

TWO-YEAR MASTERS DEGREE COURSE (FOUR SEMESTERS)
M. Sc. BIOCHEMISTRY (CBCS)

FIRST SEMESTER

Paper Code	Title of the paper	Instruction Hrs/weeks	Duration of exam	Marks	Credits
BC 401	Biochemical Techniques	4	3	70+30*100	4
BC 402	Bioorganic and Biophysical Chemistry	4	3	70+30*100	4
BC 403	Biomolecules	4	3	70+30*100	4
BC 404	Physiology	4	3	70+30*100	4
BC 405	Practicals I	8	6	70+30*100	4
BC 406	Practicals II	8	6	70+30*100	4
	Seminar/Assignment			25	1
Total				625	25

SECOND SEMESTER



BC 451	Enzymology	4		70+30*100	4
BC 452	Metabolism I	4		70+30*100	4
BC 453	Nutrition	4		70+30*100	4
BC 454	Cell Biology	4		70+30*100	4
BC 455	Practicals III	8	6	70+30*100	4
BC 456	Practicals IV	8	6	70+30*100	4
	Seminar/Assignment			25	1
Total				625	25

THIRD SEMESTER

BC 501	Basics of Biochemistry	4	3	70+30*100	4
BC 502	Immunology	4	3	70+30*100	4
BC 503	Molecular Biology I	4	3	70+30*100	4
BC 504	Metabolism-II	4	3	70+30*100	4
BC 505	Practicals V	8	6	70+30*100	4
BC 506	Practicals VI	8	6	70+30*100	4
	Seminar	1		25	1
Total				625	25

FOURTH SEMESTER

Paper Code	Title of the paper	Instruction Hrs/weeks	Duration of exam	Marks	Credits
BC 551	Molecular Biology II	4	3	70+30*100	4
BC 552	Biotechnology	4	3	70+30*100	4
BC 553	Clinical Biochemistry	4	3	70+30*100	4
BC 554	Computers Bio statistics and Bioinformatics	4	3	70+30*100	4
BC 555	Practicals VII	8	6	70+30*100	4
BC 556	Project Work	8		100	4
	Seminar	1		25	1
	Total			625	25
	GRAND TOTAL			2500	100



*Internal assessment Marks

*Project Seminar/Vivo Voce

NOTE: The First, Second, and Third semester of the course involve theory and practical while the Fourth semester involves theory, practical and project work. The project shall be carried out for 6-8 weeks (at least 30hrs per week), after the third semester of course either in the Department of Biochemistry or in an approved industry or in I under the supervision of a teacher and submit a project report. Experts from the industry may also be involved in the project work as co-guides and in the evaluation of project reports.

I SEMESTER

BC L01-BIOCHEMICAL TECHNIQUES

Total: 56 hrs

Preliminary Techniques in Biochemistry – Animal models-Choice of animals, mouse model, Rabbit model, Types of Studies, Mutant Organisms (e.g. Auxotroph), Cultured Cells (callus culture), Plant as models (Arabidasis). **6hrs.**

Cell Fractionation Techniques- Methodology of Cell lyses, Sub-Cellular fractionation, analysis using marker enzymes, role of detergents in fractionation, Principles and application of **Salting in, Salting out, Dialysis, and Ultra filtration.** **6hrs.**

Chromatographic Techniques- Principles and Applications of Paper (ascending, descending), TLC, Adsorption, Ion exchange, Gel filtration, Affinity, two dimensional chromatography, GLC, Chromato focusing, HPLC, FPLC, RP-HPLC, Hydrophobic interaction chromatography. **10hrs**

Electrophoretic Techniques- Principle, Native and Polyacrylamide gel electrophoresis, SDS-PAGE, Agarose gel Electrophoreses, gradient gel electrophoresis, Separation of Proteins, Nucleic acids, staining methodology, Fluorescent techniques, Isoelectric focusing, pulsed field electrophoresis, Capillary Electrophoresis, Isotachophoresis, two-dimensional gel electrophoresis. **10hrs**

Centrifugation : Principle and types of centrifuges, rotors, Differential, continuous and density gradient centrifugation. Preparative and analytical ultra centrifugation. Sedimentation velocity and equilibrium analysis, applications. **6hrs.**

Radioisotopes in Biology : Types of radiation, Heavy isotopes and radioisotopes, properties, ^1H , ^{14}C , ^{32}P , ^{131}I , ^{35}S , concept of half life, decay constant, detection and quantitation-GM counter and scintillation counter, solid and liquid scintillation. Specific activity, Carrier free isotope, Isotope dilution techniques autoradiography. Pulse Chase labeling of DNA, RNA and proteins (antibodies) and its applications in biology. Synthesis of Isotopically labeled glucose (Glucose 1- ^{14}C , and uniformly labeled glucose) acetate (1- C^{14} and 2- C^{14}) Leucine, ATP ($\alpha\text{-P}^{32}$ and $\gamma\text{-P}^{32}$). Determination of position of labeling, dual labeling, cld ratio, quenching, Biological hazards.

Physical methods of determining size shape and structure of molecules :-

Magnetic Resonance- NMR and ESR-Principles and Applications.

Vibration Spectra- IR and Raman-Principles and Application.

Light Scattering :- Determination of size and shape of macromolecules.

Polarized Light- Plane and circularly polarized light. CD, Applications of CD. Turbidimetry, Flame photometry, Atomic absorption, Spectrophotometry instrumentation and Applications. **10hrs**

References :-

- Analytical Biochemistry: D.J.Holme and H.Pick. 3rd Ed : (1998) Longman
- Biochemical Calculations, Irvin, H.Sigel, 2nd Edn.,(1976) John Wiley and s
- Practical Biochemistry: Principles and Techniques : K.Wilson and J. Walk (1995) 4th Edn. Cambridge University Press.
- Modern experimental Biochemistry : Rodney Boyer 2000; III edn.
- Physical Biochemistry: David frifilder II edn.



BC402-BIO-ORGANIC AND BIOPHYSICAL CHEMISTRY

Total :

Stereochemistry : Importance of Stereochemistry, Position and order of groups a carbon.

Geometric and Optical isomerism, Absolute and relative configuration. **3hrs**

Chirality-Symmetry Elements of CH_4 , CH_3Cl , Ethylene, Symmetry, View of Chi Relation between Chirality and Optical Activity, Representation of Chiral Structure Fischer. **5hrs**

Structure and stereochemistry of glucose-anomer, epimer, stereoisomer, D and L a and S. System of naming, theory and construction of mass spectrometer. Ionization fragmentation, m/e, Time of flight MALDI and ESI. **4hrs**

Spectroscopic Techniques-Colorimetry, Spectrophotometry, Fluorimetry. Principle Beer-Lambert's Law, Limitation, Extinction Coefficient Applications. **6hrs**

X-ray Crystallography-Protein crystals, Bragg's law, unit cell, Isomorphous replacement, Fiber pattern of DNA 3hrs

Mechanism of Organic Reactions – Intermediates and reagents in organic reaction, Reaction energetics, Classification of reagents and reactions, Reaction rates, order and molecularity of reaction, Mechanisms and stereochemistry of substitution, addition, elimination and rearrangement reactions, Mechanisms of Ester hydrolysis, Oxidation-Reduction reactions, Redox potential.

Heterocyclic Compounds – Chemistry, Biological occurrence of Furan, Indole, thiazole, pterine, pteridine, isalloxazine, Pyrrole, Chemistry of Porphyrins and Heme, Bonding of Iron in hemoglobin and cytochromes, cobalt in Vit B12, Magnesium in Chlorophyll, chelates and complexes. 11hrs

Chemical Principles :- Acids and bases, buffers, buffer capacity, ionic strength, structure, bonding and special properties of water, Ionic product of water, pH scale, pKa, Henderson-Hassel Balch equation Importance of Buffer in biological system. 4hrs

Laws of thermodynamics -I, II and III-law, Enthalpy, entropy and free energy, Free energy and chemical equilibria. 3hrs

Bonding-Covalent bond, coordinate bond, formation in transition metals. Crystal field theory, Ligand field theory, valence bond theory. 4hrs

Electrolytes and Non-Electrolytes- Osmotic pressure, reflection coefficient, vapour pressure, vapour pressure osmometer, Donnan membrane equilibrium.

Electrodes-Hydrogen electrode, oxygen electrodes 3hrs.

References:-

Basic Principles of Organic Chemistry-Robers and Caserio

Organic Chemistry-Hendrickson, Cram and Hammonad

Organic Chemistry-Finar, L.C.

Organic Chemistry-Morrison and Boyd

Physical Chemistry with Applications to biological systems-R. Chang.

Carbohydrates :- Structure and classification of carbohydrates, monosaccharides, deoxyglucose, amino sugars, muramic acid, neuraminic acid. Linkage in sucrose, lactose and maltose. Isolation of polysaccharides. Homopolysaccharides and heteropolysaccharides-starch, cellulose, glycogen, hyaluronic acid. Polysaccharides-structure elucidation, degradation-graded acid hydrolysis, Periodate oxidation, methylation. Application of GC-MS in structural analysis. 10 hrs

Amino acids-Nomenclature classification of amino acids. Zwitter ionic structure, reaction of amino acids, stereochemistry of amino acid D and L, R and S, physical and chemical properties. 4hrs

Determination of Amino Acid analysis- Acid and base catalyzed hydrolysis, separation & quantitation determination of site of glycosylation and type of linkage (O glycosyl : N-glycosyl). 4hrs

Elucidation of Structure of Proteins - Isolation of proteins and criteria of purity. Determination of Primary structure-Sequencing strategies N-terminal and C-terminal sequencing methods. Automated sequencing. Determination of S-S bond position. 2

Conformation of proteins :- Peptide bonding Primary, Secondary, Tertiary, Quaternary and Domain structure. Secondary structure of proteins - α Helix, β -sheet, β -bend and turn. Prediction of secondary structure of proteins. Chou and Fasman algorithm. Helix forming amino acids, Helix breakers. Tertiary and quaternary structure of proteins. 8hrs

Factors Responsible for Protein folding :- Anfinsen's experiment. Weak forces interaction, Denaturation, renaturation of protein, molten globule.

3D Structure - Myoglobin, hemoglobin, Immunoglobulin, MWC model, Koshland model, Collagen, Chymotrypsin, Keratin, lysozymes, Atase. Amino acid analogs. Hedmon rearrange reaction 4hrs

Lipids- Classification of lipids. Occurrence and Properties of Fatty Acids. Esters of Fatty Acids, Phospholipids Glycolipids, sphingolipids, prostaglandins, gangliosides, terpenoids, micelles, vesicles, liposome, mixed micelles, trans fatty acids. 4hrs

Nucleic Acids - Isolation of DNA and RNA from biological sources (microbes, plants and animals). Purification of nucleic acids physicochemical properties of nucleic acids Melting of DNA, T_m , factors affecting T_m . Cot curve, classification of DNA based on cot curve. Chargaff's rule. Chemical reactions of DNA and RNA. 8hrs

Secondary structure of DNA- Watson and Crick model. B and Z DNA other models of DNA structure. Secondary structure of RNA, cloverleaf model. Other secondary structural features in DNA-stem loop structure, Cruciforms, DNA protein interaction- zinc finger, leucine zipper, Helix-turn-helix, other motifs. DNA bending and Kinks. 8hrs

References

Proteins-Creighton

Chemistry of Carbohydrates-Pigmon and Horton

Chemistry of the Nucleic Acids – Admans et al.

BC404-PHYSIOLOGY

Total : 56 hrs

Blood- Composition, cells, plasma proteins and lipoproteins. Erythrocytes-structure and function. WBC-types, differential count, functions. Platelets and function. Buffer systems, homeostasis, blood clotting, dissolved clot, anticoagulants, blood volume, blood pressure and their regulation. Plasma lipoproteins and their function. HDL, LDL, VLDL, chylomicrons. CSF-composition and function. Physiological buffers, Acid-base balance, role of lungs and kidney. 13hrs

Macro and micronutrients :- sources requirements, functions and deficiency symptoms. Distribution in body, function, special properties of water, water balances, and factors affecting water balance. 2hrs

Nervous System : Divisions of the nervous system, receptors, neurons and other cells of nervous system. Types and structure of neuron. Resting membrane potential and action potential, neuronal transmitters, Membrane models : Fluid mosaic model, Singer and Nielson model, post-synaptic potential. Autonomous nervous system. Brief account of central nervous system. 6hrs

Biochemistry of vision :-Different types of cells, Rodopsin, cones Rods, color vision, taste, olfactory organs and audio responses. 2hrs

Muscular System : Smooth, skeletal and cardiac muscles. Contractile and other proteins of muscle. Fine structure of the muscle fibre, neuron-muscular junctions, Fast and slow muscle. Phosphagens. Muscle Biochemistry-excitation of striated muscle, changes occurring at sarcolemma, transverse-tubular system and sarcoplasmic reticulum, mechanism of muscle contraction. Regulations of contraction in striated and smooth muscle. Calmodulin and its regulatory role, muscular dystrophies. 7hrs

Respiratory System –Lungs, structure and functions. Gas exchange, oxygen binding by hemoglobin, factors affecting oxygenation. Acid-base balance. 4hrs

Excretory System- Kidney-structure of the nephron. Formation and composition of urine, urine analysis for abnormal constituents, tubular functions tests. Nephritis and nephrosis. Regulation of acid-base, electrolyte and water balance. Respiratory and metabolic acidosis and alkalosis. 5hrs

Hepatobiliary System :- Anatomy of the liver, blood supply, cells-hepatocytes, endothelial cell and kupffer cell. Secretory and excretory function-formation of bile. 4hrs.

Gastrointestinal System:- GI tract, digestion and absorption of carbohydrates, proteins and lipids. Mechanism of HCl production in the stomach. Gastrointestinal hormones. Role of pancreas. 5hrs.

Endocrine System :- Endocrine organs in man. Structure and control of hypothalamus. Role of receptors in hormones. Hormones produced GRH, Somatostatin, TRH, CRH, GnRH. Pituitary-anatomy and structure. Hormones of anterior, posterior and median lobes. Pro-opiomelanocortin. Thyroid, parathyroid, adrenal, gonads-Testes and ovaries. Menstrual cycle. Hypothalamus-Pituitary target organ axis and regulation by feed back mechanism. Peptide hormones. 10hrs.

References :-

Textbook of Biochemistry-White, Handler and Smith

Textbook of Anatomy-Guttorf

Textbook of Physiology-Chatterjee

BC405 – PRACTICAL I

Chromatography :- Separation of amino acids by ascending, descending, circular and 2D-paper chromatography, TLC, Paper chromatography of carbohydrates. TLC of lipids. Gel filtration, ion exchange, affinity chromatography.

Electrophoresis :- Separation of proteins by SDS-PAGE, native gel preparation. Different staining techniques for proteins.

Purification of protein : Salting out salting in, Dialysis

Sub cellular fractionation

Agarose gel electrophoresis

Colorimetry :- Applications of Beer's law, determination of extinction coefficient, colorimetric estimation of reducing sugars (DNS methods) amino acids.

Iodine number, saponification value, acid value, peroxide value.

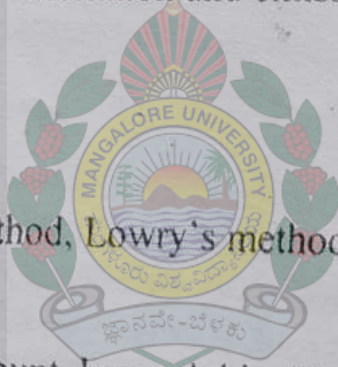
Preparation of buffer, pH titration of amino acid formal titration.

Titrimetric method for determination of reducing sugar.

Refractometry:- Determination of refractive index of oils, heated fats, changes during heating-analysis of binary mixtures.

CD of Protein-HPLC, fluorescence excitation and emission maxim, UV-VIS spectra of protein and Nucleic Acid.

BC406 – PRACTICAL II



Estimation of protein by Biuret method, Lowry's method and coomassie blue dye binding method

Blood : - Total count, differential count, hemoglobin, Platelet aggregations, HDL and LDL cholesterol determination.

Estimation of Ketoacids, ascorbic acid, Estimation of iron, calcium, phosphorus. Estimation of phospholipids, Preparation of starch from potatoes, cholesterol and phospholipids from egg yolk.

II SEMESTER

BC461-ENZYMOLGY

Total : 56 hrs

Introduction to enzymes : Nomenclature and IUB classification of enzymes. Assay methods-coupled enzyme assays, continuous, end point and kinetic assay.

Active site structure. Methods of determining active site, Structure-function of ES complex, affinity labeling, chemical modification studies. Active site structure investigation.

Nature of enzymes, localization, isolation, precautionary techniques for purification, characterization of enzymes. Criteria of purity for enzymes. Units of enzyme activity, specificity and specific activity of enzymes. 10hrs

Enzyme Kinetics:- Rate of reaction, order and molecularities. Michaelis-Menten equation, initial velocity approach, steady state approach. V_{max} , K_m and their significance. Linear transformation of Michaelis-Menten equation- Lineweaver-Burk plot, Eadie-Hofstee, Hanes-Wolf and Cornish-Bowden plot. Turnover number. 12hrs

Inhibition-Competitive, non competitive, un competitive and product inhibition. Irreversible inhibition-suicide inhibition. Determination of K_i . 5hrs

Bisubstrate Reaction- Cleland's notation with examples of ordered, Ping-Pong and random. General rate equation. Primary and secondary plots. 4hrs

Nature of Enzyme Catalysis-Transition state theory, proximity and orientation, orbital steering, acid base catalysis, covalent catalysis, metal ion catalysis, nucleophilic catalysis, intramolecular catalysis, entropy effects. Effect of temperature and pH on enzyme catalyzed reaction. 8hrs

Cooperativity- Binding of ligands to macromolecules-sequential and concerted. Positive and negative cooperativity. Oxygen binding to hemoglobin. Hill equation. Homotropic and heterotropic effectors. aspartyl transcarbamoylase as an allosteric enzyme. AT case. 6hrs

Mechanisms of Action of Specific Enzyme- Chymotrypsin, enzyme activation, acid-base catalysis, charge relay net work. Lysozyme, Alcohol dehydrogenase, Ribonuclease, Carboxypeptidase A, RNA as enzyme, Coenzymic action of NAD, FAD, TPP, PLP, biotin, CoA, Folic acid, Lipoic acid. 6hrs

Multimolecular Forms-LDH, multifunctional enzyme (DNA polymerase), multienzyme complex (PDC), feedback regulation. 4hrs

Metabolic Regulation of Enzyme Activity:- Feedback regulation, fine control of enzyme activity : 2hrs.

Fast Reactions:- Stopped flow, temperature jump method with examples of enzymes. 2hrs

Applications of enzymes in medicine and industries 1hrs

References :

Enzyme-Dixon

Enzyme Structure and Mechanism -Fersht

Enzyme-Palmer

Enzyme -Price

Methods in Enzymatic analysis-Burgmayer

Enzymes-Boyer

Biochemical calculation-Erwin segal

BC 452 - METABOLISM I



Total 56 hrs.

Introduction :- Catabolism, anabolism, catabolic and amphibolic pathways 01 hrs

Carbohydrates:- Glycolysis, energetics, regulation. Pathways of utilization of pyruvate, lactate and ethanol. Gluconeogenesis and regulation, Cori cycle, citric acid cycle and its regulation, energetics, anapleurosis, glyoxylate cycle, HMP-shunt pathway, inter conversion of hexoses. Biosynthesis of sucrose, starch and glycogen. 11hrs

Mitochondrial Electron transport- Entry of reducing equivalents for oxidation-malate aspartate shuttle, glycerol phosphate shuttle, Organization of respiratory chain complexes, structure and function of the components -Fe-S proteins, cytochromes, Q cycle, proton transfer, P/O ratio, respiratory control, oxidative phosphorylation, uncouplers and inhibitors, sequence of electron carries based on redox potentials. ATP-synthesis. ATP synthase complex, binding change mechanism, proton motive force, Mitchell's hypothesis. 14 hrs

Lipids- Degradation of triacylglycerols and phospholipids- lipase, hormone sensitive lipase phospholipases. Fatty acid degradation, β -oxidation, Knoop's experiment.

Biosynthesis of saturated and unsaturated FA and Regulation. α and ω - oxidation. Energetics, FA synthetase complex, chain elongation and desaturation. Pathways in plants and animals, conversion of linoleate to arachidonate (scheme only). Receptor mediated endocytosis, Bile and bile pigments. 8hrs

Cholesterol- Biosynthesis, Degradation and regulation, Metabolism of circulating lipids- chylomicrons, HDL, LDL and VLDL. Reverse cholesterol transport by HDL. Oxidized lipids and their metabolism. 4hrs

Phospholipids- Biosynthesis de novo pathway and inter conversion, biosynthesis of sphingolipids, ether lipids and glycolipids. Degradation and biosynthesis of gangliosides and cerebroside, Disorders- Tay Sachs's disease, Nieman-Pick disease and Fabry's disease. 6hrs

Prostaglandins – Biosynthesis, thromboxanes and leukotrienes.

Photosynthesis- Photosynthetic apparatus in plants photosynthesis I and II, light harvesting antenna complex. Electron flow and phosphorylation, oxygen evolution. Calvin cycle. C3 and C4 cycle. Photorespiration, bacterial photosynthesis. Regulation of photosynthesis. RUBISCO. 7 hrs

Importance of nitrogen-in biological systems, nitrogen cycle. Nitrogen fixation symbiotic and non-symbiotic, nitrogenase complex, energetic and regulation. Assimilation of ammonia. Integration of carbohydrate and lipid metabolism, glucose paradox. 3hrs

References

- Biochemistry - Zubey
- Biochemistry - Rawn
- Biochemistry - Voet and Voet
- Biochemistry - White and Smith

BC 453-NUTRIATION

Total 56 hrs

Nutrition- Concepts nutrients, essential nutrients and their classification. Proximate analysis of foods. Chemical and biological analysis for nutrients. Methods of determining energy value of foods, calorimetry, Basal metabolic rate (BMR) factors affecting BMR. Specific dynamic action of foods. Macro and micronutrients, requirements biochemical role, assay procedures deficiency symptoms 14 hrs

Carbohydrates-Dietary sources, dietary, essentiality of carbohydrates. 4 hrs

Proteins-Essential amino acids, nutritional classification of proteins, supplementary value of proteins, protein calorie malnutrition, PER, EV and chemical score, kwashiorkor and marasmus, Nitrogen balance, Malnutrition, protein cloric malnutrition 8hrs.

Fats-Sources, invisible fat essential fatty acids, PUFA 3hrs.

Vitamins-Fat soluble and water soluble vitamins provitamines, antivitamins, dietary sources structure, daily requirement, function and deficiency symptoms of vitamins and fat soluble vitamins, hypervitaminosis, vitamin like compounds. Biochemical role assay methods Disorders. 16hrs

Dietary formulation for different age groups - children, normal old age and pregnancy 3hrs.

Food Drug Interaction : Pharmacological aspects of food-drug interaction, Risk factors, Effect of Drugs on food and nutrition, Modification of drug action by food and nutrition 8hrs.

References:

Nutritional Biochemistry, Tom Brody (1994) Academic Press.

Frontiers in Nutrition, Ed.T.Wilson and N.J.Temple, (2000), Humana

Nutrition and Health in Developing Countries, eds.R.Semba and M.W.Bloem, (200), Humana.

BC454-CELL BIOLOGY

Total 56 hrs.

Cytoskeleton – Microfilaments and actin binding proteins. Intermediate filaments, Microtubules and MAPS, erythrocyte, cytoskeleton components in maintaining cells shape and in intracellular transport. Cell motility – cilia and eukaryotic flagella.

10hrs.

Biomembrances–Physicochemical properties of biological membranes, compositions, supra molecular organization-Singer and Nicholson's model. Membrane asymmetry- lipids proteins and carbohydrates, lateral diffusion, biogenesis of lipids and proteins, polarized cells, membrane domains-caveolae, rafts. Signal hypothesis, secretory pathways. 12hrs.

Membrane Transport–Laws of diffusion across membranes, simple diffusion, facilitated diffusion and active transport-glucose transporter $\text{Na}^+ \text{K}^+ \text{Atpase}$, bacterial phosphotransferase system. Endocytosis, receptor mediated endocytosis, exocytosis, ion channels, aquaporin channel, ionophores. Patchclamp technique. 11hrs.

Cell Signaling : Cell-cell and Cell matrix interaction. Integrins and selectins and their interaction. Inside out signaling in endothelial cell. General mechanisms of cell signaling by hydrophilic factors transmembrane receptors-7 transmembrane helical receptors, G protein coupled receptors, receptor tyrosine kinase, eicosanoid receptors. NO signaling-Generation and action. Ion channels, signal gateway voltage gating, resting channel, action potentials, symport and uniport. 13hrs.

Cytoplasmic Receptors– Steroid hormone signaling. Receptor down regulation, desensitization and upregulation.

Cell Cycle– Phases of the cell cycle, regulation by cyclins and CDKs. Programmed Cell Death-apoptosis, factors affecting apoptosis, p53 and bcl2.

Techniques : Electron microscopy, Facs, Confocal microscopy 7hrs.

References

The Cell, Cooper, Geoffrey, M., Oxford University Press, (2001)

Text Book of Biochemistry with Clinical correlations; Thomas Devlin [Ed.] (1997), Wiley-Liss.

Molecular Cell Biology, Baltimore et al. (1995) Scientific American Publication.

Cellular Physiology of Nerve and Muscle, Gray, G. Mathew (1998) Blackwell Scientific Inc.

BC 455-PRACTICALS III

Enzymes- Esterase from green peas, specific activity, pH and temperature optimum, energy of activation K_m , V_{max} . Purification by ammonium sulphate.

Fractionation and enzyme characterization.

Kinetic study of Amylase from saliva, Potato, ragi and wheat germ.

Assay methods and some characterization of invertase from yeast

Acid and Alkaline phosphatase from potato, green gram and serum

Acid phosphatase from papaya, 5' nucleotidase, acetylcholine esterase

Aspartate transaminase Estimation of Glucose 6 phosphatase, LDH,

Glucose oxidation of methylene blue

Photo synthetic reduction of 2,6 dichlorophenol, indophenol

Cellular fractionation

Preparation of Mitochondria & Erythrocyte ghost

Viability test for cell

Estimation of protein, carbohydrates, Lipid.



III SEMESTER

BC 501-Basics of Biochemistry

Carbohydrates: sources, Importance, Classification, General properties: **Biochemical** role, absorption.

Proteins: Classification of proteins. Methods of isolation and purification of proteins. Criteria of purity of proteins. Physical methods of characterization of proteins. Functional groups in proteins. Denaturation and renaturation of proteins. - 7 hrs.

Nucleic acids: Isolation and characterization of DNA and RNA. **Physiochemical** properties. Nucleic acids-melting of DNA, m-RNA and t-RNA. **Conformation** forms of DNA-A, B and Z models-supercoils and cruciform. - 7 hrs.

Techniques for biochemistry:

Principles and applications of paper, thin layer, adsorption, ion-exchange, **affinity**, and gas-liquid chromatography. - 6 hrs.

Principles and applications of starch, agar, paper, cellulose derivative, and polyacrylamide gel-electrophoresis. - 6 hrs.

Cell disruption, dialysis, salting-in, salting-out, differential centrifugation, **density** gradient, ultra centrifugation techniques, subcellular fractionation - 6 hrs.

Beer-Lambart's laws and their limitations. Principles and applications of **colorimeter**, spectrophotometer, spectrofluorimeter, flame photometry and fluorimeter

in biochemistry. - 6 hrs.

Concept of nutrition and malnutrition. Energy value of foods. **BMR Energy** - 3

Carbohydrates-sources, utilization, protein sparing action. Fats-food sources of fats, invisible fat, essential fatty acids. - 3 hrs.

Proteins:sources of proteins. Nutritional classification of proteins. **Essential amino acids**, supplementary value of proteins, Nitrogen balance. Malnutrition. - 3 hrs.

Micronutrients: sources, requirements, biochemical role, deficiency symptoms.

water soluble vitamins and Fat soluble vitamins: Sources deficiency symptoms, requirements, biochemical role Hyper vitaminosis. - 4 hrs.

Minerals: sources, biochemical role. Importance, requirements - 4 hrs.

BC 502-IMMUNOLOGY

Total : 56 hrs

Introduction-Historical development & milestones in immunology. Definition – antigenicity, immunogenicity, primary and secondary lymphoid organs, self and non-self discrimination. Innate and acquired immunity. 5hrs.

Antigens and Antibodies- Haptens, determinations, epitopes and paratopes. Antigenicity –carbohydrates, proteins, nucleic acids, and cells as antigens. Valency of antigen. Epitope analysis and tagging. Classes and subclasses of immunoglobins, structure of immunoglobulins, hypervariable region, isotypic, allotypic and idiotypic variation. 8hrs.

Cellular Basis of Immunity – Primary and secondary immune response. Siculoendothelial system, T, B and accessory cells. Subsets of T and B cells. T-helper cells, T-killer cells, T-suppressor cells. Development of T and B cells. T and B cell receptors, antigen processing and presentation. Cytokines and co-stimulatory molecules- lymphokines, interleukins structure and function of IL-1B, IL-2, TNFa. T and B interaction. uppression of immune response, immunoglobulin gene-generation, immunoglobulin diversity, gene rearrangement and other mechanisms, clonal selection theory of Burnet. 14hrs.

MHC gene and its polymorphism role of MHC in immune response. MHC in transplantation 4hrs.

Specific Defenses in Man- Barriers to infection-skin, mucous membrane, inflammation, complement, hyper sensitivity reactions (Type I, II, III and IV). 2hrs.

Transplantation-Definition, risks, Autograft, isograft, allograft and Xenograft. Graft rejection and host reaction. 3hrs.

Tumour Immunology-Tumour associated antigens, factors favoring tumor growth, immune surveillance. Tumour necrosis factor A and B. 4hrs.

Disorders of
6hrs

Vaccines-A
antibodies-

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Disorders of Immunity- Immunological tolerance, autoimmune disorders, AIDS, SCID.
6hrs

Vaccines-Adjuvants, Vaccines and their preparations. Polyclonal and monoclonal antibodies – Hybridoma technique. Applications in immunology 4hrs.

Immunological methods : Precipitation, agglutination, complement fixation, immuno diffusion, immuno electrophoresis, immunofluorescence, RIA, ELISA (different types). western blot. 7hrs.

References :

Basic and Clinical Immunology; Stites et al; [Ed.] (1982) Lange.

Roitt's Essential Immunology; Ivan, M. Roitt & Peter J Delves (2001) Blackwell Science

Immunology; Boitt et al; (2001), Mosby.

Kuby-Immunology; Goldsby et al.,(2000), WH Freeman & Co.



BC-503-MOLECULAR BIOLOGY-I

Total : 56 hrs

Introduction –Historical perspective. Central dogma of molecular biology 2hrs.

DNA-Antiparallel nature, nearest neighbor base frequency analysis. Replication of DNA semiconservative nature-Messelson and Stahl experiment. Replication of double stranded DNA –direction of replication discontinuous replication-Okazaki fragments. DNA polymerase I II and III, DNA ligase. DNA topoisomerases fidelity of replication. Replication in viruses X174, single stranded DNA virus, rolling circle model. Replication of mitochondrial DNA 14hrs.

Transcription-Co linearity of genes and proteins RNA polymerase I II and III. RNA biosynthesis in prokaryotes and eukaryotes, initiation, elongation and termination. RNA dependent RNA synthesis-RNA replicase of QB virus. Processing of eukaryotic RNA cap addition, poly A tail addition, RNA editing Processing of tRNA transcripts. 10hrs.

Translation-Genetic code, triplet codon, universal features of the genetic code, assignment of codons studies of Khrona, Nirlberg, triplet binding techniques, degeneracy, wobble hypothesis. evolution of genetic code and codon usage, variation in the codon usage. 10hrs.

3D Structure- Prokaryotic and eukaryotic ribosome. proteins synthesis, initiation, elongation and termination. Role of mRNA and tRNA, aminoacyl tRNA synthesis and its role in translation, accuracy, signal sequence, Role of inhibitors in translation 10hrs.

Post translation modification of proteins-signal cleavage, disulphide bond formation, O and N-glycosylation, folding of nascent protein, role of chaperons, attachment of glycosyl anchor, and other modifications.

References

Genes VII Benjamin Lewin [Ed.] (2001) Oxford university Press.

Molecular Biology of Gene; 6 th Ed Watson, J D et al. [Ed.] (1996). Benjamin/Cummins.

Molecular Biology of the Cell, Alberts et al. (2005) Garland Publications

BC-504-METABOLISM-II



Total : 56 hrs

Unit I Mechanisms of Amino Acid Metabolism- Deamination, transamination, desulphuration, degradation and biosynthesis of individual amino acids. Pathways in the pathways in microorganisms, plants and animals. Ketogenic and glucogenic amino acids. Regulation of amino acid biosynthesis, transglutaminase cycle, 25hrs.

Unit II General mechanisms of degradation in cells, Degradation and biosynthesis of proteins, proteoglycans. Ubiquitine pathway, protein targeting, protein sorting, chaperons in protein assembly. 10hrs.

Unit III Purines and Pyrimidines- Pathway of degradation of nucleic acids in cells, catabolism of purines and pyrimidines, uric acid formation in different systems, Salvage pathways, biosynthetic pathways. Regulation of biosynthesis, conversion of nucleotides to nucleosides. Mechanisms of action of methotrexate, 5 fluorouridine Azathymidine 16hrs.

Unit IV of NAD⁺, FAD and coenzyme A 3 hrs.

Unit V of detoxification of Xenobiotics 2hrs.

References

Biochemistry; Voet, D and Voet, J.G.[Eds.] (1999, John Wiley and sons.

Biochemistry; Geoffrey Zubey, (1998), WCB Publishers.

Biochemistry with Clinical Correlations; Thomas Devlin[Ed.] (2002), Wiley-Liss.

BC-505-PRACTICAL-V

Immunology: Raising antibodies in rat,

Quantitative and qualitative analysis of antibodies; - Immuno-diffusion-Couchterlony and radial immuno-diffusion, Agglutination-direct, indirect and bacterial agglutination, Immuno-electrophoresis,

Rocket Electrophoresis. Preparation of antigen

Adjuvant mixture, injection, antibody titre

Immunodiffusion, ELISA



BC-506-PRACTICAL-VI

Genetics and Molecular Biology-Identification of Drosophila mutants.

Single mutant Crosses, X-linked inheritance

Isolation of characterization and quantification of genomic DNA from bacterial, plant and animal sources

Quantitative estimation of DNA

Isolation of plasmids,

Agarose and polyacrylamide gel electrophoresis of nucleic acids.

Separation of DNA and RNA by agarose gel electrophoresis.

Assay of ribonuclease

Isolation of Glycoproteins and estimation,

IV SEMESTER

BC 551-MOLECULAR BIOLOGY-II

Total : 56 hrs

Gene structure- Prokaryotic and eukaryotic gene-promoters, introns, exons, other regulatory sequences, enhancers, silencers, function of introns. **4hrs.**

Regulation of Gene Expression in Prokaryotic- Operon model-Lac operon, structure and regulation Galactose Operon-Role of two promoters, Arabinose operon-Positive control, tryptophan operon-attenuation control. **7hrs.**

Regulation of gene expression at the level of DNA structure-Super coiling, DNA packaging, role of nucleosome structure of eukaryotic DNA in gene expression-eg. enhancer, cold gene, DNA kinking bending and gene regulation. **6hrs.**

Regulation at the Level of transcription- Transcription factors, TF II, NFkB, formation of NFkB and its activation. Formation of initiation complex. Role of transcription factors. **5hrs.**

Regulation at the level of RNA processing, RNA export and RNA stability. Factors affecting RNA stability RNA degradation. **5hrs.**

Regulation at the Level of Translation-Secondary structure in the 5' and 3' untranslated regions, regulation of Ferretin and Transferrin mRNA. Role of upstream AUG sequence, GCN 4 gene regulation, translational introns, protein splicing, inteins. Post translational modification secretory pathways of protein. **10hrs.**

Regulation of translation-Eukaryotic tRNA synthetase in regulation of accuracy of translation - proof reading mechanism Ribosomal optimization of translation. Regulation at the level of translation. **5hrs.**

Regulation of Gene Expression in Development-Development in Drosophila. Hunchback, bicoid, nanos and hunch back. Gap genes, pair rule genes segmentation homeotic genes. Homeobox and its role. **8hrs.**

NA Binding Protein Motifs-Zinc finger, Leucine Zipper, Helix-Turn-Helix and other motifs. Regulation at the level of post translational modification proteins stability, N-end rule, PEST and other sequences, ubiquitin mediated degradation. Targeting of proteins, protein sorting, polarized cells. 6hrs.

References:

Genes VII Benjamin Lewin[Ed] (2001) Oxford University Press.

Molecular Biology of Gene; 6th Ed Watson, J.D.et.al.,[Ed.] (1996). Benjamin/Cummings.

Molecular Biology of the Cell, Alberts et al. (2002), Garland Publications

Molecular Biolog, David Freifelder, J.(1997) Narosa publishers.

BC 552-BIOTECHNOLOGY



Total : 56 hrs

Microbial Technology-Isolation of industrially important microorganisms and screening. Improvement of stains, mutants and selection. 6hrs.

Advantages of bioprocess over chemical process. Basic principles of bioprocesses. Types of bioprocesses-Bioreactor design. Stirred tank airlift, fluidized bed, sterilization. Media carbon and nitrogen sources. Down stream processing microbial production of Vitamin (B12) enzymes (proteases, amylase,) antibiotics (penicillin) ethanol-wine and beer. 13hrs.

Cell culture-Plant Cell Culture-Micro propagation, callus culture, haploid production, somatic embryo genesis, somatic hybridization and cybridization, somaclonal variation. 5hrs.

Animal Cell Culture- Culture techniques, media, preparation of primary culture-chick embryo, HUVEC, cell lines, characterization of cultures, ploidy, cell doubling time. Purified cultures continuous cultures, applications. 6hrs.

Genetic Engineering- Enzymes in Genetic Engineering : Restriction enzymes, ligases and polymers. Gene cloning, C-DNA cloning. Vectors-plasmids, phage, cosmids and minid, yeast cloning vectors, plant vectors, bacterial artificial chromosome, SV40, lambda vectors, construction of expression vectors. Restriction endonucleases-blunt end and

is, primers. Adapters, linkers, homopolymer tailing, lytic and lysogenic
clonings, Competent cells, identification markers. 12hrs.

cloning techniques-dot blot, southern and northern blot, DNA foot print
assay, gel retardation assay, nuclease protection assay. RFLP,
colony hybridization, plaque hybridization. Microinjection,
Transgenic plants and animals, gene knockout. Replica
Dideoxy. Maximum and Gilbert method, shot gun

py. Applications in agriculture, medicine, industry. GM foods,
impact of genetic engineering, Biosafety. 6hrs.



and Application L.J. Higgins et al. [Ed.] (1985) Blackweel

Approach ; Gover, D.M. [Ed.] (1985) Vol. 1 and 2. IRL

Presscott and Dunn [Eds.] (1987) Vol. 152, Academic Press.

Click and Pastenak, (1998), ASM Press.

JD et al., Second edition, Scientific American Books (1992)

553-CLINICAL BIOCHEMISTRY MS.

Full.

Total : 56 hrs

Basic Concepts- Health and disease. Normal and pathological changes affecting cells in the body, cell death and the physiological causes - Physical, chemical and biological agents. 2 hrs.

Diagnostic Enzymology- Mechanisms of elevated enzyme activities. Some important enzymes-alkaline phosphatase, creatine Kinase, LDH, AST, ALT-isoezyme changes, acid phosphatase, CKMB 8hrs.

Blood Composition, cells, function of plasma proteins and lipo proteins in diseases. of hemoglobin-thalassemia, sickle cell anemia. Anemias-Microcytic, & macrocytic. 4hrs.

Chemical indices of hepatobiliary diseases. Bile pigments-formation of urobilinogen bile acids, jaundice-prehepatic, hepatic and posthepatic. Liver function tests, diseases of the liver-hepatitis cholestasis, cirrhosis, 5hrs.

Assessment of renal function-creatinine clearance, renal calculi, uremia, laboratory diagnosis of kidney disorders. Urea creatinine, creatinine, serum and blood urea. 4hrs.

Gastrointestinal Disorders :- Fractional gastric analysis, hypo and hyper acidity, gastric absorptions syndrome, steatorrhea, diarrhea 6hrs.

Endocrine Disorders- Laboratory diagnosis-function of pituitary, thyroid adrenals and disorders-Graves disease, Addison's disease, hypo and hyper secretion of infertility tests. 6hrs.

Carbohydrate Disorders- Disorders of carbohydrate metabolism-Diabetes mellitus, etiology, laboratory investigations-GTT, HB, diabetic complication. Disorders of carbohydrate metabolism glycogen storage diseases, galactosemia, pentosuria. 6hrs.

Amino Acid and Proteins Metabolism- Inborn errors of amino acid metabolism-Phenyl ketonuria, alcaptonuria, disorders of proteins pattern studies. 4hrs.

Purine and Pyrimidine Metabolism - Gout Lesch-Nyhan syndrome, 2hrs.

Metabolism- Determination of lipids and lipoproteins. Hyper
modification of lipoproteins-glycation, oxidations, and
metabolism-from cell formation. **4hrs.**

Disorders- Major cardio vascular system-Atherosclerosis-risk factors,
diagnosis and prognosis. **3hrs.**

Apoptosis, necrosis, angiogenesis Carcinogens,
2hrs.

of Clinical disorders – Gomal A.G.(Ed.)

Industry with clinical Correlations-Devline

Editor.

4 COMPUTERS, BIOTATISTICS AND BIOINFORMATION

Total :56 hrs.

Development, basic binary arithmetic organization and working
of software (e.g. Windows) Input/output devices, memory;
Programming, concepts of programming. **7hrs.**

Sampling, types of samples, types of data, grouped data,
frequency polygon. Graphic representation-Line graph histogram,
mean, standard deviation, standard error. **7hrs.**

Combination, normal distribution. Hypothesis testing, t test,
regression. Non parametric statistics, sign test, rank
sum statistics. **10hrs.**

Information technology, information types, sources of data. Computer
Network, Resource sharing. Biological data bases tools for
organization software. Mol-mole, ROS mol BLAST **6hrs.**

Sequence, multiple alignments search for motifs, prediction
of function, prediction of transmembrane regions

Bio-computation-Drug designing – Lead compound-
Pharmacogenomics-Antisense Technology and Micro
organism-microbial interactions and communications-Protein