

M.Sc. Biochemistry syllabus
(With effect from Academic year 2015-16 for first semesters)

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 inconsonance 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

I Semester

S.No	Course	Marks		Total Marks	Credits
		Internal	External		
BCH 1	Chemistry of Biomolecules	25	75	100	4
BCH 2	Analytical Biochemistry	25	75	100	4
BCH 3	Intermediary Metabolism – I	25	75	100	4
BCH 4	Cell Biology & Bioenergetics	25	75	100	4
BCH 5	Qualitative and quantitative Biochemical Analysis (Practical-1)	--	--	100	4
BCH 6	Biochemical Techniques and Biochemical Preparations (Practical-2)	--	--	100	4

II Semester

S.No	Course	Marks		Total Marks	Credits
		Internal	External		
BCH 7	Intermediary Metabolism II	25	75	100	4
BCH 8	Enzymology	25	75	100	4
BCH 9	Microbiology & Genetics	25	75	100	4
BCH 10	Molecular Biology	25	75	100	4
Elective I	Fundamentals of Biochemistry	25	75	100	4
BCH 11	Enzymology (Practical-1)	--	--	100	4
BCH 12	Microbiology (Practical – 2)	--	--	100	4

III Semester

S.No	Course	Marks		Total Marks	Credits
		Internal	External		
BCH 13	Endocrine Biochemistry	25	75	100	4
BCH 14	Nutritional Biochemistry	25	75	100	4
BCH 15	Nerve, Vision and Muscle Biochemistry	25	75	100	4
BCH 16	Genetic Engineering	25	75	100	4
Elective II	Nutrition and Clinical Biochemistry	25	75	100	4
BCH 17	Molecular Biology (Practical-1)	--	--	100	4
BCH 18II	Nutrition Biochemistry (Practical-2)	--	--	100	4

IV Semester

S.No	Course	Marks		Total Marks	Credits
		Internal	External		
BCH 19	Clinical Biochemistry	25	75	100	4
BCH 20	Immunology	25	75	100	4
BCH 21	Biotechnology	25	75	100	4
BCH 22	Technical writing, Biostatistics, Computers and Bioinformatics	25	75	100	4
BCH 23	Clinical Biochemistry (Practical-1)	--	--	100	4
BCH 24	Immunology and Hematology (Practical-2)	--	--	100	4

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

S.No	Course	Total Marks
Paper - I	Research Methodology	100
Paper - II	Research Specialization	100
	Total	200

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, Peptidoglycons.

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 Porphyrins, Structure and function of Heme, Cytochromes and Chlorophyll.

Unit IV

Nucleic acids: Purine and Pyrimidine Bases, Nucleosides, Nucleotides, Formation of phosphodiester bond and its stability, Structure of DNA-Watson and Crick model, different forms of DNA, types of RNA, Structure of t-RNA, Denaturation and Renaturation of DNA, melting curves.

Recommended Books:

1. Glycoproteins by Hughes R.C., Chapman & Holl.
2. Biochemistry – Mechanisms of metabolism Cunningham, E.B., Mc Grew – Hill.
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
6. Proteins: Structure, function and evolution. Dickerson Geis, 2nd Edn, Benjamin/ Cummings, Menlo Park, California.
7. The proteins: Neurath and Hill, 3rd Ed. Academic New York.
8. Biochemistry – Zubay C, Addison – Wesley.
9. Biochemistry, A Problem Approach, 2nd Ed. Wood, W.B. Addison Wesley.
10. Biochemistry of Lipids and Membranes – Vance D, Addison – Wesley.
11. Biochemistry, Lehninger A.H.
12. Textbook of Biochemistry West, E.S., Todd, Manson & Vanbruggen, Macmillan &co.
13. Principles of Biochemistry white- A. Handler and Smith E.L. Mc Graw Hill.
14. The carbohydrates: Pigman & Hartman Vol. II – A & II- B.
15. Comprehensive Biochemistry – Florkin & stotz, Academic Press.

16. Organic chemistry, I.L. Finar, ELBS.

17. Organic chemistry by J.P. Cohen. Vol. 3 Edward Arnold.

18. Basic Principles of Organic Chemistry by Roberts & Cashino (Benjamin)

19. Fundamentals of Biochemistry by Voet and Voet.

20. Organic chemistry by Morrison and Boyd Prentice Hall.

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

Concept of half – life and decay constant, units of radioactivity, Radioactivity measuring techniques and correction factors. Application of isotopes in biochemical analysis, isotope dilution techniques and autoradiography. Radioisotopes in biochemistry and medicine. Measurement of radioactivity - GM counter, Liquid Scintillation Counter, γ -Counter, Radioactive disposal, RIA, ELISA, Chemiluminescence.

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

Spectroscopy methods – Concepts of spectroscopy, electromagnetic spectrum, Beer – Lamberts law, principles and applications of colorimetry, UV-VIS spectrophotometry. Concepts of fluorimetry, flame photometry, AAS, AES, Infrared, ESR, NMR, CD & ORD and X – ray Diffraction. Flowcytometry and cell sorting and their applications.

Recommended Books:

1. Principles and Techniques of Practical Biochemistry, Ed. Williams and Wilson.
2. Techniques in Molecular Biology Ed. Walker & Gastra, Croom Helm.
3. Principles of Instrumental Analysis, 2nd Ed. Holt-Sanders.
4. An Introduction to Spectroscopy for Biochemistry, Ed. Brown Sn., Academic Press.
5. Analytical Biochemistry, Holmes and Hazel Peck, Longman.
6. An Introduction to Practical Biochemistry. David t. Plummer, Tata Mac grew – Hill.
7. Biophysical Chemistry, Ed. Shall & Wyman, Academic Press Vol II & I.
8. A text book of quantitative inorganic analysis including elementary instrumental analysis, Vogel ELBS.
9. Biochemical Calculations Seigel, IH, 2nd Ed. John Wiley & Sons Inc.
10. Analytical Biochemistry by David Friefelder.

15023: Intermediary Metabolism-I

Unit I

Outline of intermediary metabolism, methods of studying metabolism. Glycolysis – Reactions, energy yield and regulation. Entry of other carbohydrates into glycolytic sequence, fermentation, TCA cycle – Reactions, Energetics and Regulation. Glyoxylate cycle, pentose phosphate pathway-regulation and significance.

Unit II

Glucuronic acid cycle, Breakdown of glycogen, starch and disaccharides, glycogenolysis and its regulation, Biosynthesis of glucose (gluconeogenesis), Futile 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

Biosynthesis of cholesterol, triacyl glycerols, phospholipids, bile acids. Formation of prostaglandins, leukotrienes, prostacyclins. Metabolism of lipoproteins. Disorders of lipid metabolism.

Recommended Books:

1. Principles of Biochemistry, white. A, Handler, P and Smith
2. Biochemistry, Lehninger A.L.
3. Biochemistry, David E. Metzler.
4. Biochemistry, Lubert Stryer.
5. Review of Physiological chemistry, Harold A. Harper.
6. Text of Biochemistry, West and Tood.
7. Outlines of Biochemistry, Conn and Stump
8. Metabolic pathways – Greenberg.
9. Mitochondria, Munn.
10. Biochemistry, 2nd Edition, G. Zubay.

15024: Cell Biology & Bioenergetics

Unit I

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

Unit II

Plant and animal cells – variation in structure and function ,Types of tissues – Epithelial tissues, basement membrane, extracellular matrix – Collagen, Elastin, fibrillin, Chromatin organization, telomere, centromere, cell division by mitosis and meiosis, cell cycle and its regulation, cell receptors, endocytosis and exocytosis. Biomembranes - composition of Membranes (plasma and organelle membranes). Membrane lipids, proteins and carbohydrates. Molecular structure of membranes, Membrane fluidity, fluid mosaic model of biological membranes.

Unit III

Membrane transport: Active transport, Active transport of Na⁺ K⁺(sodium potassium ATPase) Ca²⁺ (Ca²⁺ - 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 Photorespiration 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.
3. Cell and Molecular Biology 2nd Ed. By P.K. Gupta, Rastogi Publ.
4. Molecular Genetics by D Friefelder
5. Cell molecular biology, albert Bruce
6. Gene VII by Lewin
7. Molecular cloning by Maniatis and Co Vol I, II, III
8. Genetics by Gardner
9. Genetics by Suzuki
10. Molecular genetics by klug and Cummings
11. Cell and Molecular Biology 2nd Ed. by P.K. Gupta, Rastogi Publ.

PRACTICALS

15025: Qualitative and Quantitative Biochemical Analysis

1. General reactions of carbohydrates. Specific reactions of selected sugars
2. General reactions of amino acids and proteins. Precipitation reactions of albumin.
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.
6. Estimation of tyrosine by Millons – reaction.
7. Estimation of amino acid by Ninhydrin method.
8. Effect of solvent system on the Rf value of two solutes.
9. Estimation of proteins by Lowry and Biuret methods.
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

Nitrogen cycle, Biological Nitrogen fixation. Nitrate and ammonia utilization, ammonia excretion, synthesis of glutamine. Formation of nitrogenous excretion products. Urea cycle.

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, Catecholamines, Polyamines, Melatonin, Creatin, Histamine, Biosynthesis and degradation of Heme, glutathione, gamma-glutamyl cycle, gramicidine.

Unit IV

Nucleic acid metabolism. Synthesis of nucleotides and its regulation, Biosynthesis and degradation of purine and pyrimidine nucleotides, Salvage pathway, Lesch-Nyhan Syndrome, Synthesis of deoxy-ribonucleotides and its regulation. Inter conversion of nucleotides. Thymidylate metabolism. Nucleotides as metabolic regulators.

Recommended Books:

1. Principles of Biochemistry, White. A, Handler, P and Smith
2. Biochemistry, Lehninger A.L.
3. Biochemistry, David E. Metzler.
4. Biochemistry, Lubert Stryer.
5. Review of Physiological chemistry, Harold A. Harper.
6. Text of Biochemistry, West and Todd.
7. Outlines of Biochemistry, Conn and Stump
8. Metabolic Pathways – Greenberg.
9. Mitochondria, Munn.
10. Biochemistry, 2nd Ed, G. Zubay.

25022: Enzymology

Unit I

Classification of enzymes, specificity and active site. Fundamentals of enzyme assay – enzyme units, enzyme coupled kinetic assay. Compartmentation of enzymes. Enzyme purification by different separation techniques. Factors affecting velocity of enzyme catalyzed reactions. Kinetics of enzyme catalyzed reactions – Initial velocity studies and rapid reaction techniques. Enzyme kinetics of single substrate reactions, steady state assumption, Michaelis – Menten, Lineweaver Burk, Eadie Hofstee, Hanes plots. Pre- steady state kinetics.

Unit II

Enzyme inhibition: Types of inhibitions, irreversible, reversible, competitive, non-competitive, un – competitive, mixed inhibition and partial inhibition. Substrate inhibition, feedback inhibition and allosteric inhibition. Bi-substrate reactions, sequential mechanism compulsory order and random order mechanism, non – sequential mechanisms, ping – pong mechanisms.

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). Covalent modification (glycogen phosphorylase, glutamine synthase, chymotrypsin) allosteric of enzyme action; sigmoidal kinetics; the MWC and KNF models. Significance sigmoidal behavior. Study of ATCase a typical allosteric enzyme.

Recommended Books:

1. The enzymes Dixon & Webb, 3rd ed. Longman.
2. Understanding enzymes: Palmer T., Ellis Harwood Ltd.
3. Enzyme Kinetics: Roberts D.V., Cambridge Univ. Press.
4. Enzyme structure and mechanism. Alan Fersht, Freeman & Co.
5. Principles of Enzymology for Food Sciences: Whitaker Marc Dekker.
6. The enzyme Boyer 3rd Ed. Academic Press.
7. Methods in Enzymology Ed. Colowick and Kaplan, Academic Press (continuing series)
8. Text book of Biochemistry with Clinical Correlations (4th edition) – Thomas M. Devlin.
9. Fundamentals of enzymology 3rd ed. Nicholas C. Price and Lewis Stevens.
10. Biological chemistry; H.R. Mehler & E.H Cordes Harper & Rev.
11. Enzymes and Metabolic Inhibitors Vol. I & II J. Webb Acada. Press
12. Enzyme Kinetic Siegel Inter Science – Wiley.
13. Biochemistry Chemical reactions of living cells by David E. Metzler. Vol.I.
14. Enzyme Catalyzed Reactions by G.H. Gray.

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 chemotherapeutic 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.

Unit IV

Basic concepts of Mendelian & non-Mendelian inheritance. Importance of heredity. Sex linked inheritance. Polygenic & maternal inheritance, linkage and crossing over.

Mutation – types of mutations, mutagens, mechanisms of mutation, Mutagenesis, induction and isolation of mutants.

Recommended Books:

1. Microbiology by Pelczar, Chan and Kreig 5th Ed. Mc Grew – Hill
2. General Microbiology: Boyd, R.F., Times Mirror / Mosby College.
3. Review of Medical Microbiology: Jawetz et al., 16th Ed. Maruzen Asian.
4. A text book of Microbiology, R.C. Dubey and D.K. Maheswari, S. Chand Co.
5. Pharmaceutical Microbiology, By Hugo and Russell, Blackwell Scientific
6. An Introduction to Viruses by S.B. Biswas, Vikas Publishing House.
7. Microbial world (5th Ed.) RY. Stainer, Hamshire – Macmillan Press.
8. Microbiology 4th Ed. Prescott, Harley, Klein (Mc Grew Hill)
9. Principles of Microorganisms – Brocks.
10. Diseases of Crop Plants – G. Rangaswamy.
11. Plant Pathology – J.C. Walker.
12. Fundamentals of Microbiology - M. Frebisher.
13. Text book of Microbiology – William Burrows
14. Biology of Microorganisms – Sandes T. Lyles
15. Instant notes in Microbiology – Nicklin et al
16. Microbial Ecology – Atlas
17. Biotechnology: Textbook of Industrial Microbiology 2nd Ed. By Wulf Crueger and Anneliese Crueger.
18. Genetics by Gardner
19. Genetics by Suzuki

25024: Molecular Biology

Unit I

Central dogma in molecular biology and its verification. Conservative, semi conservative and dispersive mode of DNA replication, discontinuous synthesis of DNA, DNA primers, Enzymology of DNA synthesis: DNA polymerases I, II, III, DNA ligase. AP endonuclease, Topoisomerases and telomerase – mechanism of its action and its role in DNA synthesis. Inhibition of DNA synthesis, fidelity of replication. Mechanism of replication of E.coli DNA. ‘ θ ’ and ‘ σ ’ replication, Replication of ‘ λ ’ Phage DNA, Phage T₇ and single stranded DNA. DNA repair and recombination.

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, r-RNA, and t-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*.

General features of the genetic code, Deciphering of the genetic code - Nirenberg and Khorana’s work. Co-linearity of gene and protein. Wobble hypothesis and deviation from wobble hypothesis. Mitochondrial genetic code and evolution of genetic code.

Unit IV

Translation and its control: composition of Prokaryotic and eukaryotic ribosomes. Polysomes and organelles ribosomes.

Amino acid activation, protein chain initiation, elongation, and termination. Mechanism of protein synthesis in relation to gene action. Inhibitors of protein synthesis. Post translation modification of proteins. Synthesis of secretory and membrane proteins – signal sequence hypothesis. Protein turnover, Mechanism of Mi and Si RNA mediated translation control.

Recommended Books:

1. Molecular Biology of the Gene by Watson
2. Genetics by G. Zubay
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
7. Genes VIII by Benjamin Lewin. Oxford Univ. Press. London.
8. Cell and Molecular Biology 2nd Ed. By P.K. Gupta, Rastogi Publ.
9. Cell and Molecular biology by De Robertis and De Robertis. 8th Ed.
10. Molecular Genetics by Sambamurty
11. Cell and Molecular Biology 2nd Ed. By S C. Rastogi.

Elective 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/RIA), UV-VIS spectroscopy.

PRACTICALS

25025: Enzymology

1. Assay of Amylase from saliva
2. Assay of Urease from Horse – gram
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)
9. Enzyme purification and Enzyme Kinetics (Determination of V-max, Km and Ki). Effect of pH, Temperature, Activators, Inhibitors, Immobilization of enzymes (demonstration only).
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. Klemir and others: Practical Biological Chemistry
5. Practical Biochemistry - Koch and Hank Dunn and Drell
6. Practical Biochemistry - Sawheny.
7. Varley's Practical Clinical Biochemistry – Ed. Alan W. Gowenlock (Heinemann Medical Books, London).

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
4. Determination of bacterial growth curve.
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.
8. Starch hydrolysis assay for the identification amylase – producing microorganisms.
9. Fermentation: preparation of wine from grapes, and production alcohol from molasses.
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
14. Water analysis for bacteria and determination of B.O.D. of water.
15. Observation of Rizobium from root nodules of ground nut plant.
16. Isolation of phages from sewage and quantification by plaque assay.

Books:

1. Microbiology laboratory Manual 4th Ed. By Cappuccino
2. Microbiology laboratory Manual (2001) by Aneja K.M.
3. Laboratory Manual in Microbiology by P. Gunasekaran (1996), New Age Publ.

Semester - III

35021: Endocrine Biochemistry

Unit I

Endocrine system – organization of the endocrine system. General features and classification of hormones, mechanism of action of hormones, chemistry, biosynthesis, Secretion, physiological functions, regulation and disorders of anterior and posterior pituitary hormones, hypothalamic hormones. Hormones of the pineal gland – Serotonin and melatonin.

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

Pancreatic and gastrointestinal hormones – Biosynthesis, secretion, physiological functions and regulation of insulin and glucagon. Role of insulin and glucagon in carbohydrate, lipid and protein metabolism. Disorders of pancreas. Gastrin, secretin, Cholecystokinin.

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

Hormones of reproduction – Gonadal hormones, chemistry, biosynthesis and physiological functions of androgens, estrogens and progesterone. Hormonal regulation of menstrual cycle, contraception, reproductive disorders.

Recommended Books:

1. Text book of Biochemistry and Human Biology by Talwar G.P., Prentice Hall India.
2. Human Physiology and Mechanism of distance. Guyton 3rd Ed. Ikgushoen/Seunders.
3. Clinical Biochemistry, Vol. 1 and 2, Williams *et al.*, Heinemann Medical, 1978.
4. Lynchs Medical Laboratory Technology by Raphael, S. S., 4th Ed. Ikgushoen/Seunders.
5. Text Book of Endocrinology, William.
6. General Endocrinology – Turner.
7. Biochemical Endocrinology of the Vertebrates – E. Fruden and H. Lines.
8. Foundation of Modern Biochemical Series, Prentice Hall Inc., 1971.
9. Metabolic and Endocrine Physiology – Jay Teppermann.
10. Metabolic Pathways – Green Berg.
11. Intermediary Metabolism and its regulation – Larner
12. Principles of Biochemistry – White A., Handler P and Smith.
13. Receptors and Hormone action. Receptors and Recognition series. Text book of medical physiology by A.C. Guytom.

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, Kwashiorkar 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
3. The Book of Human Nutrition by MS. Bamji N. Prahlad Rao and V. Reddy.
4. Essentials of food and nutrition, Vol. 1 and 2, by M.S.Swaminathan
5. Nutritional Biochemistry by Truemen.
6. Casarett and Doull's Toxicology. The Basic Science of Poisons 5th Ed. By Klaasen.

35023: Nerve, Vision and Muscle Biochemistry

Unit I

Appearance of brain – Gross appearance, fluid compartments, cerebro spinal fluid, blood brain barrier, Neuronal cell types – Neurons, Glial cells, synapses. Action potential generation and propagation.

Presynaptic events at the neuromuscular junction: cholinergic and non-cholinergic 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, catecholamines (Epinephrine, norepinephrine and dopamine), serotonin, acetyl choline.

Drugs acting on brain - anxiolytic, antidepressants 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. Plasmalemma, sarcoplasmic reticulum and myofibrils, actin, myosin, troponin, 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.
3. Neurobiology molecules, Cells and Systems by Mathews.

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 gyrases.

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 dideoxy 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:

1. Genes and probes, A Practical Approach series (1995) by BD. Hames and SJ Higgins, Oxford Univ. Press.
2. Gel Electrophoresis of Nucleic acids, A Practical Approach (1990) by D Rickwood and BD Hames. Oxford Univ. Press. Refer the books already mentioned for other Molecular Biology course.
3. Recombinant DNA – James D Watson et al.
4. Gene Cloning – T. A. Brown.
5. From Genes to Genomes – J.W. Dala and Schantz
6. Gene Biotechnology – S.N. Jogdand
7. Medical Biotechnology - S.N. Jogdand
8. Principles of gene manipulations – R. W. Old and S.B. Primerose
9. Genes – Lewin B.
10. PCR-Technology: Principles and application of DNA amplification – H.A. Erlich.

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 calorie deficiency (Kwashiorkor 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.

Micro Minerals – Iron, zinc, copper, selenium.

Unit III

Use of clinical biochemistry in Medicine. Use of biochemical tests, specimen collection 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 -amylase, 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 (T_m)
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^r plasmid
11. Transfection of M_{13} DNA into *E.coli* JM 103.
12. Isolation of phage M_{13} .
13. Isolation of single and double standard M_{13} 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 DCPIP 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
10. Measurement of inversion of sucrose by polarimetry.
11. Determination of acid value by Titrimetry.
12. Determination of available lysine in food.
13. Estimation of copper in food.
14. Estimation of Iron in food.
15. Determination of ash content.
16. Determination of free amino acids of germinating seedlings.
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. Disorders of carbohydrate metabolism. Diabetes mellitus – classification, etiology, clinical and laboratory features, diagnosis of diabetes mellitus, GTT, Random, Fasting, PP glucose levels, glycosuria, ketone bodies, glycosylated hemoglobin, metabolic complications of diabetes, lactic acidosis, glycogen storage diseases, Inborn errors of amino acid metabolism (Phenylketonuria, alcaptonuria and Maple-Syrup urine disease).

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

Gastric and pancreatic function tests – pentagastrin test, insulin stimulation test, hyper chlorohydria, achlorohydria, pancreatic diseases, Malabsorption syndrome. Plasma proteins - functions and their alterations in diseases, paraproteinemias. Lipids and lipoproteins – plasma lipids and lipoproteins and their functions, interrelation of lipids, lipoproteins and apolipoproteins, hyperlipidaemias and management.

Unit IV

Clinical Enzymology: Plasma enzymes in diagnosis and prognosis, aminotransferases, creatine kinase, LDH, alkaline and acid phosphatase, α -amylase, Cholinesterase, G-6PD, Isoenzymes in health and disease, Plasma enzyme pattern in myocardial infarction, liver disease and muscle disease. Molecular diagnosis – HIV, thalassemia, tumor markers.

Recommended Books

1. Text book of Biochemistry with Clinical Correlations. Thomas M. Devlin (John Wiley).
2. Harper's Review of Biochemistry, Murray *et al* (Longman) Investigation of lipoproteinaemias and lipidemias. Renal function: Glomerular and tubular functions.
3. Biochemical Aspects of Human Disease – R.S. Elkeles and A.S. Tavit. (Blackwell Scientific Publications, 1993)

- Clinical Chemistry in Diagnosis and Treatment – Joan F. Zilva and P.R. Pannall (Lloyd – Luke medical Books, London, (1988).
- Varley's Practical Clinical Biochemistry – Ed. Alan W. Gowen Lock (Heinemann Medical Books, London (1988)
- Clinical diagnosis and management by Laboratory Methods (John Bernard Henry, W.B Saunders Company, 1984)
- Clinical Biochemistry – S. Ramakrishnan and Rajiswami.
- Chemical Biochemistry (Metabolic and Clinical Aspects) by W.J. Marshall & S.K. Bangert.
- Text book of Clinical Biochemistry by Tietz et al.

45022: Immunology

Unit I

Lymphoid organs (primary and secondary), organization of immune system, Types of immunity – Natural and acquired, specific and non-specific immune response. Cells and organs of immune system, antigenic determinants/Epitopes. Haptens, adjuvants, classification, structure and biological functions of immunoglobulins, Isotypes, allotypes and idiotypes. Theories of antibody formation.

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

Antigen-antibody interactions, precipitation reactions – immune diffusion, radial immunodiffusion, immunoelectrophoresis, immunofluorescence, RIA, ELISA, Western blotting, Hybridoma Technology, Production of polyclonal and monoclonal antibodies and their application, Major histocompatibility complex (MHC), HLA. Graft rejection.

Unit IV

Disorders of immune response – Hypersensitivity, Basic concepts, types of hypersensitivity, Autoimmune diseases – Hashimoto's thyroiditis, RA, Immunodeficiencies – SCID, AIDS. Immunosuppressive drugs. Cancer immune therapy.

Recommended Books:

- Essential immunology – Ivan M. Roitt.
- Immunology – a short course elibezamini and Sidney Leskowitz, Alan R. Lisi Inc. New York, 1988.
- Immunology III, Joseph A. Bellanti Igaku – Shein Saunders International Ed. 1985.
- Immunology at a glance J.H. L. Playfeir 4th Ed. Blackwell Scientific Publication 1987.
- Acids to Immunology D.M. Wier Churchill, Livingtons 1986.
- Fundamentals of Immunology, Myrvik and Weiser, 1984.
- Fundamentals of Immunology, Bier *et al*, Springer 1986
- Textbook of Biochemistry and Human Biology, Talwar G.P. Prentice Hall, 1980.
- Basic and Clinical Immunology – Stites et al., 4th Ed. Lange 1982.
- The Immunosystem, Mc Connell et al., Blackwell Scientific 1981.
- Fundamentals of Immunology – William C. Boyed (Wiley Toppan)
- Introduction to Immunology – John W. Kinball.
- Fundamentals of Immunology – Otto S. View and others.
- Immunology – D.M. Weir.
- Immunology – Janis Kuby,
- Cellular and Molecular Immunology 3rd, Abul K. Abbas, Andrew K. Kich Amn Jordan S. Pober

45023: Biotechnology

Unit I

Immobilization of enzymes, their industrial and clinical applications. Production of glucose from starch, use of glucose isomerase in confectionary 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 (pencillin, streptomycin, tetracycline), Vitamins (Riboflavin and Vitamin B 12), amino acids (lysine 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:

- Fermentation Technology (2nd Ed.) Standury (Pergman Press).
- Biotechnology: Textbook of Industrial Microbiology 2nd Ed. by Wulf Crueger and Anneliese Crueger (2000).
- Molecular Biotechnology: Principles and Applications of Recombination DNA (1996) Bernard R. Glick and Jack. J. Pasternak (Panima Publishing Corporation)
- Principles of Gene Manipulation: An Introduction to Genetic Engineering (5th Ed.)
- Principles of Biotechnology (1985) Alen Weisman (Surrey University Press)
- Concepts in Biotechnology (1996) Ed. D. Balasubramanian, K. Dharmalingam, J. Green and K. Jayaraman (University Press)
- Industrial Microbiology, Miller and Litsky, Mc Graw – Hill, 1976.
- Industrial Microbiology, L.E. Casida, JR New Age International (1995)
- Industrial Microbiology (Prescott & Dunn), Ed by G. Reed, CBS Publishers.
- Immobilized Enzymes (1978) by Ichiro Chibata, Halsted Press Book.

45024: Technical writing, Biostatistics, Computers and Bioinformatics

Unit I

Technical Writing: Sentence writing, paragraph writing, story writing, review writing, various types of letters 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) χ^2 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

Bioinformatics: Branches of Bioinformatics, scope of bioinformatics, useful sites on the internet: Data bases and search tools: NCBI (<http://www.ncbi.nlm.nih.gov/>), EMBL serve: (<http://www2.ebi.ac.uk/services.html>), sequence alignment: gene bee multiple sequence alignment (<http://www.genebee.msu.su/>), Tree view (<http://taxonomy.zoology.gla.ac.uk/rod/treeview.html>), Gene doc (<http://www.cris.com/ketchup/genedoc.shtml>), Sequence analysis, repetitive elements, Image analysis, office applications, logic development. Introduction to Proteomics and genomics.

Recommended Books:

1. Biostatistics, A foundation for analysis in the Health (7th Ed. 1999) by WWW Daniel and Sons Inc., New York.
2. Bioinformatics, Sequence, Structure and Databanks by Des Higgins Willie Taylor (2000).
3. Introduction to Bioinformatics by T.K. Altwood and D.J Parry- Smith (Oearson Education Asia 1999).

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.
21. Estimation of alcohol by specific gravity method.
22. Separation of serum proteins by Paper electrophoresis.

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
7. Varley's practical clinical Biochemistry – Ed. Alan W. Gowenlock (Heinemann Medical Books, London, 1988).

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)
6. Estimation of Haemoglobin (Hb).
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 identification 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
6. Practical Biochemistry - Sawhney(2000)
7. Varley's Practical Clinical Biochemistry – Ed. Alan W. Gowenlock (Heinemann Medical Books, London,1988).