

PDM UNIVERSITY

Faculty of Life Sciences **Department of Biochemistry** **M.Sc. Biochemistry**

TWO YEAR FULL TIME PROGRAMME



PDM UNIVERSITY BHADURGARH
DELHI- NCR



*Note: Syllabi applicable for students seeking admission in the M.Sc. Biochemistry
Course from the academic year 2018*

Details of Course: M.Sc. Biochemistry

Course Structure Credits (Theory + Practical)

Core Courses (14 Papers)	14 x 04 = 56
Core Course Practicals	11 x 02 = 22
Minor group project	01 x 02 = 02
Dissertation (Experimental, Presentation and Viva-Voce)	01 x 16 = 16
PPT (Pre Placement Training)	0 x 0 = 00

Total Credits = 96

M.Sc. Biochemistry
Department of Biochemistry
Faculty of Life Sciences, PDMU

PROGRAMME STRUCTURE

	Module Code	Module Type	Module Name	Marks			Credits
				Internal	External	Total	
1st Sem	BIOC5101	Core I	Cell Dynamics	50	100	150	4
	BIOC5102	Core I (P)	Cell Dynamics Lab	25	50	75	2
	BIOC5103	Core II	Biomolecules	50	100	150	4
	BIOC5104	Core II (P)	Biomolecules Lab	25	50	75	2
	BIOC5105	Core III	Human Physiology and Nutrition	50	100	150	4
	BIOC5106	Core III (P)	Human Physiology and Nutrition Lab	25	50	75	2
	BIOC5107	Core IV	Biophysical and bio-organic chemistry	50	100	150	4
				Total	275	550	825
2nd Sem	BIOC5108	Core V	Analytical Biochemistry	50	100	150	4
	BIOC5109	Core V (P)	Analytical Biochemistry Lab	25	50	75	2
	BIOC5110	Core VI	Advanced Enzymology	50	100	150	4
	BIOC5111	Core VI (P)	Advanced Enzymology Lab	25	50	75	2
	BIOC5112	Core VII	Intermediary Metabolism	50	100	150	4
	BIOC5113	Core VII (P)	Intermediary Metabolism Lab	25	50	75	2
	BIOC5114	Core VIII	Microbiology	50	100	150	4
				Total	275	550	825
3rd Sem	BIOC6101	Core IX	Advanced Endocrinology	50	100	150	4
	BIOC6102	Core IX (P)	Advanced Endocrinology Lab	25	50	75	2
	BIOC6103	Core X	Biotechnology	50	100	150	4
	BIOC6104	Core X (P)	Biotechnology Lab	25	50	75	2
	BIOC6105	Core XI	Immunology	50	100	150	4
	BIOC6106	Core XI (P)	Immunology Lab	25	50	75	2
	BIOC6107	Core XII	Nutrition in Health and Diseases	50	100	150	4
	BIOC6108	Core XII (P)	Minor Group Project	25	50	75	2
				Total	300	600	900
4th Sem	BIOC6109	Core XIII	Molecular Biology	50	100	150	4
	BIOC6110	Core XIII (P)	Molecular Biology Lab	25	50	75	2
	BIOC6111	Core XIV	Advanced Clinical Biochemistry	50	100	150	4
	BIOC6112	Core XIV (P)	Advanced Clinical Biochemistry Lab	25	50	75	2
	BIOC6113	Core	*Dissertation (Experimental, Presentation and Viva-Voce)	400	400	800	16
			PPT (Pre Placement Training)	0			0
				Total	550	700	1250
			Grand Total after four semesters	1400	2400	3800	96

Course Code: BIOC5101
Course Title: 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.

Books :-

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)

Course Code: BIOC5103
Course Title: 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, Glycoprotein and their biological applications.

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.

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

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.

Books :-

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, Hoboken NJ publishers (2006)
5. Biochemistry by Zubey, GL WCB Publishers.

Course Code: BIOC5105

Course Title: Human Physiology & 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. 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.

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, 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.

Books:-

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

Course Code: BIOC5107
Course Title: Biophysical & 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 coordinate 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.

Course Code: BIOC5108
Course Title: 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

Basic principles. Preparative ultracentrifugation – differential centrifugation and density gradient centrifugation. Analytical centrifugation

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. 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.

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.

Books :-

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)

Course Code: BIOC5110

Course Title: 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, cozymic 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)

Course Code: BIOC5112

Course Title: Intermediary Metabolism

UNIT-I : BIOENERGETICS AND BIOLOGICAL OXIDATION

Free energy and entropy. Phosphoryl group transfers and ATP. 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. 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. The glyoxylate cycle. Futile cycles, anaplerotic reactions.

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

UNIT-III : LIPID METABOLISM

Oxidation of fatty acids -Beta. 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.

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

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

Course Code: BIOC5114 Course

Title: 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 propionic 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.

Course Code: BIOC6101
Course Title: 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.

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, 17B - 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)

Course Code: BIOC6103

Course Title: 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, cosmids.

UNIT-II : DNA CLONING AND SEQUENCING

Cloning strategies - cloning with single strand DNA vectors, recombinant selection and screening methods, expression of cloned genes-problems and solutions, DNA sequencing strategies - Sanger's and Maxam - Gilbert's methods.

UNIT-III : GENE TRANSFER AND APPLICATIONS

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.

UNIT-IV : INDUSTRIAL BIOTECHNOLOGY

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,

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.

Course Code: BIOC6105
Course Title: 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, anti-idiotypic 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 immunosuppressive 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.

Books

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).

Course Code: BIOC6107
Course Title: Nutrition in Health & disease

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

Course Code: BIOC6109
Course Title: 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, ϕ 3 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)

Course: Code: BIOC6111
Course Title: Advanced Clinical Biochemistry

UNIT-I : SPECIMEN COLLECTION AND ANALYSIS

Concepts of accuracy, precision, reproducibility, reliability, and other factors in quality control. 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- glucose tolerance test, metabolic complications - acute and late complications. 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 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, thalassimia and erythrocyte enzyme disorders. Phenylketonuria, tyrosinosis, alkaptonuria, maple zyrup 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.

Books:-

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
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.

