

## M.Sc. Biochemistry syllabus

(With effect from Academic year 2018-19 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 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

#### 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 and Physiology	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
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
BCH 17	Molecular Biology and Genetic Engineering (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

S.No	Course	Marks		Total Marks	Credits
		Internal	External		
<b>Non-Core I</b>	<b>Fundamentals of Biochemistry (I Semester)</b>	<b>25</b>	<b>75</b>	<b>100</b>	<b>4</b>
<b>Non-Core II</b>	<b>Nutrition and Clinical Biochemistry (III Semester)</b>	<b>25</b>	<b>75</b>	<b>100</b>	<b>4</b>

## Evaluation

Evaluation is done by continuous assessment and semester- end examinations. Theory, practical (Lab work) 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
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Total		=	600
			----

### II Semester

1. Four theory papers	4X100	=	400
2. Enzymology practical			100
3. Microbiology practical			100
			----
Total		=	600
			----

### III Semester

1. Four theory papers	4X100	=	400
2. Molecular Biology practical			100
3. Nutrition Biochemistry practical			100
			----
Total		=	600
			----

### IV Semester

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

Grand total Marks = 600+600+600+600= **2400**

1. Non-core I of student choice from other departments			100
2. Non-core II of student choice from other departments			100
			----
Total		=	200
			----

Non-core 200 marks will not be considered for division / percentage. The total marks will be 2400 only.

**M.Sc. BIOCHEMISTRY COURSE (CBCS)**  
**(With effect from the academic year 2018-19 for first semester)**

**SEMESTER -I**

**BCH 1: 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, 3<sup>rd</sup> Ed. Academic New York.
8. Biochemistry – Zubay C, Addison – Wesley.
9. Biochemistry, A Problem Approach, 2<sup>nd</sup> 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, Macmillian & 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.

## BCH 2: 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,  $\gamma$ -Counter, Radioactive disposal, RIA, 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, 2<sup>nd</sup> 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, 2<sup>nd</sup> Ed. John Wiley & Sons Inc.
10. Analytical Biochemistry by David Friefelder.

### **BCH 3: 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. 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.

#### **Unit II**

Glyoxylate cycle, pentose phosphate pathway-regulation and significance. 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

#### **Unit III**

Bioenergetics - Thermodynamic principles: free energy, enthalpy (H), entropy (S), Free energy change in biological transformations in living systems; high energy compounds, exergonic and endergonic reaction, oxidation – reduction reactions. Microsomal electron transport – utilization of oxygen by oxygenases, superoxide dismutase, and catalase. photosynthesis – dark and light reaction Photophosphorylation, and Photorespiration, cyclic and non – cyclic reactions; photochemical events associated with photo system – I and II. C3 and C4 plants.

#### **Unit IV**

Nucleic acid metabolism. Synthesis of nucleotides and its regulation, Biosynthesis and degradation of purines and pyrimidines and its regulation. Salvage pathway, Lesch-Nyhan Syndrome, Synthesis of ribonucleotides, deoxy-ribonucleotides and its regulation. Inter conversion of nucleotides. 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 Tood.
7. Outlines of Biochemistry, Conn and Stump
8. Metabolic pathways – Greenberg.
9. Mitochondria, Munn.
10. Biochemistry, 2<sup>nd</sup> Edition, G. Zubay.

## BCH 4: Cell Biology & Physiology

### Unit I

Structural organization of prokaryotic and eukaryotic cells, Plant and animal cells – variation in structure and function, Types of tissues – Epithelial tissues, basement membrane, extracellular matrix, Chromatin organization, telomere, centromere, Ultrastructure and functions of nucleus, mitochondria, plastids, endoplasmic reticulum, Golgi complex, lysosomes, microbodies, ribosomes. Cytoskeleton – microtubules and microfilaments.

### Unit II

Cell division by mitosis and meiosis, cell cycle and its regulation, cell receptors, endocytosis and exocytosis. Bio-membranes - composition of Membranes. Membrane lipids, proteins and carbohydrates. Molecular structure of membranes, fluid mosaic model of biological membranes. Membrane transport: Active transport, Active transport of Na<sup>+</sup> K<sup>+</sup>(sodium potassium ATPase) Ca<sup>2+</sup> (Ca<sup>2+</sup> - ATPase).

### Unit III

Basic concepts of cell signaling and transduction, different signaling molecules, second messengers, calcium, calmodulin, inositol phosphate, cAMP, cGMP, NO. Signal cascades. Introduction to physiology. Homeostasis. Excretory System: Kidneys – Glomerular filtration, tubular function, formation of urine, regulation of water and mineral balance.

### Unit IV

Digestive system: Various regions of digestive system. Gastrointestinal secretions-composition, function of saliva, gastric, pancreatic, intestinal and bile secretions. Regulation of gastrointestinal function.

Circulatory System: Blood composition, Heart-Structure. Electrical activity, Heartbeat, Arterial system, micro circulation and lymphatics, cardiac cycle and cardiac output, control of circulation.

Respiratory system: Mechanics of respiration, gas exchange in the lungs, control of breathing.

### 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 2<sup>nd</sup> 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 2<sup>nd</sup> Ed. by P.K. Gupta, Rastogi Publ.

## **PRACTICALS**

### **BCH 5: Qualitative and Quantitative Biochemical Analysis**

1. General tests of carbohydrates. Specific reactions of selected sugars – Osazones, sucrose, pentoses.
2. General reactions of amino acids and proteins. Precipitation of proteins.
3. Qualitative tests of lipids and steroids.
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 R<sub>f</sub> value of two solutes.
9. Estimation of proteins by Lowry methods.
10. Estimation of proteins by Biuret methods.
11. Isolation of mitochondria from Rat liver by Density gradient centrifugation (Demonstration)

### **BCH 6: 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**

### **BCH-7: Intermediary Metabolism-II**

#### **Unit I**

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. Formation of monoenoic and polyenoic acids.

#### **Unit II**

Biosynthesis of cholesterol, triacyl glycerols, phospholipids, bile acids. Formation of prostaglandins, leukotrienes, prostacyclins. Metabolism of lipoproteins. Disorders of lipid metabolism – Gauchers disease, Tay-Sachs disease, Hypo and Hyper lipoproteinemia.

#### **Unit III**

Nitrogen cycle, Biological Nitrogen fixation. Nitrate and ammonia utilization, ammonia excretion, synthesis of glutamine. Formation of nitrogenous excretion products. Urea cycle. Amino acids as precursors – formation of Polyamines, Creatine, Histamine.

#### **Unit IV**

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 – Phenylketonuria, Alkaptonuria, Maple-Syrup urine disease. Biosynthesis and degradation of Heme, Glutathione,  $\gamma$ - glutamyl cycle, gramicidin.

#### **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, 2<sup>nd</sup> Ed, G. Zubay.



## **BCH 8: Enzymology**

### **Unit I**

Classification of enzymes, protein confirmation, specificity and active site. Units of enzyme activity, enzyme coupled kinetic assay. Compartmentation of enzymes. Factors affecting velocity of enzyme catalyzed reactions – effect of pH, temperature, enzyme concentration and substrate concentration. Kinetics of enzyme catalyzed reactions. Enzyme kinetics of single substrate reactions, study state assumption, Michaelis – Menten, Lineweaver Burk, Eadie Hofstee, Hanes plots.

### **Unit II**

Enzyme inhibition: irreversible, reversible, competitive, non-competitive, un – competitive and partial inhibition. Determination of  $K_i$  values, substrate inhibition, feedback inhibition and allosteric inhibition. Kinetics of enzymatic reactions having two or more substrates – single displacement reactions, double displacement reactions (Ping-Pong).

### **Unit III**

Types of enzyme catalysis mechanisms, acid-base catalysis, electrostatic catalysis, covalent catalysis, metal ion catalysis, proximity and orientation. Effects, preferential transition state binding.

Catalytic mechanisms of chymotrypsin, Trypsin, Carboxypeptidase, Ribonuclease and Lysozyme. Catalytic RNA (Ribozyme), abzymes, synzymes.

Mechanism of catalysis with coenzymes – Pyridoxal phosphate, flavin nucleotides, thiamine pyrophosphate, biotin, tetrahydrofolate, lipoic acid.

### **Unit IV**

Enzyme Regulation: General mechanisms, allosteric enzymes – AT case, cooperativity phenomenon, Sigmoidal kinetics and their physiological significance, Symmetric and sequential models for action of allosteric enzymes and their significance. Feedback inhibition. Reversible and irreversible covalent modifications of enzymes, cyclic and cascade systems, Zymogens, Isoenzymes, multienzyme systems – pyruvate dehydrogenase, fatty acid synthase complex.

### **Recommended Books:**

1. The enzymes Dixon & Webb, 3<sup>rd</sup> 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 3<sup>rd</sup> Ed. Academic Press.
7. Methods in Enzymology Ed. Colowick and Kaplan, Academic Press (continuing series)
8. Text book of Biochemistry with Clinical Correlations (4<sup>th</sup> edition) – Thomas M. Devlin.
9. Fundamentals of enzymology 3<sup>rd</sup> edi. 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. Matzler. Vol.I.
14. Enzyme Catalyzed Reactions by G.H. Gray.

## **BCH 9: Microbiology and Genetics**

### **Unit I**

Brief history of microbiology. Morphology and classification of bacteria. Staining methods (Grams staining, Acid fast and spore staining). Gram positive and Gram-negative bacteria. Isolation and cultivation of bacteria, bacterial growth curves, culture media and methods.

### **Unit II**

Molds – characteristics, classification and reproduction. General characterization of actinomycetes, rickettsia, Spirochetes and mycoplasmas.

Control of microorganisms: Methods of sterilization, Antibiotics and other chemotherapeutic agents. Food borne diseases – Botulism, Salmonella, E. coli diarrhea, Staphylococcal food poisoning.

### **Unit III**

Viruses: Structure and replication (TMV, T4, SV40 and M13). Methods of culturing of viruses, isolation, purification and characterization. Polio, Rabies Anti-viral agents, viral diseases- Dengue, hepatitis, SARS.

Airborne Diseases – Diphtheria, Pneumonia, Tuberculosis and Streptococcal diseases.

Direct Contact – Conjunctivitis, Gastritis, Syphilis, Tetanus, Leprosy, Candidiasis, Amoebiasis.

### **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 5<sup>th</sup> Ed. Mc Graw – Hill
2. General Microbiology: Boyd, R.F., Times Mirror / Mosby College.
3. Review of Medical Microbiology: Jawetz et al., 16<sup>th</sup> 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 (5<sup>th</sup> Ed.) RY. Stainer, Hamshire – Macmillan Press.
8. Microbiology 4<sup>th</sup> Ed. Prescott, Harley, Klein (Mc Graw 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 2<sup>nd</sup> Ed. By Wulf Crueger and Anneliese Crueger.
18. Genetics by Gardner
19. Genetics by Suzuki

## BCH 10: Molecular Biology

### Unit I

Central dogma in molecular biology and its verification. Conservative, semi conservative and dispersive mode of DNA replication, Uni and bidirectional DNA replication, discontinuous synthesis of DNA, DNA primers, DNA polymerase I, II & III, DNA ligase, AP endonuclease, Topoisomerases and telomerase. Inhibitors of DNA synthesis, fidelity of replication. Mechanism of replication of *E. coli* DNA. 'θ' and 'σ' replication, Replication of 'λ' Phage DNA, Phage T<sub>7</sub> and single stranded DNA. DNA repair and recombination. Bidirectional and unidirectional replication.

### Unit II

Structure and functions of prokaryotic and eukaryotic 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

Gene expression models in prokaryotes: 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

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. 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.*, 5<sup>th</sup> 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 2<sup>nd</sup> Ed. By P.K. Gupta, Rastogi Publ.
9. Cell and Molecular biology by De Robertis and De Robertis. 8<sup>Th</sup> Ed.
10. Molecular Genetics by Sambamurty
11. Cell and Molecular Biology 2<sup>nd</sup> Ed. By S C. Rastogi.

## PRACTICALS

### BCH 11: 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).

### BCH 12: Microbiology

1. Structure, Handling and calibration of Microscope.
2. Methods of Sterilization: Autoclave (Moistened – heat sterilization), Oven (dry heat sterilization), UV.
3. Preparation of Media for Bacteria and fungi.
4. Methods for isolation and cultivation of pure cultures: serial dilution, pour plate, spread plate and streak plate.
5. Bacterial growth curve: *E. coli/Bacillus*.
6. Methods of staining: Gram, acid fast and bacterial spore, and yeast methylene blue.
7. Determination of antibiotic sensitivity with selected antibiotics.
8. Oligodynamic action of selected metals on bacteria.
9. Starch hydrolysis assay for the identification amylase – producing microorganisms.
10. Fermentation: preparation of wine from grapes, and production alcohol from molasses.
11. Estimation of alcohol by specific gravity method
12. Cultivation of oyster mushroom (*Pleurotus* sps) using the paddy straw.
13. Induction of mutation in bacteria using physical and chemical mutagens.
14. Isolation of DNA and RNA from bacteria.
15. Water analysis for bacteria and determination of B.O.D. of water.
16. Identification of Rhizobium from root nodules of ground nut plant.
17. Isolation and quantification of phages from sewage by plaque assay.

#### Books:

1. Microbiology laboratory Manual 4<sup>th</sup> 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**

### **BCH 13: Endocrine Biochemistry**

#### **Unit I**

Endocrine system – organization of the endocrine system. General features and classification of hormones, mechanism of action of hormones, hypothalamic hormones, chemistry, biosynthesis, Secretion, physiological functions, regulation and disorders of anterior and posterior pituitary hormones, LH, FSH, Growth hormone, prolactin, oxytocin, Vasopressin. 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. cortisol, corticosterone, aldosterone, adrenaline, nor-adrenaline, Disorders of adrenal hormones, tests for the evaluation of adrenal function.

#### **Unit IV**

Hormones of reproduction – Gonadal hormones (testosterone), chemistry, biosynthesis and physiological functions of androgens, estrogens and progesterone, inhibin. Hormonal regulation of menstrual cycle, placental hormones, 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 3<sup>rd</sup> Ed. Iggushoen/Seunders.
3. Clinical Biochemistry, Vol. 1 and 2, Williams *et al.*, Heinemann Medical, 1978.
4. Lynchs Medical Laboratory Technology by Raphael, S. S., 4<sup>th</sup> Ed. Iggushoen/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 – Lerner
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. Guyton.

## **BCH 14: Nutritional Biochemistry**

### **Unit I**

Principle food components, 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, Protein requirement, Biological value of proteins, Protein calorie deficiency state, Kwashiorkor and Marasmus.

Essential fatty acids, energy value of fats, phospholipids in nutrition, Starvation, Obesity.

### **Unit III**

Mineral Nutrients, Micro nutrients and Macro nutrients, dietary sources, deficiency symptoms and recommended dietary allowances of trace elements and macro minerals (Calcium, Phosphorus, Magnesium, Iron, Sodium, Potassium, Iodine, Zinc).

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, dietary sources, requirement, chemistry and physiological significance of thiamine, riboflavin, niacin, pantothenic acid, vitamin B<sub>6</sub>, folic acid, biotin, vitamin B<sub>12</sub> 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 5<sup>th</sup> Ed. By Klaasen.

## **BCH 15: Nerve, Vision and Muscle Biochemistry**

### **Unit 1**

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

### **Unit III**

Biochemistry of aging, Neurodegenerative disorders, Parkinsons disease, Alzheimers disease, stroke, epilepsy.

Biochemistry of vision: Structure, Composition, Metabolism and blood supply to the eye, lens and retina, rods and cones. Photochemistry of vision. 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, streptomycin, troponin, muscular contraction, sliding filament mechanism, oxidative and anaerobic metabolism.

### **Recommended Books:**

1. Basic Neurochemistry 5<sup>th</sup> Ed. By Siegel.
2. Essentials of Neural Science and Behavior by Kandel.
3. Neurobiology molecules, Cells and Systems by Mathews.

## BCH 16: Genetic Engineering

### Unit I

Introduction to genetic engineering, cloning, cloning vectors - plasmids, phage vectors, shuttle vectors and cosmids.

Enzymes in genetic engineering: Restriction endonucleases, types, property and applications, RNA and DNA polymerases, nucleases, kinases, phosphatases, ligases, topoisomerases, methylases and gyrases.

Linkers and adaptors.

### Unit II

RNA isolation, preparation and use of cDNAs. Screening and determination of nucleotide sequences.

Construction of cDNA and genomic library, site-directed mutagenesis.

Polymerase chain reaction (PCR) in recombinant DNA technology, Chromosome walking

### Unit III

Maxam and Gilbert chemical degradation and Sanger's dideoxy chain termination methods of nucleotide sequencing, Restriction mapping, restriction fragment length polymorphisms (RFLP) linkage and recombination between molecular and phenotypic markers, Random amplified polymorphic DNA (RAPDs) Using PCR. Human genome project, Microarray.

### Unit IV

Cloning of specific genes and their expression in bacteria and eukaryotic system. Genetic Engineering- Applications in Medicine, Agriculture and Industry, RNAi technology for gene knock out studies, Social and moral implications, national and international guidelines/regulations. RNA technology for gene knockout mechanism.

### 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.



## PRACTICALS

### BCH 17: Molecular Biology and Genetic Engineering

1. Isolation and determination of DNA from bacteria, plant and animal cells.
2. DNA estimation by Diphenylamine method.
3. Determination of DNA and purity by UV absorption method.
4. Isolation and determination of RNA content from yeast.
5. RNA estimation by Orcinol method
6. Determination and analysis of melting curve of DNA ( $T_m$  of DNA)
7. Isolation and concentration determination of plasmid DNA from *E. coli*
8. Agarose gel electrophoresis for isolation of various forms of plasmid.
9. Determination of restriction activity on DNA.
10. Amp<sup>r</sup> plasmid transformation in *E. coli*.
11. Isolation of phage M<sub>13</sub>.
12. Isolation of single and double standard M<sub>13</sub> DNA.
13. Transfection of M<sub>13</sub> DNA into *E. coli* JM 103.

### BCH 18: Nutritional Biochemistry

1. Isolation of casein from milk and estimation.
2. Determination of moisture content of foods/food grains powders
3. Isolation of lactose from skimmed milk and its estimation.
4. Determination of reduced Ascorbic acid by DCPIP method.
5. Determination of calcium in food.
6. Determination of Iodine value of edible oil by Titrimetry.
7. Estimation of fructose in the fruit juice and honey.
8. Measurement of inversion of sucrose by polarimetry.
9. Determination of acid value by Titrimetry.
10. Determination of available lysine in food.
11. Estimation of copper in food.
12. Estimation of Iron content of apple juice.
13. Determination of ash content of foods.
14. Determination of free amino acids of germinating seedlings.
15. Determination of pyridoxine of fruits/leaves.
16. Estimation of magnesium in food.

## **SEMESTER – IV**

### **BCH 19: Clinical Biochemistry**

#### **Unit I**

The place of clinical Biochemistry in medicine, the use of Biochemical tests and the clinical biochemistry laboratory, Specimen collection, reference values, Automation and autoanalyzers, quality assurance in clinical laboratory – internal and external quality control.

Investigation of disorders of carbohydrate metabolism: Hypoglycemia, Hyperglycemia. Diabetes mellitus – classification, clinical and metabolic features and management. laboratory diagnosis of diabetes mellitus – glucose tolerance test (GTT), Random, Fasting, post prandial (PP) blood glucose levels, glycosuria, ketones, glycosylated hemoglobin (GHb), metabolic complications of diabetes – Diabetic keto acidosis (DKA), glycogen storage diseases,

Plasma proteins – functions and their alterations in disease, paraproteinemias.

#### **Unit II**

Kidney function: Formation of urine, Normal and abnormal constituents of urine, Glomerular and tubular function, renal function tests, nephrotic syndrome and CRF.

Liver function: structure and function of liver, liver function tests, Bilirubin metabolism and Jaundice, kernicterus, liver diseases - hepatitis, gall stones, cirrhosis.

Gastric and pancreatic function: Gastric function tests - Penta gastrin test, insulin stimulation test, hyper chlorhydria, achlorhydria, pancreatic diseases – acute pancreatitis, Malabsorption syndrome.

#### **Unit III**

Fluid and electrolyte balance – hyponatremia and hypernatremia, hyperkalemia, acid-base balance in the body fluids - Blood buffers, role of kidney and lungs, metabolic acidosis and alkalosis.

Plasma Lipids and lipoproteins and their functions – lipid profile, clinical disorder of lipid metabolism - hyperlipidemias and management, Atherosclerosis.

Molecular diagnosis – HIV, thalassemia, tumor markers. Cerebrospinal fluid analysis (CSF)

#### **Unit IV**

Plasma enzymes in diagnosis and prognosis: Transaminases (SGOT & SGPT), alkaline and acid phosphatase, lactate dehydrogenase (LDH), creatine kinase (CK),  $\alpha$ -amylase, acid phosphatase,  $\gamma$  – glutamyl transferase, acetyl Cholinesterase, Isoenzymes of clinical importance, Plasma enzyme pattern in myocardial infarction, liver disease and muscle disease.

Inborn errors of amino acid metabolism - Phenylketonuria, alkaptonuria and Maple-Syrup urine disease.

Hemoglobinopathies.

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

## BCH 20: 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. Cytokines. Major histocompatibility complex (MHC).

### Unit III

Antigen-antibody interactions, precipitation reactions – immune diffusion, radial immunodiffusion, immunoelectrophoresis, immunofluorescence, Western blotting, Hybridoma Technology, Production of polyclonal and monoclonal antibodies and their application, RIA and ELISA.

### Unit IV

Disorders of immune response – Hypersensitivity, Basic concepts, types of hypersensitivity, Autoimmune diseases – Hashimoto's thyroiditis, RA, Immunodeficiencies – SCID, AIDS. Cancer immune therapy. Graft rejection, HLA typing, Immunosuppressive drugs (cyclosporine, methotrexate, steroids).

### Recommended Books:

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

## **BCH 21: Biotechnology**

### **Unit I**

Immobilized enzymes and their applications. Protein engineering. 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, Biosensors (glucose oxidase in enzyme electrodes).

### **Unit II**

Isolation, preservation and maintenance of industrial microorganisms, batch, continuous culture techniques, Types of fermenters. 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 (lysine and glutamic acid and single cell protein (SCP)

### **Unit III**

Therapeutic proteins (urokinase/ etheepidtes/Mabs/ plasminogen). Acting prozgi ADA gene activation. 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**

Animal and plant cell /tissue culture techniques: Micro propagation, somatic cell culture, soma clonal variations, somatic cell hybridization, protoplast fusion, genetic transformation, methods of gene transfer, vector and vector less methods, production of transgenic plants and animals and their applications.

### **Recommended Books:**

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

## **BCH 22: Technical writing, Biostatistics, Computers and Bioinformatics**

### **Unit I**

Technical Writing: Sentence writing, paragraph writing, story writing, review writing, various types of letters writing.

Preparation of a research project proposal: Selection of appropriate funding agency, Informal proposal, formal proposal, submission of technical report (format: title page, introduction, aims of the proposal/research, methodology, results, interpretation of results, references, acknowledgments, budgetary allocations), execution of results, submission of progress report (year wise), scientific communications (Articles, papers, reviews etc.) and critical comments writing.

### **Unit II**

Scope of statistical methods in life sciences. Variables, Measure of central tendency: Mean, median and mode, Measuring Dispersion: Standard deviation, co-efficient of variation, probability, probability distributions, test of significance and estimation, Linear regression and correlation, the chi-square test, ANOVA, t-Test and F-Test.

### **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. Bio-statistics, A foundation for analysis in the Health (7<sup>th</sup> Ed. 1999) by WWW Daniel and Sons Inc., New York.
2. Introduction to Bio-statistics and Research Methods by P.S.S. Sundar Rao and Richard.
3. Bio-statistics by Sokal and Rolf.
4. Bioinformatics, Sequence, Structure and Databanks by Des Higgins Willie Taylor (2000).
5. Introduction to Bioinformatics by T.K. Altwood and D.J Parry- Smith (Oearson Education Asia 1999).
6. UGC-MRP gudelines and format, DST and DBT gudelines and formats for project praposals.
7. Authour gudelines of any UGC recognized journals.
8. English grammar books for formal and informal letter writing.

**PRACTICALS**  
**BCH 23: Clinical Biochemistry**

1. Determination of glucose in plasma by GOD-POD.
2. Estimation of blood urea
3. Estimation of serum creatinine
4. Determination of creatinine clearance.
5. Estimation of serum uric acid.
6. Estimation of serum total proteins.
7. Estimation of serum albumin.
8. Estimation of total serum Cholesterol.
9. Determination of SGOT activity
10. Determination of SGPT activity
11. Estimation of serum calcium
12. Estimation of serum phosphate
13. Determination of serum bilirubin
14. Determination of thymol turbidity
15. Determination of urine ascorbic acid
16. Tests for abnormal constituents in urine.
17. Estimation of alcohol by specific gravity method.
18. 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).

**BCH 24: Immunology and hematology**

1. Determination of antigen and antibody reaction: Ouchterlony Technique.
2. Determination of human blood group antigens.
3. Raising of antibodies to specific antigen in rabbits.
4. Rocket Immunoelectrophoresis.
5. Detection of HCG by latex agglutination inhibition test.
6. ELISA: Antibody capture assay.
7. Complete blood picture: RBC count.
8. Complete blood picture: TLC.
9. WBC differential count.
10. Erythrocyte sedimentation Rate (ESR).
11. Packed cell volume (PCV)
12. Determination of Haemoglobin (Hb).
13. Mean cell Haemoglobin and Mean cell RBC volume.
14. Osmotic fragility of RBC.

**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).

## **Non-Core 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, endocrine glands. Hormones. Polypeptides and steroids. Immunoglobulins and immune action.

### **Unit III**

Metabolism: outline of metabolism, anabolism, catabolism, oxidation of glucose to  $\text{CO}_2$  and  $\text{H}_2\text{O}$ , synthesis of glucose. Protein synthesis, lipid biosynthesis. Inborn errors of metabolism.

### **Unit IV**

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

## **Non-Core 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.

Microminerals – 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 tumor markers.

### **Unit IV**

Organ function tests – Liver function tests, kidney function tests.

Plasma enzymes in diagnosis and prognosis – Transaminases, CK, LDH, Alkaline phosphatase,  $\alpha$ -amylase, molecular diagnostics.



**Papers for pre-Ph.D. Examination**

S. No.	Course	Total Marks
Paper - I	Research Methodology	100
Paper - II	Research Specialization	100
Total		<b>200</b>

## **Department of Biochemistry**

### **Syllabus for Research Methodology**

#### **Unit I**

**Technical Writing:** Preparation of research proposal – informal proposal, modification of informal proposal, 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, hypothesis, methodology, results, interpretation of results, references, acknowledgements, budgetary preparation).

#### **Unit II**

**Literature Search:** Search Engines: Selection of research topic, Collection and review of literature, databases, data mining, how to write a research paper and plagiarism.

#### **Unit III**

**Techniques in Biochemistry:** I Separation Techniques: 1. Chromatography – Counter current distribution, Paper, Thin Layer, Reverse phase, absorption, ion exchange, Affinity, gel filtration, gas chromatography and HPLC. 2. Centrifugation – RCF, Gradient and analytical Ultra centrifuge in characterizing biomolecules. 3. Electrophoresis – paper, agar, immune electrophoresis, High voltage electrophoresis, capillary electrophoresis, iso-tachophoresis, Northern blot and Southern blot analyses. *in situ* hybridization, PCR, RT-PCR, Microarray.

#### **Unit VI**

**Techniques in Biochemistry:** II i. Radioactive Tracer techniques – Radioactivity, units of radioactivity, half-life, Decay constant, Radioactivity measuring techniques, biological effects of radiation, isotope dilution techniques, safety measurements from radioactivity and radioisotopes in biochemical and medical research, Autoradiography. ii. Spectroscopy – Electromagnetic spectrum, Beer-Lamberts Law, Principles and applications of UV-VIS, Fluorescence, Flame, FT-IR, flow cytometry, ESR, NMR and MALDI, CD & ORD, Principles and applications of X-ray diffraction, iii. Immunological Techniques – ELISA, Chemiluminescence, RIA. Western blot, introduction to animal cell culture techniques.

#### **Unit V**

**Biostatistics and Computers in biology:** i. Biostatistics – Measures of Dispersion, Probability and distribution, Correlation Co-efficient, Test of hypothesis – chi square test, F-Test, t-Test, simple liner regression, one way and two ways ANOVA. ii. Use of computers in Biology – Basics. Fundamentals of bioinformatics: Biological database sequence alignment, functional genomics, genome mapping, proteomics.