**Bharathiar University: Coimbatore – 641 046**  
M.Sc. Biochemistry (University Dept.)  
(For the students admitted during the academic year 2015–2016 batch & onwards)  

**Scheme of Examination – CBCS Pattern**

<table>
<thead>
<tr>
<th>Paper</th>
<th>Subject</th>
<th>Hrs / Week</th>
<th>University Examination</th>
<th>Total Marks</th>
<th>Credits</th>
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<td>Dur/Hrs.</td>
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<tr>
<td>Paper-I</td>
<td>Biomolecules and Bioenergetics</td>
<td>4</td>
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<td>Paper – II</td>
<td>Cell and Molecular Biology</td>
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<td>Paper – III</td>
<td>Analytical Biochemistry</td>
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<td>Paper – IV</td>
<td>Genetics and Developmental Biology</td>
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<td>Elective – 1</td>
<td>Microbiology / Nutrition</td>
<td>4</td>
<td>3</td>
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<td>Supportive-1</td>
<td>Offered from other Departments</td>
<td>2</td>
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<tr>
<td>Practical - I</td>
<td>Biochemistry, cell biology and microbiology</td>
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<td>Paper – V</td>
<td>Enzymology</td>
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<td>Paper – VI</td>
<td>Intermediary metabolism</td>
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<td>Paper – VII</td>
<td>Human Physiology</td>
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<td>Molecular Physiology</td>
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<td>Summer Training*</td>
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<td>Paper IX</td>
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<td>Paper X</td>
<td>Recombinant DNA Technology</td>
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<td>Paper XI</td>
<td>Pharmacology and Toxicology</td>
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<td>Paper – XII</td>
<td>Biostatistics and Research Methodology</td>
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<td>“Biology of Cancer and Stem cell”</td>
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<td>Practical III</td>
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<td>Industrial Visit**</td>
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<td>Project Work***</td>
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*Summer Training*: All the students have to undergo summer training for a period of minimum 30 days. Final reports have to be submitted which will be evaluated.
**Industrial visit:** Students have to undertake an industrial/institutional visit and have to submit report for evaluation.

***Project work:** The report is the bonafied work carried out by the candidate under the guidance of a faculty authenticated and countersigned by the HOD. This project work must be presented and defended by the candidate in the department attended by all faculties and reviewed by external examiner. Candidate who has presented the work as ‘Not qualified as per CBCS’ must resubmit the project again in the ensuing academic year.

**SUPPORTIVE PAPERS OFFERED FOR OTHER DEPARTMENT STUDENTS**

Paper I : Tools and Techniques in Bioscience  
Paper II : Medical Lab Technology  
Paper III : Clinical Diagnosis in health and disease
BIOMOLECULES AND BIOENERGETICS

Paper-I

Unit-I: Water - Unique properties, weak interactions in aqueous systems, ionization of water, buffers. Classification, chemical properties of carbohydrates, Chemistry and biological roles of homo and heteropolysaccharides. Structural elucidation of polysaccharides; Oligosaccharides – lectin interaction in biochemical processes. Structure and role of proteoglycans, glycoproteins and glycolipids (gangliosides and lipopolysaccharides).


Unit-IV: Nucleotides- structure and properties, physicochemical properties of nucleic acids, cleavage of nucleic acids by enzymatic methods, non – enzymatic transformation of nucleotides and nucleic acids, methylation, Sequencing, chemical synthesis of DNA. Three dimensional structure of DNA. Different forms of DNA – circular DNA and Supercoiling. Types of RNA. Structure of t-RNA. Nucleotides as source of energy, component of coenzymes, second messengers. Porphyrins – Structure and properties of porphyrins – heme, Chlorophyll and Cytochromes.


Reference Books:
CELL AND MOLECULAR BIOLOGY

**Paper-II**

**Unit-I:** Structure and function of cells – prokaryotes and eukaryotes, difference. Structure and organization of membrane – structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, ion pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes. Extracellular matrix, cell-cell communication.

**Unit-II:** Plasma membrane, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure & function of cytoskeleton and its role in motility and Mechanism of cell division: Mitosis; meiosis and genetic recombination; regulation of cell cycle; factors and genes regulating cell cycle.

**Unit-III:** Unit of replication, enzymes involved, replication origin and replication fork, fidelity of replication, extra chromosomal replicons, and DNA damage and repair mechanisms.

**Unit-IV:** Transcription factors and machinery, formation of initiation complex, transcription activators and repressors, RNA polymerases, capping, elongation and termination, RNA processing, RNA editing, splicing, polyadenylation, structure and function of different types of RNA, RNA transport. gene regulation – lac and trp operon.

**Unit-V:** Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase, translational proof-reading, translational inhibitors, post- translational modification of proteins.

**Reference Books:**
1. Molecular and Cell Biology – Baltimore
3. Biochemistry – Lehninger, Cox, Nelson
4. Biochemistry – Cohn and Stum.
ANALYTICAL BIOCHEMISTRY

Paper-III

Unit-I: Light microscope, Fluorescence microscope, Phase contrast microscope, Electron microscope, Confocal microscope. Centrifugation: Small bench top centrifuges, large capacity refrigerated centrifuges, High speed refrigerated centrifuges, preparative and analytical ultra centrifuge. Electrochemical techniques: Principles of electrochemical techniques, redox reactions, the pH electrode, ion-sensitive and gas-sensitive electrodes. The clark oxygen electrode, Biosensors. Spectrophotometry: visible and UV spectrophotometry.

Unit-II: Principles of chromatography, size exclusion, Ion-exchange and affinity chromatographies. High performance liquid chromatography (HPLC), Gas liquid chromatography (GLC), Thin layer chromatography (TLC), Paper chromatography, GC-MS, LC-MS, MaldiTof.


Unit-V: Electrophoresis: General principles, Electrophoresis of proteins: SDS-PAGE, Native gels, Gradient gel, Isoelectric focusing, 2-D gel electrophoresis (2-D PAGE), cellulose acetate electrophoresis, continuous flow electrophoresis; Detection, estimation and recovery of proteins, Western blotting. Electrophoresis of nucleic acids: agarose gel electrophoresis of DNA, DNA sequencing gels, Pulse field gel electrophoresis, electrophoresis of RNA, Capillary electrophoresis.

References:
4. Instrumental methods of chemical analysis – P.K. Sharma
5. Biophysical chemistry – Upadhyay., Upadhyay and Nath
6. A Biologist’s guide to principle and techniques of practical biochemistry – Brigan L. Williams.
GENETICS AND DEVELOPMENTAL BIOLOGY

Unit-I: Principles of Mendelian inheritance; Mendel’s experiments-monohybrid, dihybrid trihybrid and multihybrid crosses. Interaction of genes: incomplete dominance, codominance, epistasis, complementary genes, duplicate genes, polymeric genes, modifying genes; lethal genes. Environment and gene expression: penetrance and expressivity; temperature, light, phenocopies. Environmental effects and twin studies; human intelligence, drug resistance. Quantitative or polygenic inheritance: Inheritance of kernel color in wheat; corolla length in tobacco skin color inheritance in man, transgressive and regressive variation. Multiple alleles; Sex determination; Extra chromosomal inheritance.


Unit-IV: Cell division in cleavage – Chemical changes–Patterns of embryonic cleavage – Morula and Blastula – Role of egg cortex – Morphogenetic gradients – Fate map – Gastrulation – Primary organ, Rudimental organs, Organizer – Morphogenetic movements.


Reference Books:
1. Developmental Biology, Berrill N.J., 1974, TMH Edition
5. Genes VII, Benjamin Lewin, 2000, Oxford University Press
MICROBIOLOGY

Elective-1

Unit-I: isolation, preservation, improvement of strains – handling and development of innoculum for various fermentation processes, upstream processing. Media for industrial fermentation, Formulation and sterilization.

Unit-II: Energy from inorganic compounds - ET in chemolithotrophs, production of reducing power in chemolithotrophs; Energy from visible radiation – photosynthesis in eukaryotes, blue-green algae, bacteria. Energy from aromatic compounds – two carbon compounds, one carbon compounds, endogenous reserve polymers). Energy from hydrocarbons – alkanes, alkenes, acyclic aromatic hydrocarbons.


Unit-IV: Medical Microbiology - Infectious Diseases process – Diagnosis – Process of sample collection, transport and examinations of the specimens. Antibiogram. Bacteriology: Morphology, cultural characteristics, pathogenicity and laboratory diagnosis of Gram positive organisms - *Staphylococcus aureus*, *Mycoplasma*; Gram negative organisms: *E.coli*.


Reference Books:
1. Microbiology by Pelczar M.J., Ried, RD and Chan, ECS
4. Microbial Physiology – S. Meenakumari
7. Food Microbiology by Frazier
9. Text Book of Microbiology by Ananthanarayanan and Jayaram Paniker.
NUTRITION

Elective-1


Unit-IV: Role of diet and nutrition in the prevention and treatment of diseases: Dental carries, Fluorosis, Renal failure, Hyperlipidemia, Atherosclerosis & Rheumatic disorders, Inherited metabolic disorders: Phenylketonuria, Maple syrup diseases, Hemocystinuria, Galactosemia, Gout, Diabetes Insipidus and Diabetes Mellitus.

Unit-V: Diagnosis and management of allergy. Naturally occurring food borne toxicants: protease inhibitors, haemoagglutinins, Hepatotoxins, Allergens, Oxalates, Toxins from mushrooms, animal food stuffs and sea foods.

References Books:
5. Nutritional Biochemistry and metabolism. Maria C. Linder
6. Principles of Food Science – I (Food Chemistry) Fennemona D.R.
7. Human Nutrition and Dietetics (8th Ed. 1982) by Davidson and Passmore ELBS
BIO-CHEMISTRY, CELL BIOLOGY & MICROBIOLOGY

Practical - I

Bio-chemistry

1. Estimation of reducing sugar.
2. Estimation of lipids.
4. Separation of amino acids and lipids using thin layer chromatography (TLC).
5. Separation of two proteins using column chromatography.
7. Estimation of DNA using DPA.

Cell biology

2. Squash preparation of onion root tip and anther lobes.
3. Preparation of buccal smear.

Microbiology

1. Isolation of bacteria from soil and air.
2. Staining techniques – simple, differential and special staining.
4. IMVIT test.
5. Motility of bacteria by hanging drop method.

Reference Book:
1. Experimental Biochemistry: A Student companion- Sashidhar Rao, B and Deshpande, V. IK International (P) Ltd.
2. Experiments and Techniques in Biochemistry: by Sheel Sharma, Galgotia publications.
3. Industrial Microbiology by Casida, LE Industrial Microbiology by Patel.
4. AH Industrial Microbiology by Miller.
5. BM and Litsky Industrial Microbiology by Prescott
6. Dunn Microbial Technology by Peppler, JH and Perlman, D
ENZYMOLOGY


**Unit-II:** Kinetics of enzyme-catalyzed reactions-Methods used in the investigation of the kinetics of enzyme-catalyzed reactions, initial velocity studies, rapid reaction techniques and relaxation technique. Enzyme kinetics of single substrate reactions – Michaelis-Menten and Briggs and Haldane theory (rapid equilibrium and steady state theory). Kinetic data evaluation-linear transformation of Michaelis-Menten equation. Pre-steady state kinetics. Integrated velocity equation. Haldane equation. King-Altman procedure for deriving the rate equation. Effect of pH & temperature on enzymatic reactions, Arrhenius plot, determination of activation energy.

**Unit-III:** Mechanism of Enzyme Action – Acid-base catalysis, covalent catalysis, proximity, orientation effect. Strain & distortion theory. Chemical modification of active site groups. Site directed mutagenesis of enzymes. Mechanism of action of chymotrypsin, lysozyme, glyceraldehyde 3-phosphate dehydrogenase, aldolase, carboxypeptidase, triose phosphate isomerase and alcohol dehydrogenase.

**Unit-IV:** Enzyme Regulation – General mechanisms of enzyme regulation, product inhibition. Reversible (glutamine synthase & phosphorylase) and irreversible (proteases) covalent modifications of enzymes. Mono cyclic and multicyclic cascade systems with specific examples. Feed back inhibition and feed forward stimulation. Allosteric enzymes, qualitative description of “concerted” & “sequential” models for allosteric enzymes. Half site reactivity, Flipflop mechanism, positive and negative co-operativity with special reference to aspartate transcarbamoylase & phosphofructokinase. Protein-ligand binding measurement, analysis of binding isotherms, Hill and Scatchard plots.

**Unit-V:** Application of enzymes in food, Pharmaceutical, pulp, textile and other industries; diagnostic & therapeutic applications. Immobilized enzymes-Techniques of enzyme immobilization; applications of immobilized enzymes.

**References Books:**
17. An Introduction to Enzyme and Coenzyme Chemistry; Timothy B. Bugg, (1997) Jones
INTERMEDIARY METABOLISM

Paper-VI

Unit-I: Intermediary metabolism of carbohydrates - Reactions, energetics and regulation of glycolysis; Feeder pathways for glycolysis; Fate of pyruvate under aerobic and anaerobic conditions; Pyruvate dehydrogenase complex and its regulation; Reactions, regulation and amphibolic nature of TCA cycle; Anaplerotic reactions; Glyoxalate cycle; Poylol pathways; Pentose phosphate pathway; Gluconeogenesis; Cori cycle; Biosynthesis of lactose, sucrose and starch; Glycogenesis and Glycogenolysis; Control of glycogen metabolism;

Unit-II: Metabolism of Lipid - Fatty acid oxidation - Franz Knoop’s experiment; β-oxidation of saturated, unsaturated and odd carbon fatty acids; Peroxisomal β-oxidation; α- and ω- oxidations of fatty acids; Ketone bodies – Formation and utilization; Biosynthesis of saturated fatty acids; Elongation and desaturation of fatty acids; Triacylglycerols – Biosynthesis, and mobilization from adipose tissue; Regulation of fatty acid metabolism; Cholesterol biosynthesis and its regulation; Biosynthesis of phosphoglycerides and sphingolipids.


Unit-IV: Photosynthesis –organization of thylakoid; role of photosynthetic pigments; light absorption and energy conservation.Light absorption by pigment molecules; the reaction centre complex. The photo systems I and II; cyclic and noncyclic photophosphorylation.Carbon reactions in C3, C4 and CAM plants - Calvin cycle; Hatch-Slack pathway. pathways of glucose oxidation in plants; starch biosynthesis and degradation; .Photorespiration: role of photorespiration in plants.


Reference Books:
3. Biochemistry - D.Voet & J.G.Voet (John Willey)
HUMAN PHYSIOLOGY

Paper-VII


**Unit-II:** Comparative anatomy of heart structure, myogenic heart, specialized tissue, ECG – its principle and significance, cardiac cycle, heart as a pump, blood pressure, neural and chemical regulation of all above.

**Unit-III:** Digestive secretions - composition, functions and regulation of saliva, gastric, pancreatic, intestinal and bile secretions. Digestions and absorption of carbohydrates, lipids, proteins and nucleic acids. Comparative physiology of excretion, kidney, urine formation, urine concentration, waste elimination, micturition, regulation of water balance, electrolyte balance, acid-base balance.

**Unit-IV:** Comparison of respiration in different species, anatomical considerations, transport of gases, exchange of gases, waste elimination, neural and chemical regulation of respiration. Neurons, action potential, gross neuroanatomy of the brain and spinal cord, central and peripheral nervous system, neural control of muscle tone and posture. Muscle physiology.

**Unit-V:** Exo and Endocrine glands, basic mechanism of hormone action, hormones and diseases; reproductive processes, neuroendocrine regulation.

**Reference Book:**
IMMUNOLOGY

Paper-VIII


Unit-II: Antigen antibody reactions, Applications of Immunological techniques, genetic control of immune response, effector mechanisms, MHC, antigen recognition and presentation, activation of B and T lymphocytes.


Unit-V: Vaccine technology and recombinant vaccines, Identification of B and T epitopes for vaccine development. In situ characterization of cells from tissues, Immunoscreening of Recombinant library, Hybridoma – Monoclonal Antibody production and applications ; MAbs in diagnosis and therapy.

References Books:
MOLECULAR PHYSIOLOGY

Elective-2

Unit-I: Signaling Components: Endocrine, Paracrine and Autocrine signaling; Signaling molecules- Hormones (agonists and antagonists) NO; Receptor Classification: Receptor linked to Trimeric G proteins (G proteins linked Receptors), Receptors with intrinsic or associated enzymic activity (TGF-β, cytokine, Receptor Tyrosine kinase, Receptor guanylyl cyclase, Receptor Phosphotyrosine phosphatase, T-Cell Receptor), Ion Channels as receptors, receptors involving proteolysis (Wnt, Hedgehog Hh, Notch/ Delta, NF-kβ), intracellular receptor (NO. Pathway, Nuclear receptor). Membrane anchoring process - myristoylation, palmitoylation, Farnesylation, Geranylation, GPI anchor.

Unit-II: Nuclear Receptors: Principle of signaling with nuclear receptors, classification and structures; Transcriptional regulation by nuclear receptors-coactivators, co-repressors; Regulation and variability of signaling; Signaling pathways via steroids hormones receptors, Nuclease localized (retinoid, vit D3 and T3 hormones).

Unit-III: G Protein Coupled Signal Transmission: GPCR Structure and classification, ligand binding domain; Signaling pathways via cAMP, ion Channel regulation, Phospholipase C; Trimeric and monomeric G proteins and their effectors; Regulation –GTPase super family and GTP hydrolysis; Regulation of GPCR signaling – GDP-GTP cycling, GTPase activity, phosphodiesterase activity, feedback inhibition, heterologous desensitization, phosphorylation of receptors, β-arrestin in regulation of GPCR.

Unit-IV: Signaling Pathway That Control Gene Activity: TGFβ Receptors and Smad activation; cytokine receptors and JAK–STAT pathway; RTK and Ras activation; MAP Kinase pathways; phosphoinositides as signal transducers; Signal induced protein cleavage (NF-kB, Notch/Delta, Wnt, Hedgehog).

Unit-V: Integration Of Signals And Gene Controls: Responses of cells to environmental influences control of cell fates by graded amounts of regulators, boundary creation by different combination of transcription factors; Boundary creation by extra cellular signals; Reciprocal induction and lateral inhibition; Integrating and controlling signals; Down modulation of receptor signaling.

Reference Books:
NANOSCIENCE AND TECHNOLOGY

Elective-2

Unit-I: Introduction to Nanoscience and Nanotechnology; Milestones in Nanotechnology; Overview of Nanobiotechnology and Nanoscale processes; Physicochemical properties of materials in Nanoscales. Polymers in nano material synthesis natural and synthetic polymers.

Unit-II: Types of Nanomaterials (Quantum dots, Nanoparticles, Nanocrystals, Dendrimers, Buckyballs, Nanotubes); Gas, liquid, and solid phase synthesis of nanomaterials; Lithography techniques (Photolithography, Dip-pen and Electron beam lithography); Thin film deposition; Electrospinning. Bio-synthesis of nanomaterials.

Unit-III: characterization of Nano material; Absorption, Fluorescence, and Resonance; Microscopy measurements: SEM, TEM, AFM and STM. Confocal and TIRF imaging.

Unit-IV Reactive groups on biomolecules (DNA & Proteins); Surface modification and conjugation to nanomaterials. Fabrication and application of DNA nanowires; Nanofluidics to solve biological problems. Bio mimics

Unit-V: Properties of nanocarriers; drug delivery systems used in nanomedicine; Enhanced Permeability and Retention effect; Blood-brain barrier; Active and passive targeting of diseased cells; Health and environmental impacts of nanotechnology.

Reference Books:
IMMUNOLOGY AND ENZYMOLGY LAB

Practical-II

Immunology

1. Immunodiffusion – single radial and double diffusion
2. Immunoelectrophoresis
3. Rocket immunoelectrophoresis
4. Haemagglutination and passive hemagglutination
5. Identifying blood group and Rh typing
6. ELISA
7. Isolation and purification of IgG from serum

Enzymology

1. Determination of total and specific activity of salivary amylase.
2. Effect of pH on enzyme activity (Acid phosphatase/Alkaline phosphatase).
3. Effect of temperature on enzyme activity (Urease/ALP) and determination of activation energy.
4. Effect of substrate concentration on enzyme activity (Salivary Amylase) and determination of Km value.
5. Effect of inhibitor on activity of any one enzyme.
7. Isoenzyme analysis (LDH) from serum sample

Reference Books:

2. Modern Experimental Biochemistry - R. Boyer (Pearson Education)
5. Practical Biochemistry - D.T. Plummer (TATA McGraw-Hill)
6. Practical Biochemistry - R.C.Gupta & S. Bhargava
7. Experimental Physiology and Biochemistry - P.V.Chadha
8. Experiments in Microbiology - Gilstrap-Kleyne-Nester
CLINICAL BIOCHEMISTRY

Unit- I: Clinical investigation of sugar levels in blood and urine; factors influencing blood glucose level; carbohydrate tolerance tests-procedures and interpretation, biochemical basis of Diabetes, glycogen storage diseases; carbohydrate metabolic disorders. Biosynthesis of bile acids, bile pigments and steroid hormones, plasma lipoproteins, Disorders associated with lipid metabolism and its therapeutic intervention, ketone bodies and ketosis; Fatty liver, Atherosclerosis, biochemical basis of Jaundice.

Unit II: Hemoglobin, Met-Hb, embryonic-Hb, heme metabolism associated Diseases, sickle cell anemia, thalassemia, metabolic disorders of amino acid metabolism and urea cycle, phenylketonuria, Alkaptonuria, Albinism, Lesch-Nyhan syndrome.

Unit-III: Disorders of nucleic acids metabolism, Biochemistry of cancer, carcinogens; oncogenes, protooncogenes and tumor suppressor genes; metastasis and cancer stem cells; anticancer drugs and their mechanism of actions, Resistance against anticancer drugs and cancer therapy. Biochemical mechanism of blood Clotting and hemorrhagic disorders, disseminated intravascular coagulation, anticoagulants, acquired prothrombin complex disorders. Biochemistry of vitamins and micronutrients, and their deficiency.

Unit-IV: Functional test of liver, kidney, thyroid, gastrointestinal and pancreas, biochemical diagnosis of diseases by enzymatic assays-ALP, SGOT, SGPT, Creatinine, cholinesterase, Creatine kinase and LDH. Electrolytes, reabsorption of electrolytes, metabolism of iron, calcium and phosphorus, acid-base balance, regulation of electrolyte content of body fluids and maintenance of pH, disorders of acid base balance.

Unit-V: Metabolism of Xenobiotics, phase I and Phase II transformation reactions, basic component of Cytochrome P450 systems and its role in xenobiotic metabolism. Disorders of nitrogen metabolism - Assimilation and excretion of nitrogen with reference to ammonia, urea, uric acid, creatine, creatinine - excretion of nitrogenous waste products - abnormalities of nitrogen metabolism including uremia, porphyrias, porphyrinurias, aminoaciduria - factors affecting nitrogen balance.

Reference Books
1. Clinical Chemistry in Diagnosis and Treatment. - Ziwa J.F.P Peter, Mayne P.D.
2. Medical Biochemistry – A.C Deb
3. Medical Biochemistry - M.N. Chatterjee, Shinde
4. Textbook of Biochemistry for Medical Students. by Dr. D.M. Vasudevan and Dr. Sreekumari.
RECOMBINANT DNA TECHNOLOGY

**Paper-X**

**Unit-I:** DNA modifying enzymes and their uses in Molecular Biology a) Restriction enzymes b) DNA Polymerase i) Klenow ii) DNA polymerase I iii) T4/T7 DNA Polymerase c) Reverse Transcriptase d) Terminal Transferases e) T4 Polynucleotide kinases & Alkaline phosphatase f) DNA dependent RNA polymerases. g) DNA ligases h) Nucleases: - Bal 31, S1 nucleases, DNase I, Mungbean nucleases, Ribonucleases, EXO III. Thermostable DNA polymerases used in PCR.

**Unit-II:** Host cells and Vectors- Host Cell Types (Prokaryotic and eukaryotic). Plasmid vectors for use in E. coli and Gram positive bacteria. Bacteriophage - Lambda and M13 vectors c) Cosmids d) Phagemids. Artificial chromosomes (YACs, PACs, BACs, MACs and HACs). Specialized vectors & their uses a) Expression vectors for Prokaryotes & Eukaryotes - Inducible vectors; vectors with tags (Histidine tags, signalling peptides for exportation), b) Gene fusion vectors.

**Unit-III:** Cloning strategies: DNA cloning a) Sticky ends b) Blunt ends c) Homopolymeric tailing d) Use of adapters & linkers. Construction of genomic DNA libraries (shotgun cloning) and cDNA libraries. Screening of recombinants - Antibiotic resistance, lacZ complementation (Blue-white selection), fluorescent markers (e.g. GFP). Preparation of radiolabelled/non-radiolabelled DNA & RNA probes. Southern/Northern/Western blot, dot blot and Zoo blot. Screening of genomic libraries with oligo-probe. Immunological screening for expressed genes.

**Unit-IV:** PCR – basic process, types and applications. DNA sequencing- Principle of chemical and enzymatic methods. Automated DNA sequencing, high throughput Pyrosequencing, next generation sequencing - Lynx Therapeutics' Massively Parallel Signature Sequencing (MPSS), Polony sequencing, Ligation based sequencing (SOLiD sequencing), Ion semiconductor sequencing, DNA nanoball sequencing, sequencing based on reversible dye-terminators (Illumina or Solexa sequencing), Real-Time DNA sequencing, Optical sequencing, Microchip based Sanger Sequencing of DNA, Deep sequencing. Site-directed mutagenesis and protein engineering. DNA footprinting, chromosome jumping, chromosome walking.

**Unit-V:** Biotechnological applications of rDNA technology: Synthesis and purification of proteins from cloned genes- Native and fusion proteins. Yeast expression system. Production of enzymes. Therapeutic products for use in human health care- insulin, growth hormones, TPA, alpha interferon, Hepatitis B vaccine and Factor VIII. Medical and forensic applications of rDNA technology- DNA Profiling, Multiplex PCR, Diagnosis of inherited disorders and infectious diseases, diagnosis and management of cancer. Treatment using rDNA technology- gene therapy. Gene therapy for ADA and cystic fibrosis.

**Reference Books:**
PHARMACOLOGY AND TOXICOLOGY

Paper-XI

UNIT-I: General Principles: Basic principles of drug action-Pharmacokinetics: Absorption, distribution and elimination of drugs, routes of drug administration. Pharmacogenetics. origin of drug from plants and animals.


UNIT-III: Pharmacodynamics - receptor concepts, theory, drug receptor interaction (DRI), Factors affecting DRI, Cholinergic and anticholinergic drugs, Adrenergic and adrenergic blockers, General anesthetics, Local anesthetics. Adverse reactions to drugs and common drug receptor interactions.


Reference Books:
BIOSTATISTICS AND RESEARCH METHODOLOGY

**Paper-XII**

**UNIT I:** Organising a statistical survey - Planning and executing the survey. Source of data - Primary and secondary data. Collection - observation; interview; enquiry forms, questionnaire schedule and check list. Classification and tabulation of data. Diagrammatic & graphic presentation of data.

**UNIT II:** Measures of central tendency; arithmetic mean, median, mode, quartiles, deciles and percentiles. Measures of variation: range, quartile, deviation, mean deviation, standard deviation. Correlation analysis: Scatter diagram, Karl Peason's coefficient of correlation and Spearman's rank method. Regression analysis.

**UNIT III:** Probability - definition, concepts, theorems (proof of the theorems not necessary) and calculations of probability. Theoretical, distributions. Binomial - Poisson and normal distribution. Normal importance, properties, conditions and constants of the distribution (proof not necessary). Simple problems. Analysis of variance one way and two-way classification, Duncans Multiple Range Test. Design of experiment - completely randomized block design randomized clock design

**UNIT IV:** Sampling distribution and test of significance: Testing of hypothesis errors in hypothesis testing, standard error and sampling distribution. sampling of variables (large samples and small samples ). Student's 't' distribution and its applications. Chi - square test & goodness of fit.

**UNIT V:** Thesis writing, Publication in a scientific journal, Preparation of Abstract and manuscript. Contents-Preamble, the problem, objectives, hypothesis to be tested, study, design, setup, measurement procedures, analysis of data, organization of report; Displaying data tables, graphs and charts – preparation of project proposal: Thrust area – funding agencies (National and International) – kinds of research program in India and abroad – career development in laboratory research – principle and method of patenting.

**References Books:**
2. Biostatistics – A foundation for analysis in health science Danien.
7. MS office; Sexena S, Vikas Publishing House.
8. Statistical methods; Snedecor GW and Cohran WG, Oxford and IBH publishing CO Pvt. Ltd.
BIOINFORMATICS

Elective-3

Unit-I: History and development of computers, mainframe, mini and super computer systems. Principles of computing: Operating systems, Basic word processing and database management soft wares: LOTUS, DBASE, Wordstar, and other scientific application packages. Data acquisition and management: Types of data-DNA, RNA and protein sequences, protein structure data, gene and protein expression data


Unit-III: Databases: Biological databases (Eg. Genbank, SWISSPROT, PDB, etc) - searching and retrieving data form databases- FASTA – BLAST: parameters and its types. Sequence analysis with acquired data: Sequence comparison with pair wise and multiple sequence alignment. Deducing phylogenetic relationships from multiple sequence alignment. phylogenetic analysis. Genome sequencing projects.


Reference Books:

2. Developing bioinformatics computer skills by Cynthia Gibas and Per Jambeck, O’ Reilly publications.
5. Instant notes in bioinformatics by D.R. Westhead, J.H.Parish and R.M.Twyman
BIOLOGY OF CANCER AND STEM CELL

Elective-3

Unit-I: Introduction to Cancer: Definition; Cancer incidence and mortality; Origin of neoplastic cells; Cancer as cellular disease; Types of Cancer: Benign Tumors Vs. Malignant Tumors, Common Symptoms, Causes of Cancer: Chemical Carcinogenesis; Irradiation Carcinogenesis; Oxygen Free Radicals, Aging and Cancer; Genetic Susceptibility and Cancer; Viral Carcinogenesis.


Unit-III: Cancer Diagnosis & Therapy: Tumor Markers; Gene Expression Microarrays; Proteomic Methods; Circulating Epithelial Cells; Circulating Endothelial Cells and Endothelial Progenitor Cells; Molecular Imaging; Haplotyping. Cancer therapy: Surgery, Radiotherapy, Chemotherapy, Hormone therapy, Immune, Prodrug and Targeted therapies.

Unit-IV: Introduction To Stem Cell: Definition, Types of Stem cell, characterization, pluripotency, niche specification – Drosophila germ line stem cells, self-renewal and differentiation, tooth primodia, gut specifications. Occurrence of stem cell in mammals: In Mesenchymal cells - Hemangioblasts, skeletal muscle cells, adipose cells, bladder cells; In Epidermal cells – skin, mammary gland, dental and neural cells; In Endodermal cells – liver, GI tract, pancreatic cells

Unit-V: Embryonic Stem Cells: Blastoyst and inner cell mass cells, Organogenesis, Adult versus embryonic stem cells, post genomic adult stem cells, stemness, characteristics, hierarchy, stem cell niche; Adult stem cell from amniotic fluid and cord blood; Stem cell characterization techniques and cryopreservation

References:
CLINICAL BIOCHEMISTRY AND MOLECULAR BIOLOGY LAB

Clinical Biochemistry

1. Enumeration of blood cells (RBC, WBC)
2. Blood sugar determination by glucose oxidase method
3. Estimation of bilirubin
4. Estimation of blood urea
5. Estimation of serum enzymes - Creatine phosphokinase (CPK), ALP and SGPT
6. Normal and abnormal constituents of urine
7. Determination of blood cholesterol
8. Estimation of total protein and albumin from serum

Molecular Biology Lab

1. Isolation of DNA from E. coli/ liver/ plant
2. Agarose gel electrophoresis of DNA
3. Restriction digests of DNA.
4. Isolation of plasmid
5. Separation of serum protein by SDS -PAGE
6. Western blotting

Reference books:
SUPPORTIVE PAPERS FOR OTHER DEPARTMENT STUDENTS

TOOLS AND TECHNIQUES IN BIOSCIENCE

Supportive-1

Unit-I: Cell fractionation techniques: Cell lysis, homogenization, extraction, salting in, salting out, dialysis and ultra-filtration. Radioisotopes in Biology: Concept of half-life, decay constant, detection and quantitation - GM counter and solid and liquid scintillation counter. Specific activity, autoradiography and Applications of radioactivity.


Unit-III: Chromatographic techniques: Principles and applications of paper, TLC, adsorption, ion exchange, gel filtration, affinity, GLC, chromatofocusing, HPLC and FPLC.

Unit-IV: Electrophoretic techniques: Polyacrylamide gel electrophoresis, SDS-PAGE, 2D electrophoresis, agarose gel electrophoresis, isoelectric focusing, pulse field electrophoresis.


Reference Books:
MEDICAL LAB TECHNOLOGY

Supportive-2

**Unit-I:** Basic laboratory principles - Code of conduct of medical laboratory personnel - Organization of clinical laboratory - Role of medical laboratory technician - Safety measures - Medical laboratory professional and professionalism in laboratory workers - communication between physician and lab technician - hospital and clinic borne infection and personnel hygiene

**Unit-II:** Common glass wares in clinical laboratory - care and maintenance - Calibration of pipettes and volumetric apparatus - Cleaning and sterilization methods - antiseptics and disinfectants - Principle, care, maintenance and application of Light - Fluorescent - Phase contrast - Electron microscope – staining techniques – vital stains.

**Unit-III:** Automation in Clinical Biochemistry- Instrumental concept, Selection of Instrument, Quality assurance, Control of pre-analytical and analytical variables, External and internal quality control measurements. Good Clinical Practices.

**Unit-IV:** Clinical samples and specimens - Specimen collection, transport, storage and disposal –common laboratory infections - Anticoagulants: EDTA, Di-potassium salts of EDTA, double oxalate, single oxalate, sodium citrate and sodium fluoride.

**Unit-V:** Acid - Base balance – Electrolytes - Buffer and pH- Preparation of solution : Normal , per cent and Molar solution - normal saline -Methods of measuring liquids- Clinical laboratory records- Modern laboratory set up - Quality control: Accuracy, Precision, and Reference values.

**Reference Books**


UNIT-III: Test for heart function: Blood pressure (cystolic and diastolic), lipid profile (cholesterol, triglycerides, HDL, LDL estimation) and their importance. Test for lung function: Chest X-ray, Spirometry. Test for Brain function: EEG, MRI, CT. Test for Surgery: Bleeding time, clotting time. Special test: X-ray, CT, MRI, Doppler, TMT, angioplasty.


Reference Books: