1. Principles and Techniques of Practical Biochemistry- Wilson, K. and Walker, J. Cambridge Press.
2. The Tools of Biochemistry- Cooper, T. G. John Wiley & Sons Press.
3. Physical Biochemistry- Friefelder, D. W.H. Freeman Press.
4. Analytical Biochemistry – Holme.D.J. and Peck.H., Longman.
5. Biophysical Chemistry: Principle and techniques- Upadhyay A, Upadhyay K and Nath. N. Himalaya Publishing House.
6. Experimental Biochemistry- Clark Jr. J.M and Switzer, R. L. Freeman & Co..

### **Physiology, Nutrition and Clinical Biochemistry:**

1. Textbook of Biochemistry and Human Biology – Talwar, G.P. and Srivastava. L.M., Printice Hall of India
2. Review of Medical Physiology-Ganong. McGraw-Hill.
3. Human Physiology – Chatterjee.C.C, Medical Allied Agency
4. Textbook of Medical Physiology – Guyton.A.G and Hall.J.E., Saunders
5. William’s Textbook of Endocrinology – Larsen, R. P. Korenberg, H. N. Melmed, S. and Polensky, K. S. Saunders
6. Mammalian Biochemistry- White, A. Handler, P. and Smith, E. L. McGraw-Hill.
7. Textbook of Human Nutrition- Bamji, Pralhad Rao and Reddy V. Oxford & IBH Publishers.
8. Foods: Facts & Principle- Shakuntala and Shadaksharaswamy. Wiley Ester Press.
9. Essentials of Food and Nutrition – Swaminathan.M. Bangalore Press.
10. Human Nutrition and Dietetics. Davidson, S. and Passmore, J. R. ELBS.
11. A Textbook of Biochemistry: Molecular and Clinical Aspects. Nagini, S. Scitech Publishers.
12. *Tietz* Fundamentals of Clinical Chemistry- Burtis, A. A. and Ashwood, E. R. Saunders-imprint Elsevier Pub.
13. Textbook of Biochemistry with Clinical Correlations – Devlin.T.M.,Wiley – Liss
14. Textbook of Medical Biochemistry – Chatterjea.M.N. and Shinde.R, Jaypee Brothers Medical Publishers.
15. Textbook of Medical Biochemistry- Ramakrishnan, S., Prasannan, K. G. and Rajan, R. Orient Longman

### **Immunology:**

1. Immunology. Tizard, I. R. Thomson Press.
2. Kuby Immunology – Kindt.T.J., Goldsby.R.A. and Osborne.B.A., Freeman & Co.
3. Roitt’s Essential Immunology – Roitt.I.M. and Delves.P.J., Blackwell Science.
4. Immune system- Parham. Garland Publishing.

### **Microbiology:**

1. Introduction to Microbiology: A Case History Approach- Ingraham and Ingraham. Thomson Press.
2. Textbook of Microbiology – Ananthanarayan, R and Jayaram Paniker, C.K., Orient Longman.
3. Microbiology – Prescott.L.M.,Harley.J.P. & Klein.D.A, McGraw-Hill.
4. Microbiology: An Introduction- Tortora, G. J. Funke, B. R. and Case, C. L., Pearson-Benjamin-Cummings Co.
5. Microbiology – Pelczar Jr.,M.J., Chan.E.C.S. and Krieg.N.R., Tata McGraw-Hill.
6. Textbook of Microbiology- Dubey, R. C. and Maheshwari, D. K. S. Chand & Co.

### **Molecular Biology and Biotechnology:**

1. Protein Biochemistry & Biotechnology- Walsh. John Wiley & Sons Press.
2. Molecular Biology of Cell- Alberts, B. Bray, D. Lewis, J. Raff, M. Roberts, K. and Watson, J. D. Garland Publishing.
3. Recombinant DNA and Biotechnology: A Guide for teachers- Helen and Massey. ASM Press.
4. Genes VIII – Lewin. B, Oxford University Press .
5. Molecular Biology- Freifelder. D. Narosa Pub. House
6. Molecular Biology of the Gene- Watson. J.D., Baker, T.A, Bell, S.P.,Gann.A, Levine, M. and Losick.R, Pearson Education.
7. Molecular Biotechnology- Glick, B. R. and Pasternak, J. J. ASM Press
8. Principles of Gene Manipulation: An Introduction to GE- Old, R. V. and Primrose, S. B. Blackwell Sci. Pub.
9. A Textbook of Biotechnology-Dubey, R. C. S. Chand & Co.
10. Gene Biotechnology- Jogdand. Himalaya Pub. House.
11. Introduction to Biotechnology: An Agricultural Revolution-Herren. Thomson Press.
12. Molecular Cell Biology- Lodish, H., Berk, A., Matsudaira, P., Kaiser, C. A., Krieger, M. Scott M. P., Zipursky, S. L. and Darnell, J. Freeman & Co.

### **Bioinformatics**

1. Instant Notes-Bioinformatics- Westhead *et al.*, Viva Books (P), Ltd
2. Introduction to Bioinformatics- Attwood T K and Parry-Smith, D. J. Pearson Education.
3. Introduction to Bioinformatics- Lesk, A.M. Oxford University Press

### **Practical Biochemistry:**

1. Experimental Biochemistry: A Student companion- Sashidhar Rao, B and Deshpande, V. IK International (P) Ltd. Pub.
2. Modern Experimental Biochemistry- Boyer. R. Pearson Education
3. Biochemical Methods –Sadasivam, S and Manickyam, A.- New Age International publishers
4. An Introduction to Practical Biochemistry- Plummer, D. T. Tata McGraw-Hill.
5. Introductory Practical Biochemistry (ed) Sawhney, S. K. Randhir Singh- Narosa Publications House
6. Lab Manual in Biochemistry, Immunology and Biotechnology- Arti Nigam and Archana Ayyagari- Tata McGraw-Hill New Delhi
7. Enzyme Assays – A Practical Approach – Eisenthal, R and Dawson, M.J., IRL Press
8. Practical Biochemistry – Rameshwar. A, Kalyani Publisher.
9. Experiments and Techniques in Biochemistry – Sheel Sharma, Galgotia Publications.
10. Practical Clinical Biochemistry-Varley,H. CBS Publishers.
11. Practical Clinical Biochemistry –Methods and Interpretations –Ranjna Chawla- Jaypee



12. Manipal Manual of Clinical Biochemistry-Shivande Naik, B - Jaypee Brother Medical publications, New Delhi
13. Hawk's Physiological Chemistry- (ed) Oser, O. Tata-McGraw-Hill
14. Laboratory Manual in Biochemistry. Jayaraman, J. Wiley-Eastern
15. Biotechnology: A laboratory Project in Molecular Biology- Thiel, Bissen and Lyons. Tata McGraw-Hill.
16. Methods in Biotechnology- Hans-Peter Schmauder. Taylor & Francis.

**Practical Microbiology:**

1. Microbiology – A Laboratory Manual- Cappuccino, J. G. and Sherman, N. Pearson Education.
2. Laboratory Experiments in Microbiology- Gopal Reddy, M., Reddy, M.N., Sai Gopal D. V.R. and. Mallaiah, K.V.
3. Experiments in Microbiology, Plant Pathology, Tissue Culture and Mushroom cultivation-Aneja, K. R - New Age International publishers.
4. Microbiology – A Laboratory Manual- Reddy, S. M. and Ram Reddy, S. Sri Padmavathi Pub.
5. Practical Microbiology- Dubey, R. C. and Maheshwari, D. K. S. Chand & Co.

**Mathematical Problems in General Biochemistry:**

1. Biochemical Calculations- Segel, I.H. John Wiley & Sons.

**Lab Reference Book:**

1. Lab Ref A Hand book of Recipes, Reagents and Other Reference Tools for Use at the Bench- (ed) Roskams, J. and Rodgers, L.- I.K International Pvt. Ltd, New Delhi.

**MODEL QUESTION PAPER FOR END SEMESTER EXAM**

B. Sc Degree Course (CBCS Semester pattern)

**B. Sc Biochemistry**

Time : 3 Hrs

Max marks : 75

**SECTION A**

(5 x 5 = 25 marks)

Attempt any five of the following

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.
- 8.

**SECTION – B**

(10 x 5 = 50 marks)

Attempt all the questions

9.

(OR) Unit I

10.

11.

(OR) Unit-II

12.

(OR) Unit-III

13.

(OR) Unit IV

14.

15.

(OR) Unit V

16.

**Distribution of Practical Exam Marks**

Practical Exam Time: 3 Hrs

Max marks: 50

1. Major Experiment	20 (Principle -5M, Methodology-10M, Results-05)
2. Minor Experiment	10 (Principle -2M, Methodology-05M, Results-03)
3. Spotters	10 (5 nos. x 2 M)
4. Record	05
5. Viva-voce	05

**MODEL QUESTION PAPER FOR SEMESTER END PRACTICAL EXAMINATIONS**  
**B.Sc., Course Semester End Practical examination**  
**B.Sc., Biochemistry**

TIME: 3 hours

Max. Marks: 50

- |   |          |
|---|----------|
| 1. Major experiment.  | 20 marks |
| 2. Minor experiment   | 10 marks |
| 3. Identify the given spotter and write a brief note on it- A, B, C,D,E, F (5x2M) | 10 marks |
| 4. Record   | 05 marks |
| 5. Viva-voce  | 05 marks |

**MID TERM EXAMINATIONS**

**(Ist and IInd Internal Assessment Examinations)**

Internal assessment; after completion of two Units one internal test will be conducted

No. of internal tests; Two

Average two internal tests will be taken

Total no. of Marks 25

Pattern; out of five short answers three questions have to be attempted each carries 5 Marks.

In essay questions out of two questions, one has to be attempted which carries 10 marks.

**MID SEM EXAM MODEL QUESTION PAPER**

**Ist INTERNAL ASSESMENT EXAMINATION**

**B. Sc Degree Course (CBCS-Semester pattern)**

**B. Sc., Biochemistry**

Time : 1 Hr

Max marks : 25

**SECTION -A**

(3 x 5 M= 15M)

Attempt any **THREE** short questions of the following

- 1.
- 2.
- 3.
- 4.
- 5.

**SECTION – B**

(1x 10M = 10 marks)

Attempt any **ONE** essay question of the following

- 6.
- 7.

**MID SEM EXAM MODEL QUESTION PAPER**  
**IIInd INTERNAL ASSESMENT EXAMINATION**  
**B. Sc Degree Course (CBCS-Semester pattern)**  
**B. Sc Biochemistry**

**Time : 1 Hr**

**Max marks : 25**

**SECTION - A**

**(3 x 5 M= 15M)**

Attempt any **THREE** short questions of the following

- 1.
- 2.
- 3.
- 4.
- 5.

**SECTION – B**

**(1x 10M = 10 marks)**

Attempt any **ONE** essay question of the following

- 6.
- 7.