

THIRUVALLUVAR UNIVERSITY

MASTER OF SCIENCE

DEGREE COURSE

M.Sc. BIOCHEMISTRY

UNDER CBCS

(with effect from 2008-2009)

The Course of Study and the Scheme of Examinations

Year / Semester	Subject	Paper	Title of the Paper	Ins. Hrs/ Week	Credit	Exam hrs	Max.Marks		
							IA	Uni. Exam.	Total
I Year I Semester	Core	Paper I	Cell Dynamics	5	4	3	25	75	100
	Core	Paper II	Biomolecules	5	5	3	25	75	100
	Core	Paper III	Human Physiology and Nutrition	5	4	3	25	75	100
	Core Practical			10	-	-	-	-	-
	Elective I	Paper I	Biophysical and Bioorganic Chemistry	5	4	3	25	75	100
I Year II Semester	Core	Paper IV	Analytical Biochemistry	5	4	3	25	75	100
	Core	Paper V	Advanced Enzymology	4	4	3	25	75	100
	Core	Paper VI	Intermediary Metabolism	5	5	3	25	75	100
	Core Practical	Practical I	Isolation and Characterization Studies, Quantitative Analysis and Techniques		5	6	40	60	100
	Core Practical	Practical II	Enzymology - Purification and Kinetic Studies and Microbial Biochemistry	10	5	6	40	60	100
			Human Rights	2	2	3	25	75	100
	Elective II	Paper II	Microbiology	4	4	3	25	75	100
II Year III Semester	Core	Paper VII	Advanced Endocrinology	4	4	3	25	75	100
	Core	Paper VIII	Research Methodology	4	4	3	25	75	100
	Core	Paper IX	Biotechnology	4	4	3	25	75	100
	Core Practical			10	-	-	-	-	-
	Elective III	Paper III	Immunology	4	4	3	25	75	100
	Elective IV (Non-Major Subject)	Paper IV	Nutrition in Health and Diseases	4	4	3	25	75	100

M.Sc. Biochemistry : Syllabus (CBCS)

Year / Semester	Subject	Paper	Title of the Paper	Ins. Hrs/ Week	Credit	Exam hrs	Max.Marks		
							IA	Uni. Exam.	Total
II Year IV Semester	Core	Paper X	Molecular Biology	5	5	3	25	75	100
	Core	Paper XI	Advanced Clinical Biochemistry	5	5	3	25	75	100
	Core Practical	Practical III	Biochemical Analysis of Blood and Immunological and Molecular Biology Techniques	-	5	6	40	60	100
	Core Practical	Practical IV	Haematological Methods and Urine Analysis	10	5	6	40	60	100
	Core		Project/ Dissertation with Viva-Voce	10	4	-	50	150	200
			Total	120	90				2200

THIRUVALLUVAR UNIVERSITY

M.Sc. BIOCHEMISTRY

SYLLABUS

UNDER CBCS

(with effect from 2008-2009)

I SEMESTER

PAPER I

CELL DYNAMICS

UNIT-I : CELLULAR ORGANIZATION, DIVISION AND CYTOSKELETONS

Cell types - organization of prokaryotic and eukaryotic cells, cell division - mitosis and meiosis, cell cycle - phases of cell cycle, and regulation of cell growth and cell cycle, cell motility - molecular motors, microtubules, structure and composition, microtubular associated proteins - role in intracellular motility.

UNIT-II : CELLULAR ORGANELLES

Cellular organelles - Nucleus - internal organization, traffic between the nucleus the nucleolus, and cytoplasm, endoplasmic reticulum - protein sorting and transport, golgi apparatus and lysosomes, morphology and function of mitochondria, chloroplasts and peroxisomes, glyoxysomes.

UNIT-III : METHODS IN CELL BIOLOGY

Methods for disrupting tissues and cells, organ and tissue slice techniques, isolation of clones, tissue culture techniques (animal and plant), cell fixation - fluid fixatives, freezing and section drying, fixation for electron microscopy - buffered osmium solutions, fixation of organic and inorganic substances, staining techniques acid and basic, fluorescent and radioactive dyes, staining of lipids, steroids, nucleic acids, proteins and enzymatic reaction products. Histopathological studies - organ specific morphohistological examination, identification of morphological changes related to pathology.

UNIT-IV : CELLULAR COMMUNICATION AND TRANSPORT

Differentiation of cell membrane - microvilli, tight junctions, epithelia, Bell and sqot desmosomes - mechanical function, cell-cell interaction, cell adhesion proteins, cell junctions, tight junctions, cell surface of plant cells and cancer cells. Overview of membrane protein - peripheral and integral, molecular model of cell membrane - fluid mosaic model and membrane fluidity, solute transport across membrane - passive transport, active transport by ATP powered pumps, types of transport systems.

UNIT-V : CELL DEATH AND SIGNALING

Cell aging and death - necrosis and apoptosis - mitochondrial and death receptor pathway. Cell signaling - signaling molecules and their receptors, functions of cell surface receptors, pathways of intracellular signal transduction, G protein coupled receptors, receptors tyrosine kinases, ras, MAP kinase pathways.

References

1. The World of the cell by Becker, Kleinsmith and Harden Academic Internet Publishers; 5th edition (2006)
2. **The Cell: A Molecular Approach, Fourth Edition** by Geoffrey M. Cooper and Robert E. Hausman.
3. Cell and Molecular Biology by concepts and experiments by Gerald Karp (2005) John Wiley sons & Inc.
4. Molecular cell Biology by Harvey Lodish. W. H. Freeman; Sol edition (2007)
5. The Cell - Biochemistry, physiology and morphology by J. Brachet and A. E. Mirsky, Academic Press (1963)

PAPER II
BIOMOLECULES

UNIT-I : HOMO AND HETEROGLYCANS

Polysaccharides - occurrence, structure, isolation, properties and functions of homoglycans - starch, glycogen, cellulose, dextrin, inulin, chitins, xylans, arabinans, galactans. Occurrence, structure, properties, and functions of heteroglycans - bacterial cell wall polysaccharides, glycoaminoglycans, agar, alginic acid, pectins, amino sugars and deoxy sugars, blood group substances and sialic acids. Glycoprotein and their biological applications. Lectins structure and functions.

UNIT-II : PROTEINS

Classification of proteins on the basis of solubility and shape, structure, and biological functions. Isolation, fractionation and purification of proteins. Denaturation and renaturation of proteins. Primary structure - determination of amino acid sequence of proteins. The peptide bond: Ramachandran plot. Secondary structure - weak interactions involved - alpha helix and beta sheet and beta turns structure. Pauling and Corey model for fibrous proteins . Collagen triple helix. Super secondary structures - helix-loop-helix. Tertiary structure - alpha and beta domains. Quaternary structure - structure of hemoglobin. Solid state synthesis of peptides.

UNIT-III : NUCLEIC ACIDS

Watson - Crick model of DNA structure. A, B and Z - DNA Cruciform structure in DNA, formation and stability of cruciforms, miscellaneous alternative conformation of DNA, slipped mispaired DNA, parallel stranded, anisomorphic DNA, palindrome, secondary and tertiary structure of RNA, hnRNA, methods for nucleic acid sequence determination, denaturation, strand separation, fractionation, isolation and purification of DNA mRNA, rRNA and tRNA, molecular hybridization, Cot value curve, hypochromic effect, DNA-protein interactions.

UNIT-IV : LIPIDS

Lipids - classification - saturated and unsaturated fatty acids, phospholipids - classification, structure and functions. Ceramides and sphingomyelins. Eicosanoids, structure and functions of prostaglandins, thromboxanes, leukotrienes Types and functions of plasma lipoproteins. Amphipathic lipids - membranes, micelles, emulsions and liposomes. Steroids - cholesterol structure and biological role - bile acids, bile salts.

UNIT-V : VITAMINS AND PORPHYRINS

Vitamins - water soluble - thiamine, riboflavin, niacin, pyridoxine, folic acid, ascorbic acid- sources, structure, biochemical functions, deficiency diseases, daily requirements; fat soluble - vitamin A, vitamin D₂, vitamin E and vitamin K - sources, structure, biochemical functions, deficiency diseases, daily requirements. Porphyrins the porphyrin ring system, chlorophyll, hemoglobin, myoglobin and cytochrome.

References

1. Biochemistry by L. Stryer, W.H. Freeman and Co. 5th 2002
2. Fundamentals of Biochemistry by Voet and Voet, John Wiley and sons NY [2002].
3. Lehninger's Principle of Biochemistry by [David L. Nelson](#) and [Michael M. Cox](#). W. H. Freeman; 4th edition (2004)
4. Text Book of Biochemistry with clinical correlation by Thomas .M. Devlin, John Wiley-Liss, Hobokhen NJ publishers (2006)
5. Biochemistry by Zubey, GL WCB Publishers.

PAPER III

HUMAN PHYSIOLOGY AND NUTRITION

UNIT-I : DIGESTION, ABSORPTION AND EXCRETION

Digestive secretions - composition, functions and regulation of saliva, gastric, pancreatic, intestinal and bile secretions. Digestions and absorption of carbohydrates, lipids, proteins and nucleic acids.

Excretory system - structure of nephron. Formation of urine - glomerular filtration, tubular reabsorption of glucose, water and electrolytes, tubular secretion.

UNIT-II : BLOOD AND CIRCULATION

Composition and functions of blood and plasma. Blood groups. Blood coagulation - mechanism, fibrinolysis, anticoagulants. Hemoglobin - structure, abnormal types, anemia. Structure of heart, cardiac cycle, heart sounds, E.C.G [elementary knowledge] vasomotor circulation, coronary circulation, blood pressure, spleen, lymph, normal composition and function of lymph - role of different lymph cells.

UNIT-III : RESPIRATION AND REPRODUCTION

Structure of lungs, mechanism and regulation of respiration. Transport of blood gases - O₂ and CO₂. Acid-base balance - role of buffers, erythrocytes, respiratory system and kidneys. Acidosis and alkalosis - metabolic and respiratory. Fluid electrolyte balance - regulation of water balance and sodium balance - role of renin-angiotensin and ADH.

Structure and function of reproductive organs, composition of semen, transport of sperm, ovulation, sexual cycle, physiology of pregnancy, parturition and lactation.

UNIT-IV : NEUROMUSCULAR FUNCTION

Structure and function of nerves, neurons, resting and action potential, transmission of nerve impulses, synaptic transmission, compounds affecting synaptic transmission, neuromuscular junction, composition and functions of cerebrospinal fluid, brain - chemical composition and metabolic adaptation, neurotransmitters and cAMP, biochemical aspects of learning and memory, enkephalins and endorphins. Structure of muscle cells and muscle contraction, molecular organization of muscle, proteins of contractile element - their organization and role in contraction, energy for contraction.

UNIT-V : NUTRITION

Basal metabolism, basal metabolic rate, factors affecting BMR, determination of BMR - direct and indirect method, height, respiratory quotient - biological oxygen demand, weight, skin - fold thickness and arm circumference - their importance in nutrition. Role of fiber in diet, role of essential amino acids - relation with Marasmus, Kwashiorkor disease, role of essential fatty acids, disorders of fatty acid metabolism, Refsum's disease. Trace elements - macro and micro, daily requirements, functions, deficiency manifestations, nutrition at different stages of life - during infancy, adolescence, pregnancy and old age.

References

1. Review of Medical Physiology by William. F. Ganong. McGraw-Hill Medical; 22nd edition (2005)
2. Human Physiology and Mechanisms of Disease by Guyton. Saunders Publications; 6th edition (1996)
3. Human physiology by C.C. Chatterjee. 11th edition (1985)
4. Human Nutrition and Dietetics by Davidson and Passmore. Churchill Livingstone; 8th edition (1986)
5. Principles of Nutrition by M.S.Swaminathan
6. Modern Nutrition and Health Diseases by M.E. Skilis and V.R. Young

ELECTIVE

PAPER I

BIOPHYSICAL AND BIOORGANIC CHEMISTRY

UNIT-I : BIOENERGETICS

Thermodynamics - basic concepts. First, second and third laws of thermodynamics - enthalpy and entropy, exothermic and endothermic reactions. Free energy - standard free energy. Temperature and pressure dependence of free energy. Equilibrium for biochemical reactions. High energy phosphates and free energy. Redox reactions and free energy changes in biological reactions.

UNIT-II : SPECTROSCOPY AND STRUCTURAL ELUCIDATION

The electromagnetic spectrum - quantization of energy. Regions of the spectrum. Basic principles of UV, IR, NMR and mass spectrometry and their biological applications. FT-NMR Nuclear overhauser effect. Use of X-ray crystallography and CD in the study of proteins and nucleic acids.

UNIT-III : ATOMIC STRUCTURE AND CHEMICAL BONDS

Atomic orbitals. quantum numbers. Shapes of s, p and d orbitals. Aufbau principle, Pauli exclusion principle and Hund's rule. Electronic configuration of atoms, formation of chemical bonds, octet rule, ionic bond, covalent bond and co-ordinate bonds with examples.

UNIT-IV : FUNCTIONAL GROUPS AND REACTIONS

Classification of organic compounds based on functional groups and their nomenclature. Biologically important organic compounds (names and structures). Homolytic and heterolytic cleavage of covalent bonds. Reactive species: electrophiles, nucleophiles and radicals. Types of organic reactions with examples. Inductive effect and resonance.

UNIT-V : ISOMERISM

Isomerism in organic compounds. Types of isomerisms, tautomerism with special reference to purines.

Stereoisomerism. Geometric isomerism with special reference to fumaric and maleic acids and unsaturated fatty acids. E-Z notation. Partial double bond character of C-N bonds in amides. Geometrical isomerism in such compounds.

Optical isomerism, optical activity, enantiomers, diastereomers. Meso and dl forms. R-S and D-L notations in amino acids and sugars. Conformational analysis, conformations of ethane, butane and cyclohexane. Relative stability of various conformations. Difference between conformation and configuration. Elementary idea of conformation of amino acids and peptides.

II SEMESTER

PAPER IV

ANALYTICAL BIOCHEMISTRY

UNIT-I : MICROSCOPY AND ELECTROCHEMICAL TECHNIQUES

Microscopy - bright field, darkfield, fluorescence and phase contrast microscope. Scanning and transmission electron microscopy. Electrochemical techniques - principles, electrochemical cells - pH, Henderson - Hasselbalch equation, buffer capacity, pH measurement, glass electrode. Ion-selective and gas sensing electrodes, oxygen electrode - principle and application. Biosensors.

UNIT-II : ULTRACENTRIFUGATION AND RADIOACTIVITY

Ultracentrifugation - basic principles. Preparative ultracentrifugation - differential centrifugation and density gradient centrifugation. Analytical centrifugation - Schlieren optical system - applications - determination of molecular mass and purity of macromolecules.

Nature of radioactivity - stable and radioactive isotopes - units and interaction of radioactivity with matter. Detection and measurement of radioactivity - GM counter, solid and liquid scintillation counter - tissue solubilizers, counting efficiency, primary and secondary fluors, quenching - Cerenkov counting. Autoradiography. Applications of radioisotopes in the biological sciences.

UNIT-III : ELECTROPHORESIS

Electrophoresis: General principles. Support media. Electrophoresis of proteins - SDS - PAGE, 2D - PAGE, native gels, gradient gels, isoelectric focusing. Cellulose acetate electrophoresis. Detection, estimation and recovery of proteins in gels. Protein blotting. Electrophoresis of nucleic acids - agarose gel electrophoresis, DNA sequencing gels, pulsed field gel electrophoresis.

UNIT-IV : CHROMATOGRAPHY

Chromatographic techniques - General principles of partition and adsorption chromatography. Thin layer, column, ion - exchange, molecular exclusion, gas - liquid and HPLC, normal phase, reverse phase, chromatofocusing, immunoaffinity, capillary electrochromatography.

UNIT-V : SPECTROSCOPY

Laws of absorption and absorption spectrum. Principles of turbidimetry and nephelometry. Principle, instrumentation and application of luminometry. Atomic spectroscopy - Principle and applications of atomic flame and flameless spectrophotometry. Use of lasers for spectroscopy.

Reference

1. Practical Biochemistry by K. Wilson and I. Walker. 5th edition, Cambridge University press (2000)
2. Practical Biochemistry by Shawney
3. Analytical Biochemistry by P.Asokan, China publications, [2003]
4. Physical Biochemistry by David Frifelder. W. H. Freeman; 2 edition (1982)
5. Instrumental Methods of Chemical Analysis by [Galen Wood Ewing](#) Mcgraw-Hill College ; Fifth edition (1985).
6. Introduction to Instrumental Analysis by Robert D. Braun, Pharma Book Syndicate (2006)

PAPER V

ADVANCED ENZYMOLOGY

UNIT-I : CLASSIFICATION, PURIFICATION AND ACTIVE SITE

Nomenclature and classification of enzymes, isolation and purification of enzymes - enzyme protein determination by different methods, criteria of purity - specific activity. Enzyme units - Katal, IU. Measurement of enzyme activity - two point assay, kinetic assay, using radiolabelled substrates. Active site - determination of active site amino acids - chemical probe, affinity label, and site-directed mutagenesis, intrinsic and extrinsic regulations. Investigation of 3-D structure of active site. A brief account of nonprotein enzymes - ribozymes and DNA enzymes.

UNIT-II : ENZYME KINETICS

Kinetics of single substrate enzyme - catalysed reactions - Michaelis - Menten equation, importance of V_{max} , K_m , MM equation, and turnover number; Lineweaver - Burk plot, Eadie - Hofstee plot, Hanes - Woolf plot and Eisenthal and Cornish - Bowden plot.

Presteady - state kinetics and relaxation kinetics. Kinetics of Allosteric enzymes - MWC and KNF models Hill' equation coefficient. Kinetics of multi - substrate enzyme - catalysed reactions - Ping-pong bi-bi, random order and compulsory order mechanism.

UNIT-III : ENZYME CATALYSIS AND INHIBITION

Mechanism of enzymic action - general acid-base catalysis, covalent catalysis, role of metal ion in enzyme catalysis, mechanism of serine proteases - chymotrypsin, lysozyme, carboxy peptidase A and ribonuclease.

Reversible inhibition - competitive, uncompetitive, noncompetitive, mixed, substrate and allosteric inhibition. Irreversible inhibition.

UNIT-IV : COENZYMES AND ISOENZYMES

Coenzymes - prosthetic group, classification - vitamin and nonvitamin coenzymes, thiamine pyrophosphate - mechanism of oxidative and nonoxidative decarboxylation, transketolase reaction, FMN and FAD - flavoprotein enzymes -

mechanism of oxidation and reduction of: flavin enzymes, NAD and NADP role in enzyme catalysis, PALP and PAMP - role of PALP in transamination and decarboxylation reaction, Coenzyme A involved reactions, biotin - carboxylation reaction, folate coenzymes, coenzymic role of vitamin B₁₂ and vitamin C, metabolite and nonvitamin coenzymes, lipoic acid, coenzyme Q, nucleoside triphosphate and S-adenosyl methionine. Isoenzymes.

UNIT-V : INDUSTRIAL AND CLINICAL USES OF ENZYMES

Industrial uses of enzymes - sources of industrial enzymes, thermophilic enzymes, amylases, glucose isomerases, cellulose degrading enzymes, lipases, proteolytic enzymes in meat and leather industry, detergents and cheese production.

Clinical enzymology - Enzymes as thrombolytic agents, anti-inflammatory agents, digestive aids. Therapeutic use of asparaginase, streptokinase. Enzymes and isoenzymes in diagnosis - LD, CK, transaminases, phosphatases, amylase and cholinesterase. Immobilization of enzymes and their applications.

References

1. Enzymes by Dixon and Webb, Academic Press (1964)
2. Understanding enzymes by Palmer. Prentice Hall; 4 Sub edition (1995)
3. Enzymes by P.Asokan. China publications (2003).
4. Enzymes by Boyer. Academic Press; 3rd edition (November 1983)
5. Biochemistry by Metzler. Academic Press (2000)
6. Biochemistry by Stryer. W. H. Freeman; 6 edition (2006)

PAPER VI

INTERMEDIARY METABOLISM

UNIT-I : BIOENERGETICS AND BIOLOGICAL OXIDATION

Free energy and entropy. Phosphoryl group transfers and ATP. Enzymes involved in redox reactions. The electron transport chain - organization and role in electron capture.

Oxidative phosphorylation - Electron transfer reactions in mitochondria. F₁F₀ ATPase - Structure and mechanism of action. The chemiosmotic theory. Inhibitors of respiratory chain and oxidative phosphorylation - Uncouplers and ionophores. Regulation of oxidative phosphorylation.

Mitochondrial transport systems - ATP/ADP exchange, malate / glycerophosphate shuttle, creatine - phosphate shuttle.

UNIT-II : CARBOHYDRATE METABOLISM

Glycolysis and gluconeogenesis - Pathway, key enzymes and coordinate regulation. The citric acid cycle and regulation. The pentose phosphate pathway. Metabolism of glycogen and regulation. Metabolism of galactose and fructose. The glyoxylate cycle. Cori cycle. Futile cycles, anaplerotic reactions.

Photosynthesis - Photosynthetic apparatus, light reaction, cyclic and noncyclic photophosphorylation. Dark reaction - Calvin cycle, Hatch-Slack pathway. Photorespiration. Starch biosynthesis and degradation. Bioluminescence.

UNIT-III : LIPID METABOLISM

Oxidation of fatty acids - α , β and ω . Metabolism of ketone bodies - Formation, utilization, excretion and clinical significance. Biosynthesis of fatty acids. Metabolism of triglycerides, phospholipids and sphingolipids. Cholesterol - Biosynthesis, regulation, transport and excretion. Metabolism of lipoproteins. Eicosanoid metabolism.

UNIT-IV : AMINO ACID, PURINE AND PYRIMIDINE METABOLISM

Overview of biosynthesis of nonessential amino acids. Catabolism of amino acid nitrogen - Transamination, deamination, ammonia formation and the urea cycle. Disorders of the urea cycle. Catabolism of carbon skeletons of amino acids. Conversion of amino acids to specialized products.

Metabolism of purines - *De novo* and salvage pathways for biosynthesis. Purine catabolism. Biosynthesis and catabolism of pyrimidines.

UNIT-V : PORPHYRINS, MINERALS AND METABOLIC INTEGRATION

Biosynthesis and degradation of porphyrins and heme. Minerals - Sources, daily allowance, absorption, metabolism, biological role and clinical significance of calcium, phosphate and magnesium trace elements - Metabolism of iron - Absorption, storage, transport and excretion. Iron deficiency and overload. Copper, zinc, selenium, cobalt, manganese and fluoride.

Integration of metabolism - Interconversion of major foodstuffs. Metabolic profile of the liver, adipose tissue and brain. Altered metabolism in starvation.

Text Books

1. Campbell and Farrell, 2002. Biochemistry 4th ed. Brooks/Cole Pub Co.
2. Davidson and Sittman, 1999. Biochemistry NMS. 4th ed. Lippincott. Williams and Wilkins.
3. Donald Voet, J.G. Voet and John Wiley, 1995. Biochemistry.
4. Kuchel and Ralston, 1998. Biochemistry, 2nd ed. Schaum's Outlines McGraw Hill.
5. Murray, et al. 2003. Harper's Biochemistry. 26th ed. McGraw Hill.
6. Nelson Cox, 2004. Lehninger's Principles of Biochemistry, 4th ed. McMillan Worth.
7. Biochemistry by Stryer. W. H. Freeman; 6 editions (2006).

CORE PRACTICAL I

A. ISOLATION AND CHARACTERIZATION STUDIES

1. Isolation and estimation of glycogen from liver.
2. Isolation and estimation of DNA from liver and spleen.
3. Isolation and estimation of RNA from plant tissues or yeast.
4. Isolation of lecithin from egg yolk.
5. Denaturation of DNA and UV absorption studies. [demonstration].
6. Determination of N- and C-terminal amino acids [demonstration].

B. QUANTITATIVE ANALYSIS

1. Determination of calcium using sodium chloranilate.
2. Estimation of inorganic phosphorus by Fiske and Subba Rao method.
3. Determination of pyruvate or lactate
4. Determination of tryptophan.
5. Determination of protein by Lowry's method.
6. Estimation of sodium by flame photometry.
7. Estimation of glucose by glucose oxidase method.

C. TECHNIQUES

1. Preparation of buffers and measurement of pH using indicators and pH meter.
2. Separation of amino acids sugars and lipids by thin layer chromatography.
3. Separation of plant pigments by column chromatography.
4. Separation of serum proteins by PAGE.

CORE PRACTICAL II

A. ENZYMOLOGY - PURIFICATION AND KINETIC STUDIES

1. Subcellular fractionation of organelles from liver cells and identification by marker enzymes.
2. Purification of acid phosphatase and alkaline phosphatase from potato and kidney respectively.
 - a. Inhibition of alkaline phosphatase activity by EDTA.
 - b. Effect of substrate concentration on alkaline phosphatase activity.
 - c. Determination of optimum temperature.
 - d. Determination of optimum pH.
3. Effect of activators and inhibitors on purified acid phosphatase activity.
4. Assay of clinically important enzymes.
 - a. Assay of serum alkaline phosphatase activity.
 - b. Assay of serum acid phosphatase activity.
 - c. Assay of serum creatinine phosphokinase activity
 - d. Assay serum alanine aminotransferase activity.
 - e. Assay of serum aspartate aminotransferase activity

B. MICROBIAL BIOCHEMISTRY

1. Handling and maintenance of microscopy.
2. Sterilization techniques - principles, methods, moist heat, dry heat, filter types CDC, safety levels.
3. Preparation of media - liquid, solid, agar deep. Slant and plate.
4. Staining techniques - simple, differential and special staining.
5. Pure culture techniques - streak plate, pour plate.
6. Growth curve - visual method - haemocytometer method, non-visual method turbidity method.
7. Identification and enumeration of microorganisms from soil - streak plate, pour plate.
8. Identification and enumeration of microorganisms from water - standard plate count, MPN test and membrane filtration technique.
9. PCR Technique - Demonstration

* University Examination for practical II will be held at the end of the first year.

HUMAN RIGHTS

COMPULSORY PAPER

UNIT-I

Definition of Human Rights - Nature, Content, Legitimacy and Priority - Theories on Human Rights - Historical Development of Human Rights.

UNIT-II

International Human Rights - Prescription and Enforcement upto World War II - Human Rights and the U.N.O. - Universal Declaration of Human Rights - International Covenant on Civil and Political Rights - International Covenant on Economic, Social and Cultural Rights and Optional Protocol.

UNIT-III

Human Rights Declarations - U.N. Human Rights Declarations - U.N. Human Commissioner.

UNIT-IV

Amnesty International - Human Rights and Helsinki Process - Regional Developments - European Human Rights System - African Human Rights System - International Human Rights in Domestic courts.

UNIT-V

Contemporary Issues on Human Rights: Children's Rights - Women's Rights - Dalit's Rights - Bonded Labour and Wages - Refugees - Capital Punishment.

Fundamental Rights in the Indian Constitution - Directive Principles of State Policy - Fundamental Duties - National Human Rights Commission.

Books for Reference:

1. International Bill of Human Rights, Amnesty International Publication, 1988.
2. Human Rights, Questions and Answers, UNESCO, 1982

3. Mausice Cranston - What is Human Rights
4. Desai, A.R. - Violation of Democratic Rights in India
5. Pandey - Constitutional Law.
6. Timm. R.W. - Working for Justice and Human Rights.
7. Human Rights, A Selected Bibliography, USIS.
8. J.C.Johari - Human Rights and New World Order.
9. G.S. Bajwa - Human Rights in India.
10. Amnesty International, Human Rights in India.
11. P.C.Sinha & K. Cheous (Ed) - International Encyclopedia of Peace, Security Social Justice and Human Rights (Vols 1-7).
12. Devasia, V.V. - Human Rights and Victimology.

Magazines:

1. The Lawyer, Bombay
2. Human Rights Today, Columbia University
3. International Instruments of Human Rights, UN Publication
4. Human Rights Quarterly, John Hopkins University, U.S.A.

ELECTIVE

PAPER II

MICROBIOLOGY

UNIT-I : MORPHOLOGY AND ULTRASTRUCTURE

Ultrastructure of bacteria, fungi, algae and protozoa. Classification of microbes, molecular taxonomy, cell walls of eubacteria - peptidoglycan and related molecules. Structure and synthesis of cell wall and cell membrane of gram - positive and negative bacteria. Flagella and motility. Cell inclusion bodies.

Purple and green bacteria. Budding and appendaged bacteria, spirilla, spirochaetes, gliding and sheathed bacteria, pseudomonads, lactic and propionoc acid bacteria. Endospore forming rods and cocci, myobacteria, rickettsia and mycoplasma. Archaeobacteria.

UNIT-II : MICROBIAL GROWTH AND METABOLISM

Microbial growth - definition. Mathematical expression of growth, growth curve, measurement of growth and growth yields, synchronous growth, continuous culture, factors affecting growth.

Microbial metabolism - overview, photosynthesis in microbes. Role of chlorophylls, carotenoids and phycobilins, Calvin cycle. Chemolithotrophy: hydrogen - iron - nitrite oxidizing bacteria: nitrate and sulfate reduction: methanogenesis and acetogenesis, fermentations - diversity, syntrophy - role of anoxic decompositions. Nitrogen metabolism, nitrogen fixation, hydrocarbon transformation.

UNIT-III : MICROBIOLOGICAL TECHNIQUES

Methods in microbiology, Currents methods in microbial identification. Pure culture techniques. Theory and practice of sterilization. Principles of microbial nutrition, construction of culture media. Enrichment culture techniques for isolation of chemoautotrophs, chemoheterotrophs and photosynthetic microbes.

UNIT-IV : VIRUSES

Bacteria, plant, animal and tumor viruses. Classification and structure of viruses. Lytic cycle and lysogeny. DNA viruses: positive and negative strand. Double stranded RNA viruses. Replication: example of herpes, pox, adenoviruses, retroviruses, viroids and prions.

UNIT-V : MEDICAL MICROBIOLOGY

Disease reservoirs; Epidemiological terminologies. Infectious disease transmissions. Respiratory infections caused by bacteria and viruses; Tuberculosis, sexually transmitted diseases including AIDS; Vector borne diseases, water borne diseases, Public health and water quality. Pathogenic fungi, Antimicrobial agents, Antibiotics. Penicillins and cephalosporins, Broad spectrum antibiotics. Antibiotics from prokaryocytes, antifungal antibiotics - mode of action, Resistance to antibiotics.

Text Books

1. Brooks, et al 1998. Jawetz, Melnick and Adelberg's Medical Microbiology. Lange Med.
2. Davis, et al. 1989. Microbiology. 4th ED. Lippincott Williams and Wilkins.
3. Joklik, et al. 1995. Zinsser's Microbiology, McGraw Hill Professional.
4. Madigan, et al. 2002. Brack Biology of Microorganisms, 10th ed. Prentice Hall.
5. Pelczar et al. 2000. Microbiology, 5th Ed. McGraw Hill
6. Prescott et al. 1999. Microbiology, Mcgraw Hill.
7. Stainer RY, et al. 1986. General Microbiology. 5th ed, Prentice Hall.

III SEMESTER

PAPER VII

ADVANCED ENDOCRINOLOGY

UNIT-I : CLASSIFICATION AND MECHANISM

Hormones - definition, classification based on receptors, hormone cascade system involving CNS, hypothalamus, anterior pituitary, target gland, feed back mechanisms, classification of hormones (polypeptides, glycoproteins and POMC peptides), major polypeptide hormones and their actions, genes and formation of polypeptide hormones - POMC peptides and vasopressin.

UNIT-II : AMINO ACID DERIVED HORMONES

Synthesis of amino acid derived hormones-epinephrine and thyroxine, inactivation and degradation of hormones, signal transduction and second messengers - adenylate cyclase system, cAMP, adrenalin and glycogen degradation. G-protein as cellular transducer, inositol triphosphate and calcium release, glycogen phosphorylase kinase, DAG and protein kinase C-pathway.

UNIT-III : CYCLIC HORMONAL CASCADE SYSTEM AND PROTEIN KINASES

Cyclic hormonal cascade system - chronotropic control, melatonin and serotonin - light and dark cycle, ovarian cycle and role of hormones, hormone - receptor interactions, multiple hormone subunits Sactchard analysis, structure beta -adrenergic receptor and insulin receptor, internalization of receptors, intracellular action - protein kinases, insulin receptor - transduction through tyrosine kinase, vasopressin - protein kinase A, GnRH-protein kinase C, atrial natriuretic factor - protein kinase G.

UNIT-IV : STEROID HORMONES

Structure, biosynthesis, transport of steroid hormones in blood and metabolic inactivation of steroid hormones, control of synthesis and release of steroid hormones, Hormones that directly stimulate synthesis and release of steroid hormone with reference to the second messengers and the signal pathway [cortisol, aldosterone, testosterone, 17 β - estradiol, progesterone and calcitriol].

UNIT-V : HORMONE RECEPTORS AND REGULATION

Steroid hormone receptors, intracellular protein receptors, structural organization of receptor protein, hormone binding domain, antigenic domain and DNA binding domain, organizations of functional elements - hormone response elements, positive and negative transcriptional effects of S.R, receptor activation - upregulation and down regulation, apoptosis - steroid hormone action at cell level, multiple endocrine neoplasia - different types.

References

1. Textbook of biochemistry (with clinical correlation) by Devlin, Wiley-Liss; 6 edition (2005)
2. Textbook of endocrinology by Wilson and Foster, W.B. Saunders Co.
3. Harper's Biochemistry by R.K. Murray et al. McGraw-Hill Medical; 27 edition (2006)

PAPER VIII

RESEARCH METHODOLOGY

UNIT- I : SCIENTIFIC RESEARCH & WRITING

Importance and need for research. Ethics and scientific research. Formulation of hypothesis. Types and characteristic designing a research work. Scientific writing - Characteristics - Logical format for writing thesis and papers. Essential features of abstract, introduction, review of literature, materials and methods, and discussion. Effective illustration - tables and figures. Reference styles - Harvard and Vancouver systems.

UNIT-II : BIOSTATISTICS

Collection and classification of data - diagrammatic and graphic representation of data-measurement of central tendency - standard deviation - normal distribution - test of significance based on large samples - small samples - Student t test - correlation and regression - Chi square test for independence of attributes - ANOVA.

UNIT- III : BIOINFORMATICS

Introduction to bioinformatics, scope of bioinformatics, role of computers in biology The internet. The World Wide Web. Useful search engines - Boolean searching, search engine algorithms. Finding scientific articles - PubMed. Running computer software, computer operating systems, soft downloading and installation.

UNIT-IV : DATABASES

Data base concepts - database, database system, database management systems - hierarchical , relational and network, database security. Biological databases - types, sequence and structure. Genome and organism specific databases. Data submission and data retrieval. Searching sequence databases - sequence similarity searches, amino acid substitution matrices. Database search - FASTA and BLAST, CLUSTAL.

UNIT-V : BIOETHICS AND PATENTING

Declaration of Bologna. Ethics in animal experimentation. CPCSEA guidelines - Animal care and technical personnel environment, animal husbandry, feed, bedding, water, sanitation and cleanliness, waste disposal, anesthesia and euthanasia.

Composition of (Human) institutional Ethical Committee (IEC) - General ethical issues. Specific principles for chemical evaluation of drugs, herbal remedies and human genetics research, Ethics in food and drug safety. Environmental release of microorganisms and genetically engineered organisms Ethical issues in human gene therapy and human cloning.

Patenting - definition of patent. Product and process patents. Patenting multicellular organisms. Patenting and fundamental research.

Books Recommended

1. R.A. Day. How to write a scientific paper. Cambridge University Press.
2. Cooray P.G. Guide to scientific and technical writing.
3. Carter V. Good and Douglas E seats Methods of Research.
4. Alley, Michael. The craft of scientific writing. Englewood Cliffs. N.N. Prentice 1987.
5. M.C. Sharma, Desk Top Publishing on PC, BPB Publications, 1997.
6. Lesk, A.M. Introduction to Bioinformatics Oxford 2002.
7. Bergeron BP 2002 Bioinformatics Computing 1st Edition, Printice Hall
8. Krane et al Fundamental concepts of bioinformatics Benjamin Cummings.
9. Sundar Rao, Jesudian Richard - An Introduction to Biostatistics.
10. S.P. Gupta - Fundamentals of statistics, Sultan Chand.
11. Ethics and the use of alternatives to animals in research and education, ShiraneePereira, CPCSEA.
12. CPCSEA guidelines for laboratory animal facility (CPCSEA) - No.13 Seaward road, Valmiki Nagar, Chennai-41.
13. Ethical guidelines for biomedical research on human subjects. ICMR, New Delhi,2000.
14. Dickson. Molecular and cell biology of human gene therapeutics. Series Chapman and Hall 1995.

**PAPER IX
BIOTECHNOLOGY**

UNIT-I : TOOLS OF GENETIC ENGINEERING

Basic principles - mechanism of natural gene transfer by *Agrobacterium*, generation of foreign DNA molecules, restriction enzymes, their types and target sites, cutting and joining DNA molecules, linkers, adapters, homopolymers, enzymes used in genetic engineering, cloning vehicles and their properties, natural plasmids, in vitro vectors, cosmids and T-DNA based hybrid vectors.

UNIT-II : DNA CLONING AND SEQUENCING

Cloning strategies - cloning with single strand DNA vectors, cDNA cloning and gene libraries, recombinant selection and screening methods, expression of cloned genes-problems and solutions, shuffle vectors, DNA sequencing strategies - Sanger's and Maxam - Gilbert's methods, applications of PCR and DNA hybridization, Southern, Northern and Western blotting.

UNIT-III : GENE TRANSFER AND APPLICATIONS

Techniques of tissue culture-culturing explants and haploids, protoplasts fusion and embryoids, methods of gene transfer to plants, animals and bacteria-Ca transfection, electroporation, shotgun and others, transgenic plants, GM foods, and biopesticides, gene knockouts and transgenic animals, animal pharming and xenografting, biodegradation, stimulation and its applications, bioleaching.

UNIT-IV : INDUSTRIAL BIOTECHNOLOGY AND GENE THERAPY

Applications of biotechnology-industrial biotechnology-fermentors, principle, types product recovery and purification of ethanol, citric acid, vitamin B₁₂, streptomycin, enzyme biotechnology-production and uses of industrially important enzymes such as protease, immobilization of enzymes and their applications, waste treatment, bioenergy and biogas production. Gene therapy [somatic]-the principle and approaches.

UNIT-V : BIOSAFETY AND BIOETHICS

Biotechnology - potential hazards, biological weapons, biosafety of GM foods and GMOs - substantial equivalence and safety testing, gene drain, the tangled genes, human genome research - the objectives and approaches, genomics and genome prospecting - the controversies, issues of biotechnology-social and scientific, technology protecting systems and the terminator, IPR, its concepts and conditions -patenting of genes, cells and life forms, evaluation of life patenting.

References

1. Genes - VIII by Lewin B (2003), Oxford University Press.
2. Ratledge & Kristianeen, Basic Biotechnology Cambridge University press 2nd ed.
3. Gene cloning - an introduction by TA Brown, Chapman and Hall.
4. Glick & Pasternak, Molecular Biotechnology, 2nd ed. Panima Publications.

**ELECTIVE
PAPER III
IMMUNOLOGY**

UNIT-I : LYMPHOID SYSTEM, ANTIGENS AND ANTIBODY

Lymphoid system - central and peripheral lymphoid organs and cells involved in immune system. Antigen, haptens, adjuvants, antigenicity, antigenic determinants and epitopes. Immunoglobulins basic structure, classification, functions, allotypes and idiotypes. Theories of antibody formation- side chain and clonal selection theory. Antibody diversity - mechanisms contributing to diversity - somatic recombination, rearrangement and generation of antibody diversity. Class switching.

UNIT-II : IMMUNITY AND COMPLEMENT SYSTEM

Types of immunity - innate and acquired immunity, antitoxin, antibacterial and antiviral immunity. Immune response - primary and secondary - humoral and cell mediated immunity. Antigen recognition - T cell and B cell receptor complexes, antigen processing and presentation. Interaction of T and B cells, cytokines. Immunological memory, cytotoxicity - immunotolerance, immunosuppression.

Complement system - components, nomenclature, activation of complement, complement receptors and alternate pathway.

UNIT-III : VACCINES AND IMMUNOLOGICAL TECHNIQUES.

Vaccines - killed attenuated organisms, toxoid, recombinant vaccines, subunit vaccines, DNA vaccines, synthetic peptide vaccines, antiidiotypic vaccines. Immunization practices-immunoprophylaxis and immunotherapy.

Immunological techniques - Production of polyclonal and monoclonal antibodies. Immunoprecipitation, RIA, ELISA, fluorescent immunoassay, avidin-biotin mediated assay, immunohistochemistry, immunoelectrophoresis, immunoblotting. Complement fixation test.

UNIT-IV : GENETIC BASIS OF IMMUNOLOGY, TRANSPLANTATION AND TUMOR IMMUNOLOGY

MHC complex - gene organization - HLA genes class I and II antigens. Structure and function. Histocompatibility testing - lymphocytotoxicity test - cross matching. MHC and disease association.

Transplantation - types, genetics of transplantation - graft versus host reactions. Tissue matching and immuno suppressive agents.

Tumor immunology - immune surveillance, tumor antigens, immune response to tumors, immunotherapy of tumors.

UNIT-V : HYPERSENSITIVITY, AUTOIMMUNE AND IMMUNODEFICIENCY DISORDERS

Hypersensitivity - definition and classification - type I, II, III, IV and V hypersensitivity, mechanism involved, diagnosis and treatment.

Autoimmunity and autoimmune diseases - mechanism of development, diagnosis and treatment.

Immunodeficiency disorders-B cell deficiencies, T cell deficiencies, secondary immunodeficiency diseases-pathogenesis, diagnosis and treatment of AIDS.

References

1. Essential Immunology by Ivon Roitt, Blackwell Publishing, Incorporated; 11 edition (2006)
2. Cellular and Molecular Immunology by [Abul K. Abbas](#), [Andrew Lichtman](#), Saunders; 5 edition (2005)
3. Practical Immunology by Frank C. Hay, Olwyn M. R. Westwood, Paul N. Nelson, and Leslie Hudson, Blackwell Science Ltd. Blackwell Publishing, Incorporated; 4 edition (December 1, 2001)
4. Immunological Techniques by D. M. Weir.
5. Basic and Clinical Immunology by [Daniel P. Stites](#), [John D. Stobo](#), [J. Vivian Wells](#), Appleton & Lange; 6th edition (1987).

**ELECTIVE
PAPER IV
NON MAJOR SUBJECT**

NUTRITION IN HEALTH AND DISEASES

UNIT-I:

Nutrition - Concept - Composition of food - Macro and Micro nutrients and their functions.

Plant and animal sources of simple and complex carbohydrates, fats and proteins.

National and regional food pattern in India.

UNIT-II:

A brief account of digestion and absorption of carbohydrates, fats, proteins, minerals and vitamins. Care and preservation of foods.

Nutritional requirements of infants, children & youth. Nutritional demand in pregnancy, lactation and menopause.

Nutrition for old people.

Food with increased nutritive value in terms of protein - Calorie. Biological value of proteins

UNIT-III:

Diseases arising due to protein - Calorie malnutrition and under nutrition (Kwashiorkar and Marasmus diseases)

Vitamins (fat and water soluble) deficiency diseases - Mineral deficiency diseases - symptoms and dietary supplementation.

UNIT-IV:

Dehydration in infants and children and its treatment

Diet therapy for under weight and over weight children.

Food allergy due to wheat, milk and egg and diet therapy.

Atherosclerosis - Symptoms. Low calorie diet and fat controlled dietary pattern.
Hypertension (High Blood pressure) - Symptoms. Sodium restricted dietary pattern.

UNIT-V:

Symptoms of diseases and modification of dietary pattern for patient suffering from fever (Typhoid and Malaria), Jaundice, hyper acidity (Ulcer), moderate and severe diabetes in adults.

Diet therapy for patients having kidney diseases due to diabetes and hypertension.

RECOMMENDED BOOKS

1. Principles of Nutrition - M. Swaminathan.
2. Nutrition in Health & Diseases - Cooper.
3. Modern Nutrition in Health and Diseases - M.E. Skilis and V.R. Young

IV SEMESTER

PAPER X

MOLECULAR BIOLOGY

UNIT-I : DNA REPLICATION

Types of replication, evidence for semiconservative replication - Meselson and Stahl experiment, replications in circular chromosomes - Cairns model, rolling circle model. Replication in prokaryotes and inhibitors of replication, replication bubble, bidirectional replication, replicon, action of SSB, primase, DNA gyrase, topoisomerases, DNA polymerase I, II, and III, lagging and leading strand synthesis, Okazaki fragments, replication in RNA virus, plasmid replication (x174, λ A. DNA) reverse transcriptase, retroviruses, temporal control of replication. Eukaryotic replication.

UNIT-II : TRANSCRIPTION

Transcription - definition, coding strand, template strand, sense strand and antisense strand, promotor, foot-printing experiment, DNA - dependent RNA polymerase role of Pribnow box, template binding, prokaryotic transcription, Rho - dependent and independent transcription, posttranscriptional processing in prokaryotes, split genes, overlapping genes, housekeeping genes, biosynthesis of rRNA and tRNA, eukaryotic transcription, RNA editing - post-transcriptional modifications of eukaryotic RNAs, RNA splicing, introns and splicing reactions, self-splicing introns - group I and group II, exons, spacer sequences, enhancers.

UNIT-III : GENETIC CODE AND TRANSLATION

Genetic code - definition, deciphering of the genetic code, codon dictionary, salient features of genetic code. structure of tRNA, activating enzymes, binding of amino acids to tRNA, wobble mechanism and its significance, composition of prokaryotic and eukaryotic ribosomes, leader region, Shine-Dalgarno sequence, reading frameshift, prokaryotic and eukaryotic protein biosynthesis - initiation, elongation, translocation and termination, polysomes, post-translational

modifications in prokaryotes and eukaryotes, role of endoplasmic reticulum, role of signal peptide, signal hypothesis, inhibitors of protein synthesis.

UNIT-IV : PROTEIN TRANSPORT AND GENE EXPRESSION

Protein targeting, translocation, heat shock proteins, glycosylation, SNAPs and SNAREs, bacterial signal sequences, mitochondrial, chloroplast and nuclear protein transport, endocytosis-viral entry, ubiquitin TAG protein destruction, gene expression and regulations, molecular mechanism of regulation, prokaryotes - operon model, lac, trp, arabinose operons, repression and attenuation, eukaryotes - C value paradox, repetitive DNA, gene dosage and gene amplifications.

UNIT-V : MUTAGENESIS, DNA DAMAGE AND REPAIR

Mutagenesis and replication fidelity, numerical mutations involving full chromosome set - causes, structural chromosome mutations - balanced and unbalanced - causes, karyotype mixing, misincorporation of nucleotides during DNA synthesis, transient and spontaneous chemical changes in DNA, frameshift mutagenesis, DNA damage - different types, DNA repair - direct reversal repair, direct repair of nicks, excision repair, nucleotide excision repair, mismatch repair, long and short patch mismatch repair, recombination error, SOS response and mutagenic repair.

References

1. Molecular biology by [Robert F. Weaver](#) McGraw-Hill 4 edition (2007)
2. Advanced molecular biology by [R. M. Twyman](#), (1998)
3. Genes VII by B. Lewin Oxford University Press, Cell Press, London (2000).
4. Cell and molecular biology by G. Karp, John Wiley & Sons Inc (2002).
5. Biochemistry by D.Voet and J. Voet. John Wiley and Sons Ltd (1990)

PAPER XI

ADVANCED CLINICAL BIOCHEMISTRY

UNIT-I : SPECIMEN COLLECTION AND ANALYSIS

Concepts of accuracy, precision, reproducibility, reliability, and other factors in quality control. Normal values. Specimen collection and Processing: Collection of blood - venipuncture, skin puncture, arterial puncture. Anticoagulants. Collection and analysis of normal and abnormal urine - timed urine specimens, preservatives. Clinical significance of sugars, proteins, ketone bodies, bilirubin and porphyrins. CSF - collection, composition and analysis. Amniotic fluid - Origin, collection, composition.

Radioisotopes in diagnosis and therapy.

UNIT-II : DISORDERS OF CARBOHYDRATE AND LIPID METABOLISM

Disorders of carbohydrate metabolism - blood sugar levels, hyper-and hypoglycemia, regulation of blood glucose, renal threshold, diabetes mellitus - etiologic classification and diagnostic criteria, glucose tolerance test, metabolic complications - acute and late complications. Hypoglycemic agents, insulin receptors and insulin C-peptide assay. Glycogen storage diseases, galactosemia, fructose intolerance and fructosuria.

Disorders of lipid metabolism - plasma lipids and lipoprotein abnormalities, lipidosis, Xanthomatoses, hypocholesteremic agents, fatty liver, obesity. Atherosclerosis and risk factors. Tay Sach's disease, Niemann Picks disease, Gaucher's disease, inherited disorders of familial hyper and hypolipoproteinemias.

UNIT-III : DISORDERS OF PROTEIN METABOLISM AND CLINICAL ENZYMOLOGY

Disorders of protein metabolism - non-protein nitrogenous constituents in blood - urea, uric acid and creatinine. Plasma protein abnormalities - deficiency, agammaglobulinemia, multiple myeloma, proteinuria, glomerulonephritis, nephrotic syndrome. Haemoglobinopathies - sickle cell anaemia, thalassimia and erythrocyte enzyme disorders. Phenylketonuria, tyrosinosis, alkaptonuria, maple

syrup urine disease, Hartnup disease, homocystinuria, histidinuria, albinism, disorders of urea cycle.

Serum enzyme activities in diseases - Principle and assay of aspartate aminotransferase, alanine aminotransferase, alkaline phosphatase, acid phosphatase, streptokinase, asparaginase, α -hydroxybutyrate dehydrogenase, ceruloplasmin, γ -glutamyl transpeptidase, creatine kinase and lactate dehydrogenase.

UNIT-IV : HEPATIC AND RENAL FUNCTIONAL TESTS

Normal structure and functions of liver, diseases of the liver, hepatitis types, cirrhosis, alcoholic liver disease, hepatic tumor and biliary tract diseases, liver function tests, disorders of bilirubin metabolism. Pancreatic and gastric function tests.

Renal function tests and related disorders - acute and chronic renal failure, urinary tract obstruction and analysis of urinary calculi.

UNIT-V : FREE RADICALS, CANCER AND DISORDERS OF NUCLEIC ACID METABOLISM

Free radicals in health and disease - Endogenous and exogenous free radicals. Oxidative damages to lipids, proteins and DNA. Role of enzymatic and non-enzymatic antioxidants. Cancer: Morphological and metabolic changes in tumor cells. Tumor markers - AFP, CEA, hCG. Carcinogenic agents.

Inborn errors of nucleic acid metabolism - Lesch Nyhan syndrome, immunodeficiency diseases associated with defects in purine nucleotide metabolism, gout, orotic aciduria, xanthinuria. Serology: C-reactive protein, immunological test for pregnancy, Rheumatoid arthritis test and prothrombin test.

References

1. Text book of Biochemistry with clinical correlation by T.M. Devlin (1994), John Wiley and Sons.
2. Clinical chemistry in diagnosis and treatment by P.D. Mayne. A Hodder Arnold Publication; 6th Rev Ed edition (1994).
3. Enzymes by P. Asokan (2003), Chinna Publications.

4. Clinical biochemistry - Metabolic concepts and clinical aspects by W.J. Marshall and S.K. Bangeit, (1995), Churchill Livingstone.
5. Text Book of Medicine by K.V. Krishna Das, (1996), Jaypee Brothers Medical Publishers (P) Ltd.
6. Text Book of Medical Physiology by A.C. Guyton and J.E. Hall, (2000), Harcourt Asia.

CORE PRACTICAL III

A. BIOCHEMICAL ANALYSIS OF BLOOD

1. Estimation of blood glucose by o-toluidine method.
2. Estimation of blood glucose by GOD-POD method using semiautoanalyser. (Demonstration)
3. Estimation of serum proteins by Bradford's Method.
4. Estimation of plasma fibrinogen.
5. Estimation of A.G. ratio in serum.
6. Estimation of blood urea by DAM method.
7. Estimation of serum uric acid by phosphotungstate method.
8. Estimation of serum creatinine by alkaline picrate method.
9. Estimation of serum triglycerides.
10. Estimation of serum cholesterol by Zlatkis, Zak and Boyle method.
11. Estimation of serum phospholipids.
12. Estimation of serum calcium.
13. Estimation of serum bilirubin by Jendrassik and Crof method.
14. Estimation of glycosylated hemoglobin.

B. IMMUNOLOGICAL AND MOLECULAR BIOLOGY TECHNIQUES

1. Grouping of blood and Rh typing.
2. Latex agglutination test for rheumatoid factor and pregnancy.
3. ELISA - demonstration.
4. Extraction of genomic DNA and electrophoresis in agarose gel. (Demonstration)
5. Determination of molecular size of DNA. (Demonstration)
6. Restriction enzyme digestion and electrophoresis. (Demonstration)

CORE PRACTICAL IV

A. HAEMATOLOGICAL METHODS

1. Collection and storage of blood
2. Total RBC count
3. Total WBC count
4. Total platelet count
5. Differential WBC count
6. Absolute eosinophil count
7. Determination of hemoglobin content
8. Determination of clotting time.
9. Determination of prothrombin time
10. Determination of ESR.
11. Pathological examination of blood film.

B. URINE ANALYSIS

1. Qualitative analysis of normal and pathological constituents in urine.
2. Microscopic analysis of urine
3. Estimation of titrable acidity of urine.
4. Estimate of true acidity.
5. Estimation of protein in urine by biuret method
6. Analysis of urinary calculi.
7. Estimation area in urine
8. Estimation uric acid in urine.

PROJECT / DESSERTATION
WITH *VIVA VOCE*

ANNEXURE

I. Staff qualifications and requirements for a strength of 16 to 20 students

I Year - Head of Department + Faculty :1 + 2

II year - Faculty: 3

Total Faculties : 6

Lab Technician and other Lab Staff

Year	Designation	Qualification	Number
I and II	Lab Technician	B.Sc., Biochemistry / Chemistry	2
	Lab attender	10+2 / SSLC	1

II. List of instruments (M.Sc.,) (up to the strength of 20)

I M.Sc., Biochemistry

Sl.No.	Instruments	Number required
1.	Refrigerated centrifuge	1
2.	Refrigerator	1
3.	Semiauto analyzer	1
4.	Centrifuge [Table top with speed and time control]	4
5.	Vacuum pump	1
6.	Microfuge	1
7.	UV transilluminator	1
8.	UV visible spectrophotometer	1
9.	Photoelectric colorimeter	4
10.	pH meter	1
11.	Laminar flow	1
12.	Autoclave	2
13.	Pressure cooker	2
14.	Hot air oven	2

15.	Bacteriological incubator	1
16.	Microwave oven	1
17.	Electronic balance (0.001g sensitivity)	2
18.	Digital top pan balance (1 - 100 g sensitivity)	3
19.	Digital top pan balance (10 -500g sensitivity)	1
20.	Electrophoresis - submerging with power pack unit	1
21.	Vertical electrophoresis with power pack unit	1
22.	Chromatography - ascending using boiling tubes or cylinders	12
23.	Deionizing plant for deionized water preparation	1
24.	Dessicator for circular paper chromatography	2
25.	TLC chamber with lid	3
26.	TLC applicator	2
27.	Flourimeter	2
28.	Heating mantles	3
29.	Hot plate	2
30.	Cyclomixer	3
31.	Magnetic stirrer	3
32.	Tissue homogeneizer	3
33.	Glass distillation unit	1
34.	Water bath with temperature regular	4
35.	Water bath with shaker	2
36.	Microscopes x 100 x monocular with built-in illuminator (Olympus)	1
	Binocular with built-in illuminator	1
37.	Micrometer	1
38.	Orbital shaker	1
39.	Microkjeldal apparatus	1
40.	Waring blender / mixie	2
41.	Dry bath	1
42.	Heamocytometer	6
43.	Wintrobe's tubes with stand for ESR	2sets
44.	Petri plates	2 dozens
45.	Inoculation loops	4

II M.Sc BIOCHEMISTRY

ADDITIONAL REQUIREMENT FOR II YEAR

1. ELISA reader	1
2. PCR	1
3. Flame photometer	1

Accessories: (Common for both I and II M.Sc.,)

1. Bottle dispenser

2. Autopipettes (mixed: variable volumes) 5 sets
3. Culture wares
4. Animal cages / animal house
5. Room stabilizers
6. Kits
7. Millipore filter 1 set
8. ICE buckets
9. UV lamps
10. Hair dryer 2
11. Bunsen burner with (Indane) gas connection 6 in each Laboratory

III. LIST OF BOOKS FOR M.Sc., BIOCHEMISTRY

I M.Sc., BIOCHEMISTRY

S.No	AUTHOR	TITLE	PUBLISHER
1.	McOregor	Polymers in Nature	
2.	Creishton T.E WH Freeman	Proteins Structure & Molecular Properties	
3.	Sinden R.R.	DNA Structure and Function	Academic Press Oxford
4.	Nagai .K LW Mattai	RNA - Protein Interaction	Oxford
5.	Jack Kyte	Mechanism in Protein Chemistry	University Press
6.	Brander R & I. Tooze	Introduction to Protein Structure	Garland Publis
7.	Devlin T.M	Textbook of Biochemistry with Clinical Correlations III Edition	Sons In
8.	David Rawn J	Biochemistry	NIFI Patterson
9.	Sipor & Ungar	Nuclei Acids Probes	ASEP Press
10.	Oliven R.W	HPLC of Macromolecules A Practical Approach	IRI Press
11.	Homie D.T & Hazel Pack	Analytical Biochemistry	Longman Group
12.	Kirby L.T	DNA Fingerprinting	Stockton Press
13.	Griffin H.S & Griffin Am	PCR Technology - Current Innovations	CRC Press
14.	Sezzuto, Johnson Mona	Biotechnology & Pharmacy	Charman & Hall
15.	Innis M.A, Belfand & J.J Sninsky	PCR Strategies	Academic Press
16.	Millis, Moritz & Mable	Molecular Systematics	Sinaner Association Inc. USA
17.	Glover & Hames	DNA Clones-A Practical Approach	Oxford University Press
18.	Sambrock, Maniatis et al.	Gene Cloning (Vol 3)	
19.	Dixon & Webb	Enzymes	
20.	Bowden & Wharton	Enzyme Kinetics	
21.	Trevan	Immobilized Enzymes	

22.	Alan Weisman	Hand Book of Enzyme Technology	Practical Hall
23.	Chaplin & Bushe	Enzyme Technology	University Press
24.	Walsh. G & Headon	Protein Biotechnology	John Wiley & Bon
25.	Lippard S.J & Berg J.M	Principles of Bio-Organic Chemistry	Panama Publishing House
26.	Garett & Grishna	Biochemistry	Dannders College
27.	Baltimore L.M. & Others	Molecular Cell Biology	Scientific American Books
28.	Alberts, Bruce et al	Molecular Biology of The Cell	
29.	Cooper. M	The Cell – A Molecular Approach	ASM Press
30.	Karp. G	Cell & Molecular Biology	Tonn Wiley & Concepts & Experiments Sons Inc.
31.	Wolfe S.L.	Molecular & Cellular Biology	Wadsworth Publishing Company
32.	Sadava D.E	Cell Biology – Organelle Structure & Function	Jones & Barflett
33.	Elliott. H. William	Biochemistry & Molecular Biology (1997)	Oxford University Press
34.	Newshome. E.A. & Start. S	Regulation in Metabolism	John Wiley & Sons
35.	Zubay S.L	Biochemistry	WM.C. Brown Publishers
36.	Lewis Kleinsmith Valeric.M. Rich (1995)	Principles of Cell & Molecular Biology	Rarland Publishers, New York
37.		Annual Reviews of Biochemistry	Every Year From 1994
38.	Lubert Stryer	Biochemistry (IV Edn)	W.H. Freeman
39.	Wilson & Hunt	Molecular Biology of The Cell-A Problem Book	Garland Publishers, New York
40.	Voet & Voet	Biochemistry (III Edn)	John Wiley & Sons
41.	Benjamin . L	Genes VI	Oxford University Press
42.	Adams R.L. Knowler & Leader D.F	The Biochemistry of Nucleic Acids	Chapman & Hall
43.	Kornbers.A & Baker	DNA Replication	W.H. Freeman &
44.	Freidfelder. D	Microbial Genetics	Maresa Publishing House
45.	Watson	Molecular Biology of The Gene	
46.	Ms. Conkey E.H.	Human Genetics – The Molecular Revolution	Jones & Bartlett Publishers
47.	Maxine Singer & P. Berg	Genes & Genomes – A Changing Perspective	Books, Mill Valley California
48.	Ptarshne. M	A Genetic Switch Phage Lambda & Higher Organism	Blackwell Scientific Publication
49.	Dale J.W	Molecular Genetics of Bacteria	John Wiley & Sons
50.	Mandelstram	Biochemistry of Bacterial Growth	Blackwell Scientific

			Publishers
51.	Doelle	Bacterial Metabolism	
52.	Rose A.H	Chemical Microbiology	Butterworth Pergaman Publishers
53.	Stanbury. B.F & Whittakar. A & S.J. Hall	Principles of Fermentation Technology	
54.	Glazer A.N. & Katoo. H	Microbial Biotechnology	W.H. Freeman & Co
55.	Paeppler H.J. & Perman. D	Fermentation Technology Vol. I & II	
56.	Demain. A & Soloman.N.A	Manual of Industrial Microbiology & Biotech	American Society for Microbiology
57.	Juan.A. Asenjo	Separation Process in Biotechnology	Marcel Dekker Inc. Pub. New York
58.	Anderson J.W & Bearcall J	Metabolic Activities of Plants Cells	Blackwell Scientific Pub.
59.	Goodwin & Mercer	Introduction to Plant Biochemistry	Pergaman Press
60.	Bonner & Warner	Plant Biochemistry	Academic Press
61.	Dey. P. M And Harborne J.B	Plant Biochemistry	Academic Press
62.	Devlin & Witham	Plant Physiology	CBS Publishers
63.	Croy. R.R.D	Plant Molecular Biology	Bins Scientific Publishers
64.	Chrispee. M.J & Sadava. D.E	Plant Genes & Agriculture	Jones & Barlet Publishers
65.	Becker, Kleinsmith and Harden	The World of the cell	Academic Internet Publishers; 5th edition [2006]
66.	GeoffreyM. Cooper and Robert E. Hausman.	The Cell: A Molecular Approach, Fourth Edition	
67.	Gerald Karp	Cell and Molecular Biology by concepts and experiments	John Wiley sons & Inc [2005].
68.	Harvey Lodish	Molecular Cell Biology	W. H. Freeman; Sol edition [2007]
69.	J. Brachet and A. E. Mirsky	The Cell - Biochemistry, physiology and morphology	Academic Press [1963]
70.	David L. Nelson and Michael M. Cox	Lehninger's Principle of Biochemistry	Freeman; 4th edition [2004]
71.	William. F. Ganong	Review of Medical Physiology	McGraw-Hill Medical; 22 edition [2005]
72.	Guyton	Human Physiology and Mechanisms of Disease	Saunders Publications 6 th edition [1996]

73.	C.C. Chatterjee	Human physiology	11 th edition (1985)
74.	Davidson and Passmore	Human Nutrition and Dietetics	Churchill Livingstone; 8th edition (1986)
75.	M.S. Swaminathan	Principles of Nutrition	
76.	M.E.Skilis V.R.Young	and Modern Nutrition and Health Diseases	
77.	K. Wilson and I. Walker	Practical Biochemistry	Cambridge University press
78.	Shawney	Practical Biochemistry	Shawney
79.	P.Asokan	Analytical Biochemistry	Chinaa publications, (2003)
80.	David Frifelder	Physical Biochemistry	W. H. Freeman; 2 edition (1982)
81.	Galen Wood Ewing	Instrumental Methods of Chemical Analysis	Mcgraw-Hill College; Fifth edition (1985).
82.	Robert D. Braun	Introduction to Instrumental Analysis	Pharma Book Syndicate (2006)
83.	Dixon and Webb	Enzymes	Academic Press (1964)
84.	Palmer	Understanding enzymes	Prentice Hall; 4 Sub edition (1995)
85.	P.Asokan	Enzymes	Chinaa publications, (2003)
86.	Boyer	Enzymes	Academic Press; 3rd edition (November 1983)
87.	Metzler	Biochemistry	Academic Press (2000)
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