# Department of Biochemistry
## Restructured Academic Programme – CBCS

### I Year
#### Semester I

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Semester - I  
Cell Biology  
6 Hours/ week  
5 Credits

Paper – I

Unit – I
An overall view of cells – Definition, Cell Theory, Scope of cell biology, Types of cell – Prokaryotic and eukaryotic cells. Salient features of cell [Pro & Eu], Composition of cells.

Unit – II

Unit – III

Unit – IV
Mitochondria – Chemical composition, structure and functions. Ribosomes – types, structure and functions. Microtubules – Chemistry and functions (esp. cilia and flagella).

Unit – V

References:

4. Cell and molecular Biology – D.Robertis
5. Molecular cell biology –Lodish, Berk, Baltimore, Freeman
6. Cell, A molecular approach- cooper
8. Biochemistry – L. Stryer
Semester – II

Biomolecules

Paper - II

6 Hours /week

5 Credits

Unit – I: Carbohydrates
Classification of carbohydrates, stereo isomerism and optical isomerism of sugars, anomer form and mutarotation. Structure of mono, di, and polysaccharide. (esp. starch, glycogen & cellulose ). An introduction to mucopolysaccharide (proteoglycon). Reaction of carbohydrates due to the presence of hydroxyl, aldehyde & keto group(Structural elucidation not necessary).

Unit – II: Amino Acids

Unit – III: Proteins

Unit – IV: Lipids
Classification, essential fatty acids, structure and functions of phospholipids (esp. lecithin, cephalin, phosphotidyl inositol and phophotidyl serine) sphingomyelin, plasmalogens. Structure and function of glycolipids, cholesterol.

Unit – V: Nucleic Acid
Structure of purine and pyrimidine, nucleotide. Composition of DNA and RNA – Watson crick model of DNA. Types of nucleic acid DNA & RNA, Structure and properties of DNA and Structure and property of RNA. Properties of nucleic acid include TM, denaturation and renaturation, hypo & hyperchromcity.

Reference:
Semester - II
Core Practicals
6 Hours/week
4 Credits

Paper – III

I Experiments Involving Titrimetric Procedures

a) Estimation of Amino acids by Formal titration.
b) Estimation of Ascorbic acid by titrimetric method using 2,6 Dichlorophenol indo phenol.
c) Determination of Saponification value of Edible oil.
d) Determination of Acid Number of Edible oil.
e) Estimation of reducing sugar from biological fluids by Benedict's Titrimetric method.
f) Determination of Iodine value of Oil.

II Qualitative Analysis

a) Reactions of simple sugars including Glucose, fructose, galactose, mannose, Ribose, Xylose, maltose, sucrose, lactose, starch, Glycogen and Dextrin.
b) Reactions of Proteins - Solubility, Biuret, Millions Xanthoproteic test, Denaturation by Heat, pH change and precipitation by acidic reagents. Color reactions of amino acids like Tryptophan, Tyrosine, cystine, Methionine, Arginine, Proline and Histidine.
c) Reactions of Lipids – Solubility, Saponification test for Unsaturations, Libermann Burchard test for Cholesterol.

Question Paper Pattern for Theory Papers

The Question paper shall have three sections with the maximum of 75 marks with the following break-up:

Section - A
Section A shall contain 10 short answer questions without choice drawn from all the units on the basis of minimum two from each unit. Each question shall carry 2 Marks. (10 X 2 = 20 Marks)

Section - B
Section B shall contain 5 either or questions drawn from all the five units. Each question shall carry 5 marks. (5 X 5 = 25 Marks)

Section - C
Section C shall contain 5 questions drawn one each from the five units. Three questions out of the five are to be answered each carrying 10 marks. (3 X 10 = 30 Marks)
Core Practical - I

The practicals contain two components: Internal and External
Internal Marks 40
External Marks 60

Internal Components

Internal Components includes lab work of 40 marks

**Titration**
- Total Experiments = 6
- Total marks = 60
- Total marks obtained by student = X
- Marks calculated = \((X / 60) \times 10\)

**Qualitative analysis**
- Total Experiments = 15
- Total marks = 10
- Total marks obtained by student = X
- Marks calculated = \((X / 150) \times 15\)
- CA marks = 15

External Components

External Components includes Practical examination

Practical Exam = 50
Record = 10
III & IV Semester
Biophysical Chemistry

6 Hours / week
5 Credits

Paper III

Unit - I: Units of Measurement
Units of measurement of solutes in solution, normality, molality, molarity, and milliosmol and ionic strength, examples for this concept. Isotonic solution, hypertonic and hypotonic solution. Osmosis and its applications and osmotic pressure. Principles of sonication, dialysis and ultra filtration.

Unit -II: Buffers in Body Fluid System

Unit – III: Electrochemical Techniques

Unit -IV: Thermodynamics
Work heat and energy, enthalpy, Reversible & irreversible process, isothermal and adiabatic process, Hess’s law and its applications, kirchoff’s equation, First law of thermodynamics, relations between Cp & Cv, entropy, carnot engine, clausius clapeyron equation, determination of free energy change (G) in bio – chemical reaction, high energy compounds and coupled reactions.

Unit- IV: Electrophoretic Techniques
General principles, factors affecting the migration rate – sample, electric field, buffer and supporting medium. Paper electrophoresis, Tiselius moving boundary electrophoresis, PAGE, determination of molecular weight of proteins using SDS-PAGE, immuno electrophoresis, Agarose gel electrophoresis.

References
1. Biophysical Chemistry-Upadhyay and Upadhyay Nath, Himalayan Publication
2. Biomedical Instrumentation- M.Arumugam, Anuradha agencies, Chennai.
5. Physical Chemistry – Puri & Sharma
6. Physical biochemistry – P.E. ATKINS
7. Physical biochemistry and molecular biochemistry – David Freifelder
Paper IV

Unit -I: Centrifugation Techniques
Basic principles - Sedimentation rate, Svedberg unit, different types of rotors. Different types of centrifugation - Differential, density gradient, isopycnic and equilibrium centrifugation. Preparative and analytical ultra centrifugation techniques. Determination of molecular weight by analytical centrifugation method.

Unit-II: Chromatographic Techniques

Unit-III: Spectrophotometric Techniques

Unit-IV: Spectrofluorimetry, Flame Photometry and Atomic Absorption Techniques
Principles, instrumentation and applications in vitamins assays (riboflavin and thiamine), enzyme assays, fluorescent probes in the study of protein. Flame photometry – principle, instrumentation and applications. Principle and instrumentation of Atomic absorption and Spectrophotometry with one example.

Unit-V: Radio Isotopic Techniques
Atomic structure, radiation, types of radioactive decay, half-life, and units of radioactivity (Roentgen, Rad, Rem, Let). Detection and measurement of radioactivity – methods based upon ionization (GM counter), methods based upon excitation (scintillation counter) and Autoradiography, Applications of radioisotopes – investigation of metabolic pathway, clinical studies, isotonic dilution technique, protein turnover, radio carbon dating. Biological hazards of radiation and safety measures in handling radio isotopes.

References
6. Biophysical chemistry – David Friefleder
IV Semester
Main Practical -II

6 Hours / week
4 Credits

1. Oxidometry
   a. Use of potassium permanganate in the estimation of iron, oxalates and nitrite
   b. Estimation of calcium from biological fluids like blood, milk and urine.
   c. Use of potassium dichromate in the standardization of sodium thiosulphate and estimation of copper by iodimetry.

2. Volumetric Analysis
   a. Estimation of chloride by Morh’s and Volhard’s method.

3. Preparation Of Buffers
   Phosphate buffer, Tris buffer and Citrate buffer.

4. Colorimetry
   a. Estimation of inorganic phosphorus by Fiske and Subbarow method.
   b. Estimation of amino acids by Ninhydrin method.
   c. Estimation of protein by Biuret method.

5. Biochemical Preparation
   a. Preparation of starch from potatoes.
   b. Preparation of casein and lactalbumin from milk.
   c. Preparation of albumin from egg.

Question Paper Pattern for Theory Papers
The question paper shall have three sections with the maximum of 75 marks with the following break-up:

   Section - A

Section A shall contain 10 short answer questions without choice drawn from all the units on the basis of minimum two from unit. Each question shall carry 2 Marks. (10 X 2 = 20 Marks)

   Section - B

Section B shall contain 5 either or questions drawn from all the five units. Each question shall carry 5 marks. (5 X 5 = 25 Marks)

   Section – C

Section C shall contain 5 questions drawn one each from the five units. Three questions out of the five are to be answered each carrying 10 marks. (3 X 10 = 30 Marks)

9
Question Paper Pattern for Practical (2008-09 Batch)

Total: 100 Marks
Time: 6 Hours

Main Practical - II

The practical papers consist of the internal assessment of 40 marks and semester examination for 60 marks.

Internal Marks (40)
- Class Work: 20 marks
- CA Exam: 20 marks

Semester Examination (60)
- Volumetric Analysis: 25 Marks
- Preparation or Volumetric Analysis: 25 Marks
- Record: 10 Marks
Unit- I: Laboratory Care and Instrumentation
Instrumentation to laboratory equipments and basic laboratory operation and role of laboratory technician. Types of specimen collection and collection procedure- Blood, urine. Reagent Preparation and Laboratory calculation. Quality control.

Unit-II: Hematology and Blood Banking
Blood pressure (BP), Pulse, Clotting time, Bleeding time, Hemoglobin estimation, RBC count and WBC count, Differential WBC count, Erythrocyte Sedimentation Rate (ESR), Hematocrite value (Packed cell volume), Blood grouping and rh factor.

Unit-III: Clinical Pathology
Composition, Collection, Preservation, Microscopic Examination, Macroscopic Examination- Physical Examination, Chemical examination of Urine. Examination of urine sedimentation – Ketone bodies, Bile pigment, hematuria, uric acid. Significance of sugar in urine.

Unit-IV: Stool Examination
Specimen collection, Macroscopic Examination, Microscopic Examination, Reducing Substance, pH interfering substance, Test for occult blood.

Unit-V: Medical Microbiology
Culturing of organism from various specimens, culture media and antibiotic sensitivity test (Pus, Urine, Blood, Sputum, Throat Swab) Gram staining, Safety procedure in Microbiological Techniques.

References:

2. Medical Laboratory Technology- V.H.Talib.
VI Semester
Immunology

3 Hours / week
2 Credits

Paper - II
Unit – I
Historical development of the science of the immunology. Innate and acquired immunity, antibody and cell mediated response tolerance. Primary and secondary lymphoid organs structure of T,B and NK cells. Receptors of the surface of lymphocytes. Structure and functions of neutrophills, macrophages – phagocytosis and inflammation.

Unit – II
Antigen: Properties, specificity, cross reactivity, antigenecity, immunogenecity, antigen determinants, haptons, adjuvants, self antigen (MHC) an outline only. Antibodies: Properties, classes and subclasses of immunoglobulines: structure, specificity and distributions.

Unit – III

Unit – IV

Unit – V
Vaccination: passive and active immunization, Recombinant vaccines, DNA vaccine, Benefits and adverse effects of vaccination. Principle and applications of RIA and ELISA.

References:
8. Immunology – Roitt
9. Immunology – ElibenJaminie
**Question Paper Pattern for Theory Papers [2007-08]**

The question paper shall have three sections with the maximum of 75 marks with the following break-up:

**Section - A**

Section A shall contain 10 short answer questions without choice drawn from all the units on the basis of minimum two from unit. Each question shall carry 2 Marks. 

\[10 \times 2 = 20\text{ Marks}\]

**Section - B**

Section B shall contain 5 either or questions drawn from all the five units. Each question shall carry 5 marks.

\[5 \times 5 = 25\text{ Marks}\]

**Section – C**

Section C shall contain 5 questions drawn one each from the five units. Three questions out of the five are to be answered each carrying 10 marks.

\[3 \times 10 = 30\text{ Marks}\]

**Question paper pattern for practical (2007-08 Batch)**

**Total**: 100 Marks  
**Time**: 6 Hours

**Main Practical III & IV**

The practical papers consist of the internal assessment of 50 marks and semester examination for 50 marks.

**CA Components (50)**
- Class Work - 20 marks
- CA Exam - 20 marks
- Viva-Voce - 10 marks

**Semester Examination (50)**
- Colorimetric Analysis : 20 Marks
- Colorimetric Analysis or Enzyme Assay or Urinary Analysis : 20 Marks
- Record : 10 Marks
V Semester

4 Hours / week

2 Credits

Paper - V  Enzymes

Unit – I
Enzymes Introduction – chemical nature and general characterization – Nomenclature and IUB system of enzyme classification and specificity, units, active site, Mechanism of action of enzyme – Lock and Key theory and induced fit theory, Enzyme turnover.

Unit – II
Coenzymes and multi-enzyme systems – coenzymes and co-factors, Apoenzyme and holoenzyme. Structure and functions of coenzyme reaction involving nucleotide, NAD/NADP and FMN/FAD coenzymes.

Unit – III
Introduction to chemical kinetics, reaction rate, energy of activation, factors influencing velocity of enzyme reaction, Michaelis-Menton equation, Line-Weaver Burk plot, Eadic – Hofstee plot, regulation of enzyme activity. Enzyme inhibition; competitive, non-competitive and uncompetitive inhibitors (kinetics and derivations not required) Allosteric enzymes and feedback inhibition.

Unit – IV
Photosynthesis – Hill reaction, light reaction, cyclic and non-cyclic photo phosphorylation, dark reaction – Calvin cycle.

Unit – V
Industrial application of enzymes, immobilized enzymes, types, a note of advantages and disadvantages with applications.

References:
V Semester

Paper - VI  Intermediary Metabolism

3 Hours / week

2 Credits

Unit - I

Unit – II

Unit – III
Oxidation of fatty acids – beta oxidation, metabolism of ketone bodies. Biosynthesis of triacyl glycerol, cholesterol and phospholipids.

Unit – IV
Catabolism of aminoacids – transamination, oxidative deamination and non-oxidative deamination, decarboxylation and urea cycle.

Unit – V
Nucleic acid metabolism – Biosynthesis and degradation of purine and pyrimidine nucleotides – Denovo synthesis and Salvage pathway.

References:
V Semester
Genetics and Moleculer Biology

4 Hours / week
2 Credits

Unit – I
Mendelian genetics: Mendel’s laws of inheritance, test cross, back cross and laws of incomplete dominance.

Unit – II
DNA as genetic material, types of replication, evidence for semi conservative replication. Replication in prokaryotes and inhibitors of replication. DNA polymerases I, II, III, topoisomerasers, okazaki fragments, DNA ligases and reverse transcriptase.

Unit – III
Prokaryotic transcription: Central dogma, RNA polymerases, role of sigma factor, initiation, elongation and termination [Rho-dependant and independent]. Inhibitors of transcription.

Unit – IV

Unit- V

References:
V Semester
Medical Laboratory Technology

3 Hours /
2 Credits

Unit- I: Laboratory Care and Instrumentation
Instrumentation to laboratory equipments and basic laboratory operation and role of laboratory technician. Types of specimen collection and collection procedure- Blood, urine. Reagent Preparation and Laboratory calculation. Quality control.

Unit-II: Hematology and Blood Banking
Blood pressure (BP), Pulse, Clotting time, Bleeding time, Hemoglobin estimation, RBC count and WBC count, Differential WBC count, Erythrocyte Sedimentation Rate (ESR), Hematocrite value (Packed cell volume), Blood grouping and rh factor.

Unit-III: Clinical Pathology
Composition, Collection, Preservation, Microscopic Examination, Macroscopic Examination-Physical Examination, Chemical examination of Urine. Examination of urine sedimentation – Ketone bodies, Bile pigment, hematuria, uric acid. Significance of sugar in urine.

Unit-IV: Stool Examination
Specimen collection, Macroscopic Examination, Microscopic Examination, Reducing Substance, pH interfering substance, Test for occult blood.

Unit-V: Medical Microbiology
Culturing of organism from various specimens, culture media and antibiotic sensitivity test (Pus, Urine, Blood, Sputum, Throat Swab) Gram staining, Safety procedure in Microbiological Techniques.

References:
2. Medical Laboratory Technology- V.H.Talib.
VI Semester  
Human Physiology  
3 Hours/week  
2 Credits

Unit-I: Blood and Composition.
Composition of blood, function, types of blood cells, morphology and function. Blood groups and Rhesus factors. Composition lymphatic system and lymph. Circulatory system.

Unit-II: Respiratory System and Excretory System

Unit-III: Digestive System
Outline of various components structure, function. Digestion and absorption of Carbohydrate, lipids and proteins, nucleic acid. Role of bile salt in digestion and absorption. Role of enzyme and hormones involved in digestion.

Unit-IV: Nervous System
Structure of nerve cell- dendrons, axon, cell body, synapse. Conduction of nerve in synapse- (electrical and chemical), neuro- transmitters-adrenergic, chollinergic reflex action.

Unit-V: Muscles
Types of muscle, structure and their functions. Ultra structure of skeletal muscle- light band, thick filament, thin filament, myofilament, contraction and relaxation of skeletal muscle via $\text{Ca}^{2+}$ pump.

References:
3. Atext book of Animal physiology, KA Goel, KV Sastri, Rastogi publication, s.chand &co.
5. A Hand Book of Basic Human physiology- Nk. Saradhs Subramanyam, S.Chand&co., Ltd.
VI Semester

Clinical Biochemistry

Unit-I: Basic Concept of Clinical Biochemistry
Specimen collection and processing (Blood, urine and feces), anticoagulant and preservatives for blood and urine. Transport of specimens. Disease and disorders- polio, AIDS, measles, TB, typhoid, diarrhea, dysentery, cholera, tetanus, whooping cough, anemia (Symptoms, causes, and treatment)

Unit-II: Disease Related to Carbohydrate Metabolism
Blood sugar level, renal threshold, regulation of blood glucose- hormonal action, hypo, hyperglycemia, diabetes mellitus, GTT, complication of diabetes mellitus, glycosuria, ketoacidosis.

Unit-III: Disease Related to Amino Acids and Lipid Metabolism
Disease related to amino acid- Clinical manifestation of phenylketonuria, cystinuria, and alkaptonuria. Lipoproteins, various types, hyper lipoproteinemia, hypo lipoproteinemia, atherosclerosis and fatty liver.

Unit-IV: Organ Function Test
Metabolism of bilirubin - jaundice, classification, causes and differential diagnosis, liver function test. Renal function test: clearance test – urea, creatinine, inulin, PAH test, concentration and dilution test. Gastric function test- collection of gastric content, examination of gastric residue, FTM stimulation test, tubeless gastric analysis.

Unit-V: Clinical Enzymology
Plasma enzymes-functional and non-functional plasma enzymes. Isoenzymes and diagnostic tests-LDH, enzyme pattern in myocardial infarctions, acute pancreatitis, liver damage bone disorders and muscle wasting.

References:
1. Clinical chemistry in Diagnosis and Treatment – P.D. Mayne, ELBS / Arnold, New Delhi.
Unit – I

Unit – II

Unit – III
Plant tissue culture – Media composition, nutrients, growth regulators, initiation and differentiation. Callus and suspension culture, Micro propagation, Somatic embryogenesis and somoclonal variation.

Unit – IV
Equipment and requirements for animal cell culture, laminar flow, CO₂ incubator, natural media, synthetic media, substrate for cell culture, substrate treatment, desegregations of tissues, establishment of cell culture.

Unit – V
Transgenic plant and transgenic animal, Herbicide resistant, stress resistant, pesticide resistant and insect resistant, transgenic fish and transgenic sheep. Hybridoma technology – monoclonal antibodies.

References:
2. Plant tissue culture – Razdan, Oxford IBH Publisher.
VI Semester
Immunology

3 Hour/week
2 Credits

Unit – I
Historical development of the science of the immunology. Innate and acquired immunity, antibody and cell mediated response tolerance. Primary and secondary lymphoid organs structure of T,B and NK cells. Receptors of the surface of lymphocytes. Structure and functions of neutrophills, macrophages – phagocytosis and inflammation.

Unit – II
Antigen: Properties, specificity, cross reactivity, antigenecity, immunogenecity, antigen determinants, haptens, adjuvants, self antigen (MHC) an outline only. Antibodies: Properties, classes and subclasses of immunoglobulines: structure, specificity and distributions.

Unit – III

Unit – IV

Unit – V
Vaccination: passive and active immunization, Recombinant vaccines, DNA vaccine, Benefits and adverse effects of vaccination. Principle and applications of RIA and ELISA.

References:
8. Immunology – Roitt
9. Immunology – ElibenJaminie
VI Semester
Main Practical – III

4 Hours / week
4 Credits

I. Colorimetric Estimation
   a) Estimation of Creatinine by Jaffè’s Method.
   b) Estimation of Urea by Diacetyl Monoxime Method.
   c) Estimation of DNA.
   d) Estimation of RNA.

II. Electrophoretic Techniques
    Separation of protein by SDS –PAGE and Agarose gel.

III. Experiments On Enzymes By Colorimetry
    a) Effect of pH, temperature and substrate concentration for amylase and urease.
    b) Assay of activity of Serum transaminases (SGOT & SGPT).

IV. Haematology
    RBC count, PCV, ESR, Total and Differential WBC count.
VI Semester
Main Practical - IV

4 Hours / week
4 Credits

I. Colorimetric Estimation
   a) Estimation of glucose by
      i. Folin Wu
      ii. O-Toluidine methods
   b) Estimation of albumin and A/G ratio in serum
   c) Estimation of Cholesterol by Zak’s method.

II. Experiments on Enzymes by Colorimetry
   a) Assay of activity of alkaline phosphatase in serum.
   b) Estimation of nitrogen by Micro Kjeldahal distillation procedure.

III. Urine And Faeces Analysis
   a) Collection of urine and faecal samples.
   b) Faecal analysis to detect fats, undigested food and blood.
   c) Qualitative analysis of urine for normal and pathological conditions.

References:
6. Introduction to Practical Biochemistry – David T. Plummer