Structure of M.Sc. Biochemistry course

A two years M.Sc. programme is formulated for developing competent Biochemists. The course is based on choice based credit system (CBCS) and interdisciplinary nature of Biochemistry, Chemistry, Quantitative Biology, Genetics and Microbiology. The programme obliges students to read original publications and envisages significant inputs in Laboratory work, communication skills, creativity, planning, execution and critical evaluation of the scientific data. The course titles have been carefully chosen to represent the core courses and the specialization introduced in the two years course of Biochemistry are :- Enzymology, Molecular Biology, Biotechnology, Clinical Biochemistry, Nutritional Biochemistry and Immunology in consonance with the objectives of the University. The courses formulated have a biochemical slant than biological and are up to date. The course is fine tuned in order to enhance the job opportunities of the students.

M.Sc. BIOCHEMISTRY

<table>
<thead>
<tr>
<th>Table</th>
<th>Semester</th>
<th>S.No</th>
<th>Course</th>
<th>Marks</th>
<th>Total Marks</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>I Semester</td>
<td></td>
<td></td>
<td></td>
<td>Internal</td>
<td>External</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>BCH 1</td>
<td>Chemistry of Biomolecules</td>
<td>25</td>
<td>75</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BCH 2</td>
<td>Analytical Biochemistry</td>
<td>25</td>
<td>75</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BCH 3</td>
<td>Intermediary Metabolism – I</td>
<td>25</td>
<td>75</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BCH 4</td>
<td>Cell Biology &amp; Bioenergetics</td>
<td>25</td>
<td>75</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BCH 5</td>
<td>Qualitative and quantitative Biochemical Analysis (Practical-1)</td>
<td>--</td>
<td>--</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BCH 6</td>
<td>Biochemical Techniques and Biochemical Preparations (Practical-2)</td>
<td>--</td>
<td>--</td>
<td>100</td>
</tr>
<tr>
<td>II Semester</td>
<td></td>
<td></td>
<td></td>
<td>Internal</td>
<td>External</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>BCH 7</td>
<td>Intermediary Metabolism II</td>
<td>25</td>
<td>75</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BCH 8</td>
<td>Enzymology</td>
<td>25</td>
<td>75</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BCH 9</td>
<td>Microbiology &amp; Genetics</td>
<td>25</td>
<td>75</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BCH 10</td>
<td>Molecular Biology</td>
<td>25</td>
<td>75</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Elective I</td>
<td>Fundamentals of Biochemistry</td>
<td>25</td>
<td>75</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BCH 11</td>
<td>Enzymology (Practical-1)</td>
<td>--</td>
<td>--</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BCH 12</td>
<td>Microbiology (Practical – 2)</td>
<td>--</td>
<td>--</td>
<td>100</td>
</tr>
<tr>
<td>III Semester</td>
<td></td>
<td></td>
<td></td>
<td>Internal</td>
<td>External</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>BCH 13</td>
<td>Endocrine Biochemistry</td>
<td>25</td>
<td>75</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BCH 14</td>
<td>Nutritional Biochemistry</td>
<td>25</td>
<td>75</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BCH 15</td>
<td>Nerve, Vision and Muscle Biochemistry</td>
<td>25</td>
<td>75</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BCH 16</td>
<td>Genetic Engineering</td>
<td>25</td>
<td>75</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Elective II</td>
<td>Nutrition and Clinical Biochemistry</td>
<td>25</td>
<td>75</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BCH 17</td>
<td>Molecular Biology (Practical-1)</td>
<td>--</td>
<td>--</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BCH 18</td>
<td>Nutrition Biochemistry (Practical-2)</td>
<td>--</td>
<td>--</td>
<td>100</td>
</tr>
<tr>
<td>IV Semester</td>
<td></td>
<td></td>
<td></td>
<td>Internal</td>
<td>External</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>BCH 19</td>
<td>Clinical Biochemistry</td>
<td>25</td>
<td>75</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BCH 20</td>
<td>Immunology</td>
<td>25</td>
<td>75</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BCH 21</td>
<td>Biotechnology</td>
<td>25</td>
<td>75</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BCH 22</td>
<td>Technical writing, Biostatistics, Computers and Bioinformatics</td>
<td>25</td>
<td>75</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BCH 23</td>
<td>Clinical Biochemistry (Practical-1)</td>
<td>--</td>
<td>--</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BCH 24</td>
<td>Immunology and Hematology (Practical-2)</td>
<td>--</td>
<td>--</td>
<td>100</td>
</tr>
</tbody>
</table>
Evaluation

Evaluation is done by continuous assessment and semester-end examinations. Theory, practical (Lab work) and dissertation will be carried out under the supervision of faculty.

I Semester
1. Four theory papers 4X100 = 400
2. Quantitative and qualitative Biochemical Analysis practical 100
3. Biochemical Techniques and Biochemical Preparations practical 100
   
   Total = 600

II Semester
1. Four theory papers 4X100 = 400
2. Elective I of student choice from other departments 100
3. Enzymology practical 100
4. Microbiology practical 100
   
   Total = 700

III Semester
1. Four theory papers 4X100 = 400
2. Elective II of student choice from other departments 100
3. Molecular Biology practical 100
4. Nutrition Biochemistry practical 100
   
   Total = 700

IV Semester
1. Four theory papers 4X100 = 400
2. Clinical Biochemistry practical 100
3. Immunology and Hematology practical 100
   
   Total = 600

Grand total Marks = 600+700+700+600= 2600

Electives 200 Marks will not be considered for division/percentage. The total marks will be 2400.

Papers for pre-Ph.D. Examination

<table>
<thead>
<tr>
<th>S.No</th>
<th>Course</th>
<th>Total Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper - I</td>
<td>Research Methodology</td>
<td>100</td>
</tr>
<tr>
<td>Paper - II</td>
<td>Research Specialization</td>
<td>100</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>200</td>
</tr>
</tbody>
</table>
M.Sc. BIOCHEMISTRY DEGREE COURSE (CBCS)
(With effect from the academic year 2015-16 for first semester)

Semester - I

**15021: Chemistry of Biomolecules**

Unit I
Molecular logic of Life – Major constituents of cells. Biomolecules. Carbohydrates: Classification, structure, Chemical properties of carbohydrates, reactions of monosaccharides, formation of glycosidic bond, oligosaccharides, chemistry and biological role of homo and heteropolysaccharides; Structural polysaccharides (Cellulose and Chitin), storage polysaccharides (Starch, Glycogen and Inulin), Mucopolysaccharides, Blood group substances, Peptidoglycans.

Unit II
Amino acids and Proteins: Classification, structure and physico chemical properties of amino acids, Essential and non-essential amino acids, Acid base properties and general reactions of amino acids, Non-protein or unusual amino acids, Peptide bond formation and stability, Classification of proteins, Purification and isolation of proteins, criteria of purity, structural organization of proteins-Primary, Secondary, Tertiary and Quaternary structure, confirmation of proteins-Ramachandran plot, Denaturation of proteins.

Unit III
Lipids and Porphyrins: Classification and Structure, properties and classification of lipids, fatty acids, waxes, phospholipids, cerebrosides and gangliosides, lipoproteins, prostaglandins, leukotrienes, thromboxanes, steroids and bile acids.
Structure of Porphyrrins, Structure and function of Heme, Cytochromes and Chlorophyll.

Unit IV

**Recommended Books:**
3. Nucleic acid – Chargaff & Davidson Vol. II
4. The Biochemistry of Nucleic acids, Adams et al., Chapman and Hall.
5. Proteins: A guide to study by Physical & Chemical
11. Biochemistry, Lehninger A.H.
12. Textbook of Biochemistry West, E.S., Todd, Manson & Vanbruggen, Macmillian &co.

Semester - II

**15022: Analytical Biochemistry**

Unit I
Safety and good lab practices, Solutions –Percentage, Molarity, Molality, Normality, pH, Measurement of pH, pKa of functional group in biopolymers such as proteins and nucleic acids. Microscopy: basic principles of light microscopy, phase contrast microscopy, electron microscopy and fluorescence microscopy.
Sedimentation methods: principles of centrifugation, analytical and ultra centrifugation/Gradient centrifugation.

Unit II

Unit III
Separation methods: principle, methodology and application of counter current distribution, paper, thin layer, ion-exchange, gas chromatography, affinity chromatography, gel filtration, HPLC, electrophoresis - paper, agar, high voltage electrophoresis, iso - electrophoresis, iso - tachophoresis, Northern blot, southern blot, western blot analyses. in situ hybridization.

Unit IV

**Recommended Books:**
2. Techniques in Molecular Biology Ed. Walker & Gastra, Croom Helm.
5. Analytical Biochemistry, Holmes and Hazel Peck, Longman.
8. A text book of quantitative inorganic analysis including elementary instrumental analysis, Vogel ELBS.
10. Analytical Biochemistry by David Friefelder.

**15023: Intermediary Metabolism-I**

Unit I

16. Organic chemistry, I.L. Finar, ELBS.
18. Basic Principles of Organic Chemistry by Roberts & Cashino (Benjamin)
20. Organic chemistry by Morrison and Boyd Prentice Hall.
Unit II
Glucoronic acid cycle, Breakdown of glycogen, starch and disaccharides, glycolgenolysis and its regulation, Biosynthesis of glucose (gluconeogenesis), Fucose cycle, glycogen synthesis and its regulation, Regulation of blood glucose homeostasis Disorders of carbohydrate metabolism.

Unit III
Lipid metabolism: lipids as energy reserves. Oxidation of fatty acids, Oxidation of odd chain fatty acids, Energy yield and regulation. Ketone bodies, Fatty acid biosynthesis- control of fatty acid synthesis.

Unit IV

Recommended Books:
1. Principles of Biochemistry, white. A. Handler, P and Smith
2. Biochemistry, Lehninger A.L.
4. Biochemistry, Lubert Stryer.
6. Text of Biochemistry, West and Tood.
7. Outlines of Biochemistry, Conn and Stump
9. Mitochondria, Munn.

15024: Cell Biology & Bioenergetics

Unit I
Structural organization of prokaryotic and eukaryotic cells, Ultrastructure and functions of nucleus, mitochondria, plastids, endoplasmic reticulum, Golgi complex, lysosomes, microbodies, ribosomes. Cytoskeleton – microtubules and microfilaments.

Unit II

Unit III
Membrane transport: Active transport, Active transport of Na+ K+ (sodium potassium ATPase) Ca+ (Ca+2 - ATPase). Basic concepts of cell signaling and transduction, different signaling molecules, second messengers, calcium, calmodulin, inositol phosphate, CAMP, cGMP, NO. Signal cascades, inhibition of cell signaling pathways.

Unit IV
Bioenergetics - Thermodynamic principles : free energy, enthalpy (H), entropy (S), Free energy change in biological transformations in living systems; high energy compounds, oxidation – reduction reactions, Organization of electron carriers and enzymes in mitochondria, mitochondrial respiratory chain, Classes of electron transferring enzyme, inhibitors of electron transport, oxidative phosphorylation, Mechanism of oxidative phosphorylation. Microsomal electron transport – Photophosphorylation and Photosrespiration cyclic and non – cyclic reactions; photochemical events associated with pigment system – I and II.

Recommended Books:
1. Molecular Biology of the cell by Alberts et al.
2. Cell and Molecular Biology by EDP de Robertis and EMF de Robertis.
4. Molecular Genetics by D Frieldher.
5. Cell molecular biology, albert Bruce
6. Gene VII by Lewin
8. Genetics by Gardner
9. Genetics by Suzuki
10. Molecular genetics by klug and Cummings

PRACTICALS

15025: Qualitative and Quantitative Biochemical Analysis
1. General reactions of carbohydrates. Specific reactions of selected sugars
3. General reactions of lipids and cholesterol.
4. Titration curve of amino acid and calculation of pKa and pI value.
5. Estimation of amino acids by formal titration.
7. Estimation of amino acid by Ninhydrin method.
8. Effect of solvent system on the Rf value of two solutes.
10. Isolation of mitochondria from Rat liver by Density gradient centrifugation (Demonstration)

15026: Biochemical Techniques and Biochemical Preparations
1. Preparation of buffers and pH measurement.
2. Separation of amino acids by paper chromatography
3. Separation of sugars by TLC
4. Separation of amino acids by paper electrophoresis (Demonstration)
5. Separation of proteins by SDS-PAGE.
6. Standardization of pH meter and measurement of pH of a biological fluid using pH meter
7. Absorption spectra of phenol red, amino acids and nucleic acid.
8. Isolation and Spectrophotometric characterization of plant pigments.
9. Verification of Beer’s law and determination of molar extinction coefficient using p-nitro phenol.
10. Separation of plant pigments by paper chromatography.
11. Separation of amino acids by ion-exchange chromatography.
12. Isolation of starch from potatoes.
13. Isolation of cholesterol from brain.
Semester II

25021: Intermediary Metabolism-II

Unit I

Unit II
Amino acid degradation, transamination, oxidative deamination, pathways of degradation of different amino acids, biosynthesis of essential and non-essential amino acids. Regulation of amino acid biosynthesis. Inborn errors of amino acid metabolism.

Unit III
Amino acids as precursors – formation of GABA, serotonin, Catacholamines, Polyamines, Melatonin, Creatin, Histamine, Biosynthesis and degradation of Heme, glutathione, gama-glutamyl cycle, gramicidicin.

Unit IV

Recommended Books:
1. Principles of Biochemistry, White, A, Handler, P and Smith
2. Biochemistry, Lehninger A.L.
4. Biochemistry, Lubert Stryer.
6. Text of Biochemistry, West and Todd.
7. Outlines of Biochemistry, Conn and Stump
9. Mitochondria, Munn.

25022: Enzymology

Unit I

Unit II

Unit III
Chemical nature of enzyme catalysis: general acid – base catalysis, electrostatic catalysis, covalent catalysis, intermolecular – catalysis, metal ion catalysis, proximity and orientation.

Catalytic mechanisms of chymotrypsin, Trypsin, Carboxypeptidase, Ribonuclease and Lysozyme.

Unit IV
Role of co-enzymes - Nicotinamide nucleotides, flavin nucleotides, Co – enzyme A, Lipoic acid, Thiamine pyrophosphate, Biotin, tetrahydrofolate and co-enzyme B12. evaluation of catalysis – catalytic RNA (Ribozyme), abzymes (catalytic antibodies), Synzymes (synthetic enzymes).

Enzyme Regulation & Multienzyme systems: Monomeric enzymes, the serine proteases, zymogen activation, oligomeric enzymes – Isoenzymes (LDH) and multienzyme complexes (pyruvate dehydrogenase complex).

Cova lent modification (glycogen phosphorylase, glataminasynthese, chymotrypsin) allostery of enzyme action; sigmodial kinetics; the MWC and KNF models. Significance sigmodal behavior. Study of ATCase a typical allosteric enzyme.

Recommended Books:
2. Understanding enzymes: Palmer T, Ellis Harwood Ltd.
4. Enzyme structure and mechanism. Alan Fersht, Freeman & Co.
12. Enzyme Kinetic Siegel Inter Science – Wiley.

25023: Microbiology and Genetics

Unit I
Brief history of microbiology. Morphology and classification of bacteria. Staining methods (Grams staining, Acid fast and spore staining). Nutritional requirements in microorganisms: Modes of nutrition, phototrophy, chemotrophy, methylotrophy, organotrophy, mixotrophy, saprophytic, symbiotic and parasitic modes of nutrition. Types of media-natural and synthetic media (basal, complex, enrichment, selective, deferential and transport media).

Unit II
Isolation and cultivation of microorganisms – direct and indirect, Culture Methods, Maintenance of culture, Growth and kinetics of bacterial cells: Normal and biphasic growth curve, batch and continuous cultures, chemostats.

Control of microorganisms: fundamentals of control by physical and chemical agents. Antibiotics and other chemotherapy agents. Microbiology of food, water, sewage and Biogas. Food and water – borne infections.

Unit III
Classification, morphology, size, ultra structure and replication of some representative viruses (TMV, T4, SV40 and M13). Methods of culturing of viruses, isolation, purification and characterization. Anti viral therapies (small pox/polio/AIDS), viral diseases- Dengue, hepatitis, SARS.
Recommended Books:
3. Review of Medical Microbiology: Jawetz et al., 16th Ed, Maruzen Asian.
5. Pharmaceutical Microbiology, By Hugo and Russell, Blackwell Scientific
14. Biology of Microorganisms – Sandes T. Lydes
15. Instant notes in Microbiology – Nicklin et al
16. Microbial Ecology – Atlas
18. Genetics by Gardner
19. Genetics by Suzuki

25024: Molecular Biology

Unit I

Unit II
Prokaryotic and eukaryotic RNA polymerases. Structure and functions of prokaryotic RNA polymerase. Inhibitors of Transcription. DNA binding motifs. Biosynthesis of prokaryotic and Eukaryotic m-RNA, t-RNA, and r-RNA. Post transcriptional modifications of RNA- capping, adenylation and splicing. Role of hn RNA, sn RNA and sn RNP in processing of RNA.

Unit III
Operon model: operon, operator, promoter, attenuator, repressor, co-repressor, inducer, apoinducer, gratuitous inducer, induction and repression. Lac operon, His- operon, Trp- operon of E.coli.


Unit IV

Recommended Books:
1. Molecular Biology of the Gene by Watson
2. Genetics by G. Zubah
3. Molecular Biology of the Cell by Albert Bruce et al., 5th Ed.
4. Cell Molecular Biology by Baltimore
5. Molecular Biology by D Friefelder
6. Molecular Genetics by D Friefelder
9. Cell and Molecular biology by De Robertis and De Robertis, 5th Ed.
10. Molecular Genetics by Samaharty

Elecive I: Fundamental Biochemistry

Unit I
Biomolecules: Molecular logic of life, major constituents of cells. Classification, structure and functions of carbohydrates (glucose, fructose, lactose, Maltose, sucrose, glycogen, starch). Lipids (fatty acids, phospholipids, triacylglycerol), proteins (hemoglobin, albumin, myoglobin, collagen and insulin) and nucleic acids (RNA and DNA).

Unit II
Enzymes- Classification, compartmentation of enzymes, enzyme inhibition, use of enzymes. Hormones. Immunoglobulins.

Unit III
Metabolism: outline of metabolism, anabolism, catabolism, oxidation of glucose to CO2 and H2O, synthesis of glucose. Protein synthesis, lipid biosynthesis. In born errors of metabolism.

Unit IV
Biochemical techniques in biochemistry: safety and good lab practices. Microscopy, centrifugation, chromatography, immunoassays (ELISA/RRIA), UV-VIS spectroscopy.

PRACTICALS
25025: Enzymology
1. Assay of Amylase from saliva
2. Assay of Ureaase from Horse – gum
3. Assay of Acid phosphatase from serum
4. Assay of serum alkaline phosphatase
5. Assay of SDH from Liver
6. Assay of Invertase from Yeast
7. Assay of Trypsin
8. Assay of LDH from serum (Isoenzymes)
10. Assay of Cholinesterase from blood.

Recommended Books:
1. Hawk’s Physiological Chemistry
2. Practical Biochemistry by T Plummer
3. Practical Biochemistry by J Jayaraman
4. Klemm and others: Practical Biological Chemistry
5. Practical Biochemistry - Koch and Hank Dunn and Drell
6. Practical Biochemistry - Sawhney.

25026: Microbiology

1. Handling of Microscopes: calibration of Microscopes.
2. Sterilization techniques: Autoclaving (Moistened – heat sterilization), Oven sterilization (dry heat sterilization), UV irradiation and chemical Preparation of Media: for Bacteria and fungi.
3. Isolation and cultivation of pure cultures: serial dilution, pour plate method, spread plate method and streak plate method
5. Staining techniques: Gram staining, acid fast staining and spore staining for bacteria, and methylene blue staining for yeast.
6. Antibiotic sensitivity test with selected antibiotics.
7. Oligodynamic action of selected metals on bacteria.
10. Estimation of alcohol by specific gravity method
11. Cultivation of oyster mushroom (pleurotus sps) using the paddy straw.
12. Induction of mutation in bacteria using physical and chemical mutagens.
13. Isolation of nucleic acids from bacteria
15. Observation of Rhizobium from root nodules of ground nut plant.
16. Isolation of phages from sewage and quantification by plaque assay.

Books:

Semester - III

35021: Endocrine Biochemistry

Unit I

Unit II
Thyroid hormones – chemistry, biosynthesis, secretion, physiological function, regulation and disorders, hypo and hyperthyroidism, tests for thyroid function.
Parathyroid hormones – Parathormone and calcitonin, their role in calcium and phosphate metabolism, disorders of parathyroid hormone.

Unit III
Adrenal hormones – Chemistry, biosynthesis and functions of adrenal medullary and adrenal cortical hormones.
Disorders of adrenal hormones, tests for the evaluation of adrenal function.

Unit IV

Recommended Books:
5. Text Book of Endocrinology, William.

35022: Nutritional Biochemistry

Unit I
Principle food components, diet, Balanced diet, Nutritional Requirement, Recommended daily requirements, Recommended dietary allowances (RDA), Body composition and energy requirements, Measurement of energy expenditure, direct and indirect calorimetry, BMR
Unit II
Nitrogen balance and muscle protein turnover, essential and non-essential amino acids, Biological value of proteins, Protein calorie deficiency state, Kwashirkar and Marasmus.
Essential fatty acids, energy value of fats, phospholipids in nutrition.

Unit III
Mineral Nutrients, Micro nutrients and Macro nutrients, dietary sources, deficiency symptoms and recommended dietary allowances of trace elements and macro minerals.
Nutrition for infants, children, pregnant and lactating women and in old age. Importance of nutrition under stress conditions.

Unit IV
Vitamins: Fat soluble vitamins- Structure, Biological sources, requirement, functions and deficiency symptoms of vitamins A, D, E and K
Water soluble vitamins- structure, classification, properties, biological sources, requirement, chemistry and physiological significance of thiamine, riboflavin, niacin, pantothenic acid, vitamin B6, folic acid, biotin, vitamin B12 and Vitamin C.

Recommended Books:
1. Harper’s Biochemistry
2. Trace Elements by Underwood
4. Essentials of food and nutrition, Vol. 1 and 2, by M.S.Swaminathan
5. Nutritional Biochemistry by Truemen.

35023: Nerve, Vision and Muscle Biochemistry

Unit I
Appearance of brain – Gross appearance, fluid compartments, cerebro spinal fluid, blood brain barrier.
Presynaptic events at the neuromuscular junction: cholericergic and non-cholericergic synapses.
Chemical composition of brain, formation, structure and biochemistry of myelin, chemistry of major brain lipids, lipid composition, Special nervous system proteins.

Unit II
Neurotransmitter: Definition and classification of neurotransmitters.
Neurotransmitters - chemistry, synthesis, storage and release of neurotransmitters, transmitter action, chemical events at synapses, post synaptic events.
Various classes of neurotransmitters - Glutamate, GABA, catacholamines (Epinehrine, norepinephrine and dopamine), serotonin, acetyl choline.
Drugs acting on brain - anxiolytic, antidepressents and benzodiazepines.

Unit III
Biochemistry of aging, brain disorders, parkinsons disease, alzheimers disease, stroke, epilepsy.
Biochemistry of vision: Structure, Composition, Metabolism and blood supply to the eye, photochemistry of vision, lens and retina, rods and cones. Role of vitamin A in vision. Processing of visual information.

Unit IV
Structure and function of muscle – skeletal muscle structure, Biochemical characterization and extracellular matrix. Plaslemma, sarcoplasmic reticulum and myofibrils, actin, myosin, trophomycin, troponin, muscular contraction, sliding filament mechanism, oxidative and anaerobic metabolism.

Recommended Books:
1. Basic Neurochemistry 5th Ed. By Siegel.
2. Essentials of Neural Science and Behavior by Kandel.

35024: Genetic Engineering

Unit I
Molecular vectors- plasmids, phage vectors, shuttle vectors and cosmids.
DNA modifying enzymes: Restriction endonucleases, types, property and applications, RNA and DNA polymerases, nucleases, kinases, phosphatases, ligases, topoisomerases, methylases and gyrase.

Unit II
Linkers and adaptors. RNA isolation, preparation and use of cDNAs. Screening and determination of nucleotide sequences. Construction of cDNA and genomic library, Expression sequence tags, site-directed mutagenesis. Polymerase chain reaction (PCR) in recombinant DNA technology, Chromosome walking

Unit III
molecular genetics maps: Restriction mapping, restriction fragment length polymorphisms (RFLP) linkage and recombination between molecular and phenotypic markers, Random amplified polymorphic DNA (RAPDs) Using PCR.

Unit IV
Sequencing of nucleic acids- Maxim and Gilber chemical degradation and Sanger’s deoxydeo chain termination methods. Cloning of specific genes and their expression in bacteria and eukaryotic system. Human genome project, Microarray, Genetic Engineering- Applications in Medicine, Agriculture and Industry, Social and moral implications, national and international guidelines/regulations

Recommended Books:
5. From Genes to Genomes – J.W. Dala and Schantz
7. Medical Biotechnology - S.N. Jodgand
9. Genes – Lewin B.
Elective II: Nutrition and Clinical Biochemistry

Unit I
Diet, Balanced diet, calorific value of foods, nutritional requirements, RDA, BMR, biological value of proteins, energy value of fats, protein calory deficiency (Kwashior and Marasmus), malnutrition (under nutrition and over nutrition), Obesity, dietary guidelines for Indians.

Unit II
Micronutrients: water soluble and fat soluble vitamins- structure, sources, requirements, functions and deficiency symptoms.
Macrominerals – calcium, phosphorus, magnesium, sodium, potassium, chloride.

Unit III
Use of clinical biochemistry in Medicine. Use of biochemical tests, speciecollection and sample analysis.
Tests for diabetes, thyroid, jaundice, lipid profile, anemia and tumour markers.

Unit IV
Organ function tests – Liver function tests, kidney function tests.
Plasma enzymes in diagnosis and prognosis – Transaminases, CK, LDH, Alkaline phosphatase, α-amylose, molecular diagnostics.

PRACTICALS

35025: Molecular Biology and Genetic Engineering
1. Isolation of DNA from bacterial, plant and animal cells.
2. Estimation of DNA by Diphenylamine method
3. Isolation RNA from yeast cells
4. Estimation of RNA by Orcinol method
5. Estimation of DNA and purity determination by UV absorption method.
6. Determination of melting temperature (Tm)
7. Isolation of Plasmid DNA from E.coli
8. Detection and differentiation of open circular, linear and closed covalent circular plasmid DNA by submarine gel electrophoresis.
9. Restriction digestion.
10. Transformation of E.coli with amp' plasmid
11. Transfection of M13 DNA into E.coli JM 103.
13. Isolation of single and double standard M13 DNA
14. Conjugation: use of broad host range plasmid RP in demonstrating conjugation transfer of plasmid bacteria.
15. Catabolite repression: Evidence of β- Galactosidase induction

35026: Nutritional Biochemistry
1. Determination of reduced Ascorbic acid by DCPPIP method.
2. Determination of calcium in food.
3. Isolation of casein from milk and determination of its protein.
4. Determination of moisture content of foods/food grains powders
5. Determination of fructose from honey/ fruit pulp
6. Isolation of lactose from skimmed milk and the estimation of lactose.
7. Determination of Iodine value of edible oil by Titrimetry.
8. Preparation of casein from Milk
9. Estimation of fructose in the fruit juice
11. Determination of acid value by Titrimetry.
12. Determination of available lysine in food.
13. Estimation of copper in food.
15. Determination of ash content.
17. Determination of pyridoxine of fruits/leaves.
18. Estimation of magnesium in food.

Semester – IV

45021: Clinical Biochemistry
Unit I
The place of clinical Biochemistry in medicine, the use of Biochemical tests, Specimen collection, reference values, Automation and quality assurance in clinical laboratory, use of external and internal quality control.

Unit II
Homeostatic mechanisms – Maintenance of water, electrolyte and acid-base balance in the body fluids. Blood buffers, role of kidney, lungs, acidosis and alkalosis.
Kidney function – Glomerular and tubular function, renal function tests, nephrotic syndrome, ARF and CRF.
Liver function: Liver as an organ for detoxification – phase I and Phase II reactions, Bilirubin metabolism, Jaundice – Classification and differential diagnosis, kernicterus, hepatitis, gall stones, cirrhosis and fatty liver, liver function tests.

Unit III

Unit IV

Recommended Books

45022: Immunology

Unit I

Unit II
Active and passive immunity. Humoral and cell mediated immune response, T-Cell and B-Cell activation. Antigen processing and presentation. T-Cell and B-Cell receptors, Complement system. Alternate and classical pathways of complement activation. Complement fixation tests.

Unit III

Unit IV

Recommended Books:
1. Essential immunology – Ivan M. Roitt.
5. Principles of Gene Manipulation: An Introduction to Genetic Engineering (3rd Ed.)
7. Micropropagation, somatic cell culture, somaclonal variations, somatic cell hybridization, protoplast fusion, genetic transformation, methods of gene transfer, vector and vector less methods, production of transgenic plants, animals and their applications.

45023: Biotechnology

Unit I
Immobilization of enzymes, their industrial and clinical applications. Production of glucose from starch, use of glucose isomerase in confectionery industry, use of lactase in dairy industry, production of invert sugar from Glucose and sucrose, Use of protease in food, detergent and leather Industries, medical application of immobilized enzymes, Biosensors (glucose oxidase in enzyme electrodes).

Unit II
Isolation, preservation and maintenance of industrial microorganisms, batch, continuous culture techniques, principle types of fermentors. Industrial production of chemicals, alcohols, acids (citric and acetic), solvents (acetone and Butanol), antibiotics (penicillin, streptomycin, tetracycline), Vitamins (Riboflavin and Vitamin B 12), amino acids (lysin and glutamic acid and single cell protein (SCP)

Unit III
Hybridoma technique, monoclonal antibodies production, myeloma cell lines, fusion of myeloma cells, selection of hybridomas, protoplast fusion and HAT medium. Screening, purification and application of monoclonal antibodies. Vaccines-types, Subunit vaccines – against Herpes simplex virus, foot and Mouth disease, Live recombinant vaccines – attenuated (cholera, salmonella), Vector vaccines directed against viruses and bacteria.

Unit IV
Micro propagation, somatic cell culture, somaclonal variations, somatic cell hybridization, protoplast fusion, genetic transformation, methods of gene transfer, vector and vector less methods, production of transgenic plants, animals and their applications.

Recommended Books:
1. Fermentation Technology (2nd Ed.) Standury (Pergman Press).
4. Principles of Gene Manipulation: An Introduction to Genetic Engineering (3rd Ed.)
9. Micropropagation, somatic cell culture, somaclonal variations, somatic cell hybridization, protoplast fusion, genetic transformation, methods of gene transfer, vector and vector less methods, production of transgenic plants, animals and their applications.

45024: Technical writing, Biostatistics, Computers and Bioinformatics

Unit I
Technical Writing: Sentence writing, paragraph writing, story writing, review writing, various types of writing, critical comments writing.
Preparation of a research proposal: Preparation of scientific report, submission of formal proposal. Experimental design and collection of results, submission of progress report (year wise) and submission of technical report (format: title page, introduction, aims of the proposal/research, methodology, results, interpretation of results, references, acknowledgements, budgetary allocations.)
Unit II
Biostatistics: Significance of statistical methods in biological investigation. Measures of central tendency, Measures of Dispersion or spread, Probability, Probability distribution, Test of hypothesis (i) x² test (ii) t – test, Simple linear regression, Correlation measurements

Unit III
Organization of computers: components, storage devices, graphic devices, concepts of hardware and software, methods and types of networks, basics of operating systems and types. Intranet and Internet.

Unit IV

Recommended Books:

PRACTICALS
45025: Clinical Biochemistry

1. Estimation of blood glucose.
2. Estimation of blood urea
3. Estimation of creatinine in serum
4. Determination of creatinine clearance.
5. Estimation of uric acid in serum
6. Estimation of serum total protein
7. Estimation of serum albumin
8. Agar gel electrophoresis of serum proteins
9. Agar gel electrophoresis of serum lipoproteins
10. Estimation of serum cholesterol
11. Determination of SGOT
12. Determination of SGPT
13. Estimation of serum calcium
14. Estimation of serum phosphate
15. Gastric analysis
16. Estimation of serum bilirubin
17. Determination of thymol turbidity
18. Determination of zinc turbidity
19. Determination of urine ascorbic acid
20. Tests for abnormal constituents in urine.

Recommended Books:
1. Hawk's Physiological chemistry
2. Practical Biochemistry by T Plummer
3. Practical Biochemistry by J Jayaraman
4. Klemir and others: Practical Biological chemistry
5. Practical Biochemistry – Koch and Hank Dunn and Drell
6. Practical Biochemistry – Sawhney

45026: Immunology and hematology

1. RBC count
2. Total WBC count.
3. WBC Differential count.
4. Erythrocyte sedimentation Rate (ESR)
5. Packed cell volume (PCV)
7. Mean cell Haemoglobin and Mean cell RBC volume
8. Colour index and volume index of RBC.
9. Osmotic fragility of RBC.
10. Raising of antibodies to soluble antigen in rabbits
11. Immunodiffusion
12. Single Radial Immuno diffusion
13. Rocket Immunoelectrophoresis
14. Cross over Immunoelectrophoresis
15. Detection of HCG by latex agglutination inhibition test
16. Haemeagglutination tests for indentification of human blood groups
17. Detection by viral fever by slide agglutination tests.

Recommended Books:
1. Hawk's Physiological Chemistry
2. Practical Biochemistry by T Plummer
3. Practical Biochemistry by J Jayaraman
4. Klemir and others: Practical Biological Chemistry.
5. Practical Biochemistry – Koch and Hank Dunn and Drell