THIRUVALLUVAR UNIVERSITY

MASTER OF SCIENCE
DEGREE COURSE

M.Sc. BIOCHEMISTRY
UNDER CBCS

(With effect from 2017 - 2018)

The Course of Study and the Scheme of Examinations

S. No.	Subject	Paper	Ins. hrs /week	Credit	Title of the Paper	Maximum Marks		
SEMESTER I						**CIA**	**Uni. Exam**	**Total**
1	MAIN	Paper-1	6	4	Cell Dynamics and Environment Biology	25	75	100
2	MAIN	Paper-2	6	5	Chemistry of Macromolecules	25	75	100
3	MAIN	Paper-3	5	5	Human Physiology and Nutrition	25	75	100
4	MAIN Practical	Paper – 1	5	-	Isolation and Characterization studies, Quantitative Analysis, Techniques	-	-	-
5	Main Practical	Paper - 2	5	-	Enzymology – Purification and Kinetic Studies, Microbial Biochemistry	-	-	-
6	Elective	**Paper – 1**	3	3	**(to choose 1 out of 3)** 1. Biophysical and Bio organic chemistry 2. Pharmaceutical Biochemistry 3. Plant biochemistry and plant molecular biology	25	75	100
			30	**17**		**100**	**300**	**400**
SEMESTER II								
7	MAIN	Paper-4	5	4	Analytical Biochemistry	25	75	100
8	MAIN	Paper-5	5	4	Advanced Enzymology	25	75	100
9	MAIN	Paper-6	5	4	Intermediary Metabolism	25	75	100

10	MAIN Practical	Paper - 1	5	5	Isolation and Characterization studies, Quantitative Analysis, Techniques	25	75	100
11	MAIN Practical	Paper - 2	5	5	Enzymology – Purification and Kinetic Studies, Microbial Biochemistry	25	75	100
12	Elective	Paper – 2	3	3	**(to choose 1 out of 3)** 1. Microbiology 2. Diagnostic Biochemistry 3. Biochemical and Environmental	25	75	100
13	Compulsory paper		2	2	Human Rights	25	75	100
			30	**28**		**175**	**525**	**700**
SEMESTER III						**CIA**	**Uni. Exam**	**Total**
14	MAIN	Paper-7	6	5	Advanced Endocrinology	25	75	100
15	MAIN	Paper-8	6	5	Research Methodology	25	75	100
16	MAIN	Paper-9	5	5	Biotechnology	25	75	100
17	MAIN Practical	Practical-3	5	-	Biochemical analysis of blood, Immunological and Molecular Biology techniques	-	-	-
18	MAIN Practical	Practical-4	5	-	Haematological methods, Urine analaysis	-	-	-
19	Elective	Paper - 3	3	3	**(to choose 1 out of 3)** 1. Immunology 2. Bioinformatics 3. Nano biotechnology	25	75	100
			30	**18**		**100**	**300**	**400**

SEMESTER IV						CIA	Uni. Exam	Total
20	MAIN	Paper-10	6	5	Molecular Biology	25	75	100
21	MAIN	Paper – 11	6	5	**Advanced Clinical Biochemistry**	25	75	100
22	MAIN	Practical-12	5	5	Project / Dissertation with *Viva Voce*	50	150	200
23	MAIN Practical	Paper-3	5	5	Biochemical analysis of blood, Immunological and Molecular Biology techniques	25	75	100
24	Main Practical	Paper – 4	5	5	Hametological methods, Urine analysis	25	75	100
24	Elective	Paper - 4	3	3	(to choose 1 out of 3) 1. Stem cell technology 2. Herbal Technology 3. Genetic Engineering	25	75	100
			30	**28**		**175**	**525**	**700**

Subject	**Papers**	**Credit**	**Total Credits**	**Marks**	**Total Marks**
Main	12	4-5	56	100	1300
Main Practical	4	5	20	400	400
Elective	4	3	12	100	400
Compulsory Paper	1	2	2	100	100
Total	**21**	**-**	**90**	**-**	**2200**

THIRUVALLUVAR UNIVERSITY

M.Sc. BIOCHEMISTRY

SYLLABUS

UNDER CBCS

(With effect from 2017-2018)

SEMESTER I

PAPER-1

CELL DYNAMICS AND ENVIRONMENTAL BIOLOGY

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, micro tubular associated proteins - role in intracellular motility.

UNIT-II : CELLULAR ORGANELLES, CELLULAR COMMUNICATION AND TRANSPORT

Cellular organelles – morphology and function. Differentiation of cell membrane - microvilli, epithelia, Bell and sqot desmosomes - mechanical function, cell-cell interaction, cell adhesion proteins, cell junctions, tight junction and gap junction, 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-III : ENVIRONMENT AND ECOLOGICAL SUCCESSION

Physical environment – Biotic and abiotic environment; concept of habitat and niche, niche width and overlap, fundamental and realized niche, resource partitioning, character displacement. Ecological succession - types, mechanisms, and changes involved in succession.

UNIT-IV : POPULATION ECOLOGY & ORIGIN OF CELLS

Characteristics ofa population, population growth curves, population regulation, life history statergies (r and k selection). Concept of metapopulation – demes and dispersal, interdemic extinctions, age structured populations. Origin of basic biological molecules; abiotic synthesis of organic monomers and polymers; concept of oparin and Haldane, experiment of miller. Evolution of prokaryotes and eukaryotes.

UNIT V : PALEONTOLOGY , EVOLUTIONARY HISTORY AND MOLECULAR EVOLUTION

The evolutionary time scale, eras, periods and epoch; major events in the evolutionary time scale. Concepts of neutral evolution, molecular divergence and molecular clocks; molecular tools in phylogeny, classification and identification; Convergent evolution, sexual evolution and co-evolution.

References

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

PAPER-2

CHEMISTRY OF MACROMOLECULES

UNIT-I: HOMO AND HETEROGLYCANS

Polysaccharides - occurrence, structure, properties and functions of homoglycans - starch, glycogen, cellulose, dextrin, inulin, chitins. 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: AMINOACIDS AND PROTEINS

Classification, properties and function of aminoacids and 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. Collagen triple helix. Super secondary structures - helix-loop-helix. Tertiary structure - alpha and beta domains. Quaternary structure - structure of hemoglobin.

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.Types of RNA, hnRNA, methods for nucleic acid sequence determination, denaturation and renaturation, Cot value curve, hypochromic effect, DNA-protein interactions.

UNIT-IV : LIPIDS

Lipids - classification, 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

Vitamins - water soluble - thiamine, riboflavin, niacin, pyridoxine, folic acid, ascorbic acid-sources, structure, biochemical functions, deficiency diseases, daily requirements; fat soluble - vitamin A, vitamin D, vitamin E and vitamin K - sources, structure, biochemical functions, deficiency diseases, daily requirements.

References

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

PAPER-3

HUMAN PHYSIOLOGY AND NUTRITION

UNIT-I : DIGESTION, ABSORPTION AND EXCRETION

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

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. Hemoglobin - structure, abnormal types, anemia. Structure of heart, cardiac cycle, heart sounds, E.C.G (elementary knowledge), 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 - O_2 and CO_2. 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, 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. 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, respiratory quotient. Role of fiber in diet, role of essential amino acids - relation with Marasmus, Kwashiorkar 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 - William. F. Ganong. McGraw-Hill Medical; 22 edition, 2005.
2. Human Physiology and Mechanisms of Disease - Guyton. Saunders Publications; 6th edition, 1996.
3. Human physiology - C.C. Chatterjee. 11th edition, 1985.
4. Human Nutrition and Dietetics - Davidson and Passmore. Churchill Livingstone; 8th edition, 1986.
5. Principles of Nutrition - M.S.Swaminathan
6. Modern Nutrition and Health Diseases - M.E. Skilis and V.R. Young

ELECTIVE

PAPER-1
(To choose 1 out 3)

A. BIOPHYISCAL 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, NMR and mass spectrometry and their biological applications. FT-NMR Nuclear overhauzer 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). Hemolytic 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 lactic acid.

Stereoisomerism. Geometric isomerism with special reference to maleic acid and unsaturated fatty acids. 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 and cyclohexane.

B. PHARMACEUTICAL BIOCHEMISTRY

UNIT-I

Drug - Structural feature and pharmacology activity, prodrug concept. Absorption -first – pass effect. Distribution, metabolism- Phase I, II reactions, action of cytochrome p450 & elimination of drug receptor- localization, type and subtypes, models and their drug – receptor interaction, agonist & antagonist.

UNIT-II

Adverse response to drugs, Drug tolerance, Drug intolerance, Idio syneracy (pharmacogenesis), drug allergy. Tachyphylaxis, Drug abuse, vaccination against infection, factor that modifies the effect of drug. Assay of drug potency- bioassay and immunoassay.

UNIT-III

Biotechnology and pharmacy: Genetically engineered protein and peptide agents. Novel drug delivery systems – non conventional routes of administration. Anti-AIDS drug development, oncogenes ras target for drugs, multi-drug resistance.

UNIT-IV

Mechanism of action of drugs used in therapy of: Respiratory system – cough, bronchial – asthma, pulmonary tuberculosis. GIT – Digestants, appetite suppressants. Hypolipidemia agents, vomiting, constipation and peptic ulcer. Antimicrobial drugs – sulfonamides, trimethoprim, cotrimoxazole, penicillin, and macrolides. Aminoglycosides, Cephalosporin and bacterial resistance. Insulin and oral diabetic drugs, antifertility and ovulation inducingdrugs.

UNIT-V

Drugs of plant origin: Drug dependence and abuse – Management of self poisoning cancer. Chemotherapy – Cytotoxic drug. Immuno suppressive drug therapy. New Biological Targets for Drug Development. Novel Drug Screening Strategies.

References:

1. The pharmacology Vol I and II- Goodman And Gillman, Mc Graw Hill
2. Basic pharmacology- Foxtercox Bulter Worth’s, 1980.
3. Pharmacology and pharmacotherapeutics- R.S.Satoskar. S.D.Bhandhakar & S.S.Anilapure Popular Prakashar Bombay.
4. Principles of medicinal chemistry- William O. Foge.B.I. Waverks Pvt Ltd, New Delhi.
5. Oxford textbook of clinicasl pharmacology and drug therapy. D.G. Burger’s medicinal Chemistry & Drug Discovery.
6. Principles and practice- Manfred.E. Wolf John Wiley and sons

ELECTIVE

PAPER-4

(to choose 1 out 3)

C. PLANT BIOCHEMISTRY AND PLANT MOLECULAR BIOLOGY

UNIT-I : ENERGY GENERATING MECHANISM

Photosynthetic Pigments, Light and Dark reactions of photosynthesis. Proton gradient and ATP synthesis of chloroplast and Bacterium. Mode of action of DCMU, Regulation of photosynthesis, Bacterio rhodopsin, CAM metabolism, RUBISCO, photorespiration and crop productivity.

UNIT-II: NITROGEN METABOLISM AND PLANT HORMONES

Nitrogen cycle, biochemistry of Symbiotic and Nonsymbiotic nitrogen fixation. Assimilation of ammonium , carbon-nitrogen ratio, Uride metabolism, nitrate metabolism, genetics of nitrogen fixation, genetic manipulation of Nif genes, Biosynthesis, Mode of action, transport, distribution and physiological effect of Auxin, Giberrilin, Cytokinin, Aba and ethylene.

UNIT-III : PLANT DISEASE AND SECONDARY METABOLITES

Biochemistry of plant disease, defence mechanism of plants, biosynthesis, distribution and biological functions of industrially important secondary metabolite, (Any 10) Principles of plant disease control.

UNIT-IV : PLANT PHYSIOLOGY

Water relations of plant, Mechanism of water absorption. Aquaporin Symplast - Apoplast concept. Ascent of sap, Transpiration and Stomatal mechanism. Source and sink relationship, Translocation of Inorganic and Organic substances, Bud and Seed dormancy. Senescence, Stress response in plant, Phytochromes- Properties, Photochemicals, transformation, Mode of action and physiological effect.

UNIT-V : PLANT MOLECULAR BIOLOGY AND BIOTECHNOLOGY

DNA polymorphism – Importance of RFLP and RAPD in plant breeding management. Aspects of plant genetic engineering. Tacking, Mapping and Cloning of plant genes, Selectable markers. Reporter genes and promoters used in plant vectors. Ti plasmids and Crown gall tumor, Genetic engineering of plant for disease resistance, Cytoplasmic Male Sterility, Edible oil, Biodegradable plastics, Delay of fruit ripening. Methods and Application of plant tissue culture.

Text Books:

1. Modern Plant Physiology - R.K. Sinha, Narosa Publishing House, 2004.
2. Microbiology – M.J. Pelczar, E.C.S. Chan and N.R. Kreig, Tata McGraw Hill Publishing Co., 5th Edition, 1986.
3. Microbiology – L.M. Prescott, J.P. Harley and D.A. Klein, McGraw Hill, 6th Edition, 2004.

References:

1. Introduction to Plant Biochemistry – T.W. Goodwin, Pergamon Press, 1986.
2. Plant Biochemistry and Molecular Biology – P.J. Lea, L.L. Castle and Lea, 2nd Edition, John Wiley & Sons, 1999.
3. Microbiology – B.D. Davis, R. Dulbecco, H.N. Eisen and H.S. Ginsberg. 3rd Edition, Harper & Row, 1980.

SEMESTER II
PAPER-4
ANALYTICAL BIOCHEMISTRY

UNIT I - ELECTROCHEMICAL TECHNIQUES AND ELECTROPHORESIS

Electrochemical techniques – principles, electrochemical cells – pH, Henderson – Hasselbalch equation, buffer capacity, pH measurement, glass electrode. Oxygen electrode – principle and application. Biosensors.
Separation of DNA fragments – Pulsed field gel electrophoresis. Autoanalyser – principal, instrumentation and applications. Isoelectric point-2D gel electrophoresis

UNIT II - ENZYME ASSAY, CENTRIFUGATION AND RADIOCHEMICAL TECHNIQUES

Enzyme monitoring technique – Assay methods, Immobilized enzymes.
Centrifugation: Preparative and Analytical ultracentrifuges.
Radiochemical methods – Basis concepts, counting methods and application. Autoradiography.

UNIT III – CHROMATOGRAPHY AND SPECTROSCOPY TECHNIQUES

GC, HPLC – principle, components, limitations and applications.
HPTLC – technique and applications
Optical rotatory dispersion, Circular dichroism, X-ray diffraction, Nuclear magnetic resonance, Electron spin resonance and Mass spectrometry – basic principle and application principle and applications of trubidimetry and nephelometry. Flow cytometry and cell separation.

UNIT IV – MOLECULAR TECHNIQUES

Restriction endonucleases, Restriction mapping, Nucleic acid probes – cloned probes, oligonucleotide probes and labelling of nucleic acid probs. Membrane blotting and hybridization of nucleic acids – Southern, Northern, Western, dot-plot and Fluorescent insitu hybridization. RFLR – Technique & applications.
PCR basic principle, technique, diagnostic and laboratory applications of PCR, RAPD
Construction of DNA and Oligonucleotide microarray.

UNIT V–MOLECULAR MARKERS ANALYSIS

Diagnostic applications of nucleic acid probes – sickle cell anaemia, thalassemia, haemophilia and lymphoid malignancy. Mutagenicity testing – Ames test. Comet assay and DNA fragmentation assay. Identifying protein – DNA interactions – DNA foot printing, DNA finger printing – Technique and applications. HLA typing – applications.

REFERENCES

1. Keith Wilson and John Walker - Principles and techniques of Biochemistry and Molecular Biology, Cambridge University Press, 6th Edition,2006.
2. Boyer R. - Experimental Biochemistry, Addison Wesley, 3rd Edition, 2002.
3. Bernard R. Glick and Jack.J. Pasternak - Molecular Biotechnology, ASM Press Washington 3rd Edition, 2003.
4. D W Brown - Organic Spectroscopy, Wiley New York 1st Edition, 1998.
5. M.Valcatcel - Principles of analytical chemistry-A Text book. Springer, 2000.
6. David James Holme and Hazel Pack - Longman, 1994.

PAPER-5
ADVANCED ENZYMOLOGY

UNIT-I : CLASSIFICATION, PURIFICATION AND ACTIVE SITE

Nomenclature and classification of enzymes, isolation and purification of enzymes – enzymeprotein 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 Vmax, Km, MM equation, and turnover number; Lineweaver - Burk plot, Eadie - Hofstee plot, and Hanes - Woolf 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 enzymicaction , mechanism of serine proteases - chymotrypsin, lvsozyme, 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, PALP and PAMP - role of PALP in transamination and decarboxylation reaction, folate coenzymes 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 cheesed production.

Clinical enzymology - Enzymes as thromblytic agents, anti-inflammatory agents.Immobilization of enzymes and their applications.

References

1. Enzymes - Dixon and Webb, Academic Press, 1964

2. Understanding enzymes - Palmer. Prentice Hall; 4 Sub edition, 1995

3. Enzymes - Boyer. Academic Press; 3rd edition, November 1983

4. Biochemistry - Metzler. Academic Press, 2000.

5. Biochemistry - Stryer. W. H. Freeman; 6 edition, 2006.

PAPER-6

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. F_1F_0 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 / glycerophosphae shuttle, creatine - phosphate shuttle.

UNIT-II : CARBOHYDRATE METABOLISM

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

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. Eicosanoid metabolism.

UNIT-IV : AMINO ACID, PURINE AND PYRIMIDINE METABOLISM

Biosynthesis of aromatic aminoacids.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,PHOTOSYNTHESIS AND METABOLIC INTEGRATION

Biosynthesis and degradation of heme.

Photosynthesis - Photosynthetic apparatus, light reaction, cyclic and noncyclic photophosphorylation. Dark reaction - Calvin cycle, Hatch-Slack pathway.Photorespiration.Starch biosynthesis and degradation.Bioluminescence.
Integration of metabolism - Interconversion of major foodstuffs.Metabolic profile of the liver, adipose tissue and brain.Altered metabolism in starvation.

Text Books

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

MAIN PRACTICAL

PAPER-1

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).

B. QUANTITATIVE ANALYSIS

1. Estimation Of Ascorbic Acid

2. Estimation of inorganic phosphorus by Fiske and SubbaRao 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 glutathione from tissue/blood

8. Estimation of Iron

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.

5. PCR Technique - Demonstration

References

1. Practical Biochemistry - K. Wilson and I. Walker. 5th edition, Cambridge University press, 2000.

2. Practical Biochemistry – Shawney.

3. Biochemical Methods - S.Sadasivam & A.Manickam, New Age International.

MAIN PRACTICAL

PAPER-2

A. ENZYMOLOGY - PURIFICATION AND KINETIC STUDIES

1. Subcellular fractionation of organelles from liver cells and identification by marker enzyme - LDH

2. Isolation of acid phosphatase from potato.

a. Determination of optimum pH.
b. Determination of optimum temperature.
c. Effect of substrate concentration on acid phosphatase activity.
d. Inhibition of acid phosphatase activity.

3. Assay of clinically important enzymes.

a. Assay of serum/tissue 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 TECHNIQUES

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 - 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

References

1. Practical Biochemistry - K. Wilson and I. Walker. 5th edition, Cambridge University press, 2000.

2. Practical Biochemistry – Shawney.

3. Biochemical Methods - S.Sadasivam & A.Manickam, New Age International.

4. Medical laboratory Technology Volume I, II & III - KL Mukherjee

ELECTIVE

PAPER-2

(to choose 1 out of 3)

A. 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 motlility.Cell inclusion bodies.

Blue 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.Archaebacteria.

UNIT-II : MICROBIAL GROWTH AND METABOLISM

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

ELECTIVE

PAPER-2 (to choose 1 out of 3)

B. BIOCHEMICAL AND ENVIRONMENTAL TOXICOLOGY

UNIT-I

Definition and scope of toxicology: Eco-toxicology and its environment significance toxic effects. Basis for general classification & nature, dose - response relationship. Synergism and Antagonism, Determination of ED 50 & LD 50.

Acute and chronic exposures. Factors influencing toxicity. Pharmaco dynamics & Chemo dynamics.

UNIT-II

Principles & procedures of testing for acute toxic effects. Regulators guidelines, mammalian systems affected & the clinical signs of systemic toxicity. Factors affecting acute toxicity studies. Biochemical basis of toxicity. Mechanism of toxicity: disturbance of excitable membrane function altered calcium homeostasis. Covalent binding to cellular macromolecules. Genotoxicity. Tissue specific toxicity.

UNIT-III

Toxicity testing : Test Protocol, Genetic Toxicity Testing & Mutagenesis Assays: *Invivo* test systems- Bacterial Mutation Tests: Reversion Tests, Ames test, Fluctuation Tests & Eukaryote Mutation Tests In Vivo Mammalian Mutation Tests – host mediated assay & dominant lethal test. Use of drosophila in toxicity testing. DNA repair assays. Chromosome damage test. Toxicological Evaluation of Recombinant DNA –Derived Proteins.

UNIT-IV

Food toxicology: Toxicology of food additives. Metal toxicity: Toxicology of Arsenic, Mercury, Lead and Cadmium. Environmental Factors Affecting Metal Toxicity- Effect of Light, Temperature & PH. Diagnosis of toxic changes in liver and kidneys: Metabolism of Haloalkanes. Haloalkenes & Paracetomol with their toxic effects on tissues.

UNIT-V

Air pollution: common air pollutants and their sources. Air pollution & ozone. Air pollution due to chloroflurocarbons (CFCS) and asbestos. Occupational toxicology and assessment of occupational hazards: industrial effluent toxicology & environmental health. An overview of regulatory agencies: responsibilities of regulatory agencies. Management of toxicological risks. Regulatory approaches. Regulatory systems and organizations.

References:

1. Casarett and Doull's Toxicology, III rd edition - Klaassen C D, Amdur M O & Doull J (1986), Macmillan publishing company, New York. 26

2. Industrial Toxicology - Williams P L & Burson J L Van- Nostrand Reinhold, New York, 1985

3. Principles and methods of toxicology, II nd edition -Hayes A W, Raven press New York, 1988

4. Toxicology, Vol I - Stewart C P&Stolman A Academic press, New York, 1960

SEMESTER III

PAPER-7

ADVANCED ENDOCRINOLOGY

UNIT-I : CLASSIFICATION AND MECHANISM

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

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 : 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.

UNIT-V : 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, 17B - estradiol, progesterone and calcitriol).

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-8

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,Science direct.

UNIT-IV : DATABASES

Data base concepts - database, database system, database management systems - hierarchical , rational and network, database security. Biological databases - types, sequence and structure. 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 Bologina. 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. How to write a scientific paper- R.A. Day.. Cambridge University Press.
2. Guide to scientific and technical writing - Cooray P.G.
3. Methods of Research - Carter V. Good and Douglas E seats.
4. The craft of scientific writing - Alley, Michael. Englewood Cliffs. N.N. Prentice 1987.
5. Desk Top Publishing on PC - M.C. Sharma, BPB Publications, 1997.
6. Introduction to Bioinformatics - Lesk, A.M. Oxford 2002.
7. Bioinformatics Computing 1st Edition - Bergeron BP 2002 Printice Hall
8. Fundamental concepts of bioinformatics - Krane et al Benjamin Cummings.
9. An Introduction to Biostatistics - Sundar Rao, Jesudian Richard.
10. Fundamentals of statistics - S.P. Gupta , 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-9

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, i*nvitro* 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, shuttle vectors, DNA sequencing strategies - Sanger's and Maxam Gilbert's methods, PCR-types and applicationsand DNA hybridization, Southern, Northern andWestern blotting.

UNIT-III : GENE TRANSFER AND APPLICATIONS

Techniques of tissue culture-culturing explants and haploids, protoplasts fusion, 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, xenogarfting, biodegradation, stimulation and its applications, bioleaching.

UNIT-IV : INDUSTRIAL BIOTECHNOLOGY

Applications of biotechnology-industrial biotechnology-fermentors, principle, types product recovery and purification of ethanol, citric acid, vitamin B 12, streptomycin, enzyme biotechnology-production and uses of industrially important enzymes such as protease.

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

ELECTIVE
PAPER – 3
(To choose 1 out of 3)

A. 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.

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.

Immunity toextracellular and intra cellular microbes-Bacteria,Virus,Fungi and Parastites

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 - lymphocytotoxicty 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 - Ivon Roitt, Blackwell Publishing, Incorporated; 11 edition, 2006
2. Cellular and Molecular Immunology -Abul K. Abbas, Andrew Lichtman, Saunders; 5th edition,2005
3. Practical Immunology - 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 - D. M. Weir.
5. Basic and Clinical Immunology -Daniel P. Stites, John D. Stobo,J. Vivian Wells,Appleton & Lange; 6th edition,1987.

B. BIOINFORMATICS

UNIT-I

Computer peripherals and hardware description: computer system design. Recognition and Structure of Different Components of A Computer System And Their Respective Usage. I/O and Storage Devices with Data Communication with Introduction of Internet. Connections to the internet, internet service requirements and applications – e-mail - World Wide Web, URL, HTML, TCP/IP

UNIT-II

Operating systems: system and applications software, evolution of operating systems, layered structure of operating system, CUI and GUI's DOS internet and external commands, batch files: WIN 95/98: Anatomy of windows and features, multitasking.
Office applications : MS-Office 95/97/2000/2003 including MS-Word, MS-Excel, MS Powerpoint.

Logic developments: generation of programming languages, emulation of common DOS commands using C and C++, data structures in C objects and classes, pointers arravasione and two dimensional) normal string and file handling in C.

UNIT-III

Introduction to bioinformatics – biological data bases- sequence analysis-need and importance-pajirwise alignments – dot plot, dynamic programming – global(needle man-wunsch) and local (smith-waterman) alignment algorithms- scoring and substitution matrix – data base searching. Basics of Entrez, BLAST, and FASTA search procedures- multiple alignment. CLUSTAL – Njplot-Phylogenetis trees.

UNIT-IV

Secondary structure prediction of RNA and protein – detecting ORFs- restriction maps, algorithm for Tm calculations, primer design and probe synthesis – structural classification of proteins (SCOP and CATH) – structural genomics-functional genomics and proteomics – DNA microarrays – present status and future prospects.

UNIT-V

3-D Structural analysis of biomolecules – Molecular Visualization Tools – rasmol, Chime, weblab Viewer, Deep View, ISIS Draw, chemdraw, molmol, etc – computer modeling of proteins. Simulation studies and virtual reality – Simulation Of ES Complex Interaction and stereodynamic concept- structural studies of substrate – Ligand Binding – Drug Designing-introduction to PERL and BIOPERL to facilitate Biological Analysis.

References:

1. . Introduction to Bioinformatics-Lesk, A.M Oxford, 2002.
2. Campbell and Heyer. Discovering Genomics, Proteomics and Bioinformatics. Cold Spring Harbour Laboratory. Press & Benjamin Cummings, 2002.
3. Developing Bioinformatics Computer Skills-Gibas and Per Jambeck. O'Reilly & Associates, 2001.
4. Fundamental concepts of bioinformatics -Benjamin Cummings,Krane et al, 2002.
5. Bioinformatics computing Bergeron BP. 1st ed. - Printice Hall, 2002.
6. Bioinformatics: A practical guide to analysis of genes and proteins.2nd ed. - Baxevanis & Ouellette, Wiley-Inter Sci, 2001.

C. NANO BIOTECHNOLOGY

UNIT I: NANOBIOMATERIALS

Introduction – Biocompatibility - Antibacterial activity- Principles involved - Applications. Biomaterial Nanocircuitry: Protein based nanocircuity: Neurons for network formation. DNA nanostructures for mechanics and computing and DNA based computation: DNA based nanomechanical devices.

UNIT II: NANOBIOTECHNOLOGY

Interaction between Biomolecules and Nanoparticle surface, Different types of inorganic materials used for the synthesis of Hybrid Nano-bio assemblies, Application of Nano in biology, Nanoprobes for analytical applications- A new methodology in medical diagnostics and biotechnology, Current status of Nanobiotechnology, Future perspectives of Nanobiology, Nanosensors.

UNIT III: NANOMEDICINES

Developing of Nanomedicines, Nanosystems in use, Protocols for Nanodrug administration, Nanotechnology in Diagnostics applications, Materials used in diagnostics and therapeutic applications - Molecular Nanomechanics, Molecular devices, Nanotribology, Studying Tribology at Nanoscale, Nanotribology applications.

UNIT IV: MOLECULAR AND CELLULAR BIOLOGY

Molecular and cellular biology applications, 2-D electrophoresis and mass spectrometry of proteins, Protein Microarrays (Fabrication – Fluorescencedetection) - Binding Assays and Immunosensors- Integrated Nanobiotechnology Systems.

UNIT V: BIOLOGICAL METHODS OF SYNTHESIS

Use of Bacteria, Fungi, Actinomycetes for Nanoparticle Synthesis, Magnetotactic Bacteria for Natural Synthesis of Magnetic Nanoparticles: Mechanism of Formation: Viruses As Components for the Formation of Nanostructured materials: Synthesis Process and application, Role Of Plants in Nanoparticle Synthesis.

Reference:

1. Nanotechnology - Mark Ratner and Daniel Ratner, Pearson education.
2. Nanomaterials - A.K.Bandyopathy: New Age International Publishers
3. Bionanotechnology: Lessons From Nature - David S.Goodsell
4. Nanomedicine, Vol IIA: Biocomnpatibility - ROBERT A. FREITAS
5. Handbook of Nanostructured Biomaterials and their applications in nanobiotechnology – Harisingh Nalwa
6. Nanobiotechnology: ed. C.M.Niemeyer, C.A.Mirkin.
7. Nanocomposite Science and Technology Ajayan,Schadler &Braun.
8. BioMEMS(Microsystems)- Gerald A.Urban.
9. Introduction to Nanoscale Science And Technology (Nanostructure Science And Technology) – Massimiliano Diventra
10. Nanosystems: molecular : Molecular Machinery, Manufacturing And Composition- K.Eric Drexler
11. Springer handbook of nanotechnology- Bharat Bhusha
12. Nanobiotechnology: ed - C.M. Niemeyer, C.A.Mirkin.

SEMESTER IV

PAPER-10

MOLECULAR BIOLOGY

UNIT-I : DNA REPLICATION

Types of replication, evidence for semiconservative replication - Meselson and Stahl experiment, 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) reverse transcriptase, retroviruses, temporal control of replication. Eukaryotic replication and inhibitors of 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 Prinbnow box, template binding, prokaryotic transcription, Rho - dependent and independent transcription, posttranscriptional processing in prokaryotes, split genes, overiapping 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, inhibitors of protein synthesis.

UNIT-IV : PROTEIN TRANSPORT AND GENE EXPRESSION

Protein targeting, translocation, heat shock proteins, glycosylation, SNAPs and SNAREs, bacterial signal sequences, heat shock proteins, 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, 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 -Robert F. WeaverMcGraw-Hill 4 edition, 2007
2. Advanced molecular biology -R. M. Twyman,1998
3. Genes VII - B. Lewin Oxford University Press, Cell Press, London, 2000.
4. Cell and molecular biology - G. Karp, John Wiley & Sons Inc, 2002.
5. Biochemistry - D.Voet and J. Voet. John Wiley and Sons Ltd, 1990

PAPER-11

ADVANCED CLINICAL BIOCHEMISTRY

UNIT-I : SPECIMEN COLLECTION AND ANALYSIS

Concepts of accuracy, precision, reproducibility, reliability, and other factors in quality control. Normal values. Clinical significance of sugars, proteins, ketone bodies, bilirubin and porphyrins. CSF - collection, composition and analysis. Amniotic fluid - Origin, collection, composition.

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. Glycogen storage diseases, galactosemia, fructosuria.

Disorders of lipid metabolism - plasma lipids and lipoprotein abnormalities, lipidosis, Xanthomatoses, hypocholestremic agents, fatty liver. Atherosclerosis. Tay Sach's disease, Niemann Picks disease, Gaucher's disease, inherited disorders of familiar 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 and thalassimia. Phenylketonuria, tyrosinosis, alkaptonuria, maple syrup urine disease, Hartnup disease, homocystinuria, albinism.

Serum enzyme activities in diseases - Principle and assay of aspartate aminotransferase, alanine aminotransferase, alkaline phosphatase, acid phosphatase, streptokinase, asparaginase, isocitrate dehydrogenase, ceruloplasmin, y -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 bilary tract diseases, liver function tests, disorders of bilirubin metabolism. 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, oratic aciduria, xanthinuria. Serology: C-reactive protein.

References

1. Text book of Biochemistry with clinical correlation - TM. Devlin, John Wiley and Sons, 1994
2. Clinical chemistry in diagnosis and treatment - P.D.Mayne. A Hodder Arnold Publication; 6Rev Ed edition, 1994.
3. Enzymes - P. Asokan, Chinnaa Publications, 2003.
4. Clinical biochemistry - Metabolic concepts and clinical aspects by W.J. Marshall and S.K. Bangeit, Churchill Livingstone, 1995.
5. Text Book of Medicine - K.V. Krishna Das, Jaypee Brothers Medical Publishers (P) Ltd, 1996.
6. Text Book of Medical Physiology - A.C. Guyton and J.E. Hall, Harcourt Asia, 2000.

MAIN PRACTICAL

PAPER -3

A. BIOCHEMICAL ANALYSIS OF BLOOD

1. Estimation of blood glucose by o-toluidine method.
2. Glucose tolerance test
3. Estimation of blood glucose by GOD-POD method using semiautoanalyser. (Demonstration)
4. Estimation of serum proteins by Bradford's Method.
5. Estimation of plasma fibrinogen.
6. Estimation of A.G. ratio in serum.
7. Estimation of blood urea by DAM method.
8. Estimation of serum uric acid by phosphotungstate method.
9. Estimation of serum creatinine by alkaline picrate method.
10. Estimation of serum triglycerides.
11. Estimation of serum cholesterol by Zlatkis, Zak and Boyle method.
12. Estimation of serum phospholipids.
13. Estimation of serum calcium.
14. Estimation of serum bilirubin by Evelyn Malloy method.
15. 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)
7. Immunodiffusion
8. Production of antisera

References

1. Practical Biochemistry For Medical Students - Raghu, JAYPEE, 2006
2. Practical Clinical BiochemistryHardcover–Harold Varley,Sixth Edition, Alan H Gowenlock.
3. An Introduction to Practical Biochemistry - David T. Plummer Third Edition, Tata Mc Graw Hill
4. Medical laboratory Technology Volume I, II & III - KL Mukherjee
5. Haematology for students Practitioners - Ramnik Sood
6. Biochemical Methods - S.Sadasivam & A.Manickam, New Age International.

MAIN PRACTICAL

PAPER-4

A. HAEMATOLOGICAL METHODS

1. Collection, storage of blood and anticoagulants
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.
12. Prothrombin time

B. URINE ANALYSIS

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

C.Industrial study tour (Research institute/Industry one visit per year)

D. One week hands ontraining on any biochemical instrument.

References

1. Practical Biochemistry For Medical Students - Raghu, JAYPEE, 2006
2. Practical Clinical BiochemistryHardcover–Harold Varley,Sixth Edition, Alan H Gowenlock.
3. An Introduction to Practical Biochemistry - David T. Plummer Third Edition, Tata Mc Graw Hill
4. Medical laboratory Technology Volume I, II & III - KL Mukherjee
5. Haematology for students Practitioners - Ramnik Sood
6. Biochemical Methods - S.Sadasivam & A.Manickam, New Age International.

Elective

A. STEM CELL TECHNOLOGY

UNIT-I

Stem cells -Introduction, Definition and basics of stem cells. Classification of stem cells-different types of stem cells- Human embryonic stem cells, Adult stem cells. Sources of stem cells - Fetus and various adult tissues – Advantages of stem cells.

Blastocyst culture- Various stages of embryonic development. In vitro fertilization. Xeno-free derivation of stem cells – Alternative feeder cells and feeder free culture. Cryopreservation of stem cells – Conventional slow- freezing method and Vitrification method. Properties of stem cells - self renewel, clonality and plasticity. Pluripotent nature of stem cells - Extrinsic and Intrinsic factors. Characterization of human embryonic stem cells – Expression of cell surface marker, Karyotyping.

UNIT-II

Stem Cells and their developmental potentials, Characteristics of stem cells-Transdifferntiation of stem cells. Controlled differentiation of human embryonic stem cells. In vivo and invitro differentiation of stem cells. Application of stem cells.

UNIT-III

Therapeutic cloning strategies, derivation and propagation of human embryonic stem cells. Reproductive cloning by SCNT. Use of SCNT. Limitations of cloning – Hurdles to improve the efficiency of therapeutic cloning. Stem cell research and ethics – translational medicine ethics.

UNIT-IV

Hematopoietic stem cells (HSC) - Basics, Development and Regulation of HSC. Clinical Application of HSC – Gene Therapy – using haematopoietic stem cells HSC for Leukemia.

Mesenchymal stem cells (MSC) - Differentiation and Identification. Characteristics of mesenchymal stem cells. Clinical applications of stem cells. Stem cells and regenerative medicine. Ips –induced pluripotent stem cells.

UNIT-V

Skeletal Muscle Stem Cells – Development and functions. Liver stem cells – Organization and functions. Tumor stem cells – Basics differences and Similarities of cancer stem cells and stem cells. Cancer stem cell signaling – NOTCH pathway. Canonical wnt signaling pathways in hematopoietic stem cells. Stem cell therapies in animal models. Use and benefits of stem cell for human beings.

References:

1. Handbook of stemcells- Robert Lanza.
2. Stem cell research and therapeutic.s. – Yanhong Shi
3. Stem cells reviews- Humana Press
4. Stem cells – C.S. Potten
5. Adult stem cells – Kursad Turksen.

B. HERBAL TECHNOLOGY

UNIT – I : PHARMACOGNOSY

Definition and history, Indian systems of medicine - Siddha, ayurvedha, and Unani systems. Taxonomy of locally available medicinal plants, their chemical constituents and medicinal uses - Classification of Crude drugs - Chemistry of Drugs - Future of pharmacognosy.

UNIT – II : CLASSIFICATION OF MEDICINAL PLANTS

Vernacular name and family - Geographical source, cultivation, collection, and processing for market and commerce in crude drugs. Morphological and histological studies, chemical constituents - Therapeutic and other pharmaceutical uses. Underground stem - ginger, Alpinia - Roots - Rauolfia - Belladona - Aerial parts - Bark - Cinchona.

UNIT – III : BIOMEDICAL IMPORTANCE OF MEDICINAL PLANTS

Leaves - Adathoda, Eucalyptus - Flower - Clove fruits seeds - Nux vomica Nutmegs, Gooseberry - unorganized drugs - Gum - Acacia - Resin - Turpentine, fixed oil - castor oil.

UNIT – IV : HERBAL MEDICINES FOR HUMAN AILMENTS

Drugs Acting on Cardiac Diseases, Cerebral Diseases, Nasal diseases - Blood pressure Drugs acting on Nervous system – Depressants, Stimulants. Respiration and Drugs - Urogenital system and drugs - Psychoactive plants.

UNIT – V : PROPAGATION OF MEDICINAL PLANTS

Micro and macro propagation, conservation of rare medicinal plants, Role of biotechnology in medicinal plant's banks,cultivation of medicinal and aromatic plants. Drug adulteration - methods of Drug evaluation. Herbal food - Food processing - packaging - Herbal sale and Export of medicinal plants - marketing - Intellectual property rights - Export laws.

References

1. George Edward Trease and W.C. Evans - Pharmacognosy 12th edition, English Language Books Society, Baelliere Tindall.
2. Handa, S.S. and Kapoor, V.K. Pharamcognosy - 2nd Edition, Vallabh Prakashan Publishers, New Delhi.
3. Indian Medicinal plants - Jain, S.K,1980.
4. Kokate, C.K., Durohit, A.P. and Gokhale, S.R., Pharmacognosy - 12th edition - Nirali Prakasham Publishers, Pune.
5. An Introduction to Medical Botany and Pharmacognosy - Kumar N.C., 1993.
6. Indian Materia Medica – Nadkarni, 1981.
7. A text book of Pharmacognosy - Shah, S.C. and Qudary, 1990.
8. Text book of pharmacognosy , 5th edition -Wallis, T.E, CBS publishers and distributors, New Delhi.

C. GENETIC ENGINEERING

UNIT-I

Introduction to gene cloning: Early development of Genetics - Gene cloning - Specialized tools and techniques - Importance of gene cloning

Intellectual property rights and types, Patenting, Isolation and Purification of DNA; Preparation of total cell DNA, Plasmid DNA, Bacteriophage DNA, Plant cell DNA.

UNIT-II

Cloning And Expression Vectors : Plasmids- Bacteriophages (M13 and λ) PUC vectors yeast vectors, agrobacterium, medicated gene transfer, YAC, BAC, Human artificial chromosomes, Ti plasmid, SV40, baculoviruses, adenoviruses, papilloma viruses and retroviruses.

UNIT-III

Multipulation of purified DNA: DNA manipulative enzymes – Nucleases, Ligases, polymerases, Topoisomerases, Restriction enzymes performing restriction digests, Ligation-joining DNA molecules together – Random labeling Nick translation and End filling.

UNIT-IV

Introduction to DNA into living cells: Biolistics, Electroporation, Microinjection, Liposome – mediated method and Calcium phosphate method.

UNIT-V

Construction of libraries – Studying gene and genome structure – Blotting techniques, PCR, Insitu hybridization, DNA Sequencing, Chromosome Walking and Jumping, DNA foot printing, Restriction analysis of DNA, RFLP, RAPD –Principles, Procedures and Applications.

References:

1. Molecular cloning, vol. I, II, III, II nd edition, Sambrook J, Fritsch E. F. and Maniatis, 1989 Cold spring harbor laboratory press, New York.
2. DNA Cloning : A practical approach D.M. Glover and D.B. Hames, RL Press, Oxford, 1995.

3. Molecular and cellular methods in Biology and Medicine, P.B. Kaufman, W. Wu , D. Kim and L.J. Cseke, CRC Press Florida, 1995.

4. Methods in Enzymology Guide to Molecular Cloning Techniques, Vol. 152 S.L. Berger and A. R. Kimmel, Academic Press Inc, San Diego, 1996.

5. Methods in Enzymology Gene Expression Technology, Vol. 185D. V. Goedel, Academic Press Inc, San Diego, 1990.

6. DNA Science: A First Course in Recombinant Technology, D. A. Mickloss and G. A Freyer, Cold Spring Harbor Laboratory Press, New York, 1990.
7. Molecular Biotechnology, 2nd Ed. S. B. Primrose, Blackwell Scientific publishers, Oxford, 1994.
8. Milestones in Biotechnology, Classic Papers on Genetic Engineering, J. A. Davis and W. S. Reznikoff, Butterworth-Heinemann Boston, 1992.
9. Route Maps in Gene Technology, M. R. Walker, and R. Rapley, Blakwell Science, Oxford, 1997.
10. Genetic Engineering: An Introduction to Gene Analysis and Exploitation in Eukaryotes, S. M. Kingsman, Blackwell Scientific Publications, Oxford, 1998.

PROJECT / DISSERTATION

WITH *VIVA VOCE*

PAPER-12

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