

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

To be Implemented from the academic year 2022-23

Semester I

Course Code	Topic Headings	Credits
22PS1BC1	Cell Biology	4
22PS1BC2	Human physiology	4
22PS1BC3	Bio-organic and Plant Biochemistry	4
22PS1BC4	Bio-analytical Chemistry and Nanotechnology	4

Semester II

Course Code	Topic Headings	Credits
22PS2BC1	Metabolism	4
22PS2BC2	Genetics	4
22PS2BC3	Environmental Biochemistry, Pharmacology & Toxicology	4
22PS2BC4	Biostatistics and Bioinformatics	4

SEMESTER I

COURSE CODE	MOD ULE	TOPIC HEADINGS	Credits	L/ Week
22PS1BC1	I	Cellular Organization and Cell Division	4	1
	II	Cellular Transport and Cell Signaling.		1
	III	Aging, Apoptosis and Cancer		1
	IV	Stem Cell Biology and Techniques In Cell Biology		1
22PS1BC2	I	Blood, Cardiovascular and Respiratory System	4	1
	II	Digestive System and Muscles, Bones		1
	III	Nervous System		1
	IV	Special Senses and Excretory System		1
22PS1BC3	I	Biochemical Basis Of Evolution And Protein Chemistry	4	1
	II	Enzymology		1
	III	Industrially Important Biomolecules		1
	IV	Plant Biochemistry and Secondary Metabolites		1
22PS1BC4	I	Centrifugation, Electrophoresis and Radio-isotopic Techniques	4	1
	II	Chromatography		1
	III	Spectroscopic Techniques		1
	IV	Microscopy & Nano-biotechnology		1

Course Code	Practicals	Credits
22PS1BC1P	Paper I	2
22PS1BC2P	Paper II	2
22PS1BC3P	Paper III	2
22PS1BC4P	Paper IV	2
	Total	8

SEMESTER II

COURSE CODE	MODULE	TOPIC HEADINGS	Credits	L/ Week
22PS2BC1	I	Carbohydrate metabolism & Bioenergetics	4	1
	II	Lipid Metabolism		1
	III	Protein metabolism and related disorders		1
	IV	Nucleotide metabolism and related disorders		1
22PS2BC2	I	Overview of classical genetics, structure and characteristics of nucleic acids, chromosomal aberrations.	4	1
	II	Gene regulation and techniques in nucleic acid analysis: Regulation of gene expression.		1
	III	Replication of DNA and chromosomal abnormalities.		1
	IV	Recombinant DNA Technology (RDT) and Tissue culture		1
22PS2BC3	I	Types of Pollution & Basic Concepts of Ecology and Environment	4	1
	II	Pharmacokinetics & Pharmacodynamics		1
	III	Fundamentals of Toxicology		1
	IV	Mechanism of Toxicity and Toxicity Testing		1
22PS2BC4	I	Presentation and Processing of Data	4	1
	II	Analysis of data		1
	III	Chi Square, ANOVA, Demography and Vital Statistics		1
	IV	Bioinformatics		1

Course Code	Practicals	Credits
22PS2BC1P	Paper I	2
22PS2BC2P	Paper II	2
22PS2BC3P	Paper III	2
22PS2BC4P	Paper IV	2
	Total	8

SEMESTER I

Course Code	Title	Credits
22PS1BC1	Cell Biology	4
		Number of Lectures
Module-I: Cellular Organization and Cell division <ul style="list-style-type: none"> • Cell as a basic Module of life: Organization and structure of prokaryotic and eukaryotic cells, Animal and plant cell. • Parts of the Cell: Plasma Membrane - Structure, functions of membrane proteins, membrane fluidity, membrane permeability, gradient and transport across the membrane. Cell wall and its function. • Cytoplasm: Cytosol and organelles -, Centromere, cilia and flagella, endoplasmic reticulum, Golgi apparatus, lysosomes, peroxisomes, proteasomes, mitochondria, Nucleus (Chromosomes, chromatin, histones). Plant cells - Chloroplast, xylem, phloem and epidermal cells. • Cellular transport - Principles and Mechanism of Simple and Facilitated Diffusion and Active Transport (primary and secondary). • Cell division: Somatic cell division and reproductive cell division. The cell cycle - Interphase and M phase, Mitosis and Meiosis, Regulation of cell cycle, Cell cycle checkpoints and proteins associated with it. Disorders associated with cell cycle irregularities. Cellular diversity. 		15
Module-II: Cellular transport and cell signalling. <ul style="list-style-type: none"> • Cellular communication - Cell Wall: Experimental pathways -- the role of Gap junctions in extracellular communication, Adheren Junctions - Adhesion of cells to non-cellular substrates, Cellular interaction -Extracellular space, Interactions of cells with extracellular materials, Interactions of cells with other cells, Hemodesmosomes, Desmosomes, Tight junction and Plasmodesmata. Cell wall • Cellular transport - Artificial Membranes (Liposomes) in Drug Delivery, Na-K ATPase, Transport of glucose (GLUT proteins) • Cell Signalling: General principles of cell signalling, signalling via G protein linked cell surface receptors, Signalling via enzyme-linked cell surface receptor, Ras –Proteins and their role in signaling cascade [MAP Kinase pathway], IP3 signalling pathway. 		15
Module -III: Aging, Apoptosis and Cancer <ul style="list-style-type: none"> • Aging: Definition, Symptoms, Aging theories (Free Radical theory, Glycation Theory). Molecular, Biochemical Mechanisms. Mitochondria and ageing protein damage & maintenance, neurodegeneration, DNA Damage & Repair, Telomeres, Telomerase, Cellular senescence and Apoptosis in ageing. Biomarkers of aging, method to slow Aging. • Programmed Cell Death (apoptosis): Difference between necrosis and apoptosis. Pathways, regulators and effectors in apoptosis, onco- genes and tumor suppressor genes. • Cancer: - Classification of tumors, Metastasis. Proto-oncogenes, Oncogenes and cancer induction. Tumor associated antigens. Immune Response to tumor antigens. • Cancer Chemotherapy: Basic principles. Anti-cancer drugs: Different types and their mode of action. 		15
Module - IV: Stem cell biology and techniques in cell biology <ul style="list-style-type: none"> • 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, 		15

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
- 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.

Course Code	Title	Credits
22PS1BC2	Human physiology	4
		Number of Lectures
Module I – Blood, Cardiovascular & Respiratory System (Lungs). <ul style="list-style-type: none"> • Blood: Composition, functions and physical characteristics. Formation of blood cells. Blood clotting - mechanism, role of Vitamin K & anticoagulants. Blood groups and their types. Plasma proteins- composition & their functions. Hemoglobin - structure, functions, synthesis, derivative and disorders. • Heart: Cardiophysiology- functional anatomy/structure of heart, cardiac cycle, heart sounds, cardiac output, basic E.C.G (elementary knowledge), vasomotor circulation, coronary circulation, bloodpressure. Disorders - Angina pectoris, myocardial infarction & other cardiovascular disorders. Aging and heart tissue. • Respiratory system: Functions of - Nose, pharynx, larynx, trachea, bronchi, pleural fluid, lungs. Structure of lungs, mechanism and regulation of respiration. Transport of blood gases - O₂ and CO₂. Acid-base balance - Role of blood buffers, respiratory system and kidneys in maintaining acid-base balance, Bohr & Haldane effect, Role of chloride ions in oxygen transport (Chloride shift). Effect of 2, 3- BPG on O₂ affinity of Hb. Acidosis and alkalosis - metabolic and respiratory. Disorders - Bronchitis, asthma. Aging and respiratory system. 		15
Module II – Digestive System, Muscles and Bones. <ul style="list-style-type: none"> • Digestive system - Basic structure and organization, processes & functions of the digestive system. Digestion, absorption in the GI tract. • Digestive processes at various regions of digestive system and digestive secretions, their composition, functions and regulation. Role of gastrointestinal hormones. • Digestion and absorption of carbohydrates, lipids, proteins and nucleic acids. Physiologic Anatomy and functions of the liver, Pancreas & gall bladder. Secretion, composition & functions of bile & pancreatic juice. Concentration of bile by gall bladder. Aging and digestive system. • Disorders of digestive system • Muscles: Types, functions & properties of muscular tissue. Structure and composition of muscle fibers. Thick and thin filaments. Actin, myosin, tropomyosin, troponin, Z disc and H line components. Mechanism of smooth muscle contraction and relaxation - Interaction of actin and myosin muscle contraction, energy source for muscular work. Role of calcium/calmodulin and regulation of muscle contraction. Neuro-muscular transmission • Disorders of muscle, Aging and muscle tissue. • Bones: Functions of Bones & Skeletal system, Structure of Bone, Histology of bone tissue (hydroxyapatite, calcification, osteogenic cells, osteoblasts, osteocytes, osteoclasts). Compact & spongy bone tissue. Synovial fluid - Composition & functions. Bone formation & bone growth. Bone remodelling. Factors affecting bone growth & bone remodelling. Role of bones in calcium homeostasis. Aging and bone tissue. • Disorders of Bone. 		15
Module III - Nervous system. <ul style="list-style-type: none"> • Organization & Functions of nervous system: Structure and function of the brain. Central Nervous System, Peripheral and Autonomic Nervous system. CSF - Composition & function. • Chemical composition of brain – Chemical composition of nerve tissue, Blood – Brain barrier. 		15

<ul style="list-style-type: none"> • Cells of Nervous System – Types of neuronal cells – Glial cells (neuroglia, microglia) astrocytes, oligodendrocytes, Schwann cells, satellite and epididymal cells. Structure and function of nerves, physiology/structure/organisation of neuron, dendrites, axons and synapse. • Neurotransmitters & Neurotransmission - Neurotransmitters: 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 and 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. Electrical synapse and giant neurons. 	
<p>Module IV - Special Senses and Excretory system</p> <ul style="list-style-type: none"> • Special senses: Olfaction and Gustation - Physiology & Olfactory receptors; Taste buds & Gustation. • Olfactory and Gustatory dysfunction and disorders • Vision - Physiology of an eye, accessory structures. Physiology of Vision, light/dark adaptations, Rod and cone cells, Visual cycle, mechanism, regulation and disorders of vision. • Hearing - Anatomy of ear, physiology of hearing equilibrium and disorders. • Kidney - Structure of nephron. Formation and composition of urine (normal & abnormal constituents). Urine transport, storage and elimination. Role of kidneys in maintenance of electrolyte and water balance. Aging and urinary system. Disorders of Kidney and urinary tract • Skin/Connective Tissue: Skin structure, functions, types and disorders. • Sweat - composition & function. Elastin, Melanin, Collagen (Functions and disorders). Aging and skin. 	<p>15</p>

Course Code	Title	Credits
22PS1BC3	Bio-organic and Plant Biochemistry	4
		Number of Lectures
Module I: Biochemical basis of evolution and Protein chemistry <ul style="list-style-type: none"> Theory of chemical evolution and spontaneous origin of molecular level Oparin's Hypothesis, Miller Experiment, Smith's Model, RNA first model Process or Origin of life of Eukaryotes, Molecular Evolution of Protein. Polypeptide backbone, covalent and non-covalent interactions, end-group analysis by chemical and enzymatic methods, Conformation, Configuration Details of 1°, 2°, 3° and 4° structures, problems based on determination of 1° structure, Ramchandran Plot, structure-function relation of protein (Ex. Haemoglobin) Chemical modification and cross-linking in proteins, dynamic properties and mechanisms of protein folding 		15
Module II: Enzymology. <ul style="list-style-type: none"> IUB/EC Enzymes classification active site identification and conformation Michaelis - Menten Kinetics of monosubstrate enzyme reaction, LB Plot, Einsethal Cornish Bowden Plots Enzyme Inhibition - Reversible - competitive, non-competitive, uncompetitive, Partial, Mixed, Allosteric, Irreversible and Feedback Inhibition. Allosteric Enzymes-Kinetics Significance of Sigmoidal Behaviour, Role in Metabolic Regulation. Iso-enzymes – separation and significance Enzyme Immobilization and Applications Clinical Enzymology- Enzymes as therapeutic agents, diagnostic tools and laboratory agents. 		15
Module III: Industrially important Biomolecules <ul style="list-style-type: none"> 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. 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 Biodiesel (Biofuel) from Jatropha. 		15
Module IV: Plant Biochemistry. <ul style="list-style-type: none"> Chlorophylls and accessory pigments. Photosynthesis-Light and Dark Phases, Schemes-I, II & Z. Cyclic and Non-cyclic Photophosphorylation, C-3 & C-4 Pathways. Biosynthesis of Starch Sugars and Cellulose from Glucose. Photorespiration and photoperiodism. Plant growth hormones: Auxins - Gibberellins, Cytokines, Abscisic Acid and Ethylene. 		15

<ul style="list-style-type: none">• Nitrogen Fixation and Sulphur Assimilation in Plants.• Secondary Metabolites: A brief account of the following classes: Alkaloids, terpenoids, flavonoids, Phenolics and phenolic acids, steroids, coumarins, quinines, acetylenes, cyanogenic glycosides, amines and nonprotein amino acids, gums, mucilages, resins etc. (Structures not necessary. Give examples of the compounds and the plants in which present and their 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.	
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Course Code	Title	Credits
22PS1BC4	Bio-analytical chemistry and Nanotechnology	4
		Number of Lectures
Module I : Centrifugation, Electrophoresis & Radioisotopic Techniques		15
<ul style="list-style-type: none"> • Centrifugation - Basic principles of sedimentation, relation between RCF and RPM. Principle, Instrumentation, Working and Applications of Preparative and Analytical Ultracentrifugation, Isopycnic Centrifugation, Rate Zonal Centrifugation, Differential centrifugation. • Electrophoresis - Basic principles, factors affecting electrophoresis, support mediums used. Principle, instrumentation, working and applications of electrophoretic techniques (Zone, Discontinuous, Capillary, 2-D, Pulsed Field Gel, Isoelectric Focussing, immune electrophoresis, PAGE) • 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. 		
Module II : Chromatography		15
<ul style="list-style-type: none"> • Chromatography - Basic Principles, Instrumentation, working and applications of partition chromatography (Paper), Absorption Chromatography (TLC, HPTLC, Column), Affinity Chromatography, Ion Exchange Chromatography, Gel filtration Chromatography, Gas-Liquid Chromatography (GLC), High Pressure Liquid Chromatography (HPLC), LC-MS • Gel Documentation System • Isolation and purification of proteins and enzymes • Sequencing and Blotting Techniques: Protein, DNA and RNA. 		
Module III : Spectroscopic techniques		15
<ul style="list-style-type: none"> • Spectroscopic: Beer-Lamberts Law, Its verifications and Deviation, Concept of Absorptions, Transmission, Scattering, Phosphorescence, Fluorescence, Luminescence, Diffraction Spectra • Principle, Instrumentation, working and application of – UV, Visible and IR Spectroscopy, Turbidometry, Nephelometry., Spectrofluorimetry, Flame Spectrophotometry, Atomic Absorption Spectrometry, Luminometry, 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) • LASER- Principle, applications in Medicine and Biological Sciences. 		
Module IV : Nano-biotechnology and Microscopy		15
<ul style="list-style-type: none"> • Bionanotechnology: Concept. Types of bionanostructures (Carbon nanostructures, nanoshells, dendrimers, quantum dots, nanowires, liposomes). • Synthesis of bionanoparticles: Physical, chemical and biological methods. Applications of nanotechnology: medicine and diagnostics (antimicrobial properties, therapies, drug delivery including rate programmed drug delivery, Microencapsulation of cells. imaging) agriculture, environment. • Techniques for analysis of nanomaterials, Mechanical properties of nanomaterials, structural properties of nanomaterials. <p>Potential risks of Bionanotechnology.</p> <ul style="list-style-type: none"> • Microscopy: Basic principles, instrumentation and application of Phase, ultraviolet 		

<p>and interference microscope and Fluorescence microscopy</p> <ul style="list-style-type: none">• Electron microscope – scanning emission microscopy, transmission emission microscopy• Confocal microscopy and Atomic force microscopy	
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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 , Urea and Creatinine
2. Clearance Test with Clinical Interpretation
3. Estimation of serum Electrolytes(Na & K)
4. Gastric Function Tests: Gastric Juice- Total and Free Acidity

Paper 3

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:
 - Amylase (Km, optimum pH, optimum temperature).
 - 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)
8. Estimation of Total Phenolic Contents of plant extract
9. Estimation of Total Flavanoid Contents of plant extract

Paper 4

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. Basic formulation of nanoparticles.

SEMESTER II

Course Code	Title	Credits
22PS2BC1	Metabolism	4
		Number of Lectures
Module I: Carbohydrate metabolism and Bioenergetics <ul style="list-style-type: none"> • Carbohydrate Metabolism & related disorders: Introduction to metabolism. Metabolic pathways. • An overview of Glycolysis, Glycogen Metabolism: Synthesis, breakdown, regulation, Glycogen storage disorder. • Gluconeogenesis: Cori cycle, Glucose-Alanine cycle, Regulation of Gluconeogenesis, Rapoport Luebering cycle & its significance. Shuttles- Malate-Aspartate shuttle & Glycerol phosphate shuttle. • Anaplerotic reactions; Glyoxalate cycle; Pentose phosphate pathway; Biosynthesis of lactose, sucrose and starch; • Uronic acid pathway (biosynthesis, degradation & its significance), Galactose and fructose metabolism; lactose intolerance, essential fructosuria, fructose intolerance, Sorbitol pathway, Glyoxylate pathway. • Bio-energetics - Laws of thermodynamics as applied to biological systems, enthalpy, entropy, free energy, standard free energy. • Role of High Energy phosphates in Bio-energetics and energy capture, Theories of ATP Biosynthesis. 		15
Module II: Lipid metabolism <ul style="list-style-type: none"> • Fatty acid oxidation: saturated, unsaturated, odd chain, even chain, peroxisomal minor pathways of fatty acids oxidation) Disorder related to fatty acid oxidation, (Genetic deficiencies in carnitine transport and Acyl CoA dehydrogenase, Refsum's disease, Zellweger syndrome) • Fatty acid biosynthesis, Elongases & desaturases, synthesis of Triacylglycerol. • Cholesterol: Biosynthesis, control, transport, utilization and atherosclerosis, cholesterol lowering drugs (statins etc.) • Arachidonate metabolism: Prostaglandins, Prostacyclins, thromboxanes and leukotrienes, the cyclic pathway of prostaglandins, Prostacyclins, thromboxanes' the linear pathway of leucotrienes. • Phospholipid, glycolipid and lipoprotein: metabolism of glycerophospholipids, sphingolipids, sphingophospholipids, sphingoglycolipids. • Transport of Lipids: chylomicrons, VLDL, LDL, HDL, disorders of lipoprotein metabolism (Hypo and hyper lipoproteinemias) transport lipoproteins and membrane lipoproteins • Free radical metabolism: Generation of free radicals, damage produced by reactive oxygen species (ROS), free radical scavenger systems (enzymatic & non-enzymatic). 		15
Module III: Protein metabolism and related disorders. <ul style="list-style-type: none"> • Protein metabolism and related disorders - Reactions of amino acids: Deamination, Transamination, Decarboxylation, Transmethylation, Transdeamination, Essential/non-essential amino acids. • Ammonia formation, transport and detoxification in brain and liver. Urea cycle regulation 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 		15

<p>chain amino acid, and related inborn errors of metabolism</p> <ul style="list-style-type: none"> • 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 Malnutrition – PEM, Marasmus, Kwashiorkor. 	
<p>Module IV: Nucleotide metabolism and related disorders.</p> <ul style="list-style-type: none"> • 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 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 Phosphorylase – PNP deficiencies. 	<p>15</p>

Course Code	Title	Credits
22PS2BC2	Genetics	4
		Number of Lectures
Module-I: Overview of classical genetics, structure and characteristics of nucleic acids, chromosomal aberrations. <ul style="list-style-type: none"> • Mendelian genetics: Mendelian laws and basis of inheritance, genotype, phenotype. Chromosomal theory of heredity, Meischer, Griffith, Hershey- Chase & Avery; RNA as genetic material. • Non Mendelian genetics: Incomplete dominance, codominance, multiple alleles, pleiotropy, recessivity, sex determination, sex-linked traits, sex-linked inheritance, lethal genes. • Problems based on above concepts. • Structure and characteristic of DNA & RNA: Base composition of DNA, double helical structure, Chargaff's rule, A, B & Z DNA, linear, circular and supercoiled DNA. Tm of DNA, its relation to GC content, unique and repetitive sequences of DNA, Cot curves and its significance, C-value paradox; movable genes, transposons & retrotransposons, invert repeats. Types of RNA, structure & functions, genetic code & their characteristics. • Organization of DNA in genome: Histones, nucleosomes, structure of chromatin Eukaryotic chromosomes, Prokaryotic chromosomes, lampbrush & polytene chromosomes. • Functions of gene: Gene mapping by conjugation, transformation & transduction. • Chromosomal abnormalities: Euploidy and aneuploidy (Autosomal and Sex chromosomes) Monosomies (Turner syndrome), Disomies and trisomies (Down Syndrome) and their causes. • Mutations: Types of mutations, Physical, chemical and Biological agents causing mutations • DNA repair Mechanism: Photo-reactivation, nucleotide excision, SOS repair, recombinational repair mismatch repair. 		15
Module-II: Replication of DNA and chromosomal abnormalities. <ul style="list-style-type: none"> • Replication: Modes of replication; Messelson and Stahl's experiment for semi-conservative replication. Concepts of replication initiation, elongation and termination in prokaryotes and eukaryotes, enzymes and accessory proteins involved in DNA replication, Fidelity in replication, replication of single stranded circular DNA, difference between prokaryotic and eukaryotic replication. Genomic and subcellular organelle replicons, viral and plasmids replicons, replication origin, initiation and replication, multiple initiation sites, Okazaki fragments. • Transcription of DNA: DNA dependant RNA polymerases in prokaryotes and eukaryotes, Mechanism of transcription: template directed synthesis, sigma cycle, promoter recognition. Properties of promoter in prokaryotes and eukaryotes Post-transcriptional processing; maturation of rRNA & tRNA, RNA splicing mechanism, poly A tail and 5' capping, noncoding sequences. Reverse Transcription • Translation: Mechanism of translation: activation, initiation (importance of Shine-Dalgarno sequence), elongation and termination: Rho-dependent and Rho-independent, nonsense codons, role of RF1 and RF2 and GTP Post translational processing and modification, signal hypothesis 		15
Module -III: Gene regulation and techniques in nucleic acid analysis <ul style="list-style-type: none"> • Organization of gene: Structural & regulatory elements; split genes. • Regulation of gene expression <ol style="list-style-type: none"> a) Prokaryotic gene regulation: Positive and negative control, induction and repression, attenuation. Example: lac, trp, operons; SOS regulation. b) Eukaryotic gene regulation: Role of upstream, downstream and enhancer elements, 		15

<p>cis-trans acting elements in gene expression, examples and experimental evidences.</p> <ul style="list-style-type: none"> • Medical genetics: Genetic screening, Genetic diagnosis, Genetic counselling. • Techniques in nucleic acid analysis: Amplification (PCR) , Restriction mapping, DNA sequencing methods: , RNA sequencing technique, Oligonucleotide synthesis , Allele specific oligonucleotide (ASO), RFLP, SNPS, RAPD, Quantitative trait loci, Technique based on nucleic acid hybridization, dot-blot, FISH, Karyotyping , sex determination 	
<p>Module - IV: Recombinant DNA Technology (RDT) and Tissue culture</p> <ul style="list-style-type: none"> • Gene cloning, isolation of genes, obtaining genes from eukaryotic and prokaryotic organisms, problems of isolation of genes, isolation of gene fragments. cDNA synthesis, PCR, designing of primers for PCR, chemical synthesis of genes, shotgun experiments, gene bank, gene library • Vectors for cloning in bacteria: plasmid, bacteriophage, cosmid, phagemid. • Cloning in yeast vectors: Yep, Yrp, Ycp • Cloning in plant cells: suitable vectors – caulimoviruses, Ti plasmid, cloning in mammalian cells, viral vector, shuttle vector. • Introducing DNA into cell, transformation, microinjection, electroporation, selection of recombinant clones, colony hybridization, Southern & Northern hybridization, use of probes • Medical and Biological applications of recombinant DNA technology (RDT), Diagnostic probes for genetic and other diseases, Anti-sense technology and therapeutics, agricultural, industrial and commercial applications of RDT. • Human Genome project • Plant Tissue Culture (PTC): Principles, Techniques, Methodology and Application of PTC. Micropropagation and Protoplast fusion. Suspension Cultures for production and secondary metabolites. Gene Transfer and Transgenic for crop improvement • Animal Tissue Culture (ATC): Principles, Techniques, Methodology and Application of ATC. Transfection using eggs, cultured stem cells and nuclei in development of transgenic animals. Frontiers of contraceptive research, cryopreservation of sex gametes & embryos, Ethical issues in embryo research 	<p>15</p>

Course Code	Title	Credits
22PS2BC3	Environmental Biochemistry, Pharmacology and Toxicology	4
		Number of Lectures
Module I: Types of Pollution & Basic Concepts of Ecology and Environment <ul style="list-style-type: none"> • Air Pollution: Classification & effects of air pollutants on human health, Gases containing the oxides of carbon, sulphur and nitrogen, ozone and CFC. Measures to control air pollution and suspended particulate matters in air. • Green-house effect & Global warming: sources, consequences & remedial measures. • Water Pollution: Sources and effects of water pollutants on human health, quality standards for drinking water, waste water treatment and recycling. • Noise Pollution: Sources, measurement, health hazards, prevention & control of noise pollution. • Atmosphere; Hydrosphere; Lithosphere- Principles and Concepts of ecosystem- Structure of ecosystem- cybernetics and Homeostasis- Energy transfer in an ecosystem-Food chain. Food web-Ecological efficiencies- Trophic structure and energy pyramids- Principles Pertaining to limiting factors; Biogeochemical cycles (N, C, P, S cycles). • Properties of water- water quality parameters- pH, Dissolved Oxygen (DO), Chemical Oxygen demand (COD); Biological Oxygen demand (BOD); Atmospheric toxicants- CO, NO₂, CO₂, SO₂-; Toxic heavy metals- Radionuclides -Sampling of air and water pollutants- Monitoring techniques and methodology. • Organic chemicals in the environment; Aliphatic/aromatic hydrocarbons (hydrocarbon decay, environmental effects); Soaps and surfactants (cationic, anionic and nonionic detergents, modified detergents); Pesticide residue – classification, degradation, analysis, pollution due to pesticides; phenols and petrochemicals. 		15
Module II: Pharmacokinetics and Pharmacodynamics, Pharmacokinetics: Pharmacokinetics (PK) and drug metabolism, objectives of PK Analysis in drug discovery, fundamental concepts in drug absorption, distribution, metabolism & elimination (ADME) Kinetics of drug following different modes of drug administration. Introduction to important PK parameters, PK of oral administration & bioavailability <ul style="list-style-type: none"> • Pharmacodynamics (mechanism of drug action): Function Relationship, Molecular basis of drug action; antipyretic drugs: Paracetamol, antiallergic drugs:- Cetrizine Hydrochloride. Drug-Nutrient Interaction. Computer- based drug designing. • Animal pharmacology & toxicology studies. • Investigational New Drug (IND) Application & New Drug Application (NDA): Introduction to NDA, NDA forms, contents of NDA, Preparation & Submission of documents, guidance documents for NDAS. • Strategies in drug therapy <ol style="list-style-type: none"> a. Central nervous system: antidepressants b. Respiratory system: pharmacotherapy of bronchial asthma c. GI system: antacids d. Cardiovascular system: beta adrenergic blockers 		15

e. Endocrine system: thyroid modulators	
Module III: Fundamentals of Toxicology <ul style="list-style-type: none"> • 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. • 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. 	15
Module IV: Mechanism of Toxicity and Toxicity testing <ul style="list-style-type: none"> • 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; Immunotoxicity; multi-Organ Toxicity • Mechanism of toxicity: Disturbance of excitable membrane function, Altered Calcium homeostasis, Covalent binding to cellular macromolecules & genotoxicity, Tissue specific toxicity • Toxicity testing: Test protocol, Genetic toxicity testing & Mutagenesis assay: In vitro test systems: bacterial mutation tests-Reversion 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. 	15

Course Code	Title	Credits
22PS2BC4	Biostatistics & Bioinformatics	4
		Number of Lectures
Module I: Presentation and Processing of Data. <ul style="list-style-type: none"> • Presentation of Data- Graphical presentation. Tabular, chart, Diagrammatic presentation. • Processing of Data - Measures of Central Tendency (Mean, Mode, Median). • Probability and law of probability, Measures of location (Quartiles, percentiles). • Measures of Dispersion (Quartile deviation, Mean Deviation, Standard Deviation, Coefficient of Variation) Sampling and estimating population parameters Sampling - Representation sample, sample bias. Sampling Techniques – Simple random, systematic, stratified, multistage, cluster and multiphase.Sampling distribution.		15
Module II: Analysis of Data <ul style="list-style-type: none"> • 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). • Correlation analysis - Simple correlation analysis, Multiple correlation analysis. Partial correlation analysis. Regression analysis - Simple regression analysis and Multiple regression analysis.		15
Module III: Chi Square, ANOVA, Demography and Vital Statistics <ul style="list-style-type: none"> • 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, Importance of non – parametric tests. 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		15
Module IV: Bioinformatics <ul style="list-style-type: none"> • Introduction to Bioinformatics - Definition & historical overview, Application of Bioinformatics. • Major Databases in Bioinformatics. (Genome databases, protein databases, other secondary databases.) • Information Search & Data Retrieval - Tools for Web Search, Data Retrieval Tools • Data Mining of Biological Databases. • 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.

- Gene Expression & Microarray Technique (Concept of microarrays; spotted arrays, oligonucleotide arrays, designing the experiment, Microarray design, microarray experimentation, Applications of microarray technology.
- 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.

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

Isolation of DNA and RNA

1. Isolation of DNA (crude) from germinating moong /Onion seeds
2. Isolation of RNA (crude) from Baker's yeast

Demonstration Experiments

1. Determination of base composition of DNA.
2. Staining of Cellular RNA & DNA and microscopic examination.
3. Study of bacterial conjugation
4. Study of bacterial transformation.
5. Study of mutation in E.coli by UV.
6. Induced expression of alpha & beta galactosidases and catabolic repression in microorganisms.
7. Chemical Mutagenesis in Yeasts.
8. Polymerase chain Reaction (PCR).
9. Cell free protein synthesis.
10. Restriction Digestion & separation of DNA restriction fragments
11. Gene cloning & selection of recombinant clones.
12. T_m of DNA.
13. AMES Test.
14. Estimation of Serum Glycosylated Haemoglobin
15. Separation of LDH Isoenzymes
16. Arterial Blood Gas Analysis
17. DNA Sequencing
 - a) Maxam Gilbert Method
 - b) Sanger's Method
18. Blotting Techniques (Southern, Western, Northern)

Paper 3

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. Preparation of Aspirin from salicylic acid
9. Estimation of Methyl salicylate
10. Estimation of Aspirin
11. Determination of LD50 value

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

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

Internal Assessment Scheme for M.Sc- I Semester I				
Semester I	Paper I	Paper II	Paper III	Paper IV
Internal online Test/open book test/MCQ's Written test / MCQ test/ Assignment/ Activity based assessment	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				
Semester II	Paper I	Paper II	Paper III	Paper IV
Internal online Test/open book test/MCQ's Written test / MCQ test/ Assignment/ Activity based assessment	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	I	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, Williams & Wilkins
6. Molecular Biology of the Cell- Alberts, Johnson, Lewis, Raff, Roberts and Walter, Garland Sc
7. 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, Addison 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 Biology- Concepts and experiments, 5th ed. (2008) Gerald Karp- 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 Biology- Concepts and experiments, 5th ed. (2008) Gerald Karp- Wiley & Sons
17. Trends in Stem cell Biology and Technology, Hossein Baharvand (2009), Humana Press.
18. The World of the cell by Becker, Kleinsmith and Harden Academic Internet Publishers; 5th edition (2006)
19. The Cell: A Molecular Approach, Fourth Edition by Geoffrey M. Cooper and Robert E. Hausman.
20. Cell and Molecular Biology by concepts and experiments by Gerald Karp (2005) John Wiley sons & Inc.
21. Molecular cell Biology by Harvey Lodish. W. H. Freeman; 6th edition (2007)
22. The Cell - Biochemistry, physiology and morphology by J. Brachet and A. E. Mirsky, Academic Press (1963)
23. Molecular Biology of the Cell: Alberts 5th Edition 2007 NCBI Publication
24. Principles of Biochemistry: Lehninger WH Freeman
25. Biochemistry of Signal Transduction and Regulation - Gerhard Krauss Wiley VCH 3rd Revised Edition
26. Molecular Cell Biology: Lodish 6th Edition, WH Freeman & Company
27. The cell: Cooper 2nd Edition ASM Press
28. Gene IX: Benjamin Lewin Published by Pearson Prentice Hall

29. Cell and Molecular Biology: Gerald Karp
30. Molecular Biology: Robert Weaver 1st Edition, WCB McGraw-Hill
31. Molecular Biology of the Gene: Watson 6th Edition, Pearson Publication
32. 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.
18. 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 and Nanotechnology:

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

27. publishing company Inc.Redwoodcity, California.
28. Chromatographic methods. A Braithwaite and FJ Smith.Chapman and hall, NewYork.
29. Gel Electrophoresis of Nucleic acids-A Practical approach. Rickwood D and BD Hames.
IRL Press, NewYork
30. Spectrophotometry and Spectrofluorimetry:A Practical Approach. Harris DAand CL
Bashford(Ed.)IRL Press, Oxford.
31. Introduction to Spectroscopy. DonaldL.Pavia Gary M.Lipman, George S Kriz.
Harcourt brace College Publishers, Orlands, Florida
32. Introduction to Biophysics-Sokal R.R&Rohl F.J
33. Nanotechnology, A Genetic Introduction to the next big idea – Mark Ratner & Daniel Ratner, Pearson
Education

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, Laurence 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, Addison Wesley Publ. (1983)
15. Biochemistry – Stryer (1988) 3rd Edition W.H. Freeman and Co. Harper's Biochemistry
16. Medical biochemistry by Harper's.

Genetics:

1. Peter Russel, igenetics
2. Lewin Benjamin, Genes (Latest edition) Oxford Univ. Press
3. Jha A.P. Genes and Evolution 1993, Macmillan, Delhi.
4. Williamson Robert, Genetic Engineering I, Academic Press
5. Williamson Robert, Genetic Engineering 2, Academic Pres
6. Fisher R.A. Genetic Theory of Natural Selection, RESTE, New Delhi.
7. MitraSnadhya, Genetic Engineering: Principles and Practice, Macmillan India Pvt. Ltd.
8. Sang J. H, Genetics, 1984, Longman, London, 1984.
9. Hayes, William, Genetics of Bacteria and Viruses, CBS Publisher, New Delhi.
10. Bain Bridge Brian W, Genetics of Microbes, 1980, Blackie and Son, London
11. Barrow Colin, Brown Robert, Clarke Liz, (2006). The SuccessfulEntrepreneurs guide book. London: Kogan and Page.
12. Shring S, Jardine R., Mills J. (2001). Introduction to Catering. India:
13. Delmar – Thomson Learning Coltman Michael M. (2000). Start and Run Profitable Restaurant. Mumbai: Jaico Publishing House.
14. Erdosh George (2000). Start and Run a Profitable Catering Business. Mumbai: Jaico Publishing House.
15. B. Srilakshmi. Nutrition Science. Fifth edition. New age international publishers.
16. B. Srilakshmi. Dietetics. Seventh edition. New age international publishers
17. B. Srilakshmi. Food Science. Sixth edition. New age international publishers.
18. SBP Board of consultants and Engineers (1998). SBP Handbook of Oil Seeds, Oil, Fats and Derivatives. Delhi:SBP House.
19. Booth, G.R. (1997). Snack Food, New Delhi: CBS Publishers and distributors.
20. Salunkhe, D.K. &Kadam, S.S. (2005).Handbook of Vegetable Science and Technology.
21. Marcel Dekker, INCFirst Indian Reprint .
22. D'Cunha, J.F. (1998). Modern Food Packaging, Mumbai: IIP.
23. Duffy, J.I., (1981). Snack Food Technology, New Jersey: Noyes Data Corporation.
24. Smith, J.S. &Hui, Y.H. (2004).Food Processing Principles and Applications.Blackwell Publishing.
25. Kent N.L. (1993). Technology of cereals (4th ed.) Pergamon Press. Chakraborty, M.M. (2003).

Chemistry and Technology of Oils and Fats Allied publishers Pvt. Ltd.

26. Mahadeviah, M. & Gowramma, R.V. (1996). Food Packaging Materials. New Delhi: Tata McGraw Hill Pub.Co. Ltd.
27. Fellows, P. & Hampton, A. (1992). Small Scale Food Equipment Intermediate Technology. Publications in Association with CTA.

Pharmacology:

1. GMP for pharmaceuticals, A plan for TQC – SH Wiling & JR Stoker, Marul Dekker Inc, New York, 4th Edition, 1997
2. Total Quality Assurance for the Food Industries – WA Gould & RW Gould. CTI Publications Inc, USA 1988
3. Current Good Manufacturing Practices for Food Plan Sanitation – WA Gould, CTI Publications Inc. USA 1980
4. Essentials of Pharmacotherapeutics, 3rd Ed., By F.S.K. Barar, S chand & Company Ltd. 2005.
5. Pharmaceutical chemistry, G Melentyeva L L Antonova Mir Publishers, Moscow
6. Chemical Pharmacology, R B Barlow, 2nd Ed, Methven and CO. New Fettes Lane
7. Medicinal Chemistry, Vol I, 3rd Ed, Alfred Burga, Wiley Inter sciences
8. Textbook of paramedical chemistry, Jayshree Ghosh, S chand and company, New Delhi
9. Pharmacology, B Suresh, 1st Ed. Shanti, Publication.

Biostatistics, Bioinformatics & Research methodology:

1. Introduction to Bioinformatics; Attwood T K and Parry-Smith D J Pearson Education Ltd.
2. An Introduction to Computational Biochemistry; C. Stan Tsai, Wiley India Pvt. Ltd
3. Inferring Phylogenies; Joseph Felsenstein, Sinauer Associates.
4. Basic bioinformatics, S. Ignachimuthu, SJ Narosa Publishing House
5. Introduction to Bioinformatics, Arthur M Lesk, Oxford.
6. Bioinformatics sequence, structure and database; Des Higgins, willie Taylor.
7. Introduction to Bioinformatics; V Kothe Kur DHRUV Publications.
8. Bioinformatics (Sequence and Genome Analysis) Mount David W, Press
9. CSH
10. Methods In Biotechnology, edited by Hans-Peter Schmauder. Taylor & Francis
11. Manipal Manual of Clinical Biochemistry: For Medical Laboratory and MSc Students By S. Nayak, Shivnanda Nayak B, JAPEE Brother Medical Publications, New Delhi
12. Statistics, Basic Concepts and Methodology for the Health Sciences Daniel WW, Pub Wiley India.

13. Biochemical Calculations –Segel, I.H. John Wiley & Sons.
14. Math's from Scratch for Biologists Alan J, Cann, John Wiley & Sons.
15. Calculus for Biology and Medicine, Claudida Neuhauser (third edition) Publications Prentice Hall.

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

To be implemented from academic year 2023-24

Semester III

Course Code	Topic Headings	Credits
23PS3BC1	Nutrition and Food Science	4
23PS3BC2	Immunology	4
23PS3BC3	Endocrinology and Clinical Biochemistry	4
23PS3BC4	Research Methodology and Soft Skills (Communication and Management processes)	4

Semester IV

Course Code	Topic Headings	Credits
23PS4BCP	Research Project &/or Internship	16

SEMESTER III

Course Code	MODULE	TOPIC HEADINGS	Credits	L/ Week
23PS3BC1	I	Basics of Nutrition & Food Science	4	1
	II	Diet in health and diseases		1
	III	Food spoilage, Preservation and Food Processing		1
	IV	Food safety management		1
23PS3BC2	I	Introduction of Immune system, Immunity & Immune response	4	1
	II	Antibody mediated Immunity		1
	III	Immunological Tolerance & Immunodeficiency's		1
	IV	Complement system & Cytokines		1
23PS3BC3	I	Overview of Endocrinology; Hormones of Hypothalamus, Pituitary, Thyroid and Parathyroid glands.	4	1
	II	Hormones of Gonads and adrenal glands and Pancreas		1
	III	Organ Function Tests and Immunological Tests		1
	IV	Quality Control for Laboratories Clinical Research		1
23PS3BC4	I	Research –Basics, Design, Report writing and presentation	4	1
	II	Management processes		1
	III	Organizational behavior, Reading and Listening		1
	IV	Communication Skills		1

Course Code	Practicals	Credits
23PS3BC1P	Paper I	2
23PS3BC2P	Paper II	2
23PS3BC3P	Paper III	2
23PS3BC4P	Paper IV	2
	Total	8

SEMESTER IV

Course Code	MODULE	TOPIC HEADINGS	Credits	L/ Week
23PS4BC1	I	Research Project / Internship	16	

SEMESTER III

Course Code	Title	Credits
23PS3BC1	Nutrition and Food Science	4
		Number of Lectures
Module-I: Basics of Nutrition & Food Science <ul style="list-style-type: none"> • Proximate principles:-Carbohydrates, Proteins, Lipids and trace elements (Vitamins and minerals), their nutritional significance, classification, dietary sources, biochemical function, RDA. • Recommended Dietary allowances (RDA): factors affecting RDA, Methods used to calculate RDA, Practical application of RDA, Reference man and woman. • Assessment of Nutritional Status • Definition, concept and history: Functional foods, Nutraceuticals, Traditional foods, designer foods and pharma foods. Teleology of nutraceuticals. Evolution and classification of nutraceuticals and functional foods (based on food source – plants, animals and microbial) • Significance of nutraceuticals and functional foods in the management of diseases and disorders like inborn errors of metabolism/obesity/neurological disorder/ diabetes mellitus/ hypertension/ CVD/ cancer/arthritis/AIDS and Role of nutraceuticals in sports nutrition. • Prebiotics and Probiotics, Glycaemic Index , Fat replacers 		15
Module-II: Diet in health and diseases <ul style="list-style-type: none"> • Nutrition during pregnancy, lactation, infancy, childhood, adolescence, adulthood, ageing. • Nutrition for health & weight management, Obesity. • Nutrition for Exercise and Sport performance. • Nutrition for bone health. • Mid-day programme • 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 		15
Module -III: Food spoilage, Preservation and Food Processing <ul style="list-style-type: none"> • Food Processing:-Manufacturing processes, Food processing techniques, overview, Design, Facilities and processes of food industries (Edible Oils & Fats Industry, Milk industry, Beverage industry (alcoholic and non-alcoholic), fruits and vegetable processing industry) • Bio Chemistry of Food Spoilage: - Factors causing food spoilage during food ripening, vegetable maturation and their control. Post mortem changes in meat and their control. • Food Poisoning by microorganisms and their products: Different types, symptoms of food poisoning by: Staphylococcus, Clostridium perfringens, Clostridium Botulism, Salmonella, Trichinosis. Investigations of food borne diseases. Preventive measures for food borne outbreaks. • Food Preservation:-General principles of food preservation. Preservation by use of high and low temperatures, drying, radiations, chemical preservatives, inert gases, mechanical preservation techniques (vacuum packaging, tetra packs). • QC, GMP: General principles of Quality Control and Good Manufacturing Practices in food industry. • Food Adulteration, Food additives and Sensory evaluation. • Food packaging: 		15

<ul style="list-style-type: none"> • Introduction, objectives and need of food packaging, • Different types of packaging materials, their properties, advantages and limitations • Properties of packaging materials. Adhesives used and printing of packaging materials • Food packaging systems. Shelf life of packaged foodstuff, methods to extend and determine shelf- life of food. Packaging Machinery. Advanced Packaging Technologies: RFID, Bar Codes, ESD protective packaging. Package labeling – functions and regulations 	
<p>Module - IV: Food safety management</p> <ul style="list-style-type: none"> • Introduction to Food Safety • FOOD LAWS: Codex Alimentarius Commission, Prevention of Food Adulteration (PFA) Act, Fruit Products Order (FPO), Meat Products Order (MPO), Bureau of Indian Standards (BIS), AGMARK, Legal Meteorology, etc. • Food Safety and Standards Act, 2006, Food Safety Standards Rules and Regulations, FSSAI Schedule 4 requirements • Food Safety Initiatives Projects by FSSAI: BHOG, Clean street Food Hub, Eat right Movement, Clean & Fresh Fruits and vegetables, Safe and Nutritious Food (SNF), Hygiene Rating • FoSTaC training • International Food Safety Standards: ISO 22000: 2018 Standard, HACCP, FSSC 22000, BRCGS, IFS, SQF • Terms, Definitions and principles of Food Safety Management System in context of an organization • Role of Food Safety Officer (FSO) and career in regulatory and Food Safety field <p>Auditing in food industry and Accreditations</p> <ul style="list-style-type: none"> • Food auditing: definition, overview, Types of audits (internal audit, second party audit, third party audit, product and process audits, HACCP audits and certification audits), Steps and process of auditing • Seven principles of ISO Auditing • ISO 19011 Requirements • Standard Operating Procedures (SOPs) • Qualities, traits, role and responsibilities of an auditor • Audit Management and planning • Post Audit activities : Evidence based report writing, including writing valid, factual and value adding non-conformity report, evaluation of case scenarios and assigning critical, major, minor non-conformances to specific examples of processes and plant behavior, proposals for corrective action and follow up. • Onsite Auditing VS Remote Auditing. Use of Information and Communication technology (ICT) in Remote auditing • Accreditations – IAF, QCI, National Accreditation Board for Testing and Calibration Laboratories (NABL), Role of Accreditation bodies (e.g NABCB, RvA, UKAS), and related applicable standards (ISO/ TS22003, ISO 17021-1, ISO 17025) 	<p>15</p>

Course Code	Title	Credits
23PS3BC2	Immunology	4
		Number of Lectures
Module-I: Introduction of Immune system, Immunity & Immune response <ul style="list-style-type: none"> • Cells and organs of Immune systems: Lymphoid cells, mononuclear, phagocytes, antigen presenting cell, polymorphs, mass cells and platelets. Primary and secondary Lymphoid Organs, Lymphocyte Traffic. • Major Histocompatibility Complex (MHC): General organization and inheritance of MHC. Structure of Class I and Class II HLA Molecules and organization of Class I and Class II HLA Genes. Cellular distribution of MHC Molecules. Regulation of MHC Expression- Determinant Selection Model, Holes in the Repertoire Model. MHC and susceptibility to disease. Antigen processing and presentation. Self MHC Restriction of T Cell Role of Antigen presenting cells. Pathways for Antigen Processing, Cytosolic and endocytic pathway. • T cell subset and their function. • T cell receptor, structure, organization and rearrangement of TCR genes. T cell receptor complex- TCR- CD3. T cell accessory membrane molecule. Ternary TCR Peptide MCH Complex. T cell – Maturation, Activation & Differentiation. • Development of Immune System in short- Myeloid Cells, Memory B cells • Immune Response to infectious diseases: Viral, Bacterial, Fungal and Protozoal diseases, Helminthes (parasitic worms) infections- effector mechanisms 		15
Module-II: Antibody mediated Immunity <ul style="list-style-type: none"> • B cell maturation, activation and differentiation. • Antigens, Antibodies and Their Interactions • Antigens, Antigenic determinants, antigenicity and immunogenicity. • Immunoglobulin: Basic structure, classes, subclasses, function. • Antibody receptors. • Organization and expression of immunoglobulin genes. • Theories of antibody formation, Immunoglobulin variability. • Genetic basis of antibody diversity. • Regulation of Immunoglobulin production. • Monoclonal antibodies: Production and clinical uses. • Engineered monoclonal antibodies, Chimeric and hybrid monoclonal antibodies. • Regulation of Immune response, Antigen-Antibody Interaction (Ag-Ab Interaction). • Strength of Ag-Ab Interaction, Antibody Affinity, Scatchard Equation, Antibody Avidity, Cross Reactivity. • Primary and Secondary Ag-Ab Interaction 		15
Module -III: Immunological Tolerance & Immuno deficiencies: <ul style="list-style-type: none"> • Pathways to B and T cell tolerance, General characteristics of B and T cell tolerance • Mechanisms of tolerance inductions self-tolerance • Potential therapeutic applications of tolerance • T cells Immune Response in Transplantation • Types of graft, immunological basis of graft rejection- 1st set, 2nd set rejection- role of T lymphocytes • Clinical manifestation of graft rejection, General and specific immunosuppressive therapy • Experimental Animal Models: In Breed Strength, Adoptive Transfer Systems, SCID Mice and SCID Human Mice. 		15

<ul style="list-style-type: none"> • Cell Culture System: Primary Lymphoid Cell Culture, Clone Lymphoid Cell Line, Hybrid Lymphoid Cell Line • Immunodeficiencies - Classification of Immunodeficiencies: primary and secondary • Immunology of HIV/AIDS: Discovery, causes, structure, process of infection, destruction of CD4. • Autoimmunity and autoimmune diseases and their etiology: Organspecific autoimmune diseases (Hashimoto's thyroiditis and insulin dependent diabetes mellitus). • Diagnostic and prognostic value of auto antibodies: Treatment of autoimmune diseases. 	
<p>Module - IV:</p> <ul style="list-style-type: none"> • Complement System: Definition, components and function. Complement activation, Classical and alternative pathways of membrane attack complex. Complement receptor and biological consequences of Complement activation, cell lysis, inflammatory response, opsonisation of antigen, viral neutralization, Solubilisation of immune complexes. • Complement deficiency. • Cytokines: General structure and functions, Cytokine receptors, cytokine antagonists. Cytokine secretion by TH1 and TH2 subsets. Cytokine related diseases. Therapeutic uses of cytokines. Immune Responses • Inflammation mediators of inflammation and process of inflammation • Hypersensitivity and coombs classification types I to IV with mechanisms 	15

Course Code	Title	Credits
23PS3BC3	Endocrinology and Clinical Biochemistry	4
		Number of Lectures
Module-I: Overview of Endocrinology; Hormones of Hypothalamus, Pituitary, Thyroid and Parathyroid glands.		15
<ul style="list-style-type: none"> • Organization of Mammalian Endocrine System, Classification of hormones, Overview of circulation, modification and degradation, Target tissue, feed-back control. • Biosynthesis, Storage, Secretion, Transport and Metabolic effects (including hypo and hyper conditions) of Hormones of Hypothalamus. • Biochemical assessment and changes in hypothalamus disorders. Mechanisms of Hormone action, Role of Secondary Messengers-cAMP, cGMP, Ca and Calmodulin, Plasma membrane receptors, adenylate kinase, Role of G Proteins, protein kinases, tyrosine kinases, inositol phosphates, steroid hormone receptors. • Pituitary hormones: Biochemistry and mechanism of action. Regulation of synthesis and secretion. Hypo and hyper activity of pituitary hormones- gigantism, dwarfism, acromegaly, diabetes insipidus, syndrome of inappropriate ADH secretion. • Thyroid hormones: synthesis, secretion, transport and mechanism of action. Metabolic fate and biological actions. Antithyroid agents. Thyroid diseases, thyrotoxicosis, goiter, hypothyroidism, Graves' disease, Hashimoto's disease. Thyroid function tests. • Parathyroid Hormone and Calcitonin: Biological actions, regulation of calcium and phosphorus metabolism. Calcitriol. Pathophysiology. 		
Module-II: Hormones of Gonads and adrenal glands and Pancreas		15
<ul style="list-style-type: none"> • Gonadal hormones: Androgens and estrogens-synthesis, secretion, transport and mechanism of action. Metabolic fate and biological actions. Ovarian cycle, Pregnancy, Biochemical changes in pregnancy. • Adrenal hormones: Adrenal cortex- glucocorticoids and mineralocorticoids-synthesis, secretion, transport and mechanism of action. Metabolic fate and biological actions. Adrenal androgens- metabolic effect and functions. Adrenal medulla- catecholamines- synthesis, secretion, transport and mechanism of action. Metabolic fate and biological actions. Abnormal secretion of adrenal hormones- Addison's disease, Cushing's syndrome, Congenital adrenal hyperplasia, pheochromocytoma. Biochemical assessment and changes in Endocrine disorders of Adrenal Medulla, Adrenal Cortex, ovaries, testes • Pancreatic hormones: Islets of Langerhans and Hormone secretion. Biosynthesis, secretion and mechanism of action. Biological actions. Receptors, intracellular mediators and signalling pathways of insulin and glucagon. Somatostatin, Pancreatic polypeptide and insulin like growth factors. • Biochemical assessment and changes in Endocrine disorders of pancreas • Gastrointestinal hormones: producing cells, synthesis, structure, secretion and functions, GIP, VIP, gastrin, CCK and other peptides. • Hormones secreted from other organs and tissues: liver, kidney, heart, thymus and pineal gland. 		
Module -III: Quality Control for Laboratories and Clinical Research		15
<ul style="list-style-type: none"> • Clinical diagnostics: Diagnostic Kits and their applications. • Concept and significance: Bio safety, Bio Hazards and Bio ethics. • Concept of QC, QA GMP, GLP in labs & production processes. Lab/process validation & Accreditation. • Maintenance & Management of Lab/Experimental animals and AnimalHouse, CPCEA 		

<p>guidelines, ICH-GCP</p> <ul style="list-style-type: none"> • Clinical Research and Trials: Clinical research and its importance, significance & rationale, Clinical Trials- Stages/ Phases I to IV, milestones in clinical trials. • Ethical Issues: Values & principles in clinical investigation, international guidelines, patient care in clinical research, conflict of interest. Ethical review, informed consent, vulnerable populations, biological samples. • Databases, confidentiality, fraud & misconduct 	
<p>Module - IV: Organ Function Tests and Immunological tests</p> <ul style="list-style-type: none"> • Biochemical Assessments and Changes in Endocrine Disorders (Pituitary, thyroid, adrenal medulla, adrenal cortex, ovaries, testis). • Liver Function test. • Renal Function test including mechanism of urine formation. • Gastric and Pancreatic Function test. • Thyroid Function test. • Cardiac Profile • Pregnancy tests. • Use of ELISA, RIA and IRMA techniques in assay of hormones • Tissue typing and laboratory investigations: microcytotoxicity test, mixed lymphocyte reaction (HLA Typing) • Use of ELISA, RIA and IRMA techniques in assay of hormones 	15

Course Code	Title	Credits
23PS3BC4	Research Methodology and Soft Skills (Communication and Management processes)	4
		Number of Lectures
Module I: Research –Basics, Design, Report writing and presentation		15
<ul style="list-style-type: none"> • Research - What is research? Meaning of research, types & significance of research, research & scientific methods. • Criteria for good research, problems encountered by researchers in India, selecting & defining a research problem. • Research Design - Meaning, features of good research design, types of research designs. Basic principles of experimental designs • Report Writing - Significance of report writing, different steps in report writing, types of report, layout of research paper. • Mechanics and precautions of writing research reports for scientific journals, popular magazines, seminars/symposia/ conferences/workshops, poster session. • Presentation – Oral & Written, Presentations in classrooms, scientific meets & public audience. • Defence of research thesis. • Intellectual Property Rights (IPR) - Objectives of the patent system, basic principles and general requirements of patent law, legal, development, patentable subjects and protection in biotechnology, international convention for the protection of new varieties Strasbourg convention, UPOV Convention. • Ethics in publications-plagiarism 		
Module -II : Management processes		15
<ul style="list-style-type: none"> • Understanding an organisation, definition, concept of organisation, social system, goal, organisational process- vision and mission • BHAG – Big Hairy audacious goal • Organisation process – strategy (corporate, business) structure, system, processes, job, task • Definition and important of management, Evolution of management thought, principles of management • Definition and importance of planning, steps in planning • Decision making • SWOT analysis • Definition and importance of organizing • Staffing and its importance in organization • Directing and leading- Characteristics and importance of leading, role and functions of leading • Definition, importance & process of Controlling. Effective controlling techniques. 		
Module -III : Organizational behavior, Reading and Listening		15
<ul style="list-style-type: none"> • Etiquettes and manners • Stress and time management • Definition, importance of values • Attitudes, its function and component • Emotional intelligence and its impact • EI and organization • Emotional labour 		

<ul style="list-style-type: none"> • Indian perspective of EI • Motivation:- definition and importance <p>Group, Team :- definition , overview & benefits</p> <p>Listening:</p> <ul style="list-style-type: none"> • Overview, importance, types, barriers of listening, strategies of effective listening. • Effective questioning: types of questioning. <p>Reading:</p> <p>Definition, purpose (extensive, intensive), skimming, scanning, SQ3R technique of reading</p>	
<p>Module- IV : Communication Skills</p> <ul style="list-style-type: none"> • Communication: definition, characteristics, process, barriers, overcoming barriers, classification, importance of communication, types and channels of communication • Business communication: types, channels, stakeholders, communication network in an organisation • Oral presentation: types of oral communication, powerpoint presentation. • Principles of writing business letters, types of business letter • Report: types of business report, steps in report writing, do's and don't • Resume writing: types do's and don'ts. • Letters: Job Application Letter, Acceptance of Job Offer, Letter of Resignation, Letter of Recommendation, Letter of Appointment, Promotion and Termination, Letters under Right to Information (RTI) Act, Letters of Complaints, Consumer Grievance Letters etc • Skills required for GD, types of GD's, strategies for GD's, Job interviews. • Entrepreneurship/start-ups : trends of Entrepreneurial ventures, resources, planning and process of new entrepreneurial development. National and International agencies for promotion of entrepreneurship. Small scale industries Product pricing and profit generation and assessment of financial viability. Investment and risk analysis and cost benefit analysis. Tools of analysis of costing, cost control and budgeting, market survey tools. Government scheme and funding's. 	<p>15</p>

Detail Syllabus for Semester- I Practicals

Paper 1

Microbial analysis of food products

5. Identification of salmonella, Escherichia Coli and yeast
6. Determination of shelf life of various food products
7. Preparation of Microbial Media
8. Isolation of Microbes and plating techniques
9. Methylene blue reduction test(MBRT) for quality of milk
10. Sterilization of culture media, glassware by hot air oven

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.

Estimation of Nutritive value

1. Estimation of Maltose by DNSA
2. Estimation of glucose by Folin-Wu
3. Estimation of Oxalates from spinach
4. Estimation of Iron by KCNS method
5. Estimation of Calcium by EDTA method
6. Estimation of Vitamin C by Iodometry/ DCPIP method.
7. Estimation of phosphorous from the food sample
8. Estimation of Magnesium from food sample
9. Estimation of Trypsin inhibitors from raw seeds
10. Estimation of Sodium Benzoate from Jam/Jellies/Sauces.
11. Estimate the acidity of Milk/Fruit juice
12. Isolation of Lecithin and cholesterol from Egg yolk.
13. Isolation of Lycopene from tomato
14. Isolation of Casein.
15. Food adulteration tests
16. Isolation of essential oils from orange/ lemon peels

Demonstration Experiments

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

Paper 2

Serology

1. Rheumatoid arthritis factor
2. C- reactive protein
3. Widal
4. VDRL
5. Pregnancy test
6. ELISA (Demonstration)
7. Immunodiffusion (Demonstration)

Paper 3

Biochemical Tests for Endocrine glands Assessment₁

1. Demonstration of Radioimmunoassay
2. Glucose Tolerance Test (GTT) [to assess the function of pancreas]
3. Calcium (Ca) by Clark and Collip Method/ Trinder Method [To assess the function of thyroid and parathyroid glands]

Organ function tests

1. Pancreatic Function Tests: Estimation of Serum Amylase Activity.
2. Estimation of serum Total Proteins,
3. Albumin & determination of A/G ratio.
4. Biochemical Examination of CSF: Glucose, Proteins, Chlorides.

Demonstration Experiments

1. Estimation of T3, T4 and TSH from Serum/plasma
2. Estimation of Vitamin D3 levels from serum/plasma
3. Estimation of FSH and LH levels from serum/plasma
4. Estimation of Testosterone levels from serum/plasma

Paper 4

Research Methodology

1. Preparation of Research Proposal for Minor / Major Research Projects to be submitted 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. Select any two research papers from any leading national 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

Practicals based on

1. Mock Interview
2. Group Discussion
3. Presentation
4. Letter writing
5. Resume Writing
6. Report writing
7. Activities based on Reading & Listening

SEMESTER IV

Course Code	MODULE	TOPIC HEADINGS	Credits	L/ Week
23PS4BCP	I	Research Project / Internship	16	

Internal Assessment Scheme for M.Sc- I Semester III				
Semester III & Semester IV	Paper I	Paper II	Paper III	Paper IV
Internal online Test/open book test/MCQ's Written test / MCQ test/ Assignment/ Activity based assessment	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 (online)	10	10	10	10
MOOC / Assignment / Review of Literature or Book or Paper / Field study / Mini project(online survey based) / Workshop(online) / Presentation (oral/poster) (online)/ preparing small subject related documentaries/Preparation of Diet chart / menu planning/ Recipe/Product development - foods rich in calcium / Iron Proteins / Fibres/ Vitamins/Minerals/High medium and low energy content/ One page write up on at least five food related research institutes/ industries/organization/international or National agencies/ Attending Seminars, workshops and short training program on management concepts and subject related areas / Classroom activities / tutorials based on concepts studied in the theory class/ Classroom activities/tutorials based on concepts studied in the theory class such as Presentation, Group Discussion, Mock Interview, Mock Meetings	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	I	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

Note: The options mentioned for internal evaluation (40 marks) can also be considered for external evaluation (60 marks), if needed under any natural calamity/pandemic situation

Detail Syllabus for Semester- IV Practical

23PS4BCP: Research Project / Survey based project /Internship /Online Internship /online certificate courses/programmes initiated and designed by government of India like SWAYAM, NPTEL etc.

GUIDELINE TO CARRY OUT PROJECT WORK

1. The main purpose of introduction Project Work at MSc Part II is to make the students familiar with Research Methodology i.e. reference work, experimental work, statistical analysis of experimental data, interpretation of results obtained, writing of project work and compilation of bibliography in proper order. This will not only help train the inquisitive minds of the students, but also inspire them to take up research- oriented higher studies and career.

2. Each student shall complete a research project during his/ her academic year of MSc Part- II. However, the initial reference work can be started in MSc part- I and summer vacation to MSc Part-II

3. Nature of Research Project:-

The following will be considered as the Research Project.

- a. Experimental based involving laboratory analytical work, or
- b. Survey based Field work with statistical analysis of data collected, or
- c. Any reputed research Institute training /Industrial R & D training/work experience where the candidate has undergone actual hands on training in production/ instrumental analytical techniques/FDP/ Clinical/Pharmaceutical Biochemistry etc.
- d. Start-ups in the field of Nutrition, dietetics, food science and other areas related to biochemistry can also be considered as Projects.

4. Schedule for Submission of project Work:-

- a. The final copy of the project work (2 Copies) will have to submitted to the HOD by the date assigned by the Head of the Department

5. The project containing about 50-100 pages. Should be divided into the following parts:-

- a. Certification of completion of Project Work from the HOD.
- b. Acknowledgement.
- c. Introduction
- d. Review of Related Literature
- e. Aims and Objectives
- f. Signification of research problems selected
- g. Plan of work
- h. Material and Methods
- i. Results
- j. Discussion
- k. Bibliography

Suggested reading:

Nutrition:

1. Understanding normal and Clinical nutrition, Whitney, Cataldo of holtes 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. Nutritional 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

Immunology:

1. Weir D.M., immunology, 5th ed., ELBS and Churchill Livingston.
2. Chakravarthy A.K. Immunology, Tata McGraw Hill, New Delhi.
3. Callaghan Richard B. Immunology, Academic Press
4. Weir D.M., Immunology: Student's Notes, ELBS- Oxford.
5. Bowry T.R., Immunology Simplified, 2nd Ed., ELBS and Oxford.
6. Ivan, Immunology Method Manual, Vol. 4 1997, Academic Press, Sani Diego.
7. Roitt Ivan and others, Immunology, 6th Ed., Mosby, Edinburg.
8. Kuby, Janis, Immunology. 3rd Ed., 1997, W.H. Freeman Co.
9. Hood Leroy E., Immunology, 2nd Ed., 1976, Benjamin Cummings Publication
10. Industrial Microbiology – AH Patel, McMillan India Ltd, 1st Edition
11. Topley Wilson, Topley and Wilson's Principle of Bacteriology, Virology and immunity
12. Edward Arnold Ltd., London
13. Industrial Microbiology – AH Patel, McMillan India Ltd, 1st Edition
14. Food Microbiology – Frazier & Westhoff, Tata McGraw Hill Publishers, New Delhi

Endocrinology and clinical biochemistry:

1. Murray Robert – Harper’s biochemistry, 24th edition, Prentice Hall International UK LTD, 1990
2. Satyanarayanan – Biochemistry
3. Vasudevan Text Book of Medical Biochemistry
4. Voet&Voet – Biochemistry, 2nd edition
5. Chatterjee and RanaShinde Medical – Biochemistry
6. Rodney Boyer Experimental Biochemistry Pearson Publ. Sawheny and Singh
7. Practical Biochemistry by David Plummer
8. Chemical Process Industries – Norris Shreeve& Joseph Brink
9. Roger’s Industrial Chemistry Vol I & II – Edited by CC Furnas
10. Molecular Biology and Biotechnology – Edited by JM Walker & EB Gingdd, Panima
11. Educational Book Agency, New Delhi, 2nd Edition
12. Introduction to plant Biotechnology – HS Chawla, oxford & IBH Publishing Co, New Delhi, 2nd Edition.
13. Nanotechnology, A Genetic Introduction to the next big idea – Mark Ratner & Daniel Ratner, Pearson Education
14. Animal Biotechnology – Edited by AK Shrivastava, oxford & IBH publishing Co, New Delhi, 2005
15. Proteins, Biochemistry & Biotechnology – Gary Walsh, John Wiley & Sons, 2002
16. Biotechnology, An Introduction – Susan R Barnum, Vikas Publishing House, International Student Edition
17. Enzymes, Biochemistry, Biotechnology, Clinical Biochemistry – Trevor Palmer, First East-West Press Ed. 2004
18. Principles of fermentation Technology, Stanbury, Whitaker and Hall, Butterworth Heinemann (1997), Indian Edition.
19. Basic Biotechnology. Ratledge & Kristiansen, Cambridge press (2001).

Soft skills:

1. “Personality Development and Soft Skills (Old Edition)” by Barun K Mitra
2. “Soft Skills” by Hariharan S and S P Shanmugapriya