



K. J. Somaiya College of Science and Commerce M.Sc. (I) Syllabus in Biochemistry Credit Based Semester and Grading System Scheme for Theory Paper

M.Sc. Semester I

Course Code	Topic Headings	Credits
18PS1BC1	Cell Biology	4
18PS1BC2	Human physiology	4
18PS1BC3	Bio-organic and Plant Biochemistry	4
18PS1BC4	Fundamentals of Nutrition	4

M.Sc. Semester II

Course Code	Topic Headings	Credits
18PS2BC1	Metabolism	4
18PS2BC2	Environmental Biochemistry & Toxicology	4
18PS2BC3	Bio-analytical chemistry & Bioinformatics	4
18PS2BC4	Research methodology and Biostatistics	4







<u>SEMESTER I</u>

Course Code	UNIT	TOPIC HEADINGS	Credits	L / Week
	Ι	Cellular Organization & Cell division		1
10001001	II	Cellular transport & cell signaling.		1
18P31BC1	III	Aging, Apoptosis and Cancer	4	1
	IV	Stem cell biology & techniques in cell biology		1
	Ι	Blood, Cardiovascular & Respiratory system		1
10001000	II	Digestive System and Muscles, Bones	1	1
18PS1BC2	III	Nervous system	4	1
	IV	Special senses & Excretory system		1
18PS1BC3	Ι	Biochemical basis of evolution and Protein chemistry		1
	II	Enzymology	4	1
	III	Industrially important Biomolecules		1
	IV	Plant Biochemistry & Secondary Metabolites		1
	Ι	Nutrition I: Proximate principles		1
18PS1BC4	II	Nutrition II: Minerals and Vitamins of nutritional significance		1
	III	Techniques in Nutrition , RDA & International agencies	4	1
	IV	Diet in health and disease]	1

Course Code	Practicals	Credits
18PS1BC1P	Paper I	2
18PS1BC2P	Paper II	2
18PS1BC3P	Paper III	2
18PS1BC4P	Paper IV	2
	Total	8





<u>SEMESTER II</u>

Course Code	UNIT	TOPIC HEADINGS	Credit	L /
course coue	UNII		S	Week
	Ι	Carbohydrate metabolism & Bioenergetics		1
	II	Lipid Metabolism		1
18PS2BC1	III	Protein metabolism and related disorders	4	1
	117	Nucleotide metabolism and related		4
	IV	disorders		1
	Ι	Types of Pollution		1
10000000	II	Basic Concepts of Ecology and Environment	4	1
18852802	III	Fundamentals of Toxicology	4	1
	IV	Mechanism of Toxicity and Toxicity Testing		1
	т	Centrifugation, Electrophoresis and	4	1
	1	Radioisotopic technique s		
18PS2BC3	II	Chromatography & Sequencing techniques		1
	III	Microscopy and Spectroscopic Techniques		1
	IV	Bioinformatics		1
	Ι	Research –Basics, Design, Report writing		1
18PS2BC4		and presentation		1
	II	Presentation and Processing of Data	4	1
	III	Analysis of data		1
	IV	Chi Square, ANOVA, Demography and Vital		1
	IV	Statistics		1

Course Code	Practicals	Credits
18PS2BC1P	Paper I	2
18PS2BC2P	Paper II	2
18PS2BC3P	Paper III	2
18PS2BC4P	Paper IV	2
	Total	8







Course Code	Title	Credits
18PS1BC1	Cell Biology	4
 Unit-I : Cellula Cell as a eukaryo Parts of membra and tran Cytopla endoplas proteaso Plant cellular Diffusio Cellular diffusio 	a basic unit of life : organization and structure of prokaryotic and tic cells, Animal and plant cell. a the Cell : Plasma Membrane - Structure, functions of ne proteins, membrane fluidity, membrane permeability, gradient sport across the membrane. Cell wall and its function. a sm : Cytosol and organelles -, Centromere, cilia and flagella, smic reticulum, Golgi apparatus, lysosomes, peroxisomes, omes, mitochondria, Nucleus (Chromosomes, chromatin, histones). lls - Chloroplast, xylem, phloem and epidermal cells. c transport - Principles and Mechanism of Simple and Facilitated n and Active Transport (primary and secondary). ision: Somatic cell division and reproductive cell division. The	Number of Lectures 15
cell cycl cell cycl Disorder	e - Interphase and M phase, Mitosis and Meiosis, Regulation of e, Cell cycle checkpoints and proteins associated with it. rs associated with cell cycle irregularities. Cellular diversity.	
Unit-II : Cellul	ar transport & cell signalling.	
 Cellular of Gap j Adhesio Extracel Interacti Tight jur Cellular Kinetics Riboson Cell Sig protein I surface r Kinase p 	r communication - Cell Wall : Experimental pathways the role unctions in extracellular communication, Adheren Junctions - n of cells to non-cellular substrates, Cellular interaction - lular space, Interactions of cells with extracellular materials, ons of cells with other cells, Hemodesmosomes, Desmosomes, nction and Plasmodesmata. Cell wall r transport - Artificial Membranes (Liposomes) in Drug Delivery, of Super-molecular Membrane Assembly (Viruses and nes), Na-K ATPase, Transport of glucose (GLUT proteins) nalling : General principles of cell signalling, signalling via G inked cell surface receptors, Signalling via enzyme-linked cell receptor, Ras –Proteins and their role in signalling cascade [MAP pathway], IP3 signalling pathway.	15
Unit-III : Agin	g. Apoptosis and Cancer	15
Aging : Glycatic and agei Damage	Definition, Symptoms, Aging theories (Free Radical theory, on Theory). Molecular, Biochemical Mechanisms. Mitochondria ng protein damage & maintenance, neurodegeneration, DNA & Repair, Telomeres, Telomerase, Cellular senescence and	





Apoptosis in ageing. Longevity Genes. Sirtunis, Deacetylases, hormones,	
Immune system, Inflammation, Biomarkers of aging, method to show	
Aging.	
• Programmed Cell Death (apoptosis): Difference between necrosis and	
apoptosis. Pathways, regulators and effectors in apoptosis, onco-genes and	
tumour suppressor genes.	
• Cancer :- Classification of tumours, Metastasis. Proto-oncogenes,	
Oncogenes and cancer induction. Tumour associated antigens. Immune	
Response to tumour antigens.	
Cancer Chemotherapy: Basic principles. Anti-cancer drugs: Different	
types and their mode of action.	
Unit - IV : Stem cell biology & techniques in cell biology	
• Stem cell : Essentials of stem cell, Basic principles and methodologies.	
Types of stem cells and their properties. Totipotent, multipotent,	
pluripotent stem cells. Sources of stem cells with advantages and	
disadvantages.	
• Stem cells of epithelial skin, skeletal muscle, heart, embryonic kidney,	
adult liver, pancreas, GI tract. Methods: Isolation and propagation of stem	
cells. Characterization, microarray analysis and differentiation of stem	
cells	
• Stem Cell Research: Therapeutic applications of stem cells. Problems in	
stem cell research. The ethics of human stem cell research. Stem cell based	
therapies: FDA products and preclinical regulatory consideration.	
Regenerative medicine, stem cells and rejuvenation	15
• Methods for disrupting tissues and cells, organ and tissue slice techniques,	
isolation of clones,	
Histopathological studies : Organ specific morphohistological	
examination, identification of morphological changes related to pathology.	
Cell fixation : Fluid fixation, freezing and section drying, fixation for	
electron microscopy.	
Staining techniques : Acid and base, Fluorescent and radioactive dye,	
staining of lipid, steroid, nucleic acid, protein and enzymatic techniques	
Diagnostic importance of various blood markers and tissue markers	
associated with cancer.	
• Sub-cellular fractionation : Differential and density gradient	
centrifugation, specific staining of organelles and marker enzymes	







Course Code	Title	Credits
18PS1BC2	Human physiology	4
 18PS1BC2 Unit I - Blood, Blood: (Formation mechanical anticoag Typing a serum. I Serum. Reduced Anemia, Porphyr. Heart : cardiaco knowled pressure cardiova Respira bronchi, regulation base bala maintain ions in affinity 	Human physiology Cardiovascular & Respiratory System (Lungs). Composition, functions and physical characteristics of blood. on of blood cells, RBC, WBC, & platelets. Blood clotting - sm, fibrinolysis, role of Vitamin K in blood clotting & ulants. Blood groups and blood types. ABO & Rh blood groups, nd cross matching for transfusion. Composition of Plasma & Plasma proteins & their functions - Starling hypothesis & Hemoglobin - structure, synthesis, Hb derivatives - Oxy, , Met, Carboxy, Carbamino. Disorders - Anemias (Haemolytic Polycythemia, Cyanosis, Sickle cell Anemia, Thalassemia), as, Hyperbilirubinemias (Jaundice), Cardiophysiology- functional anatomy/structure of heart, cycle, heart sounds, cardiac output, basic E.C.G (elementary ge), vasomotor circulation, coronary circulation, blood . Disorders - Angina pectoris, myocardial infarction & other scular disorders. Aging and heart tissue. tory system : Functions of - Nose, pharynx, larynx, trachea, pleural fluid, lungs. Structure of lungs, mechanism and on of respiration. Transport of blood gases - O ₂ and CO ₂ . Acid- ance - Role of blood buffers, respiratory system and kidneys in ing acid-base balance, Bohr & Haldane effect, Role of chloride oxygen transport (Chloride shift). Effect of 2,3- BPG on O2 of Hb. Acidosis and alkalosis - metabolic and respiratory. s - Bronchitis, asthma. Aging and respiratory system	4
 Digestive System, absorpti Digestive Stomach 	e system - Basic structure and organization of digestive Processes & functions of the digestive system. Digestion, on and assimilation in the gastrointestinal tract. e processes at various regions of digestive system (Mouth, , Small Intestine/large intestine). Digestive secretions -	
 composition intestina Digestion nucleic a ions and feces. Photos bladder. 	tion, functions and regulation of saliva, gastric, pancreatic, l and bile secretions. Role of gastrointestinal hormones. n and absorption of carbohydrates, lipids, proteins and icids. Basic principles of GI absorption - absorption of water, l nutrients. Absorption in large intestine and formation of ysiologic Anatomy and functions of the liver, Pancreas & gall Secretion, composition & functions of bile & pancreatic juice.	15





Concentration of bile by gall bladder. Aging and digestive system.	
• Disorders - Peptic ulcer, Constipation, Diarrhea, Gastroenteritis (food	l
poisoning), Jaundice/ Hepatitis (Acute Hepatitis and Chronic	l .
Hepatitis), Cirrhosis, Liver Failure, Gallstones, Acute Pancreatitis	l
(Acute and Chronic), Celiac disease, Crohn's disease, Intestinal	l
obstruction, Irritable bowel syndrome.	l
• Muscles : Types, functions & properties of muscular tissue. Structure	l .
and composition of muscle fibers. Thick and thin filaments. Actin,	l .
myosin, tropomyosin, troponin, Z disc and H line components.	l .
Mechanism of smooth muscle contraction and relaxation - Interaction	l .
of actin and myosin muscle contraction, energy source for muscular	l .
work. Role of calcium/calmodulin and regulation of muscle	l .
contraction. Neuro-muscular transmission Disorders of muscle -	l
Muscular dystrophies, myopathy, myotonia, paralysis, Myasthenia	l
gravis. Detection and treatment of muscle disorders -	l
Electromyography, Sherrington starling Kymograph (recording	l
drum). Aging and muscle tissue.	l
Bones : Functions of Bones & Skeletal system, Structure of Bone,	l
Alls optionalistic estangutos estanglasta). Compart & spongy hono	l
tissue Synovial fluid - Composition & functions Bone formation $\&$	l
hone growth Bone remodelling Factors affecting hone growth &	l
hone remodelling Role of hones in calcium homeostasis Aging and	l
hone tissue Disorders - Osteonorosis Osteomalacia Rickets Arthritis	l
Unit III - Nervous system.	
• Organization & Functions of nervous system: Structure and	l
function of the brain. Central Nervous System, Peripheral and	l
Autonomic Nervous system. Sensory Receptors of Taste, Vision,	l
Odour, Hearing, Touch. CSF - Composition & function.	l
• Chemical composition of brain – Chemical composition of nerve	l
tissue, utilization and uptake of glucose and amino acids, Blood –	l
Brain barrier. Influence of different factors (growth factors, hormones,	l
cytokines) in brain functions.	l
• Cells of Nervous System - Types of neuronal cells - Glial cells	l
(neuroglia, microglia) astrocytes, oligodendrocytes, Schwann cells,	15
satellite and epididymal cells. Structure and function of nerves,	
physiology/structure/organisation of neuron, dendrites, axons and	1
synapse.	1
• Neurotransmitters & Neurotransmission - Neurotransmitters :	
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neuromediator, neuromodulators, neuropeptides. Types, Characteristics and action of neurotransmitters (acetyl choline, GABA, Glutamate), pharmacology of receptors, Neurotransmitters and its action; major sense organ and receptors. Role of Ca⁺² in release of neurotransmitter from pre-synaptic membrane. Function of receptor proteins and secondary messenger on the postsynaptic neuron, Cholinergic receptors – Nicotinic and Muscarinic receptors, Agonists and Antagonists – their mode of action and effects. Adrenergic receptors, serpentine receptors and intracellular signalling. Fast and slow receptors. Exocytosis of neurotransmitter – Role of synapsins, synaptogamins, SNAP, SNARE and other proteins in docking, exocytosis and recycling of vesicles.

- **Mechanism of synaptic transmission** : Transmission of nerve impulse, Excitability & development of action potential and nerve impulse Membrane potentials, Resting potential – Depolarization, repolarization and hyperpolarization, Action potential. Mechanism of axonal neurotransmission. origin of normal resting membrane potential; voltage gated sodium and potassium channels; events causing action potential; initiation and propagation of action potential, importance of energy metabolism in re-establishing sodium and potassium ion gradient after completion of action potential.
- **Membrane channels** Types of channels, ion gated, voltage gated, chemically gated, mechanically gated and responsive to intracellular messengers, compounds affecting synaptic transmission, neuromuscular junction, composition and functions of cerebrospinal fluid. Electrical synapse and giant neurons

Unit IV - Special Senses and Excretory system

- **Special senses : Olfaction and Gustation** Physiology & Olfactory receptors; Taste buds & Gustation. Disorders Olfactory Dysfunction, Anosmia, Hyposmia, Dysosmia, Parosmia, Phantosmia, Agnosia, Ageusia, Hypogeusia, Dysgeusia.
- **Vision** Physiology of an eye, accessory structures. Physiology of Vision, light/dark adaptations, Rod and cone cells, Visual cycle, mechanism and regulation of vision, color vision. Disorders Night blindness, colour blindness, conjunctivitis, cataract, glaucoma.
- **Hearing** Anatomy of ear, physiology of hearing and equilibrium, Disorders Hearing loss. Aging and special senses.
- **Kidney** Structure of nephron. Formation of urine glomerular filtration, tubular secretion and reabsorption (glucose, water and





 electrolytes). Composition of urine - normal & abnormal co of urine. Urine transport, storage and elimination. Role of I maintenance of electrolyte and water balance. Aging an system. Disorders - Renal diabetes, kidney stones, proteinuria, urinary incontinence and urinary retentio failure. Skin/Connective Tissue : Skin structure, functions Biosynthesis, composition, Sweat - composition & function. and metabolism of Collagen and its Disorders - Ehler's (Type I to VII), Osteogenesis Imperfecta (Type I to IV). Melanin. Aging and skin. Skin disorders - Dermatitis Psoriasis, Dandruff, Acne, Cellulitis, Melanoma, Herpes Ringworm. 	nstituents kidneys in d urinary nephritis, n, kidney & types. Structure Syndrome Elastin & , Eczema, , Scabies,	
Course Code Title		Credits
18PS1BC3Bio-organic & Plant Biochemistry		4
Unit I: Biochemical basis of evolution and Protein chemistry		Number of
 Theory of chemical evolution and spontaneous origin of level Oparin's Hypothesis, Miller Experiment, Smith's Model, model Process or Origin of life of Eukaryotes, Molecular Evolution of Polypeptide backbone, covalent and non-covalent interaction end-group analysis by chemical and enzymatic Conformation, Configuration Details of 1°,2°, 3° and 4° structures, problems based on determination of 1°structure, Ramchandran Plot, structur relation of protein (Ex. Haemoglobin) Chemical modification and cross-linking in proteins, properties and mechanisms of protein folding 	molecular RNA first of Protein. ns, methods, re-function dynamic	Lectures 15
 Unit II: Enzymology. IUB/EC Enzymes classification active site identifica conformation Michaelis - Menten Kinetics of monosubstrate enzyme rea Plot, Einsethal Cornish Bowden Plots Enzyme Inhibition - Reversible - competitive, non-co uncompetitive, Partial, Mixed, Allosteric, Irreversible and Inhibition. Allosteric Enzymes-Kinetics Significance of Sigmoidal Behav 	tion and action, LB ompetitive, Feedback viour, Role	15





in Metabolic Regulation.	
 Iso-enzymes – separation and significance 	
Enzyme Immobilization and Applications	
Clinical Enzymology- Enzymes as therapeutic agents, diagnostic tools	
and laboratory agents.	
Unit III : Industrially important Biomolecules	
• Industrially important Proteins - Production and applications of	
therapeutic proteins – whole blood products (RBCs. Platelets, clotting	
factors & Immunoglobulin's), blood derived proteins. Production and	
applications of non – catalytic industrial proteins – casein, whey	
proteins, Egg proteins, wheat germ proteins.	15
• Industrially important Enzymes - production & applications of	
proteases, amylases, lipases, xylanases	
• Industrially important Carbohydrates - Production and	
applications of : Pectin, Cellulose Production Cane sugar and bye	
products of sugar industry	
• Industrially important Lipids - Extraction and industrial	
applications of essential oils (Eucalyptus, Wintergreen, Thyme, Clove)	
Extraction process of palm oil and coconut oil. Refining processes for	
oils and fats, Production and applications of Oleochemicals,	
Production of Biodiesei (Biofuel) from Jatropha.	
UNIT IV: Plant Blochemistry.	
Chlorophylis and accessary pigments.	
Photosynthesis-Light and Dark Phases, Schemes-I, II & Z.	15
• Cyclic and Non-cyclic Photophosphorylation, C-3 & C-4Pathways.	15
Biosynthesis of Starch Sugars and Cellulose from Glucose.	
Photorespiration and photoperiodism.	
• Plant growth hormones: Auxins - Gibberellins, Cytokines, Abscisic	
Acid and Ethylene. Nitrogen Fixation and Sulphur Assimilation in	
Plants.	
Secondary Metabolites	
A brief account of the following classes: Alkaloids, terpenoids,	
flavonolds, Phenolics and phenolic acids, steroids, coumarins,	
quinines, acetylenes, cyanogenic glycosides, amines and nonprotein	
ammo acius, guins, muchages, resins etc. (Structures not necessary.	
their importance)	
then importance).	





Importance of secondary metabolites: Protection of the producer plant from predators and insects; physiological effects to mammalian systems.

Uses of secondary metabolites: as drugs, precursors of drugs in pharmaceutical industry, as natural pesticides/insecticides; other uses of secondary metabolites.

Course Code Title		Credits
18PS1BC4	Fundamentals of Nutrition	4
Unit I : Nutrition I:- Proximate principles		Number of
• Carbohydrates: Role of Oligosaccharides, Dietary Fibre, Non-starch		Lectures 15
polysacc	harides, Prebiotics and Probiotics, Sugar alcohols in human	
nutrition	n, Glycaemic Index , Sweeteners	
Lipids: S	SFA, MCT, MUFA, PUFA, Trans fatty acids, Omega 3 , 6 Fatty	
Acids an	nd their implications on health, Biochemical functions and	
deficient	cy disorders of essential fatty acids, fat replacers	
Proteins	: Nitrogen Balance, Protein Energy Malnutrition-Clinical	
features	Biochemical and Metabolic Changes, Nutritional	
Require	nents. Anti-nutritional Factors-Trypsin Inhibitors, Pressor	
Amines,	Phytates, Oxalates. Quality of Protein scoring system,	
Compler	nentary value of Protein	
Unit II : Nutriti	on II :-Minerals and vitamins of nutritional	
significance.		
Minerals	: Nutritional significance of dietary calcium, phosphorus,	
magnesi	um, iron, iodine, sulphur, chloride, flourine zinc and copper;	
trace ele	ments (selenium, cobalt and molybdenum) nutrition,	
Vitamin	: Dietary sources, biochemical functions and specific	
deficient	cy diseases	
Hyperca	lcemia, Hypocalcaemia, Normocalcemia, Hyperphosphatemia.	15
Co-enzy	mes of water soluble vitamins and their physiological role.	
Co-enzy	mes of water insoluble vitamins and their physiological role.	
Disorder	s of Mineral Metabolism	
Unit III : Diet in	n Health and Disease.	
Nutrition	n during pregnancy, lactation, infancy, childhood, adolescence,	
adulthoo	od, ageing.	15
Nutrition	n for health & weight management.	
Nutrition	n for Exercise and Sport performance.	
Nutrition	n for bone health.	







Mid-day programme	
Obesity, Brown and White Adipose Tissue, Specific dynamic action	
Factors affecting thermic effect of food	
 Eating Disorders: Anorexia Nervosa, Bulimia Nervosa 	
• Nutrition for therapeutic condition: Hypertension, CVD, GI disorders,	
(peptic ulcer. H. Pylori), Diabetes mellitus, anaemia, Renal disorders,	
CRF, ARF, Jaundice	
Unit IV : Techniques in Nutrition , RDA & International agencies	
• Assessment of Nutritional Status: A B C D, i.e. Anthropometry,	
Biochemical Indices, Clinical; Examination, Dietary Assessment	
• Recommended Dietary allowances (RDA), factors affecting RDA,	15
Methods used to calculate RDA, Practical application of RDA,	
Reference man and woman.	
• Role of National and International Agencies: - WHO, FAO, UNICEF,	
ICAR, NIN, ICMR, Food Nutrition Board, CFTRI, NSI, IDA, ICDS.	

Detail Syllabus for Semester- I Practicals

Paper 1

- 1. W.B.C Count
- 2. R.B.C Count
- 3. Total and differential WBC count
- 4. Study of mitosis from onion root tip.
- 5. Calibration of Micropipettes
- 6. Preparation of Solutions of different molarity and Normality

Cell Staining, Organelle Isolation

- 1. Microscopic techniques -
- 2. Gram Staining
- 3. Spores Staining
- 4. Capsule Staining
- 5. Acid Fast Staining
- 6. Preparation of Blood Smear.
- 7. Chloride uptake by potato
- 8. Isolation of Chloroplast/ Mitochondria.
- 9. Isolation of starch
- 10. Isolation of pectin.
- 11. Isolation of cellulose from grass.
- 12. Isolation of Albumin & globulin from egg white.





Paper 2

- 1. Blood grouping analysis and Rh typing
- 2. Bleeding time
- 3. clotting time
- 4. PCV
- 5. Hb by Sahli's method and Drabkin's method
- **6.** ESR

Function Tests:

- 1. Normal and Abnormal constituents of urine,
- 2. Urea and Creatinine Clearance Test with Clinical Interpretation
- 3. Estimation of serum Electrolytes (Na & K).
- 4. Gastric Function Tests: Gastric Juice- Total and Free Acidity

Paper 3

Colorimetric, Enzymology, Isolations

- 1. Estimation of Proteins by Biuret, Bradford
- 2. Estimation of Proteins by Folin-Lowry methods.
- 3. Estimation of amino acids by Ninhydrin method.
- 4. Enzymology:
 - **a.** Amylase (Km, optimum pH, optimum temperature).
 - **b.** Urease (Km, optimum pH, optimum temperature).
- 5. pKa values of Alanine or Glycine by Titration Curve.
- 6. Immobilization using calcium alginate & invertase assay.
- 7. Production of Biodiesel. (Demonstration)

Estimation of secondary metabolites

- 1. Estimation of Total Phenolic Contents of plant extract
- 2. Estimation of Total Flavanoid Contents of plant extract

Paper 4

Techniques in Nutrition

- 1. Determination of Iodine value of an Oil
- 2. Determination of Acid value of an Oil
- 3. Determination of saponification number
- 4. Determination of peroxide value
- 5. Identification and quantification of fatty acids





- 6. Estimation of crude fibres
- 7. Preparation of Diet chart
- 8. Recipe / Product development foods rich in calcium / Iron / Proteins / Fibres/ Vitamins / Minerals / High medium and low energy content.

9. Estimation of Nutritive value

- 10. Estimation of Maltose by DNSA
- 11. Estimation of glucose by Folin-Wu
- 12. Estimation of Oxalates from spinach
- 13. Isolation of Lecithin and cholesterol from Egg yolk.

Demonstration Experiments

- 1. Estimation of phytic acid in food grains
- 2. Isolation of Glycogen from Liver







SEMESTER II

Course Code Title		Credits
18PS2BC1	18PS2BC1 Metabolism	
 Unit I: Carbohy Carbohy metaboli an ove breakdow Gluconed Gluconed Shuttles- Anaplerd Biosynth Uronic a Galactosy fructosur pathway Bio-ener systems, Role of F Theories 	vdrate metabolism & Bioenergeticsdrate Metabolism & related disorders: Introduction tosm. Metabolic pathwaysrview of Glycolysis, Glycogen Metabolism: Synthesis,wn, regulation, Glycogen storage disorderogenesis : Cori cycle, Glucose-Alanine cycle, Regulation ofogenesis, Rapoport Luebering cycle & its significance.Malate-Aspartate shuttle & Glycerol phosphate shuttle.otic reactions; Glyoxalate cycle; Pentose phosphate pathway;eesis of lactose, sucrose and starch;acid pathway (biosynthesis, degradation & its significance),e and fructose metabolism; lactose intolerance, essentialria, fructose intolerance, Sorbitol pathway, Glyoxylate.getics - Laws of thermodynamics as applied to biologicalenthalpy, entropy, free energy, standard free energyligh Energy phosphates in Bio-energetics and energy capture,of ATP Biosynthesis	15
 Unit II : Lipid n Fatty active peroxison to fattya Acyl CoA Fatty active Fatty active Fatty active Choleste atherosce Arachide thrombo Prostacy Phospho glycerop sphingog Transport 	netabolism id oxidation: saturated, unsaturated, odd chain, even chain, mal minor pathways of fatty acids oxidation) Disorder related cid oxidation, (Genetic deficiencies in carnitine transport and dehydrogenase, Refsum's disease, Zellweger syndrome) cid biosynthesis, Elongases & desaturases, synthesis of cerol. rol: Biosynthesis, control, transport, utilization and lerosis, cholesterol lowering drugs (statins etc.) onate metabolism: Prostaglandins, Prostacyclins, xanes and leukotrienes, the cyclic pathway of prostaglandins, clins, thromboxanes' the linear pathway of leucotrienes. lipid, glycolipid and lipoprotein: metabolism of hospholipids, sphingolipids, sphingophospholipids, glycolipids. rt of Lipids : chylomicrons,VLDL,LDL,HDL, disorders of	15







lipoprotein metabolism (Hypo and hyper lipoproteinemias) transport	
Free radical metabolism: Generation of free radicals damage	
produced by reactive oxygen species (ROS), free radical scavenger	
systems (enzymatic & non-enzymatic).	
Unit III : Protein metabolism and related disorders.	
 Protein metabolism and related disorders. Protein metabolism and related disorders. Protein metabolism and related disorders. Deamination, Transamination, Decarboxylation, Transmethylation, Transdeamination, Essential/non-essential amino acids. Ammonia formation, transport and detoxification in brain and liver. Urea cycleregulation and disorder. Biosynthesis & catabolism of – Glycine, Alanine, Aspartic acid, Glutamic acid, Serine, Proline, Hydroxyproline, Catabolism of threonine and basic amino acids Metabolism of aromatic amino acids, Sulphur containing aminoacids, branched chain aminoacid, and related inborn errors of metabolism Formation of specialized products from amino acids and their functions glutathione, creatine, creatinine, biogenic amines (dopamine, norepinephrine, tyramine, serotonin, melatonin, GABA, Histamine) polyamines (Putrescine, Spermodine, Spermine) Amino Acids as neuro-transmitters Biologically important peptides (Insulin, Glucagon, Adreno Cortico Trophic Hormone-ACTH, Thyrotropin Releasing Hormone, Corticotropin, Oxytocin, Vasopressin, Gastrin, Angiotensin, Carnocin and Anserine, bradikinin, encephalin, Aspartamine. Nitrogen Balance. Biological Value of Protein. Protein Energy 	15
Malnutrition – PEM, Marasmus, Kwashiorkor.	
Unit IV : Nucleotide metabolism and related disorders.	
• Nucleotide Metabolism: Biosynthesis & degradation of purines & their regulation. Biosynthesis and degradation of pyrimidine and their regulation. Inter-conversion of Nucleotides.	
• Deoxyribonucleotide Formation. Nucleoside and nucleotide kinases. Salvage pathways of Purine and Pyrimidine. Nucleotide Metabolizing Enzymes as a function of Cell Cycle and Rate of Cell Division. Biologically important nucleotides (Adenosine, Guanosine, Cytidine,	
 Uridine and their derivatives) Nucleotide coenzyme synthesis. Structural analogs of Purine and Pyrimidine bases and their use as chemotherapeutic agents, Antifolate 	15





and Antiviral Agents.

• Coenzymes and Cofactors – Role and mechanism of action of NAD+ /NADP+, FAD, lipoic acid, thiamine pyrophosphate, tetrahydrofolate, biotin, pyridoxal phosphate, B coenzymes and metal ions with specific examples.

Disorders of Purine and Pyrimidine Metabolisms, Gout, Lesch-Nyhan Syndrome, Orotic aciduria, Immune Deficiency Diseases associated with Adenosine deaminase- ADA and Purine Nucleoside Phophorylase – PNP deficiencies

Course Code	Title	Credit
18PS2BC2 Environmental Biochemistry & Toxicology		4
 UNIT I:Types of Air Pollu health, Ga ozone an particulat Green-ho remedial Water Po health, qu and recyc Noise Pol control of 	 Pollution ation: Classification & effects of air pollutants on human ases containing the oxides of carbon, sulphur and nitrogen, ad CFC. Measures to control air pollution and suspended are matters in air. buse effect & Global warming: sources, consequences & measures. blution: Sources and effects of water pollutants on human uality standards for drinking water, waste water treatment ling. flution: Sources, measurement, health hazards, prevention & Fnoise pollution. 	15
 UNIT II: Basic conservation Atmosphere ecosystem Energy transmission Pertaining Propertiee (DO),Chere demand (In heavy mere) Monitorir Organic hydrocarl surfactan 	oncepts of Ecology and Environment ere; Hydrosphere; Lithosphere- Principles and Concepts of n- Structure of ecosystem- cybernetics and Homeostasis- ransfer in an ecosystem-Food chain. Food web-Ecological es- Trophic structure and energy pyramids- Principles g to limiting factors; Biogeochemical cycles (N, C, P,S cycles). s of water- water quality parameters- pH, Dissolved Oxygen mical Oxygen demand (COD); Biological Oxygen BOD); Atmospheric toxicants- CO, NO2, CO2, SO2-; Toxic etals- Radionuclides -Sampling of air and water pollutants- ng techniques and methodology. chemicals in the environment; Aliphatic/aromatic bons (hydrocarbon decay, environmental effects); Soaps and ts (cationic, anionic and nonionic detergents, modified	15







detergents); Pesticide residue – classification, degradation, analysis, pollution due to pesticides; phenols and petrochemicals.	
UNIT III: Fundamentals of Toxicology	
• Definition, Different facets of toxicology and their interrelationships, Classification of toxic agents. Desired and undesired effects.	
• Various factors affecting toxicity: vehicles, formulation factors,	
biological half-life, volume and concentration, dose, dosage forms, routes of administration / entry, genetic status etc.	15
• Toxicants, therapeutic dose, dose-response curve, multiple toxicants	
response, serum enzymes behaviour, hepatic and non-hepatic enzyme	
change during toxicity.	
• Toxicity assessment: acute, subchronic, chronic exposure,	
determination of ED50 and LD50 values,	
UNIT IV: Mechanism of Toxicity and Toxicity testing	
Biochemical Mechanisms of Toxicity:	
Tissue Lesions: Liver Necrosis; kidney Damage; Lung Damage, Liver	
damage, Cardiac damage; Neurotoxicity; Exaggerated and Unwanted	
pharmacological effects; Physiological effects; Biochemical Effects:	
Lethal Synthesis and Incorporation, Interaction with specific Protein	
Receptors; Teratogenesis; Infinunotoxicity; multi-Organ Toxicity	
Mechanism of toxicity: Disturbance of excitable membrane function,	15
Altered Calcium nomeostasis, Covalent binding to cellular	
Tovicity tosting	
• Toxicity testing	
lest protocol, Genetic toxicity testing & Mutagenesis assay: In vitro	
Lest systems: bacterial mutation tests-keversion test, Ames test,	
Fluctuation test, and Eukaryotic mutation test. In vivo test system	
Mammalian mutation test-Host mediated assay and Dominant Lethal	
test. Biochemical basis of toxicity.	

Course Code	Code Title			
18PS2BC3	Bio-analytical chemistry & Bioinformatics			
Unit I : Centrifi				
Centrifu				
and rpm	15			
Preparat	ive and Analytical Ultracentrifugation, Isopycnic			
Centrifu	gation, Rate Zonal Centrifugation.			





 Electrophoresis - Basic principles, factors affecting electrophoresis, support media used. General principles, instrumentation, working and applications of electrophoretic techniques-zone, Disc, Capillary, 2-D, Pulsed Field Gel, Isoelectric Focussing, immune electrophoresis Radioisotopic Techniques - Nature of radioactivity & its detection 	
and measurements of Radioactivity. GM Counter, Scintillation Counter,	
Pulse Height Analyser. Isotope Dilution. Analysis, Autoradiography.	
Application of Radioisotopes in Biological Science. Safety Measures in	
Handling Isotopes.	
Unit II : Chromatography & Sequencing Techniques	
• Chromatography - Basic Principles, Instrumentation, working and	
applications of partition chromatography (Paper), Absorption	
Chromatography (TLC, HPTLC, Column), Affinity Chromatography, Ion	
Exchange Chromatography, Permeation Chromatography, Gas-Liquid	
Chromatography (GLC), High Pressure Liquid Chromatography	
(HPLC), LC-MS	
Gel Documentation System	
 Isolation and purification of proteins 	
Proteins & Enzymes – Source identification, isolation, recovery,	
concentration.	
Partial/total purification by salting in, salting out, precipitation, ion	
exchange, dialysis, ultra filtration, column chromatography (Gel	15
filtration, Affinity, HPLC) Protein characterization, functional studies,	
evidence of purity, mass determination mass spectroscopy.	
Sequencing Techniques	
Protein Sequencing Techniques	
DNA Sequencing Techniques	
RNA Sequencing Techniques	
Blotting Techniques	
Unit III : Spectroscopic techniques and Microscopy	
Basic principles, instrumentation and application of Phase, ultraviolet	
and interference microscope and Fluorescence microscopy	
• Electron microscope – scanning emission microscopy, transmission	
emission microscopy	15
Contocal microscopy and Atomic force microscopy	
• Beer-Lamberts Law, Its verifications and Deviation, Concept of	
Absorptions, Transmission, Scattering, Phosphorescence,	
Fluorescence, Luminescence, Diffraction Spectra	







٠	Principle Instrumentation, working and application of – UV, Visible	
	and IR Spectroscopy, Turbidometry and Nephlometry.	
٠	Principle, instrumentation, working and application of –	
	Spectrofluorimetry, Flame Spectrophotometry, Atomic Absorption	
	Spectrometry, Luminometry.	
٠	Principle, instrumentation, working and application of Nuclear	
	Magnetic Resonance (NMR), Electron Spin Resonance (ESR),	
	Mossbauer Spectroscopy, Matrix Assisted LASER Desorption,	
	ionization, Time of Flight-Mass Spectroscopy (MALDI-TOFMS)	
•	X-Ray Diffraction Spectra, Optical Rotatory Dispersion, (ORD), Circular	
	Dichroism (CD)	
٠	LASER- Principle, applications in Medicine and Biological Sciences	
Unit I	V : Bioinformatics	
٠	Introduction to Bioinformatics - Definition & historical overview,	
	Application of Bioinformatics.	
٠	Major Databases in Bioinformatics. (Genome databases, protein	
	databases, other secondary databases.)	
٠	Information Search & Data Retrieval - Tools for Web Search, Data	
	Retrieval Tools	
٠	Data Mining of Biological Databases.	
٠	Genomics - Genome Analysis & Gene mapping, Genetic mapping &	
	linkage analysis, physical maps, Phylogenetic analysis: Different	
	Methods and its importance	
•	Cloning the entire Genome, Genome sequencing, Sequence Assembly	15
	Tools, Applications of Genetic Maps.	15
•	Gene Expression & Microarray Technique (Concept of microarrays;	
	spotted arrays, oligonucleotide arrays, designing the experiment,	
	Microarray design, microarray experimentation, Applications of	
	microarray technology.	
٠	Proteomics - Tools & Techniques in Proteomics	
•	Protein sequence information, composition and properties,	
	physicochemical properties based on sequence, sequence comparison,	
	Primary databases, Secondary databases. Pairwise sequence	
	alignment, gaps, gap-penalties, scoring matrices, PAM250, BLOSUM62,	
	local and global sequence alignment, multiple sequence alignment,	
	Useful programs, ClustalW, BLASTp.	







Course Code	Title	Credits
18PS2BC4	Research methodology & Biostatistics	4
 Unit I : Research of resear Criteria E India, sei Research research Research research Report V writing, Mechani journals, conferent Presenta meets & Defence Intellect basic pri developpi internati Strasbou Ethics in 	rch -Basics, Design, Report writing and presentation h - What is research? Meaning of research, types & significance rch, research & scientific methods. for good research, problems encountered by researchers in lecting & defining a research problem. h Design - Meaning, features of good research design, types of designs. Basic principles of experimental designs Vriting - Significance of report writing, different steps in report types of report, layout of research paper. cs and precautions of writing research reports for scientific popular magazines, seminars/symposia/ icces/workshops, poster session. ttion - Oral & Written, Presentations in classrooms, scientific public audience. of research thesis. ual Property Rights (IPR) - Objectives of the patent system, nciples and general requirements of patent law, legal, nent, patentable subjects and protection in biotechnology, ional convention for the protection of new varieties irg convention, UPOV Convention. publications-plagiarism	15
 Presenta Diagram Processi Median) Probabil poisson a percenti Measure Deviatio Sampling Simple r multipha 	ation of Data- Graphical presentation. Tabular, chart, matic presentation. ng of Data - Measures of Central Tendency (Mean, Mode,	15





Unit	III : Analysis of Data	
•	Estimating Population Parameters - Testing of Hypothesis – Type I and	
	Type II errors, Level of significance	
•	Z – test: Paired & Unpaired	
•	Student's t-test for testing population mean (s) & proportion (s).	15
•	Correlation analysis - Simple correlation analysis, Multiple correlation	
	analysis. Partial correlation analysis.	
•	Regression analysis - Simple regression analysis and Multiple	
	regression analysis.	
Unit	IV: Chi Square, ANOVA, Demography and Vital Statistics	
•	Chi – square - Test of goodness of fit.	
•	Test for independence of attributes & yate's correction.	
•	Analysis of Variance (ANOVA) - CRD: Completely Randomized Design;	
	1-way ANOVA; RCBD: Randomized Complete Block Design; 2-way	
	ANOVA	
•	Non-parametric tests - Introduction to non-parametric tests,	45
	Importance of non – parametric tests.	15
•	Demography & Vital Statistics : Demography – collection of	
	demographic data, collection of vital statistics at state & National	
	levels, records of vital statistics, reports of special demographic	
	surveys. Measures of vital statistics of population such as growth and	
	density of population; Rates of facility, reproduction, morbidity,	
	mortality, comprehensive indicators / indices of health	

Detail Syllabus for Semester- II Practical Paper 1

- 1. Estimation of serum Total cholesterol,
- 2. Estimation of HDL, Estimation of Triglycerides,
- 3. Estimation of LDL by calculation.
- 4. Estimation of Serum Alkaline Phosphatase.
- 5. Estimation of serum Acid Phosphatase.

Paper 2

Environmental Biochemistry

Estimation of

1. Total Alkalinity of Water Effluent





- . ,
 - 2. COD of Waste Water
 - 3. BOD of water sample
 - 4. Total Hardness of Well Water
 - 5. Chlorides from Water Sample by Schales & Schales Method
 - 6. Determination of total organic matter in soil.
 - 7. Determination of pH value of different types of soil.
 - 8. Isolation of various phytochemicals (Flavanoids, Tannins), from plant sources.
 - 9. Determination of LD50 value

Paper 3

Electrophoresis, Chromatography, Microscopy

Chromatography

- 1. Ascending and Circular paper for Amino Acids and Sugars
- 2. TLC of Oils
- 3. HPTLC (Demonstration)
- 4. Separation of Glucose and Starch (Gel Filtration)
- 5. Separation of Starch and Casein (Gel Filtration) Electrophoresis and Nutritive estimation
- 1. Serum Proteins Electrophoresis(Agar/Agarose)
- 2. Haemoglobin Electrophoresis (Normal/Abnormal)
- 3. Separation of Proteins using PAGE.
- 4. Demonstration of Phase contrast Microscopy.
- 5. Southern/Northern/Western Blotting. (Demonstration)
- 6. Estimation of Iron by KCNS method
- 7. Estimation of Calcium by EDTA method

Bioinformatics

- 1. Searches on Medline, PubMed and BioMed Central
- 2. Use of Clustal X/W for alignment of protein and nucleic acid sequences
- 3. Use of TAXON to classify Microbes and Viruses
- 4. Methods of searching databases like BLAST and FASTA

Paper 4

Biostatistics

- One numerical problem each on
 - 1. Measurement of Central Tendency (Mean, Median, Mode)





- 2. Measurement of Dispersion/variability(Mean Deviation, Standard Deviation, Co efficient of variation)
- 3. Z-Test
- 4. T-Test
- 5. Chi-Squares Test
- 6. Simple Regression
- 7. Multiple Regression

Research Methodology, Biostatistics, Bioinformatics

- 1. Preparation of Research Proposal for Minor / Major Research Projects to be submitted
 - a. to the funding agencies
- 2. Review of Research work being carried out at any five National/ International Research Centres or Institutes
- 3. Access at least five scientific websites to collect relevant information with respect to the topics from the syllabus assigned to him or her by the teacher. A one page summary per website visited (i.e. a total of five pages) should be entered in the journal as a part of practical.
- 4. Select any two research papers from any leading nation and international scientific journals (not older than two years) and present these papers in his or her biochemistry department as if it his/her own research work

Semester I		Paper II	Paper III	Paper IV
	Ι			
Internal Test	20	20	20	20
Presentation/MOOC / Industrial Visit and IV Report /Assignment / Review of Literature or Book or Paper / Field study / Mini project / Workshop / Presentation (oral/poster)	20	20	20	20
Total	40	40	40	40

Internal Assessment Scheme for M.Sc- I







Semester II	Paper	Paper	Paper	Paper
	Ι	II	III	IV
Internal Test	20	20	20	20
Assignment (Active participation in the events organised by department and submission of its report) / Industrial Visit and IV Report / Research paper presentation	10	10	10	10
MOOC /Assignment / Review of Literature or Book or Paper / Field study / Mini project / Workshop / Presentation (oral/poster)	10	10	10	10
Total	40	40	40	40

A Distribution of Marks & Credit

Year	Semester	Marks			Credits		
		Theory	Practical	Total	Theory	Practical	Total
M. Sc. Part I	Ι	4 Papers X 100 = 400 Marks	4 Practical X 50= 200 Marks	600	16	8	24
	II	4 Papers X 100 = 400 Marks	4 Practical X 50= 200 Marks	600	16	8	24
M. Sc. Part II	III	4 Papers X 100 = 400 Marks	4 Practical X 50= 200 Marks	600	16	8	24
	IV	-	Research project = 600 Marks	600	-	24	24
TOTAL				2400			96





Suggested reading :

Cell Biology :

- 1. Molecular Cell Biology- Lodish, Berk, Matsudaira, Scott, Zipursky and Darnell, Freeman pub
- 2. Cell and Molecular Biology- Gerald Karp, John Willey and Sons
- 3. The Cell- A Molecular Approach, G.M.Cooper, R.E.Hausman, ASM Press
- 4. Essential Cell Biology- Alberts, Bray, Hopkin, Johnson, Lewis, Raff, Walter, Garland Science
- 5. Cell and Molecular Biology- E.D.P.DeRobertis and E.M.F.DeRobertis, Williums & Wilkins
- 6. Molecular Biology of the Cell- Alberts, Johnson, Lewis, Raff, Roberts and Walter, Garland Sc
- Molecular Biology of the cell- Bruce Alberts J.D. Watson et al Garland publishing Inc., N.Y. (1983) and recent edition.
- 8. Cell and Molecular Biology DeRobertis and Saunders (1980).
- 9. The cell C.P. Swanson, Prentice Hall (1989)
- 10. Cell Biology C.J. Avers, Addision Wesley Co. (1986).
- 11. Molecular biology by Lodish and Baltimore
- 12. Cell and Molecular Biology, 8th ed. E.D.P. De Robertis & E.M.F. De Robertis (2001), Lippincott Williams and Wilkins
- 13. Cell and Molecular Bilogy- Concepts and experiments, 5th ed. (2008) Gerald Carp- Wiley & Sons
- 14. Trends in Stem cell Biology and Technology, Hossein Baharvand (2009), Humana Press.
- 15. Cell and Molecular Biology, 8th ed. E.D.P. De Robertis & E.M.F. De Robertis (2001), Lippincott Williams and Wilkins
- 16. Cell and Molecular Bilogy- Concepts and experiments, 5th ed. (2008) Gerald Carp- Wiley & Sons
- 17. The World of the cell by Becker, Kleinsmith and Harden Academic Internet Publishers; 5th edition (2006)
- 18. The Cell: A Molecular Approach, Fourth Edition by Geoffrey M. Cooper and Robert E. Hausman.
- 19. Cell and Molecular Biology by concepts and experiments by Gerald Karp (2005) John Wiley sons & Inc.
- 20. Molecular cell Biology by Harvey Lodish. W. H. Freeman; Sol edition (2007)
- 21. The Cell Biochemistry, physiology and morphology by J. Brachet and A. E. Mirsky, Academic Press (1963)
- 22. Molecular Biology of the Cell: Alberts 5th Edition 2007 NCBI Publication
- 23. Principles of Biochemistry: Lehninger WH Freeman
- 24. Biochemistry of Signal Transduction and Regulation Gerhard Krauss Wiley VCH 3rd Revised Edition







- 25. Molecular Cell Biology: Lodish 6th Edition, WH Freeman & Company
- 26. The cell: Cooper 2nd Edition ASM Press
- 27. Gene IX: Benjamin Lewin Published by Pearson Prentice Hall
- 28. Cell and Molecular Biology: Gerald Karp
- 29. Molecular Biology: Robert Weaver 1st Edition, WCB McGraw-Hill
- 30. Molecular Biology of the Gene: Watson 6th Edition, Pearson Publication
- 31. Gene Regulation: A Eukaryotic Perspective: David Latchman 5 illustrated , Taylor & Francis, 2005

Human Physiology

- 1. Medical Physiology- A.C.Guyton,
- 2. Medical Physiology- W.F.Ganong,
- 3. Principles of Anatomy and Physiology- G.J.Tortora, B.Derickson, John Wiley and Sons pub
- 4. Human Physiology- Dr.C.C. Chatterjee, Medical Allied Agency
- 5. Vander's Human Physiology-The mechanism of Body function, Widmaier, Raff, strang.
- 6. Text book of Medical Physiology. Arthur.C.Guyton & John.E.Hall
- 7. Physiological basis of Medical Practice, John.B.West.
- 8. Review of Medical Physiology-William F.Ganong
- 9. Essentials of Medical Physiology K.Sembulingam & Prema Sembulingam
- 10. Biochemistry, 2nd edition, Moran. Neil Patterson Public
- 11. Fundamentals of Biochemistry, 2nd edition, D Voet & G J Voet. John-Wiley & sons.
- 12. Biochemistry, 5th edition, JM Berg, L Stryer. W H Freeman & Co. N York.
- 13. Lehninger's Principles of Biochemistry, 4nd edition, D L Nelson and M M Cox. (2005) W H Freeman & Co. N York.
- 14. Textbook of Medical Physiology, 11th ed., A C Guyton & J E Hall. (2005) Elsevie
- 15. Cells by David Prescott
- 16. Cell Structure and Function by Loewy and Gallant
- 17. Essential Cell Biology by Albert Bray et al, Garland Publication New York 1997.
- Review of Medical Physiology by William. F. Ganong. McGraw-Hill Medical; 22 edition (2005)
- 19. Human Physiology and Mechanisms of Disease by Guyton. Saunders Publications; 6th edition (1996) 3. Human physiology by C.C. Chatterjee. 11th edition (1985)
- 20. Human Nutrition and Dietetics by Davidson and Passmore. Churchill Livingstone; 8th edition (1986) 5. Principles of Nutrition by M.S.Swaminathan
- 21. Modern Nutrition and Health Diseases by M.E. Skilis and V.R. Young

Bio-organic, Bio- physical and Bio-analytical chemistry

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)

Bio- physical and Bio-analytical chemistry

- 1. Physical biochemistry by D. Freifelder IInd edition (1982)
- 2. Biochemical techniques by Wilson and Walker.
- **3.** Biophysical techniques by Upadhye and Upadhye.
- 4. Principles & Techniques of Practical Biochemistry, 6th edition by Keith Wilson and John Walker (2000). Cambridge University Press.
- 5. Introductory Practical Biochemistry by S.K.Sawhney and Randhir Singh (2000). Narosa Publishing House. New Delhi.
- 6. Physical Biochemistry, 2nd edition, by D Friefelder (1983). W.H. Freeman & Co., U.S.A.
- 7. Biophysical Chemistry: Principles and Techniques, 2nd edition by A. Upadhyay, K. Upadhyay and N.Nath. (1998). Himalaya Publishing House, Delhi.
- 8. Physical Biochemistry, 2nd edition, by K. E.VanHolde (1985), Prentice Hall Inc, New Jersey.
- 9. Instrumental Methods of Analysis, 7th edition by H.H.Willard, L.L Merritt Jr., J.A.Dean and F.A.Settle Jr. (1996), CBS Publishers and Distributors, New Delhi.
- 10. Chromatography: A laboratory handbook of Chromatographic & electrophoretic methods, IIIrd ed (1975) by Erich Heftman, Van Nostrand Reinhold, NY M
- 11. Principles of Physical Biochemistry- Kensl.E. van Holde, W. Curtis Johnson, P. Shing Ho, Pearson Prentice Hall, 2nd Edition.
- 12. Crystallography made crystal clear, 1993. G. Rhodes. Academic Press.
- 13. Principles and Techniques of Biochemistry and Molecular Biology, 6th Edition, Wilson Keith and Walker John (2005), Cambridge University Press, New York.
- 14. A textbook of biophysics, R. N. Roy, New Central Publication, 1st edition.
- 15. Chemistry of Organic Natural Products- O. P. Agrawal
- 16. Organic Biochemistry- I. L. Finar
- 17. Biophysical Techniques- Upadhyay, Upadhyay and Nath
- 18. Di-electrioophoresis-Nikhilesh Kulkarni and Jeetendra Dalal (Google e-Book)
- 19. Gradwohls Clinical Laboratory Techniques. Stanley S.Raphael. W.E. Company, London, UK
- 20. Practical Biochemistry-Principles and techniques. Keith Wilson and John walker(Eds), University press, Cambridge UK.





- 21. Modern Experimental Biochemistry. Rodney F Boyer.Nenjamin/Cummings
- 22. publishing company Inc.Redwoodcity, California.
- 23. Chromatographic methods. A Braithwate and FJ Smith.Chapman and hall, NewYork.
- 24. Gel Electrophoresis of Nucleic acids-A Practical approach. Rickwood D and BD Hames. IRL Press, NewYork
- 25. Spectrophotometry and Spectrofluorimetry: A Practical Approach. Harris DAand CL Bashford(Ed.)IRL Press, Oxford.
- 26. Introduction to Spectroscopy. DonaldL.Pavia Gary M.Lipman, George S Kriz. Harcourt brace College Publishers, Orlands, Florida
- 27. Introduction to Biophysics-Sokal R.R&Rohl F.J

Nutrition and Metabolism

Nutrition

- 1. Understanding normal and Clinical nutrition, Whitney, Cataldo of holfes Sixth edition
- 2. Nutritional Biochemistry- Tom Brody.
- 3. A text Book of Medical Biochemistry- M.N Chatterje and R. Shindea, Jaypeepub.
- 4. Harpers Illustrated Biochemistry- R.K murray, D.kGarnnes. And V.V Rodwell,McGraw Hill.
- 5. Medical Physiology- A.C. Guyton and J.E Hall, Saunders pub.
- 6. Human Physiology. C.C. Chatterjee, medical and Allied Agency
- 7. Nutritional Biochemistry- Swaminathan
- 8. Life span nutrition- Conception through life- S.R Rolfes, LK De Bruyne and E.N Whitney.
- 9. Normal and Therapeutic nutrition CH Robinson and MR Lawler.
- 10. Principles of Nutrition M. Swaminathan.
- 11. Nutrition in Health & Diseases Cooper.
- 12. Modern Nutrition in Health and Diseases M.E. Skilis and V.R. Young
- 13. Text book of Biochemistry & Human Biology G.P. Talwar
- 14. 2. Text book of Human Nutrition M.S.Banerji, N.Pralhad Rao & V.Reddy.
- 15. Nutrional Biochemistry & Metabolism Linten.
- 16. Human Nutrition & Dietics- Davidson & Passmore (ELBS)
- 17. Modern Nutrition in Health & Diseases Maurice E Skills & V R Yong.
- 18. Food & Nutrition M.S.Swaminathan
- 19. The Cell By Cooper.
- 20. Cell and Molecular Biology de Robertis & de Robertis.
- 21. Molecular Biology of the Cell: Alberts 5th Edition 2007 NCBI Publication
- 22. Principles of Biochemistry: Lehninger WH Freeman
- 23. Biochemistry of Signal Transduction and Regulation Gerhard Krauss Wiley VCH 3rd Revised Edition
- 24. Molecular Cell Biology: Lodish 6th Edition, WH Freeman & Company





- 25. The cell: Cooper 2nd Edition ASM Press
- 26. Gene IX: Benjamin Lewin Published by Pearson Prentice Hall
- 27. Cell and Molecular Biology: Gerald Karp
- 28. Molecular Biology: Robert Weaver 1st Edition, WCB McGraw-Hill
- 29. Molecular Biology of the Gene: Watson 6th Edition, Pearson Publication
- 30. Gene Regulation: A Eukaryotic Perspective: David Latchman 5 illustrated , Taylor & Francis, 2005

Metabolism

- 1. Lehninger: Principles of Biochemistry 4th edition by David L. Nelson and M.M. Cox (2005) Maxmillan/ Worth publishers/ W. H. Freeman & Company.
- 2. Fundamentals of Biochemistry 3rd edition by Donald Voet and Judith G Voet (2004), John Wiley & Sons, NY
- 3. Biochemistry 2nd edition by R .H. Garrett and C. M. Grisham (1999), Saunders College Publishing, NY.
- 4. Biochemistry 6th edition by Jeremy M. Berg (2007). W.H. Freeman & Co., NY
- 5. Biochemistry 3rd edition by C.K. Mathews, K.E. vans Holde and K.G. Ahern (2000), Addison- Wesley Publishing Company.
- 6. Biochemistry (2004) by J. David Rawn, Panima Publishing Corporation, New Delhi.
- 7. A Text Book of Biochemistry, E.S.West,W.RTodd, H.S Mason and T.J van Bruggen, Oxford and IBH Publishing Co.,New Delhi,19747
- 8. Biochemistry[with CDrom](2004) by Donald Voet, Judith G. Voet Publisher: John Wiley &Sons
- 9. Principles of Biochemistry (1995) by Geoffrey L Zubay, WilliamW Parson, Dennis E Vance Publisher: Mcgraw-hill Book Company-Koga
- 10. Principles of Biochemistry, 4/e(2006) by Robert Horton H, Laurenence A Moran, GrayScrimgeour K Publisher:Pearsarson
- 11. Biochemistry 6thEdiion (2007) by JeremyM.berg John L.tymoczko LubertStryer Publisher: B.I publications Pvt.Ltd
- 12. Biochemistry (2008) by Rastogi Publisher:Mcgraw Hill
- 13. Metabolic Pathways Greenberg.
- 14. Biochemistry G. Zubay, Addision Wesley Publ. (1983)
- 15. Biochemistry Stryer (1988) 3rd Edition W.H. Freeman and Co. Harper's Biochemistry
- 16. Medical biochemistry by Harper's.

Biostatistics, Bioinformatics & Research methodology

1. Introduction to Bioinformatics; Attwood T K and Parry-Smith D J Pearson Education Ltd.





- Department: Biochemistry
- 2. An Introduction to Computational Biochemistry; C.StanTsai, Wiley India Pvt.Ltd
- 3. Inferring Phylogenies; Joseph Felsenstein, Sinauer Associates.
- 4. Basic bioinformatics, S. Ignachimuthu, SJNarosa Publishing House
- 5. Introduction to Bioinfomatics, Arthur M Lesk, Oxford.
- 6. Bioinformatics sequence, structure and database; Des Higins, willie Taylor.
- 7. Introduction to Bioinformatics; V Kothekur DHRUV Publications.
- 8. Bioinformatics (Sequence and Genome Analysis) Mount David W, Press CSH
- 9. Methods In Biotechnology, edited by Hans-Peter Schmauder. Taylor & Francis
- 10. Manipal Manual of Clinical Biochemistry: For Medical Laboratory and MSc Students By S. Nayak, Shivnanda Nayak B, JAPEE Brother Medical Publications, New Delhi
- 11. Statistics, Basic Concepts and Methodology for the Health Sciences Daniel WW, Pub Wiley India.
- 12. Biochemical Calculations Segel, I.H. John Wiley & Sons.
- 13. Math's from Scratch for Biologists Alan J, Cann, John Wiley & Sons.

Calculus for Biology and Medicine, Claudida Neuhauser (third edition) Publications