

**M.Sc. Biochemistry Syllabus**  
**Under Choice Based Credit System at the Department of Biochemistry**  
**Dr. B. R. Ambedkar University, Agra**

Semester Semester I Course Code	Papers	Credit				
		C1	C2	C3	Total	Credit
BC 101	Plant Biochemistry	20	20	60	100	4
BC 102	Cell Biology	20	20	60	100	4
BC 103	Biomolecules and Bioinstrumentation	20	20	60	100	4
BC 104	Biostatistics and Computer Applications	20	20	60	100	4
BC 105	Practical				100	4
BC 106	Assignments/Tutorials/Seminars				100	4
					<b>600</b>	<b>24</b>
BC 107 Open Elective	Elementary Biochemistry					4
<b>Semester II</b>						
BC 201	Fundamentals of Molecular Biology	20	20	60	100	4
BC 202	Immunology	20	20	60	100	4
BC 203	Advanced Enzymology	20	20	60	100	4
BC 204	Intermediary Metabolism	20	20	60	100	4
BC 205	Practical				100	4
BC 206	Assignments/Tutorials/Seminars				100	4
					<b>600</b>	<b>24</b>
<b>Semester III</b>						
BC 301	Microbial Physiology and Biochemistry	20	20	60	100	4
BC 302	Human Physiology	20	20	60	100	4
BC 303	Nutritional and Clinical Biochemistry	20	20	60	100	4
BC 304	Advanced Biotechnology	20	20	60	100	4
BC 305	Practical				100	4
BC 306	Assignments/Tutorials/Seminars				100	4
					<b>600</b>	<b>24</b>
<b>Semester IV</b>						
BC 401	Project Work/ Dissertation				300	12
BC 402	Viva Voce				200	8
BC 403	Assignments/Seminars				100	4
					<b>600</b>	<b>24</b>
					<b>Total</b>	<b>96</b>
BC 404 Soft Core	Environmental Biochemistry and Toxicology					4
BC 405 Open Elective	Medical Biochemistry					4

**Note:**

1. Total number of credits in M.Sc. Biochemistry is 96 and 4 extra credits for each soft core/open elective.
2. Open elective course (inter faculty) and soft core (within faculty).
3. There shall be three periodical tests from each course of which marks of two best tests will be taken in consideration C1 and C2 in each semester.

**M.Sc. BIOCHEMISTRY**  
**SEMESTER – FIRST**  
**BC-101**  
**PLANT BIOCHEMISTRY**

**UNIT – I**

- Structure and function of plant cell, cell wall, plasmodesmata, vacuoles, peroxisomes.
- Isolation of cell organelles, mechanism of the transport of water, inorganic and organic substances.
- Seed dormancy, growth and development.

**UNIT – II**

- Photosynthesis: structure of organelles involved in photosynthesis in plants and bacteria, photo system I, II and their location, mechanism of quantum captures and energy transfers between photo system, reduction of CO<sub>2</sub>, C<sub>3</sub>, C<sub>4</sub> and CAM metabolism regulation of photosynthesis.
- Photorespiration and its significance.

**UNIT – III**

- Biological nitrogen fixation: mechanism of nitrate uptake and reduction ammonia assimilation, sulphate uptake and transport.
- Mineral nutrition: micronutrients, macronutrients and their biological role in plants.

**UNIT – IV**

- Secondary plant metabolites: biosynthesis of tannins, alkaloids (pyrrolidine, piperidine, coniine, quinolinate), flavonoids and surface waxes and their functions.
- Antioxidative defense system in plants.
- Plant hormones: Mode of action of auxins, gibberellins, cytokinins, ethylene, abscissic acid.

**Reference Books**

- Plant Biochemistry, Goodwin Mercer
- Plant Physiology, Salisbury Ross
- Biochemistry and Molecular Biology of Plants, by Buchanan
- Plant Biochemistry and Molecular Biology, by Lea and Leegood
- Plant Biochemistry, by Dey and Harborne

**M.Sc. BIOCHEMISTRY**  
**SEMESTER – FIRST**  
**BC-102**  
**CELL BIOLOGY**

**UNIT – I**

- Cell Membrane: Physicochemical Properties, Molecular Organization – asymmetrical organization of lipids, proteins and carbohydrates and functions.
- Transport across membranes: Types of transport (simple diffusion, passive-facilitated diffusion), active transport – primary and secondary group translocation, transport ATPases (V type, F type, P type, ABC type).

**UNIT – II**

- Cell classification, cell variability (size, shape, complexity, and function). Structural organization of prokaryotic and eukaryotic cell.
- The ultrastructure of nucleus, mitochondria, endoplasmic reticulum (rough and smooth), Golgi apparatus, lysosomes and their function.
- The cytoskeleton: microtubules and microfilaments.
- The extra cellular matrix: collagen.

**UNIT – III**

- Cell–cycle: phases of cell cycle, cell cycle check points, CdK, cyclins, MPF, p53, wait signal, Apoptosis.
- Cell division by mitosis and meiosis.
- Biochemistry of cancer: characteristics of cancer cell, carcinogenesis, carcinogens, oncogenes and tumor suppressor genes.

**UNIT – IV**

- Cell signaling: Forms of intracellular signaling, hormone and their receptors (steroid and plant hormones)
- Pathways of intracellular signal transduction: c-AMP pathway, c-GMP pathway, phospholipids and Ca<sup>++</sup>
- Ras, Raf and MAP kinase pathway
- JAK/STAT pathway

**Reference Books**

- Molecular Biology of the Cell, Alberts, *et al*
- Molecular Cell Biology, Lodish, *et al*
- Cell and Molecular Biology: Concepts and Experiments, Gerald Karp
- The Cell: A Molecular Approach, G.M. Cooper
- The Word of the Cell, Becker *et al*
- Cell Proliferation and Apoptosis, Hughes and Mehnet
- Essential Cell Biology, Alberts *et al*
- Biochemistry and Molecular Biology of Plants, Buchanan *et al*
- Harpers Biochemistry Murray *et al*

**M.Sc. BIOCHEMISTRY**  
**SEMESTER – FIRST**  
**BC-103**

**BIOMOLECULES AND BIOINSTRUMENTATION**

**UNIT-I**

- Carbohydrates: Classification, structure of carbohydrates (monosaccharides, disaccharides polysaccharides- homo- and heteropolysaccharides).
- Lipids: Classification, structure, properties and functions of fatty acids, essential fatty acids, fats, phospholipids, sphingolipids, cerebrosides, steroids, bile acids, prostaglandins and lipoproteins.

**UNIT-II**

- Amino acids: Structure, classification, abbreviation, properties and functions of amino acids.
- Proteins: Classification, structure and functions of proteins, Ramachandran plot, Protein Sequencing.
- Nucleic acids: Structure and function of nucleotides. Primary, secondary and tertiary structure of nucleic acids. DNA forms (single stranded DNA, A, B and Z DNA) syn and anti conformations. Types of RNA (m RNA, t RNA, rRNA, hn RNA, micro RNA).

**UNIT-III**

- Spectroscopy: Concept of spectroscopy, Laws of Photometry, Beer-Lambert's Law. Instrumentation and application of UV, Visible, and IR, Raman spectroscopy.
- Radioisotope Techniques: Units and measurement of radioactivity. Use of radioisotopes in Biomedicine and research.
- Electron Microscopy: Transmission and scanning, freeze fracture techniques.

**UNIT- IV**

- Electrophoresis: Moving boundary zonal electrophoresis, paper and gel electrophoresis, isoelectric focusing.
- Chromatography: Paper Chromatography, Thin Layer Chromatography (TLC), Ion exchange, gel filtration and affinity chromatography, High Pressure Liquid Chromatography (HPLC) – Normal & reverse phase.
- Centrifugation techniques and their application. subcellular fractionation.

**Reference Books**

- Principles of Biochemistry by Nelson, Cox and Lehninger
- Biochemistry by G.Zubay
- Biochemistry, DVoet and JG. Voet , J Wiley and Sons.
- Physical Biochemistry: Applications to Biochemistry and Molecular Biology, D Freifilder, W.H. Freeman & Company.
- Practical Biochemistry, Wilson & Walker.

**M.Sc. BIOCHEMISTRY**  
**SEMESTER –FIRST**  
**BC-104**  
**BIOSTATISTICS AND COMPUTER APPLICATIONS**

**UNIT- I**

- Measures of central tendency (arithmetic mean, mode, median), measure of dispersion, standard deviation, coefficient of variance, group data and graphic methods, frequency & distribution.
- Probability: Definition of probability, multiplication, law of probability, addition, law of probability, random variable, permutation & combination .binomial, normal & poisson distribution.

**UNIT -II**

- Tests of significance hypothesis and errors, Student statistics- Population mean equal a specified value. Equality of two independent means, Equality of two means. Non-parametric test Chi square statistics, test of goodness of fit.
- Regression and correlation coefficient, partial & multiple correlation, Relationship between regression and correlation. Analysis of variance:- One way analysis.

**UNIT- III**

- Computers: Basics of common application software packages for word processing (MS Word), spreadsheets (MS Excel) and presentation (MS Powerpoint). Introduction of Internet- LAN, MAN, WAN.

**UNIT- IV**

- Introduction to Bioinformatics: Concepts of Bioinformatics, Accessing and retrieving sequence information from genome sequence databases, use of genome data, overview of comparative and functions genomics, application of computers in Biochemistry.

**Reference Books**

- Biostatistical analysis, Zar, Pearson
- Biostatistics, Daniel, Wiley
- Biostatistics, Norman, Decker
- Fundamentals of Bioinformatics, Irfan Ali Khan, Ukaz
- Fundamentals of Biostatistics, Irfan A. Khan and Khanum, Ukaz Publication
- Fundamentals of Computers, V. Rajaraman, Prentice-Hall India
- A Handbook of Agricultural Statistics, S.R.S. Chandel, Lal Prakshan

**M.Sc. BIOCHEMISTRY**  
**SEMESTER –SECOND**  
**BC-201**

**FUNDAMENTALS OF MOLECULAR BIOLOGY**

**UNIT - I**

- Chromatin: Histone and non-histone proteins, general properties of histones, size variable linker, role of H1. Solenoid structure, transcriptionally active chromatin.
- DNA Replication: Mechanism of replication, the replicons, origin, primosome and replisomes, properties of prokaryotic and eukaryotic DNA polymerases, synthesis of leading and lagging strands, difference between prokaryotic and eukaryotic replication.
- Enzymology of DNA Replication : DNA Polymerases; Primases; Ligases; Helicases; Topoisomerases; Gyrase and Single Stranded Binding Proteins
- Regulation of DNA Replication
- DNA mutation and repair

**UNIT- II**

- Mechanism of Transcription: Transcription in Prokaryotes- Initiation, elongation and termination, Structure and functions of prokaryotic promoter . Control of transcriptional initiation in prokaryotes- Structure and functions of RNA Polymerases, Sigma factors – Types and functions. Control of transcriptional termination in prokaryotes- Intrinsic termination and rho factor dependent termination; attenuation and antitermination.
- Transcription in Eukaryotic: initiation, elongation, termination, promoters, enhancers, factors & properties of RNA polymerase I, II, & III. Reverse transcription. Inhibitors of transcription

**UNIT- III**

- Post transcriptional Processing: Maturation of rRNA, mRNA and tRNA; RNA splicing, introns and exons, consensus sequence function. Poly A tail, 5' capping.
- Regulation of gene expression in prokaryotes, operon concept (lac, tryptophan, and arabinose)
- Transposable elements in prokaryotes and eukaryotes.

**UNIT- IV**

- Translation in Pro- and Eukaryotes: Ribosomes structure and subunit assembly, adaptor role of tRNA, formation of initiation complex, chain elongation, translocation & termination, and role of respective factors involved therein. Inhibitors of protein biosynthesis. Comparison of protein biosynthesis in prokaryotes with eukaryotes.

## Reference Books

- Genes XI , by Benjamin Lewin
- Molecular Biology, by Turner *et al*
- Cell and Molecular Biology: Concepts and Experiments, by Gerald Karp
- Transcriptional Regulation in Eukaryotes, by Carey and Smale
- Translational control of gene Expression, by Sonenberg *et al*
- Chromatin and Gene Regulation, by Turner
- An Introduction to Genetic Analysis, by Griffiths *et al*
- Genome, by T. A. Brown
- Concepts of Genetics, by Klug and Cummings
- Molecular Cell Biology, by Lodhish *et al*
- Biochemistry – J. David Rawn – Neil Patterson publication, NC.

**M.Sc. BIOCHEMISTRY**  
**SEMESTER –SECOND**  
**BC-202**  
**IMMUNOLOGY**

**UNIT- I**

Introduction to Immune System

- Memory, specificity, diversity, innate and acquired immunity, self Vs non-self discrimination.
- Structure and functions of primary and secondary lymphoid organs.

Cells Involved in Immune Responses

- Structure and Functions: Mononuclear cells (phagocytic cells and their killing mechanisms), granulocytic cells (neutrophils, eosinophils and basophils), mast cells and dendritic cell.
- Lymphoid cells (B-lymphocytes, T-lymphocytes and Natural killer cells).

**UNIT-II**

Nature of Antigen and Antibody

- Antigen Vs Immunogen, Haptens
- Structure and functions of immunoglobulins
- Istopic, allotypic and idiotypic variations.

Generation of Diversity in Immune System

- Clonal selection theory-concept of antigen specific receptor.
- Organization and expression of immunoglobulin gens: generation of antibody diversity.

Immunization

- Active immunization (immunoprophylaxis)
- Passive immunization (Immunotherapy)
- Role of vaccines in the prevention of diseases.

**UNIT- III**

Humoral and Cell-mediated Immune Responses

- Kinetics of primary and secondary immune responses.
- Complement activation and its biological consequences.
- Antigen processing and presentation.
- Cytokines and co stimulatory molecules: Role in immune responses.
- T and B cell interactions.

Major Histocompatibility Complexes (MHC) Genes and Products

- Polymorphism of MHC genes.
- Role of MHC antigens in immune responses.
- MHC antigens in transplantation.



## **UNIT- IV**

### Measurement of Antigen- Antibody Interaction

- Agglutination and precipitation techniques.
- Radio Immunoassay
- ELISA and ELISPOT
- Immune fluorescence assays: Fluorescence activated cell sorter (FACS) technique.

### Hypersensitivity

- Immediate (Type I)
- Cytotoxic (Type II)
- Immune complex-mediated (Type III)
- Delayed hypersensitivity (Type IV)

### Immune Responses in Diseases

- Immune responses to infectious diseases: viral (HIV), bacterial (tuberculosis) and protozoal (malaria) infections
- Immunodeficiency disorders: congenital (SCID, Leuckocyte adhesion deficiency, Chronic granulomatous disease) and acquired (AIDS) immunodeficiencies.
- Autoimmunity

### Reference Books

- Kubey, Immunology, R.A. Goldsby, Thomas J. Kindt, Barbara, A. Osbarne. (Freeman).
- Immunology-Ashort Course, -Eli Benjamini, Richard Coico, Geoffrey Sunshine.
- Immunology by Tizzard
- Fundamentals of immunology by William Paul.
- Immunology by Roitt *et al*
- Immunology by Abbas

**M.Sc. BIOCHEMISTRY**  
**SEMESTER – SECOND**  
**BC-203**  
**ADVANCED ENZYMOLOGY**

**UNIT- I**

- Properties & classification of enzymes.
- Kinetics of order of reactions, energy of activation, concept of ES complex, active site, derivation of Michaelis-Menten and Briggs-Haldane equations for uni- substrate reactions. Different plots for the determination of  $K_m$  &  $V_{max}$  (LB plot, Hanes plot, Eadie Hofstee plot, Eisenthal Cornish Bowden plot). Importance of  $K_{cat}/K_m$ . Factors affecting the rates of enzymes catalyzed reactions- pH and temperature.
- Reversible and irreversible inhibition-competitive, non-competitive, uncompetitive inhibitor.
- Classification of multi-substrate reactions with examples of each class. Derivation of the rate of expression for Ping Pong, random & ordered Bi-Bi mechanisms.

**UNIT – II**

- Enzyme purification techniques: objectives and strategy, methods of homogenization, method of isolation and purification
- Mechanism of enzymes action: Chymotrypsin, Triose phosphate isomerase, aldolase, lysozyme – Methods to determine active site.
- Metalloenzymes.
- Turnover of enzymes and its significance.

**UNIT – III**

- **Proteins** – ligand binding concept & measurement.
- **Allosteric enzymes:** Sigmoidal kinetics & their physiological significance. Hill and Scatchard Plots Symmetric and sequential modes of action of allosteric enzymes and their significance.
- **Enzyme regulation:** General mechanism of enzyme regulation. Feedback inhibition and substrate inhibition. Reversible and irreversible covalent modifications of enzymes.

**UNIT – IV**

- Immobilized enzymes and their industrial applications. Effect of partition of kinetics and performance with particular emphasis on changes in pH and hydrophobicity.
- Multienzyme system: Mechanism of action and regulation of pyruvate dehydrogenase and fatty acid synthetase complexes. Immobilized multienzyme system and their applications.
- Enzymes in medical diagnosis (aspartate aminotransferase, alanine aminotransferase, creatine kinase, lactate dehydrogenase) and enzyme therapy.

## **Reference Books**

- The Nature of Enzymology by R.L. Foster
- Enzymes by Dixon and Webb
- Fundamentals of Enzymology by Price and Stevens
- Enzyme Catalysis and Regulation by Hammes
- Enzyme Reaction Mechanisms by Walsch
- The Enzymes vol I and II by Boyer
- Enzyme Structure and Mechanism by Alan Fersht
- Enzyme Assays: A Practical Approach by Eisenthal and Danson
- Enzyme Biotechnology by G. Tripathi
- Practical Biochemistry by Plummer.
- Practical Biochemistry by Sawhney and R. Singh
- Enzymes – Dixon & Webb – Academic press

**M.Sc. BIOCHEMISTRY**  
**SEMESTER – SECOND**  
**BC-204**  
**INTERMEDIARY METABOLISM**

**UNIT – I**

- Carbohydrates metabolism: Glycolysis, citric acid cycle and pentose phosphate pathway.
- Gluconeogenesis
- Glycogenesis & Glycogenolysis
- Regulation of blood glucose homeostasis by hormones.

**UNIT- II**

- Lipids Metabolism: Biosynthesis- Triacylglycerols, phospholipids, cholesterol, fatty acids, prostaglandins and ketone bodies.
- Fatty acid oxidation:  $\alpha$ ,  $\beta$ ,  $\omega$ , oxidation and Lipid per oxidation.
- Metabolism of circulating lipids: chylomicrons, LDL, HDL, and VLDL, free fatty acids.

**UNIT- III**

- Bioenergetics: Energy transformation, Laws of Thermodynamics, Biological oxidations, Gibb's energy, Free energy changes.
- Mitochondrial respiratory chain: ETC carriers (iron sulphur proteins, ubiquinone, universal carriers and cytochromes). ETC complexes I,II, III (Q cycle) & IV, the stoichiometry of proton extrusion uptake, shuttle system.
- Oxidative phosphorylation (OP): Coupling of ETC and OP, uncouplers, ATP synthase, proton motive force, chemiosmotic theory, : P/O and H/P ratios. Mechanism of ATP formation. Respiratory controls and inhibitors of oxidative phosphorylation.

**UNIT – IV**

Amino Acids

- Biosynthesis of nonessential amino acids.
- Catabolism of tyrosine, phenylalanine, tryptophan, branched chain amino acids.
- Urea cycle and its regulation.

Nucleic Acids

- Biosynthesis of Purines and Pyrimidines nucleotides.
- Degradation of Purines and Pyrimidines nucleotides.
- Regulation of Purine and Pyrimidine biosynthesis.

**References Books**

- Harper's Biochemistry – Murray, Granner, Mayes, and Rodwell – Prentice Hall International Inc.
- Biochemistry – Lehninger – CBS Publishers.
- Biochemistry – Stryer – W. H. Freeman & Co. – New York.
- Text Book of Biochemistry – West, Todd, Mason, Bruggen – Amerind Publishing Co. Pvt., Ltd.

**M.Sc. BIOCHEMISTRY**  
**SEMESTER –THIRD**  
**BC-301**

**MICROBIAL PHYSIOLOGY & BIOCHEMISTRY**

**UNIT – I**

- Types of microorganisms, general characteristics of main groups of microorganisms, Nutrition and growth of microbial cells with different growth curve- lag, log, stationary and decline phases.
- Synchronous growth, pure culture techniques and preservation methods

**UNIT – II**

- Morphology and fine structure of eubacteria and archaebacteria cell wall, cytoplasmic membrane and other organelles.
- Staining methods: Gram staining, acid-fast, endospore and fungal staining
- Gram positive and gram negative organisms. Structure & function of peptidoglycan in gram positive and gram negative organisms. Functions of polymeric components in outer membrane and acidic polymers in gram negative organisms. Biosynthesis of bacterial cell wall and use of different inhibitors.

**UNIT – III**

- Food spoilage, fermentation, food-borne infection (Staphylococcal, Clostridial, Salmonellosis, Shigellosis).
- Role of microorganisms in domestic and industrial sewage.
- Methods of sterilization in brief.
- Metabolism: EDP pathway, Xylose-5-phosphoketolase pathway

**UNIT – IV**

- Virus structure, virus proteins, virus classification and methods of assay.
- Structure of bacteriophage, lytic and lysogenic life cycle
- Replication of RNA viruses–negative strand (VSV), positive strand (Polio), retrovirus (to include all events in the infectious cycle). Replication of DNA viruses (Adenovirus & SV 40).
- Virus–host interaction and prevention polio/AIDS, Hepatits.

**Reference Books**

- Microbiology, Pelczar, M.J., Chan , E.C.S. and Kreig, N.R., Tata McGraw Hill.
- Microbial Genetics, Maloy , S.R., Cronan, J.E.Jr and Freifelder, D. Jones, Bartlett Publishers.
- General Microbiology – Stanier, Adelberg, Ingraham – The Macmillan Press – London.
- Fundamental Principals of Bacteriology – Salle – TMH Pub. Co. Ltd. – New Delhi.
- Microbiology-An Introduction – Tortora, Funke, Case, Benjamin – Cummings Publ. Co.

**M.Sc. BIOCHEMISTRY**  
**SEMESTER –THIRD**  
**BC-302**  
**HUMAN PHYSIOLOGY**

**UNIT – I**

- Blood: Composition and functions of plasma, erythrocytes including Hb, leucocytes and thrombocytes, plasma proteins in health and diseases. Blood coagulation mechanism and regulation, Fibrinolysis. Transfer of gases – oxygen and carbon dioxide. Bohr effect and chloride shift.

**UNIT – II**

- Digestive system: Composition, function and regulation of saliva, gastric, pancreatic, intestinal and bile secretions—digestion and absorption of carbohydrates, lipids and proteins.

**UNIT – III**

- Excretory system: Structure of nephron, formation of urine, glomerular filtration, tubular reabsorption of glucose, water and electrolytes, tubular secretion. Regulation of an electrolytes balance and regulation of kidney function by hormones.

**UNIT –IV**

- Nerve: structure of neuron, membrane potential, action potential, voltage gated channels, role of ions during action potential, transmission of action potential, synapse, synaptic transmission.
- Muscles: Structure of skeletal, smooth & cardiac muscles. Neuromuscular junction and transmission, excitation and contraction coupling.

**References**

- Human Physiology, Vol. I & II, - C. C. Chatterjee – Medical Allied Agency – Calcutta.
- Concise Medical Physiology – Choudhary – New Central Book Agency – Calcutta.
- TextBook of Medical Physiology – Guyton – Prism Books Pvt. Ltd. – Bangalore.

**M.Sc. BIOCHEMISTRY**  
**SEMESTER –THIRD**  
**BC-303**  
**NUTRITIONAL AND CLINICAL BIOCHEMISTRY**

**UNIT – I**

- Basic Concepts: Energy content of foods. Measurements of energy expenditure. Direct & indirect calorimetry. Definition of BMR and SDA and factors affecting these. Thermogenic effects of foods.
- Carbohydrates: Dietary requirements and sources of available and unavailable carbohydrates. Physico-chemical properties and physiological actions of un-available carbohydrates (dietary fibre).
- Proteins: Protein reserves of human body. Nitrogen balance studies and factors influencing nitrogen balance. Essential amino acids and concept of protein quality. Cereal proteins and their limiting amino acids.
- Protein energy malnutrition (PEM): Metabolic disorders and management of Marasmus and Kwashiorkor diseases.
- Obesity related diseases, Role of leptin in regulation of body mass.

**UNIT – II**

- Lipids: Major classes of dietary lipids. Properties and composition of plasma lipoproteins. Dietary needs of lipids. Essential fatty acids and their physiological functions.
- Minerals: Nutritional significance of dietary calcium, phosphorus, magnesium, iron, iodine, zinc and copper.
- Vitamins: Dietary sources, biochemical functions and specific deficiency diseases associated with fat and water- soluble vitamins. Hypervitaminosis symptoms of fat-soluble vitamins.

**UNIT – III**

- Disorders of Carbohydrates Metabolism: Diabetes mellitus, glycated hemoglobins, hypoglycemia, various types of glucose tolerance tests, glycogen storage diseases, galactosemia.
- Disorders of Lipid Metabolism: Tay-Sach's, Gaucher's and Niemann-Pick diseases, atherosclerosis and diagnosis tests.
- Disorders of Amino Acid Metabolism: phenylketonuria, alkaptonuria, tyrosinosis, albinism, maple syrup urine disease.
- Disorders of Nucleic Acid Metabolism: Lesch-Nyhan syndrome, gout, orotic aciduria

**UNIT – IV**

- Disorders of Erythrocyte: thalassemias and sickle cell anemia.
- Diseases and organ function test: liver diseases (jaundice, hepatitis, hemochromatosis, Reye's syndrome) and liver function tests, renal

diseases (glomerulonephritis, nephrotic syndrome, urinary tract infection, urinary tract obstruction, renal failure) and renal function tests.

- Thyroid disorders: Hyperthyroidism and Hypothyroidism.

### **Reference Books**

- Tietz Fundamentals of Clinical Chemistry, Burtis Ashwood, Saunders
- Clinical Chemistry, Kaplan
- Clinical Chemistry (Organ Function Test), M.N Chatterjee, Jaypee
- Normal and Therapeutic Nutrition, Robinson, Garwick, Macmillan
- Nutrition, Paul Insel, Don Ross, Jones and Bartlett
- Nutrition and Diet Therapy, Lutz, F. A. Davis
- Nutrition And Dietetics, Joshi, Tata McGraw Hill
- Practical Clinical Biochemistry, Varley, CBS Publisher's latest Edition



**M.Sc. BIOCHEMISTRY**  
**SEMESTER – THIRD**  
**BC-304**  
**ADVANCED BIOTECHNOLOGY**

**UNIT – I**

- Recombinant DNA Technology: Properties and nomenclature of restriction endonucleases type I, II, III and their mode of action, elementary idea on cloning vectors (lambda phage, plasmid, M-13 phage, cosmid), Ti plasmid, shuttle vectors, yeast and viral vectors and expression vectors.

**UNIT – II**

- Hybridoma technology: Monoclonal antibodies, selection of hybrids, hybridomas, HAT-medium, application of monoclonal antibodies.
- Agarose and polyacrylamide gel electrophoresis in DNA analysis construction of genomic library and C DNA library (selection/ screening). Analysis of genomic DNA by southern hybridization. Synthetic oligonucleotides probe. Screening expression with antibodies and oligonucleotides.

**UNIT – III**

- Use of cloning gene, sequencing by Maxam-Gilbert method, Sanger's method, automated sequencing.
- Site directed mutagenesis, PCR (inverse, anchored, RT, nested), RFLP, RAPD, AFLP, DNA fingerprinting and footprinting, Antisense – RNA technology, chromosomal walking.
- Nanotechnology: Definition, history and application of nanoparticles in diagnosis therapy.

**UNIT – IV**

- Plant Cell Culture: Micropropagation, Somatic cell culture, Somoclonal variations, Somatic cell hybridization- protoplast isolation, protoplast fusion, protoplast culture. Genetic transformation- various methods of gene transfer (all vector and vectorless methods). Production of transgenic plants.
- Fermentation Technology: Continuous and batch type culture techniques, principle types of fermentors, general design of fermenters, fermentation process– brewing, manufacture of penicillin, streptomycin and bacitracin. Production of single cell proteins.

**Reference Books**

- Gene Cloning, T. A. Brown, Blakwell
- Gene engineering, Joshi, Daya Publication
- Gene Isolation and Mapping Protocol, Jacqueline Boulwood, Humana Press

- Molecular Biology and Biotechnology, C A Smith; Edward J Wood, Chapman & Hall
- Molecular Biology and Biotechnology, Walker and Repley, Royal Society of Chemistry
- Molecular biology and genomics, Cornel Mülhardt, Elsevier Academic Press
- Molecular Biotechnology,,Bernard, Glick, ASM Press
- Molecular Biotechnology, Primrose,Panima

**OPEN ELECTIVE**  
**M.Sc. BIOCHEMISTRY**  
**Semester- FIRST**  
**BC-107**

**ELEMENTARY BIOCHEMISTRY**

**UNIT-I**

- **Isomerism and stereo chemistry:** Structural isomerism, stereo isomerism, geometrical isomerism (E & Z nomenclature) optical isomerism, optical activity mesocompounds, specific rotation, chirality's, chiral center, enantiomers, diastereoisomers. Monosaccharides – mutarotation, boat and chair forms, axial equatorial bonds. Anomers and epimers.
- **Carbohydrates:** Classification, structure, physical, chemical properties of carbohydrates

**UNIT-II**

- **Water and Buffer:** Physical properties and structure of water, hydrogen bonding, ionization of water. Acid and bases, Henderson – Hasselbalch equation. Buffer solution and their action.
- **Proteins & Amino acids:** Structure of amino acids and their physical and chemical properties. Function, classification and structure of proteins.

**UNIT – III**

- **Lipids :** Classification, structure and function of lipids, essential fatty acids, fats and lipoproteins.
- **Nucleic acids:** Structure and function of nucleotides. Primary, secondary and tertiary structure of nucleic acids. DNA forms (single stranded DNA, A, B and Z DNA) syn and anti conformations. Types of RNA (m RNA, t RNA, rRNA, hn RNA, micro RNA).

**UNIT – IV**

- Properties & classification of enzymes.
- Active site, Michaelis-Menten equation for uni- substrate reactions. Lineweaver-Burk plot, Factors affecting the rates of enzymes catalyzed reactions- pH and temperature.
- Reversible and irreversible inhibition
- Methods of Immobilization of enzymes and their industrial applications.

**Reference Books**

- Principles of Biochemistry by Nelson, Cox and Lehninger
- Biochemistry by G.Zubay
- Biochemistry, DVoet and JG. Voet , J Wiley and Sons.
- Physical Biochemistry: Applications to Biochemistry and Molecular Biology, D Freifilder, W.H. Freeman & Company.
- Practical Biochemistry, Wilson & Walker.

**SOFT CORE**  
**M.Sc. BIOCHEMISTRY**  
**Semester- FOURTH**  
**BC-404**

**ENVIRONMENTAL BIOCHEMISTRY & TOXICOLOGY**

**Unit-I**

- **Environment:** Basic Concept & Issues.
- **Environmental pollution:** Types of pollution.
- **Air pollution** & its control through biotechnology.
- **Water pollution & its Control:** Water as a natural resource, need for water management, measurement of water pollution, source of water pollution.

**Unit-II**

- **Toxic effect:** Basis for general classification & nature. Dose-Response relationship. Synergism & Antagonism. Determination of ED-50 & LD-50. Acute & chronic exposures. Factors influencing toxicity,.
- **Xenobiotics metabolism: Phase-I reactions:** Oxidation, reduction, hydrolysis & hydration. **Phase-II reactions\conjugation:** Methylation, glutathione & amino acid conjugations, detoxifications.

**Unit-III**

- **Pesticide toxicity:** Insecticides- Organochlorines, Anti-cholinesterase- Organophosphates and Carbamates. Fungicides, Herbicides. Environmental consequences of pesticide toxicity. Biopesticides.
- **Metal toxicity:** Toxicology of **Arsenic, Lead and Cadmium** in target organs.
- Metabolism of CCl<sub>4</sub> & Paracetamol & their effect in liver & kidney.

**Unit-IV**

- **Microbiology of degradation of xenobiotics in environment:** Ecology considerations, decay behaviour and degradative plasmid.
- **Hydrocarbons,** substituted hydrocarbons, oil pollution surfactants.
- **Global Environment problems:** Ozone depletion, Green house effect and acid rain.

**Reference Books**

- Environmental Biology and Toxicology, P. D. Sharma, Rastogi
- Textbook of Toxicology, BalramPani, IK
- Casarett&Doull's Essentials of Toxicology, Klaassen, MGH
- Toxicology: Principles and Applications, Niesink, CRC
- Clinical Toxicology, FACMT, Saunders
- Environmental Pollution and Toxicology, Johi, APH

**OPEN ELECTIVE**  
**M.Sc. BIOCHEMISTRY**  
**Semester-FOURTH**  
**BC-405**  
**MEDICAL BIOCHEMISTRY**

**UNIT – I**

**Disorders of Carbohydrates Metabolism**

- Diabetes mellitus, Glycated hemoglobins, Hypoglycemias.
- Various types of glucose tolerance tests.

**Disorders of Thyroid**

- Hyperthyroidism, Hypothyroidism.
- Thyroid function Tests: T3, T4, TSH, TRH

**UNIT – II**

**Disorders of Lipids**

- Hypolipoproteinemia, Hyperlipoproteinemia, Atherosclerosis
- Diagnostic tests for apolipoproteins, HDL – cholesterol, LDL – cholesterol and triglycerides.

**Diagnostic Tests for Proteins**

- Total protein, albumin, globulin and fibrinogen

**UNIT – III**

**Liver Function Tests**

- Van den Bergh test for bilirubin, urine and fecal urobilinogen
- Determination of galactose, epinephrine test
- Detoxification and excretion tests
- Prothrombin Time
- Determination of blood ammonia

**Kidney Function Tests**

- Urea clearance test, Creatinine clearance test
- Renal plasma flow
- Concentration and dilution test

**UNIT-IV**

**Biochemical Aspects of Hematology**

- Complete blood count (CBC)- red blood cell, white blood cell, platelet counts, percent hemoglobin
- Bleeding time, clotting time
- Serum Aspartate aminotransferase, alanine aminotransferase, creatine kinase, gamma glutamyl transpeptidase, alkaline phosphatase

**Reference Books**

- Tietz Fundamentals of Clinical Chemistry, Burtis Ashwood, Saunders
- Clinical Chemistry (Organ Function Test), M.N Chatterjee, Jaypee
- Biochemistry, A.C. Deb, Central