

Department of Biochemistry
Kakatiya University,
Warangal, Telangana State



M. Sc., Biochemistry
Revised Syllabus
(Semester System & CBCS)
***w.e.f.* Academic Year 2016-2017**

KAKATIYA UNIVERSITY
M.Sc. BIOCHEMISTRY SYLLABUS
Semester wise Credit Pattern, Instruction Hours, Marks Allotment.
[With effect from the academic year 2016-17 Under CBCS system]

Ist YEAR

Semester –I

S. No	Paper Code	Title of the paper	Instruction Hrs/ Week	No. of Credits	Marks		Total marks
					External	Internal	
1	101	Cell Biology	4	4	80	20	100
2	102	Biomolecules	4	4	80	20	100
3	103	Biophysical and Biochemical Techniques	4	4	80	20	100
4	104	Enzymology	4	4	80	20	100
5	105	Practical I	4	4	100	-	100
6	106	Practical II	4	4	100	-	100
7	107	Seminar	--	1	--	25	25
		TOTAL		25			625

Semester –II

S. No	Paper Code	Title of the paper	Instruction Hrs/ Week	No. of Credits	Marks		Total marks
					External	Internal	
1	201	Metabolism	4	4	80	20	100
2	202	Molecular Biology	4	4	80	20	100
3	203	Immunology	4	4	80	20	100
4	204	Microbial Biochemistry	4	4	80	20	100
5	205	Practical I	4	4	100	-	100
6	206	Practical II	4	4	100	-	100
7	207	Seminar	--	1	--	25	25

IInd YEAR**III Semester**

S.No.	Paper Code	Title of the paper	Instruction Hrs/ Week	No. of Credits	Marks		Total marks
					External	Internal	
1	301	Clinical Biochemistry	4	4	80	20	100
2	302	Genetic Engineering	4	4	80	20	100
3	303	Endocrinology	4	4	80	20	100
3	304	Animal Biotechnology	4	4	80	20	100
6	306	Practical I	4	4	100	-	100
7	307	Practical II	4	4	100	-	100
8	308	Seminar	----	1	--	25	25
		TOTAL		25			625

IV Semester

S. No.	Paper Code	Title of the paper	Instruction Hrs/ Week	No. of Credits	Marks		Total marks
					External	Internal	
1	401	Bioinformatics and Biostatistics	4	4	80	20	100
2	402	Nutritional Biochemistry	4	4	80	20	100
3	403	Nanotechnology	4	4	80	20	100
4	404	Plant Biochemistry	4	4	80	20	100
6	405	Practical I	4	4	100	-	100
7	406	Practical II	4	4	100	-	100
8	407	Seminar	--	1	--	25	25
		TOTAL		25			625

**M.Sc (Biochemistry) Syllabus under CBCS pattern
(with effect from 2015-2016)**

M.Sc. Biochemistry I-Semester

PAPER-I (Biochem-101): Cell Biology - Theory Syllabus

UNIT – I

- 1.1. Origin of life. Molecular logic of life. Prokaryotes and eukaryotes. Structural organization of viruses, bacteria, plant and animal cells.
- 1.2. Membranes – Plasma Membrane structure and functions. Cell wall: structure and functions.
- 1.3. Cell organelles: Nucleus: components, chromatin packing-nucleosomes, endoplasmic reticulum: signal peptide hypothesis, Golgi complex: sorting of proteins, vesicular traffic (secretory and endocytotic pathway), lysosomes, ribosomes, mitochondria, centrosome: organization of microtubules and movement of intracellular traffic, motor proteins. Peroxisomes. Animal tissue: Epithelial tissues, connective tissues, muscular tissue, nervous tissue and sensory cells).
- 1.4. Plant tissue: Dermal, vascular and ground tissue. Animal tissues: Epithelial, connective, muscular and nervous tissues.

UNIT – II

- 2.1. Biomembranes: Molecular models and chemical composition: membrane lipids and fluidity; membrane proteins: topology and significance; membrane carbohydrates and their significance.
- 2.2. Transport across the membrane: osmosis, active and passive transport. Carriers (uni, sym and antiporters) and channels (voltage-gated and ligand-gated).
- 2.3. Bulk transport: Endocytosis (pino and phagocytosis), receptor mediated endocytosis and exocytosis.
- 2.4. Cell-cell adhesion: cell junctions. Cytoskeleton and extra cellular matrix. Cell signaling: Communication between and inside the cells.

UNIT – III

- 3.1. Cell division - types of division: Molecular events of cell division and cytokinesis.
- 3.2. Cell cycle and its regulation: Checkpoints, cyclins and cyclin-dependent kinases. Cancer: oncogenes and tumor-suppressor genes, Apoptosis.
- 3.3. Animal cell culture: principles, problems and prospects. Differentiation of cells during development.
- 3.4. Stem Cells: Totipotent and Pluripotent cells. Stem cells and their renewal with blood cell formation as an example.

UNIT – IV

- 4.1. Excitable cells nerve cells – typical neuron and types of neurons.
- 4.2. Membrane potentials, nerve impulse transmission. Synapse and synaptic transmission.
- 4.3. Neurotransmitters and their mode of action. Biochemistry of vision.
- 4.4. Muscular system-types of muscles. Ultrastructure of striated muscle, mechanism of muscle contraction-sliding filament theory.

Suggested Reading

1. The Cell –Geoffrey. M. Cooper
2. Cell and Molecular Biology (8th Edition)-E.D.P. De Robertis and E.M.F. DeRobertisJr.(Lippicott Williams & Wilkins).
3. Molecular Biology of the Cell. (3rd Edition) – Bruce Alberts etal (Garland Publishing
4. Biochemistry (2nd Edition) – David Voet, Judith Voet.
5. Molecular Cell Biology (4th Edition) – Lodish, Berketal (W.H.Freeman& Co)
6. Cell and Molecular Biology – Shieler and Branchi
7. Cell Biology – Neal O. Thorpe (John Wiley & Sons)
8. Lehningers Principles of Biochemistry (3rd Edition) – David . L. Nelson and Mic structure of C. Cox

M.Sc (Biochemistry) Syllabus under CBCS pattern

(with effect from 2015-2016)

M.Sc. Biochemistry I-Semester

PAPER-II (Biochem-102): Biomolecules - Theory Syllabus

UNIT – I CARBOHYDRATES:

- 1.1. Classification; monosaccharides, isomerism, reactions of monosaccharides. Amino sugars and acidic sugars.
- 1.2. Glycosidic bond, di, oligo and polysaccharides. Their structures and biological functions
- 1.3. Isolation, purification and structural determination of glycogen (Chemical and enzymatic method).
- 1.4. Glycosaminoglycans, peptidoglycans, glycoproteins, blood group polysaccharides, bacterial cell wall polysaccharides.

UNIT – II - LIPIDS AND PORPHYRINS

- 2.1. Classification of Lipids, chemistry of fatty acids, triacylglycerol, waxes, glycerophospholipids, sphingolipids, glycosphingolipids cerebrosides, gangliosides; cholesterol, bile acids and bile.
- 2.2. Biological role of neutral fats, phospholipids cholesterol; Structure and biological role of lipoproteins. Liposomes.
- 2.3. Structure and functions of prostaglandins, prostacyclins, thromboxanes, leukotrienes,.
- 2.4. Classification, nomenclature and properties of porphyrins, structure and biological functions of metallo-porphyrins (heme), chlorophyll.

UNIT – III - AMINOACIDS AND PROTEINS

- 3.1. Classification, structure, stereoisomerism, physico-chemical properties, chemical reactions of amino acids.
- 3.2. Naturally occurring peptides-Glutathione, bradykinin. Solid phase synthesis of peptides.
- 3.3. Classification and biological functions, Physico-chemical properties of proteins: protein structure – primary (determination of N & C terminal amino acids). Secondary (Ramachandran's plot), α -helix and β -sheet, fibrous proteins; α -keratins, silk fibroin, collagen, elastin.
- 3.4. Protein folding (tertiary structure): Globular proteins: myoglobin. Quaternary structure: haemoglobin. Sickle cell haemoglobin. Isolation and purification of proteins and criteria of purity.

UNIT – IV - NUCLEIC ACIDS:

- 4.1. Properties of purines, pyrimidines. Nucleosides, nucleotides. Functions of nucleotides.
- 4.2. DNA: base composition, primary (chemical cleavage method) and secondary structure. Double helical structure (B, A and Z forms); forces stabilizing secondary structure. Tertiary structure of DNA
- 4.3. Physicochemical properties of nucleic acid: denaturation, hyperchromic effect. T_m , kinetics of reassociation. Cot values: chemical and enzymatic hydrolysis of nucleic acids. Hybridization and its significance. Isolation of nucleic acids.
- 4.4. RNA: Structure, types –mRNA, tRNA and rRNA. Primary, secondary and tertiary structure of tRNA. Functions of RNAs.

Recommended Books

- 1) Principles of Biochemistry general aspects 1983- Smith et al (mc Graw Hill)
- 2) Principle of Biochemistry 1993 Nelson & Cox (CBSINDIA)
- 3) Biochemistry(2nd Edition) –David Voet and Judith Voet
- 4) Biochemistry (4thEdition)- L.Stryer(Freeman)
- 5) Biochemistry –Zubay
- 6) Nucleic acid Biochemistry ,Molecular Biology –Man waringetal.Blackwell.

**M.Sc (Biochemistry) Syllabus under CBCS pattern
(with effect from 2015-2016)
M.Sc. Biochemistry I-Semester - Theory Syllabus
PAPER-III (Biochem-103): Biophysical and Biochemical Techniques**

Unit I

- 1.1. Biological relevance of pH, measurement of pH, pKa of functional groups in biopolymers such as proteins and nucleic acids. Importance of buffers in biological systems, ion selective electrodes, and oxygen electrode. Donnan membrane equilibrium.
- 1.2. Significance of osmotic pressure in biological systems, viscosity and determination of molecular weight using viscometers.
- 1.3. Microscopy: Basic principles of light microscopy, phase contrast microscopy, electron microscopy, and fluorescence microscopy.
- 1.4. Sedimentation methods: Basic principles of centrifugation, preparative, differential and density gradient centrifugations, analytical, ultra centrifugation, applications in the determination of molecular weight, purity of biomolecules and detection of conformational changes of biomolecules. Flow cytometry.

Unit II

- 2.1. Radioactivity: half-life, decay constant, average life, units of radioactivity, Radioactivity measuring techniques, and correction factors.
- 2.2. Statistics of counting operations, Radiation dose units, Roentgen, REP, REM maximum permissible dose, dosimetry and dosimeters.
- 2.3. Radiation monitoring hazards, Biological effects of radiation, Isotope dilution technique and its application in biochemical investigations.
- 2.4. Radioisotopes in biochemistry and medicine. RIA.

Unit III

- 3.1. Theoretical principles, methodology and biochemical applications of separation methods: Counter current distribution, Paper, Thin layer, Reverse phase, absorption, ion exchange, affinity chromatography,
- 3.2. Electrophoresis: Paper, agar, immune-electrophoresis, high voltage electrophoresis, SDS-PAGE and isoelectric focusing, Capillary electrophoresis, iso-tachopheresis, 2D electrophoresis, Pulse- field gel electrophoresis.
- 3.3. Gel filtration, HPLC, GC MS,
- 3.4. Blotting Techniques; Northern blot, Southern blot, Western blot Analyses and development of blots.

Unit IV

- 4.1. Spectroscopy: Electromagnetic radiations, Beer-Lamberts law, principles and applications of colorimetry, spectrophotometry. UV spectrophotometer.
- 4.2. Principle and biological application of fluorimetry, flame photometry,
- 4.3. Principles and applications of AAS, AES, Infrared, ESR, NMR and Polarimetry,
- 4.4. CD & ORD. Principles and applications of X-ray Diffraction. MALDI- LCMS, Biosensors.

Recommended Books

1. Principles and Techniques of practical Biochemistry. Eds. Williams and Wilson.
2. Techniques in Molecular biology Ed. Walker & Gastra, Croom Helm, 1983.
3. Principles of instrumental analysis, 2nd Ed, Holt-Sanders, 1980.
4. An introduction to spectroscopy for Biochemistry. Ed. Brown S.N., Academic press
5. Analytical Biochemistry, Holmes and Hazel peck, Longman, 1983.
6. An introduction to practical biochemistry. David T. Plummer, Tata Mac Grew-Hill.
7. Biophysical chemistry, Edshall & Wyman, Academic press Vol II & I.
8. A textbook of quantitative inorganic analysis including elementary instrumental analysis, Vogel ELBS.
9. Biochemical calculations Seigel, IH, 2nd Edit, John Wiley & sons Inc., 1983.
10. Analytical Biochemistry by Friefelder David

**M.Sc (Biochemistry) Syllabus under CBCS pattern
(With effect from 2015-2016)
M.Sc. Biochemistry I-Semester
PAPER-IV (Biochem-104): Enzymology - Theory Syllabus**

Unit I

- 1.1. Nomenclature and classification of enzymes according to I.U.B. Convention, specificity and active site.
- 1.2. Fundamentals of enzyme assay – enzyme units, coupled kinetic assay. Enzyme localization, Isolation, purification and criteria of purity. Enzyme purification by different separation techniques.
- 1.3. Elements of kinetics – Reaction rates transition state theories free energy change. Methods used in the investigation of kinetics of enzyme-catalyzed reactions – Initial velocity studies and rapid reaction techniques (Continuous flow and Stopped flow).
- 1.4. Enzyme kinetics of single substrate reactions, steady state assumption, Michaelis-Menten (Briggs-Haldane), Lineweaver Burk, Eadie Hofstee, Hanes plots. Pre-steady state kinetics. Effect of pH and temperature.

Unit II

- 2.1. Enzyme inhibition: Types of inhibition – reversible, competitive, non-competitive, uncompetitive mixed and partial inhibition.
- 2.2. Substrate inhibition, Feedback inhibition and allosteric inhibition. Irreversible inhibition.
- 2.3. Bisubstrate reactions, Sequential mechanism compulsory order and random order mechanism, non-sequential mechanism, Ping-pong mechanism.
- 2.4. Chemical nature of enzyme catalysis: General acid – base catalysis, electrostatic catalysis, covalent catalysis, intermolecular-catalysis, metal ion catalysis, and proximity and orientation.

Unit III

- 3.1. Mechanism of reactions catalyzed by the following enzymes – Chymotrypsin, Trypsin, Carboxypeptidase, Ribonuclease and Lysozyme.
- 3.2. Co-enzymes – the mechanistic role of the following co-enzymes in enzyme catalyzed reactions – Nicotinamide nucleotides, Flavin nucleotides, Co-enzymes A, Lipoic acid, Thiamine pyrophosphate, Biotin, Tetrahydrofolate and Co-enzyme B12.
- 3.3. Modern concepts of evaluation of catalysis-catalytic RNA (Ribozyme), abzymes (catalytic antibodies), Synzymes (Synthetic enzymes).
- 3.4. Site-directed mutagenesis.

Unit IV

- 4.1. Monomeric enzymes – the Serine proteases, Zymogen activation, Oligomeric enzymes – Isoenzymes (LDH) and multienzyme complexes - pyruvate dehydrogenase complex.
- 4.2. Covalent modification (Glycogen phosphorylase, Glutamine synthase, Chymotrypsin).
- 4.3. Allosteric of enzyme action; Binding of ligands to proteins Co-operativity, the Hill Plot for Myoglobin and Hemoglobin, Sigmoidal kinetics: The MWC and KNF models. Significance sigmoidal behavior.
- 4.4. Study of ATCase, a typical allosteric enzyme.

Recommended Books

1. Understanding enzymes: Palmer T., Ellis Harwood ltd., 2001.
2. Enzyme structure and mechanism. Alan Fersht, Freeman & Co. 1997
3. Principles of enzymology for food sciences: Whitaker Marc Dekker 1972.
4. Methods in enzymology Ed. Colowick and Kaplan, Academic Pr (Continuing series)
5. Text book of Biochemistry with clinical correlations (4th edition)-Thomas M.Devlin.
6. Biological chemistry; H.R. Mehler & E.H Cordes Harper & Rev.
7. Enzyme kinetics Siegel interscience – Wiley 1976.
8. Biochemistry chemical reactions of living cells (2001) David E.Matzler.Vol.I.

**M.Sc (Biochemistry) Syllabus under CBCS pattern
(With effect from 2015-2016)**

**M.Sc. Biochemistry I-Semester - Practical - I
Cell Biology and Biomolecules**

I. Qualitative analysis of Biomolecules:

1. Carbohydrates (Specific reactions of sugars like Glucose, Fructose, Sucrose, Maltose, Lactose, Xylose, Galactose).
2. Amino acids (Tyrosine, Histidine, Methionine, Tryptophan, Cysteine and Arginine).

II. Biochemical Preparations:

1. Preparation of Starch from Potatoes
2. Preparation of Casein from Milk.
3. Isolation of Cholesterol and Lecithin.
4. Preparation of Lactose from Milk.

III. Titrimetry:

1. Estimation of glucose by BQR method.
2. Estimation of Vitamine C by 2,6- DCPIP method.
3. Estimation of iodine number of oil.
4. Estimation of Saponification value of oil.

IV. Colorimetric Estimations:

1. Estimation of Glucose by Nelson-Somogyi method.
2. Estimation of maltose by Di NitroSalicylic acid method.
3. Estimation of inorganic Phosphorus by Fiske-Subbarow method.
4. Estimation of protein by Biuret method.
5. Estimation of protein by Lowry method.

Cell Biology

1. Cell Counting using hemocytometer
2. Isolation of mitochondria
3. Isolation of chloroplasts
4. Mitosis and the Cell Cycle in Onion Root-Tip Cells
5. Meiotic cell division in grasshopper testis
6. Permanent slide preparation
7. Buccal smear – Identification of Barr Body
8. Selective permeability of plasma membrane

**M.Sc (Biochemistry) Syllabus under CBCS pattern
(With effect from 2015-2016)**

**M.Sc. Biochemistry I-Semester - Practical- II
Biophysical and Biochemical Techniques and Enzymology**

I. Biochemical Techniques:

1. Electrophoresis for proteins and DNA.
2. Determination of anion exchange capacity of resin.
3. separation of amino acids by ion-exchange chromatography;
4. Lab safety, GLP, calculations and preparation of standard solutions
5. Preparation of buffers and measurement of pH using pH meter
6. Titration curves of amino acids
7. Determination of pKa and pI of acidic, basic, and neutral amino acids
8. Separation of purines and pyrimidines by paper chromatography
9. One and two-dimensional paper chromatography of amino acids
10. Paper chromatography of plant pigments
11. TLC of plant pigments
12. TLC of lipids
13. Desalting of proteins by dialysis
14. Gel filtration (Size exclusion)
15. Cell fractionation (centrifuge)

Enzymology

1. Assay of catalase from liver
2. Assay of acid phosphatase
3. Assay of alkaline phosphatase
4. Assay of urease
5. Assay of arginase from liver
6. Assay of Succinate Dehydrogenase
7. Any enzyme inhibition experiment.
8. Preparation of buffer/solution of given pH, molarity, normality and molality
9. Effect of pH on enzyme activity
10. Effect of temperature on enzyme activity
11. Effect of [S], determine K_m and V_{max}
12. Immobilization of enzymes

**M.Sc (Biochemistry) Syllabus under CBCS pattern
(with effect from 2015-2016)**

M.Sc. Biochemistry II-Semester

PAPER-I (Biochem-201): Metabolism - Theory Syllabus

UNIT – I - BIOENERGETICS:

- 1.1. Thermodynamic principles - Chemical equilibria, free energy, enthalpy, entropy. Free energy change and high energy compounds, phosphoryl transfer potential, role of ATP.
- 1.2. Biological redox systems. Organization of electron carriers in the mitochondria.
- 1.3. Substrate level and oxidative phosphorylation, un-couplers and inhibitors of oxidative phosphorylation. Mechanisms of oxidative phosphorylation.
- 1.4. Mitochondrial transport system. Microsomal electron transport. Bioluminescence.

UNIT – II – CARBOHYDRATE AND LIPID METABOLISM:

- 2.1. Reactions of glycolysis, regulation of glycolysis, fermentation, feeder pathway (fructose, galactose and mannose metabolism), T.C.A. cycle and its regulation of TCA cycle. HMP shunt. Uronic acid pathway.
- 2.2. Metabolism of glycogen and its regulation. Gluconeogenesis. Lactose synthesis, Glyoxylate pathway. Disorders of carbohydrate metabolism.
- 2.3. Biodegradation of fatty acids via β , α and ω oxidation. Oxidation of unsaturated fatty acids. Oxidation of odd chain fatty acids. Ketogenesis. Biosynthesis of fatty acids. Regulations of lipid metabolism. Metabolism of triglycerides, phospholipids and sphingolipids.
- 2.4. Biosynthesis of cholesterol and its regulation Arachidonate metabolism: Biosynthesis of prostaglandins. Thromboxanes and leukotrienes (Eicosanoids). Disorders of lipid metabolism.

UNIT – III - PHOTOSYNTHESIS AND NUCLEIC ACID METABOLISM:

- 3.1. Ultra Structure of chloroplasts, chemistry, chlorophylls and other pigments. Hill reaction photosystems I and II and their role in ATP and NADPH production (Z scheme).
- 3.2. Photo phosphorylation, CO_2 fixation via the calvin cycle. The C_4 pathway (Hatch-Slack Pathway) Regulation of photosynthesis. Plant hormones - auxins, gibberellins, cytokinins.
- 3.3. Nucleic Acid Metabolism: Biosynthesis, Degradation and regulation of purine and pyrimidine nucleotides. Inhibitors of nucleotide biosynthesis. Biosynthesis of deoxy ribonucleotides regulation of ribonucleotide reductase. Salvage pathway.
- 3.4. Disorders of purine and pyrimidine nucleotide metabolism.

UNIT – IV - PROTEIN AND AMINO ACID METABOLISM:

- 4.1. Protein turnover: chemical signals for turnover (Ubiquitin, PEST sequence). General metabolic reactions of amino acids: Transamination, deamination, oxidative and non-oxidative deamination, amino acid decarboxylation.
- 4.2. Urea cycle and its regulation Nitrogen cycle Biological nitrogen fixation nitrogenase system. Synthesis of glutamine and regulatory mechanism of glutamine synthetase.
- 4.3. Amino Acid Metabolism - Absorption of amino acids via γ - glutamyl cycle. Metabolic breakdown of individual aminoacids.
- 4.4. Biosynthesis of essential amino acids. Genetic disorders of amino acid metabolism.

Recommended Books

- 1) Principle of Biochemistry – A.L Lehninger (CBS Publisher)
- 2) Biochemistry – Lubert STRYER (5THEdt)
- 3) Principle of Biochemistry – General aspects – Smith et al(8thEdt)
- 4) Harper s Biochemistry –Murray et al (Lange)
- 5) Text Book of Biochemistry – West et al 1966 (Mcmillian)
- 6) Biochemistry (2ndEdt) C,K Mathews and K,E Van Holde (1995).
- 7). Text of biochemistry and clinical correlation- Thomos M. Devlin (John Wiley)2nd edition
- 8). Biochemistry 2nd edition David Voet and J.G Voet (1984) (john Wiley)
- 9). Outlines of Biochemistry by E.E Conn & Stump (Wiley Eastern Lt)
- 10) Biochemistry by Zubay.

M.Sc (Biochemistry) Syllabus under CBCS pattern
(with effect from 2015-2016)
M.Sc. Biochemistry II-Semester
PAPER-II (Biochem-202): Molecular Biology - Theory Syllabus

Unit I

- 1.1. DNA synthesis and repair - Topology of DNA, conservative, semi conservative and discontinuous synthesis of DNA, DNA primer for DNA synthesis. DNA polymerases I, II, III – their role in DNA synthesis.
- 1.2. DNA ligase - mechanism of its action and its role in DNA synthesis. Inhibition of DNA synthesis, fidelity of replication. Alternate lengthening of telomere. Nearest neighbour frequency analysis.
- 1.3. Mechanism of replication of *E. coli* DNA. Role of DNA binding proteins – Histones in Eukaryotes, SSB in prokaryotes.
- 1.4. Replication of lambda phage DNA, phage T-7 and single stranded DNA, the rolling circle model of replication of DNA. Mitochondrial replication, transcriptional switch.

Unit II

- 2.1. RNA synthesis and processing: RNA polymerases in prokaryotes and eukaryotes. Molecular composition of prokaryote RNA polymerase. Mechanism of transcription. Role of various compounds on RNA polymerases.
- 2.2. Biosynthesis of prokaryotic and Eukaryotic mRNA, rRNA, and tRNA. Inhibitors of RNA synthesis.
- 2.3. Processing of RNA- post transcriptional modifications, capping, adenylation and splicing. Role of the hnRNA, snRNA and snRNP in processing of RNA.
- 2.4. Functions and information content of DNA methylation, Transcriptional transcript RNA, template DNA, recombination and silencing repair in yeast, sRNA and gene regulation.

Unit III

- 3.1. Genetic code: General features of the code, Deciphering of the genetic code – Nirenberg and Khorana's work.
- 3.2. Central dogma in the molecular biology and its verification.
- 3.3. Colinerarity of gene and protein. Wobble hypothesis and deviation from wobble hypothesis.
- 3.4. Mitochondrial genetic code and evolution of genetic code. RNA editing and evolution.

Unit IV

- 4.1. Ribosomology: Prokaryotic and Eukaryotic molecular components of ribosomes. Assembly and dissociation of subunits. Polysomes and organelles ribosomes. Ribosomal switch.
- 4.2. Biosynthesis of proteins: Different stages and components of protein synthesis, ribosomes, m RNA and tRNA. Amino acid activation, protein chain initiation, elongation, and termination. Mechanism of protein synthesis in relation to gene action.
- 4.3. Some aspects of eukaryotic translation. Inhibitors of prokaryotic translation. Post – translational modification of proteins.
- 4.4. Synthesis of secretory and membrane proteins – signal sequence hypothesis. Mechanism of translation control. Proteins local synthesis and disposal.

Recommended Books

1. Molecular Biology of the gene by Watson
2. Genetics by G Zubay
3. Molecular Biology of the Cell by Albert Bruce
4. Cell molecular Biology by Baltimore
5. Molecular Biology by D Friefelder
6. Molecular Genetics by D Friefelder
6. Genes VII Benjamin Lewin (2000). Oxford Univ.Press. London.
7. Cell and Molecular Biology 2nd Edit. (2002) By P.K.Gupta, Rastogi Publ.

**M.Sc (Biochemistry) Syllabus under CBCS pattern
(with effect from 2015-2016)
M.Sc. Biochemistry II-Semester
PAPER-III (Biochem-203) Immunology - Theory Syllabus**

Unit I

- 1.1. Historical background of Immunology, Biological aspects of Immunology, Self and non-self recognition, specificity, memory of immune system.
- 1.2. Antigens: Essential features of Ag, haptens, Carrier molecule, Immunological valence, Antigenic determinants. Adjuvants: Freund's complete and incomplete.
- 1.3. Antibodies: Nature, Primary structure of immunoglobulins, light chain, heavy chain, variable region, constant region, Hinge region; Enzymatic fragmentation of Ig. Domain structure of Ig and significance;
- 1.4. Classification of Immunoglobulins: Types –IgG (G1, G2, G3 & G4), IgM, IgA, IgD and IgE (Origin, structural functions). Theories of Ab formation-Instructive, selective, clonal selection theories and evidences; Immunological memory.

Unit II

- 2.1. Antibody diversity: Mini gene theory, Mutation theory, Germ line theory, Somatic recombination, V (D) J recombination, Combinatorial diversity, Junctional diversity.
- 2.2. Types of immunity, Active and passive immunity. Cell mediated immunity, humoral immunity, immune response; primary and secondary response. Phagocytosis, mechanism of phagocytosis.
- 2.3. Types of Interferons, Null cells: Natural Killer cells. Complement system: Nature, components of complement.
- 2.4. Pathways: Classical and alternative pathways. Complement fixation tests.

Unit III

- 3.1. Hypersensitivity (HS): Type I: Allergies and anaphylaxis – IgE, Mast cell degranulation, biologically active agents released in reactions, Clinical manifestations. Type II: Antibody mediated HS reactions; Mechanism, pathogenicity and cases of type II reactions; Hemolytic-disease of new born (HDN).
- 3.2. Type III: Immune complex mediated HS reactions: Mechanism and pathogenicity of type III reactions. Soluble immune complexes and insoluble immune complex mediated reactions. Arthus reaction, Serum sickness. Type IV: Delayed type (or) cell-mediated HS reactions; Mechanisms and pathogenicity, Tuberculin reaction.
- 3.3. Type V: Stimulatory HS reactions. Mechanism and pathogenicity, Grave's disease.
Blood groups: AB, Rh system, Lewis-Luthern systems, significance, practical application of immuno methodology in blood transfusions, Erythroblastosis foetalis.
- 3.4. Auto immunity: Auto recognition, classes of auto immuno diseases. (Hashimoto disease, thyrotoxicosis, Systemic lupus erythomatosis, Autoimmune haemolytic anaemia, Rheumatoid arthritis).

Unit IV

- 4.1. Transplantation: Terminology, Auto graft, Isograft, Allograft, Xenograft, Immunological basis of transplantation reactions, GVH reaction, Immuno suppression,
- 4.2. General mechanisms of Immune suppression, Immune suppression, drugs (azothioprine, methotrexate, cyclophosphamide, cycosporin-A, Steroids).
- 4.3. Immune Deficiencies: Introduction, primary and secondary deficiencies. T-cell, B-cell and combined immune deficiencies, Complement system deficiency. Acquired immuno deficiency syndrome. SCID. Major Histocompatibility Complex: MHC in mice and HLA in man-fine structure and functions only.

4.4. Immunological techniques: Precipitin curve, Immuno diffusion, one and two dimensional, single radial immuno diffusion, Ouchterlony immuno diffusion.
Immuno-electrophoresis: Rocket immuno-electrophoresis; CIE, Graber and William technique.
Agglutination: Direct and Indirect, Widal test, VDRL test.
Radioimmunoassay: ELISA – Principle, Methodology and applications.
Immuno-fluorescence: Direct, indirect and Sandwich, *in situ* localization by techniques such as FISH and GISH.

Recommended Books

1. Essential immunology- Ivan M. Roitt.
2. Introduction to Immunology – John W.Kinball.
3. Immunology – D.M. Weir.
4. Immunology – Janis Kuby.

**M.Sc (Biochemistry) Syllabus under CBCS pattern
(With effect from 2015-2016)**

**M.Sc. Biochemistry II-Semester - Theory Syllabus
PAPER-IV (Biochem-204): Microbial Biochemistry**

UNIT – I - GENERAL PRINCIPLES

- 1.1. History of microbiology, major contribution in microbiology related to biochemistry; Pasteur's contributions,
- 1.2. Classification of microbial world (Haeckel, Whittaker, Carl Woese).
- 1.3. Comparative account of Archea, eubacteria and eukaryotes.
- 1.4. Nutrition of microorganisms; major and minor bioelements, their sources and physiological functions. Growth factors and their functions in metabolism.

UNIT – II - MICROBIAL GROWTH

- 2.1. Isolation, cultivation and identification of bacteria.
- 2.2. Growth curve, mathematics of growth, measurement of microbial growth.
- 2.3. Effect of limiting factor, continuous cultures: chemostat, turbidostat, balanced and unbalanced growth.
- 2.4. Influence of environmental factors on growth solutes, water activity, pH, temperature, oxygen pressure, radiation, growth inhibition.

UNIT – III - VIRUSES AND BACTERIOPHAGES

- 3.1. Nature of viroids, prions and viruses; composition.
- 3.2. structure of viruses; isolation and assay of viruses- General methods of virus isolation with examples of TMV and t phages; Assay of TMV and bacteriophages.
- 3.3. Assay of animal viruses with special reference to oncogenic viruses, pock assays.
- 3.4. Bacteriophages structure and life cycles of T7 phages, λ -phage, ϕ x 174, Q β and M13, one step growth, burst size and eclipse.

UNIT – IV - ANIMAL VIRUSES AND CANCER

- 4.1. Animal viruses – General features, genome organization and replication strategies of adenoviruses, 4.2. Polioviruses, influenza virus, SV 40, retroviruses (RSV and HIV).
- 4.3. Oncogenic viruses and carcinogenesis, oncogenes.
- 4.4. Mechanism of cell transformation, interaction in permissive and non permissive hosts.

Recommended Books

- 1) Tex Book of Microbiology – william Burrows
- 2) The Microbial World – R,Y.Stainer et al
- 3) Microbiology –Pelczar ,Reid and Chain
- 4) Biology of Microorganisms –sandes T,Y lyles
- 5) Fundamentals of Microbiology – M Frebisher
- 6) Microbiology –Pyalkin
- 7) Principles of Microorganisms—Brocks
- 8) Cell biology (1993) –David E Sada(jones and Baret)

**M.Sc (Biochemistry) Syllabus under CBCS pattern
(With effect from 2015-2016)**

**M.Sc. Biochemistry II-Semester - Practical- I
Metabolism and Molecular Biology**

Metabolism

1. Estimation of glucose by Nelson Somogyi method.
2. Estimation of total sugar by anthrone method.
3. Estimation of maltose by dinitrosalicylic acid method.
4. Estimation of inorganic phosphorous by Fiske Subbarow method.
5. Estimation of protein by Lowry method.
6. Estimation of protein by Biuret method.
7. Estimation of ammonia by Nessler's method.
8. Estimation of ammonia by Berthelot method.
9. Estimation of Urea by Dam method.
10. Estimation of Pyruvate.
11. Estimation of creatinine by Jaffe's methods.

Molecular Biology

1. Isolation and purification of genomic DNA
2. Isolation and purification of plasmid DNA
3. Isolation of total RNA
4. Analysis of proteins by SDS-PAGE (1D electrophoresis)
5. Molecular hybridization- Southern blotting (DNA), Northern blotting (RNA), Western blotting (proteins)
6. Strategies in genome sequencing-DNA sequencing
7. Amplification of DNA by Polymerase chain reaction (PCR)
8. Restriction Fragment Length Polymorphism (RFLP)
9. Amplified Fragment Length Polymorphisms (AFLP)
10. Restriction digestion and DNA Ligation

**M.Sc (Biochemistry) Syllabus under CBCS pattern
(with effect from 2015-2016)**

**M.Sc. Biochemistry II-Semester - Practical- II
Immunology and Microbial Biochemistry**

Immunology

1. ABO Blood grouping
2. WIDAL Test
3. COOMB's Test/Direct antiglobulin test
4. Anti-streptolysin-O Test
5. Rapid plasma reagin (Rpr) 18-Mm circle card test
6. C-Reactive Protein Testing (CRP)
7. Radial Immuno-diffusion
8. Ouchterlony double diffusion (Antibody titration)
9. ELISA quantification of Immunoglobulins
10. Determination of antigen concentration by capture or competitive ELISA
11. Estimation of haemoglobin by Sahli's method
12. Checking antisera for the presence of antibody towards a specific antigen COUNTER CURRENT IMMUNO ELECTROPHORESIS (CCIE)

Microbial Biochemistry

1. Sterilization techniques (Autoclaving, hot air oven sterilization, filtration, membrane filtration)
2. Preparation of routine laboratory media – nutrient broth, LB Broth, agar media
3. Isolation of bacteria, actinomycetes and fungi from soil/water
4. Development of a single colony from a bacterial culture
5. Techniques of maintenance of stock cultures
6. Staining techniques – simple, differential, acid-fast and spore staining
7. Measurement of microbial growth
8. Motility (hanging drop) of microbial cells
9. Microscopic observations of microbial culture
10. Study of growth of bacteria, cyanobacteria and fungi
11. Effect of pH, temperature and osmotic concentrations on bacterial growth
12. Differentiation of bacteria based on fermentation, starch hydrolysis, gelatin liquefaction, urease activity, catalase activity, nitrate reductase activity
13. Oligodynamic action of metals on bacteria
14. Microbiological assay of antibiotics
15. Isolation and assay of bacteriophages
16. Plaque assay
17. One-step growth assay

**M.Sc (Biochemistry) Syllabus under CBCS pattern
(With effect from 2015-2016)**

**M.Sc. Biochemistry III-Semester - Theory Syllabus
PAPER-I (Biochem-301): Clinical Biochemistry**

UNIT – I – Disorders of Carbohydrate Metabolism

- 1.1. Importance of extracellular glucose, blood glucose homeostasis-role of tissues and hormones; diseases due to low and high carbohydrate levels.
- 1.2. Diabetes mellitus –classification, etiology, clinical and laboratory features. Diagnosis of diabetes mellitus-glucose tolerance test, random, fasting and post prandial glucose levels, glycosuria, ketone bodies, glycosylated haemoglobin. Plasma insulin.
- 1.3. Metabolic complications- diabetic hyperglycemic come, hyperosmolalnonketotic come, lactic acidosis, atherosclerosis, neuropathy.
- 1.4. Hypoglycemia, fasting & provoked-stimulation tests (IV, glucagon & leucine test), extended GTT, hypoglycemia in children, neonatal and early infancy. Insulinomas. Galactosaemia, hereditary fructose intolerance. Glycogen storage diseases.

UNIT – II – Disorders of Lipids And Proteins

- 2.1. Disorders of Lipids – Plasma lipoproteins, cholesterol, triglycerides & phospholipids in health and disease, hyperlipidemia, hyperlipoproteinemia, Gaucher's disease, Tay-Sach's and Niemann-Pick disease, ketone bodies, Abetalipoproteinemia.
- 2.2. In born Errors of aminoacids, purines, pyrimidines and porphyrin metabolisms.
- 2.3. Inborn Errors of Metabolism – Phenylketonuria, alkaptonuria, albinism, tyrosinosis, maple syrup urine disease, Lesch-Nyhan syndrome, sickle cell anemia, Histidinemia.
- 2.4. Muscular Dystrophy and cystic fibrosis, Blood Disorders Immunodeficiency disorders. Autoimmunity.

UNIT – III - Biochemical Evaluation of Diseases

- 3.1. Biochemical aspects of liver disease: Bile acid metabolism and bile formation. Bilirubin metabolism, biosynthesis, hepatic uptake and transport, conjugation and excretion, enterohepatic circulation. Liver function tests. Serum enzymes in liver disease. Cirrhosis, gallstones, hepatitis: types and clinical manifestation. Jaundice- classification and differential diagnosis, kernicterus.
- 3.2. Gastric function tests: Gastric function, stimulation of gastric secretion. Compassion of gastric secretion. Tests for gastric function – fraction test meal. Pentagastrin test. Insulin stimulation test, hyperchlorohydrria, achlorohydrria, achylia, gastrica.
- 3.3 Tests for evaluation of Pancreatic diseases, Steatorrhea and malabsorption syndrome.
- 3.4. Renal function tests: Glomerular and tabular functions. Tests for evaluation- concentration, dilution, excretion, clearance test. Nephritis and nephritic syndrome

UNIT-IV – Clinical Diagnostics

- 4.1. Basic techniques used in molecular diagnostics, future of molecular diagnostics,
- 4.2. Fluorescent in-situ hybridization for identification of chromosomal abnormalities.
- 4.3. Pre Clinical Studies: Pre clinical Models - Drug discovery and development, including animal studies, tissue culture studies, safety, efficacy,
- 4.4. Assessment of pharmacokinetics in early phase drug evaluation, Metabolism studies - in vitro and in vivo tests, Pharmacogenomics,

Recommended Books

- 1) Text Book of Biochemistry with Clinical correlations . Thomas M.Devlim (John wily)
- 2) Harper Review of Biochemistry Murray et al (Longman)
- 3) Clinical chemistry in diagnosis and treatment – joan f zilva and P R Pannall (1988)
- 4) Clinical diagnosis and management by Laboratory methods(John Bernard Henry 1984)
- 5) Medical Biochemistry – S-Rmakrishnan and Rajiswami.
- 6) Clinical Biochemistry A cantorow and L, Trumper (Saunders)
- 7) Clinical chemistry in diagnosis and treatment – joan f zilva and P R Pannall (1988)
- 8) Clinical diagnosis and management by Laboratory methods(John Bernard Henry 1984)
- 9) Medical Biochemistry – S-Rmakrishnan and Rajiswami.
- 10) Clinical Biochemistry A cantorow and L, Trumper (Saunders)
- 11) Biochemical disorders in Human diseases R.H S Thompson and E,J King (churchil)
- 12) Harper s Review of Biochemistry ,Murray et al (Longman.)
- 13) Principles of gene manipulation – R.W Old and S.B. Primrose.
- 14) Elements of Biotechnology – R.K. Gupta.

**M.Sc (Biochemistry) Syllabus under CBCS pattern
(With effect from 2015-2016)**

**M.Sc. Biochemistry III-Semester - Theory Syllabus
PAPER-II (Biochem-302): Genetic Engineering**

UNIT - I - GENE TRANSFERS AND MAPPING

- 1.1. Bacterial chromosomes, plasmids; fertility, resistance, colicinogenic and others.
- 1.2. Recombination In Bacteria – Transformation, Conjugation, F- mediated sexduction- Generalised and specialized transduction.
- 1.3. Mechanism of recombination and recombinant frequencies. Mapping of bacterial chromosome. Use of interrupted mating – transduction and recombination frequencies.
- 1.4. Data elucidation, construction of genetic map. Benzer's classical studies on the r II region of T4 Phage genetic map.

UNIT – II - RECOMBINANT DNA TECHNOLOGY

- 2.1. Screening of clones: Introduction and overview of methodology for cloning. DNA library. Identification of clones of interest. Applications of gene cloning. Chromosome walking and mapping techniques. Subtractive cDNA cloning.
- 2.2. Fragmentation of nucleic acids: Restriction Endonucleases. Methods of ligation. DNA ligases, ligation of fragments with cohesive ends. Adapters and linkers. Blunt end ligation.
- 2.3. Homopolymertailing . vectors: P^{BR} 322 and related vectors. Cosmids, Phagemids, YAC, Shuttle (Shuttle vectors), BAC vectors.
- 2.4. Eukaryotic vectors. Copy number, subcloning strategies.

UNIT – III - EXPRESSION OF RECOMBINANT PROTEINS AND DNA SEQUENCING

- 3.1. Use of expression vectors to overproduce proteins. Bacterial and Baculoviral expression, Yeast expression. Reporter genes and identification of upstream control elements. Secretion of recombinant proteins. Fusion proteins. 3.2. Production of recombinant proteins with examples of insulin, somatostatin and interferon.
- 3.3. DNA sequencing methods. Maxim and Gibert's method. Dideoxy chain termination method of Sanger. Gene probes in detection of disease. DNA finger printing and Diagnostics,
- 3.4. Human genome project. PCR, RFLP, RAPD and its applications. Shotgun and hierarchical sequencing, Next Generation sequencing

UNIT – II - DNA SEQUENCING

- 4.1. DNA sequencing methods. Maxim and Gibert's method. Dideoxy chain termination method of Sanger.
- 4.2. Gene probes in detection of disease. Shotgun and hierarchical sequencing, Next Generation sequencing
- 4.3. DNA finger printing and Diagnostics,
- 4.4. Human genome project. PCR, RFLP, RAPD and its applications.

Recommended Books

1. Genetics, Strick Berger, M.W. (1990) 3rd edn. McMillan.
2. Human Molecular Genetics; Peter Sudbery, (2002) Printice Hall.
3. Introduction to Modern Virology, Primrose and Dimmock (1988), Blackwell Sc.
4. Genetics and Molecular Biology; Robert Schleif, The Johns Hopkins University Press Baltimore, (1993).
5. Discovering Genomics, Proteomics and Bioinformatics, Campbell A M &Heyer L J, 2nd Edn. Benjamin Cummings, (2007).
6. Introduction to Genetics: A Molecular Approach; T A Brown, Garland Science (2011).
7. Molecular Cell Biology; Lodish et al., 7th Edn. W.H. Freeman and Co. (2012).
8. Molecular Biology of the Cell; 7th Edn. Bruce Alberts et al., Garland Publications (2008).
9. Nuclear Organization; Chromatin Structure and Gene- Expression, Roen Van Driel and Arie P. Otte Oxford University Press (1997).
10. Principles of Developmental Genetics; S.A. Moody, Academic Press (2007).
11. The Cell; Geoffrey Cooper, and Robert E.; 5th edn. HausmanSinauer Associates (2009).
12. The Science of Genetics, George W. Burns and Paul J. Bottino (1989), Maxwell-McMillan.
13. Human Genetics; Lewis, 7th Edn. WCB & McGraw Hill (2007).
14. Essential Genetics: A Genomics Perspective; Daniel L. Hartl, 6th Edition, Jones and Barlett Learning (2012).
15. Bacterial and Bacteriophage Genetics; Edward A. Birge, 5th Edition, Springer (2006).
16. Nucleosome Histone, and Chromatin; Part-A; Carl Wu and C. Allis, Academic Press (2012).
16. J. Sambrook, E. Frisch and T. Maniatis 2000. Molecular Cloning: Laboratory manual , Cold Spring Harbor Laboratory Press New York.
17. D.M. Glover and BD Hames 2001. DNA Cloning: A Practical Approach, IRL Press, New York.
18. D.V. Goeddel 1990. Methods in Enzymology Vol.185, Gene Expression Technology, , Academic Press, Inc. San Diego,
19. D.A. Mickloss and GA Freyer 1990. DNA Science. A first Course in Recombinant Technology, Cold Spring Harbor Laboratory Press, New York.
20. S.B. Primrose. 1994. Molecular Biotechnology (2nd Edn), Blackwell Scietific Pub. Oxford.
21. M.R. Walker and R Rapley.1997.Route Maps in Gene Technology, Blackwell Science Ltd, Oxford
22. Glick and Pasternock 2002. Molecular Biotechnology, Paneema-2004.
23. D. Balasubramanian 2005. Concepts of Biotechnology new edition..
24. Old and S.B. Primrose. 2002. Principles of Gene Manipulation by Blackwell, Oxford.
25. T.A. Brown, 2002. Gene cloning – DNA Analysis – Blackwell, London.

M.Sc (Biochemistry) Syllabus under CBCS pattern (With effect from 2015-2016)

M.Sc. Biochemistry III-Semester - Theory Syllabus PAPER-III (Biochem-303) Endocrinology

UNIT – I - ENDOCRINE SYSTEM

- 1.1. Organization of endocrine system, classification of hormones. Structure, secretion and action of hypothalamic releasing and inhibitory hormones.
- 1.2. Signal transduction: second messenger concept and mechanism of hormone action. Hormone receptors. Up and down regulation of receptors.
- 1.3. Insulin, glucocorticoid and adrenergic receptors. Super family of steroid and thyroid hormone receptors.
- 1.4. Growth factors: Growth factors chemistry and functions of IGF-I & II, NGF, EGF and PGDF.

UNIT – II - HORMONES OF PITUITARY, PINEAL, THYROID AND PARATHYROID

- 2.1. Classifications chemistry, functions and regulation of anterior pituitary (GH, PRL, TSH, ACTH, LH, FSH & MSH) and posterior pituitary hormones (oxytocin & ADH),
- 2.2. Chemistry functions and regulation of pineal gland hormones. Melatonin and serotonin.
- 2.3. Biosynthesis of thyroid hormones and Iodine metabolism. Regulation of secretion. Mechanism of action and general functions.
- 2.4. Calcitonin and parathyroid hormones role of calcium in calcium and phosphate homeostasis in blood.

UNIT – III - HORMONES OF PANCREAS AND ADRENAL MEDULLA

- 3.1. Chemistry, biosynthesis and secretion of insulin and glucagon. Action of insulin and glucagon on carbohydrate. Lipid and protein metabolism.
- 3.2. Mode of action of glucagon and insulin.
- 3.3. Structure, biosynthesis, functions and metabolism of adrenaline and noradrenaline.
- 3.4. Effects of epinephrine and norepinephrine. Cascade events.

UNIT – IV - HORMONES OF ADRENAL CORTEX, GONADS AND G.I TRACT

- 4.1. Biosynthesis, mode of action, metabolism of cortical steroids: Cortisol, deoxycorticosteroids. Role of adrenal steroids,
- 4.2. Aldosterone-renin-angiotensin system. Mode of action of adrenal steroids, Sex steroid hormones.
- 4.3. Biosynthesis and role of androgens, estrogens and progesterone. Hormonal regulation of menstrual cycle.
- 4.4. Gastro-intestinal hormones-Gastrin, secretin, pancreaticozymins and Somatostatin.

Recommended Books

- 1) Harpers Biochemistry - 25th ed – RK Murray et al
- 2) Biochemistry – white, Handler and Smith
- 3) Endocrinology – Mc – E Hadly (prentice Hall)
- 4) Endocrinology --Williams
- 5) Essential Endocrinology –J E Wise (oxford press)
- 6) Biochemistry – D Voet and Voet
- 7) Text book of Biochemistry with clinical correlations –T,M Devlin (Johan wiley)

**M.Sc (Biochemistry) Syllabus under CBCS pattern
(With effect from 2015-2016)
M.Sc. Biochemistry III-Semester
PAPER-IV (Biochem-304): Animal Biotechnology - Theory Syllabus**

UNIT I - ANIMAL CELL CULTURE

- 1.1. Animal Biotechnology and its scope, animals in Biotechnology - State of the Art.
- 1.2. Principles of sterile techniques and cell propagation, Chemically defined and serum
- 1.3. Free media for membrane cell culture, cell culture preparation and maintenance preservation and characterisation of animal cell, organ culture, Cell growth curve.
- 1.4. Viability of cells, cytotoxicity and viability assays, MTT assays, FACS, confocal, immunofluorescence, thymidine uptake cytotoxicity.

UNIT II - SCALE-UP AND CULTURE

- 2.1. Scale-up: Cell culture reactors; Scale-up in suspension; Scale and complexity; Mixing and aeration;
- 2.2. Rotating chambers; Perfused suspension cultures; Fluidized bed reactors for suspension Culture;
- 2.3. Scale-up in monolayers; Multisurface propagators; Multiarray disks, spirals and tubes; Roller culture; Microcarriers; Perfused monolayer cultures;
- 2.4. Membrane perfusion; Hollow fiber perfusion; Matrix perfusion; Microencapsulation; Growth monitoring.

UNIT III - rDNA TECHNOLOGY IN ANIMAL BIOTECHNOLOGY

- 3.1. Mammalian genome, genetic recombination in mammalian cells and embryos,
- 3.2. Protein production by genetically engineered mammalian cell lines.
- 3.3. Optimization of animal cells growth in bio reactors
- 3.4. Hybridoma technology; live stock improvement; cloning in animals; monoclonal antibodies; animal modelling

UNIT IV - APPLICATION OF ANIMAL BIOTECHNOLOGY

- 4.1. Application of animal cell culture to human welfare - medical and therapeutical purposes.
- 4.2. Pharmaceutical products of animal cell culture,
- 4.3. Transgenic animals-its application.
- 4.4. clinical trials; Ethical issues related to animal biotechnology

PRACTICALS

1. Packing and sterilization of glass and plastic wares for animal cell culture
2. Preparation of reagents and media for cell culture
3. Preparation of Sera
4. Primary culturing (chick embryo fibroblast)
5. Secondary culturing (chick embryo fibroblast)
6. Characterization of cell lines
7. Quantification (cell counting) of animal cells by Trypan blue exclusion dye method
8. Preservation of primary cell cultures and cell lines
9. Transfection of cells with recombinant DNA
10. DPPH radical scavenging assay
11. MTT assay (Proliferation assay)
12. XTT assay (Proliferation assay)
13. Handling of animals and care

**M.Sc (Biochemistry) Syllabus under CBCS pattern
(with effect from 2015-2016)**

**M.Sc. Biochemistry III-Semester - Practical- I
Clinical Biochemistry and Genetic Engineering**

Clinical Biochemistry

1. Qualitative analysis of abnormal constituents in urine
2. Determine urinary titrable activity
3. Determine PCV, ESR, differential count
4. Determine osmotic fragility of RBC
5. Determine urinary glucose, creatinine
6. Determine blood hemoglobin (Drabkins) and glycosylated hemoglobin
7. Determine blood urea
8. Determine blood glucose (POD-DOD method, enzymatic method)
9. Determine A:G ratio
10. Analyze plasma Ca, K, Na, and Mg by flame photometry
11. Assay serum alkaline phosphatase
12. Assay serum ALT (SGPT)
13. Assay serum AST (SGOT)
14. Assay serum LDH
15. Serum lipid profile
16. Determine total protein content (Kjeldahl) in a food item
17. Determine total carbohydrate and lipid content in a food item

Genetic Engineering

1. Preparation of electro and chemically competent E.coli
2. Isolation of plant genomic DNA
3. Restriction digestion of lambda DNA
4. Construction of restriction map of lambda DNA
5. Cloning of foreign DNA in pUC 18 and screen for positive clones using blue white selection
6. Amplification of selected DNA fragment of PCR
7. Reporter gene assay (Gus/CAT/ β -GAL)

**M.Sc (Biochemistry) Syllabus under CBCS pattern
(with effect from 2015-2016)**

**M.Sc. Biochemistry III-Semester - Practical- II
Endocrinology and Animal Biotechnology**

Endocrinology

1. Effect of adrenalectomy on glycogen content in liver in terms of glucose.
2. Monitoring the plasma progesterone levels during estrous cycle in bovine.
3. Role and application of *PGF2a* in bovines
4. To study the ferning pattern of vaginal mucus during estrus stage of the cycle.
5. Isolation and study of the histological structure of the rat mammary gland
6. To enumerate somatic cells in milk and study its relationship with various hormones.
7. To assess the responsiveness of mammary epithelial cells to hormones

Animal Biotechnology

1. Packing and sterilization of glass and plastic wares for animal cell culture
2. Preparation of reagents and media for cell culture
3. Preparation of Sera
4. Primary culturing (chick embryo fibroblast)
5. Secondary culturing (chick embryo fibroblast)
6. Characterization of cell lines
7. Quantification (cell counting) of animal cells by Trypan blue exclusion dye method
8. Preservation of primary cell cultures and cell lines
9. Transfection of cells with recombinant DNA
10. DPPH radical scavenging assay
11. MTT assay (Proliferation assay)
12. XTT assay (Proliferation assay)
13. Handling of animals and care

**M.Sc (Biochemistry) Syllabus under CBCS pattern
(With effect from 2015-2016) - Theory Syllabus
M.Sc. Biochemistry IV-Semester
PAPER-I (Biochem-401): Bioinformatics and Biostatistics**

UNIT – I

- 1.1. Introduction to computers, concepts of hardware and software. Basic concepts of programming languages. Use of data bases in biology, websites pertaining to gene and protein data. EST tag databases and SNP database.
- 1.2. Introduction to Bioinformatics: Overview and Definition - Need for Bioinformatics - Different fields in Bioinformatics. Sequence formats used in Bioinformatics databases and tools.
- 1.3. Tools for primary structure analysis: BLAST, FASTA, ClustalW, hydropathic plots. Concepts of DNA /protein sequence alignment and their importance.
- 1.4. Analysis of whole genome sequencing (human genome project).

UNIT II

- 2.1. Bibliographic Databases, WWW, Internet and its Uses in Bioinformatics.
- 2.2. Gene finding and functional annotation: sequence annotation and bioinformatics tools for genomics and genome comparison;
- 2.3. Analyzing gene expression – DNA microarrays – design, analysis and visualization of data. RNA data handling/manipulation; using gene expression arrays for disease profiling. RNA interference.
- 2.4. Pharmacogenomics. Genetic network analysis - Functional genomics,

UNIT III

- 3.1. Proteomics: Determination of structure of proteins. Predicting protein secondary structure and identification of protein families; Tertiary structure database: Cambridge database. PDB, specialist structural databases.
- 3.2. Programs for analysis and visualization of tertiary structure, RasMol/RasTop, protein explorer, Swiss-prot, PDB viewer, Homology modeling, Domain structure- DNA binding domains.
- 3.3. Structural genomics: Assembly of a contiguous DNA sequence- shotgun method, clone contig method, and whole –genome shotgun sequencing
- 3.4. Understanding a genome sequence: locating the genes in a genome sequence, determining the functions of individual genes and by studying the activity of a protein coded of an unknown gene

UNIT – IV – Biostatistics

- 4.1. Introduction, parameters in statistics, probability in biology, laws of probability; Bayesian, Normal, Binominal, Poisson distribution. Significance level, degrees of freedom.
- 4.2. Presentation of data graphs and histograms. Normal distribution. Measures of central tendency –mean, mode and median. Standard Deviation; 1- way and 2 – way ANNOVA.

4.3. Measures of dispersion of variation – Range, standard deviation, standard error and coefficient of variation.

4.4. Design of experiments-factorial experiments, Tests of significance – Student's t- test, F-test, chi square test, contingency tests,

REFERENCE BOOKS

1. Introduction to Bioinformatics; Arthur M. Lesk Oxford University Press.
2. Introduction to Bioinformatics, Attwood T.K and Parry-Smith D J Pearson Education, 2001.
3. Bioinformatics-A practical guide to the analysis of genes and proteins, Andreas D Baxevanis, Francis B F ouellete; 2nd Edition, John Wiley and sons,
4. Bioinformatics- A Beginner's Guide, Jean Michel Claverie and Cedric Notrdame; 2nd Edition, Wiley Dreamtech India Pvt. Ltd., 2004.
4. Biostatistics- Mahajan
5. Fundamentals of Statistics –s c,Gupta
6. Bioinformatics sequence , structure and databanks ed by Des Higgins Wille Taylor-2000
7. Molecular Biology –Dfinfaelder (Jones and Bouletts U.SA)

**M.Sc (Biochemistry) Syllabus under CBCS pattern
(With effect from 2015-2016) - Theory Syllabus
M.Sc. Biochemistry IV-Semester
PAPER-II (Biochem-402): Nutritional Biochemistry**

UNIT - I – Basic Concepts

- 1.1 Function of nutrients. Measurement of the fuel values of foods. Direct and indirect calorimetry.
- 1.2 Basal metabolic rate - factors affecting BMR, measurement and calculation of BMR. Measurement of energy requirements.
- 1.3 Recommended dietary allowance of macro and micro nutrients.
- 1.4 Biological value of proteins. Concept of protein quality. Specific dynamic action of proteins. Biological value of proteins and essential amino acids. Kwashiorkor and marasmus.

UNIT – II - Nutritional Supplements

- 2.1. Elements of nutrition – Dietary requirement of carbohydrates and lipids. Protein sparing action of carbohydrates and fats.
- 2.2. Essential fatty acids and their physiological functions.
- 2.3. Minerals – Nutritional significance of dietary calcium, phosphorus, magnesium, iron, iodine, zinc and copper
- 2.4. Vitamins – Dietary sources, biochemical functions, requirements and deficiency diseases associated with vitamin B complex, C and A, D, E & K vitamins.

UNIT – III - Nutritional Disorders

- 3.1 Malnutrition – Prevention of malnutrition, improvement of diets. Recommended dietary allowances, nutritive value of common foods. Protein-calorie malnutrition. Requirement of proteins and calories under different physiological states- infancy, childhood, adolescence, pregnancy, lactation and ageing.
- 3.2. Requirement of calories and nutrients for conditions like malnutrition, diabetes anemias, pregnancy, lactating women and obesity.
- 3.3. Starvation – Techniques for the study of starvation. Protein metabolism in prolonged fasting.
- 3.4. Obesity – Definition, Genetic and environmental factors leading to obesity.

UNIT – IV - HOMOEOSTATIC MECHANISMS AND XENOBIOTICS:

- 4.1. Structure and function of nephrons. Urine formation, composition.
- 4.2. Water and electrolyte balance. Abnormal constituents of urine. Homeostatic control of body fluids.
- 4.3. Metabolism of xenobiotics: biomedical importance, metabolism of xenobiotics, hydroxylation, conjugation (glucuronidation, sulfation, conjugation with glutathione, acetylation, methylthionetc).
- 4.4 Toxic effects of xenobiotics.

Recommended Books

- 1) Essentials of food and nutrition , Vol 1&2 . M.SSwaminathan.
- 2) Physiological basis of medical practice (12thedt)- Best and Taylor
- 3) Human physiology .C Chatterji(vol 1&2)
- 4) Review of physiological chemistry by H .A.Harper(lange)
- 5) Biochemistry- White ,Handler and smith
- 6) Text book of Genaral Physiology by H.Davson (chruchill)
- 7) Text book of biochemistry by West Todd Mason and Brugger (Macmillan)
- 8) The chemical analysis of food by David pearson (churchill)
- 9) Human Nutrition and Dietectics by Davidson &passmore(williams)
- 10) Human physiology – stuart Ira Fox (5thEdt) (WCB)

M.Sc (Biochemistry) Syllabus under CBCS pattern
(With effect from 2015-2016) - Theory Syllabus
M.Sc. Biochemistry IV-Semester
PAPER-III (Biochem-403) Nanotechnology

UNIT I

- 1.1. Introduction to nano scale size – definition, concepts, history of development, types of approaches.
- 1.2. Comparative study of micro and nano technology (BIO-MEMS, NEMS).
- 1.3. Dimensions of nano science, nano mechanics, nano chemistry, nano electronics – principles and applications.
- 1.4. Production and synthesis of nano particle – physical, chemical, biological methods,

UNIT II

- 2.1. Nano properties, characterization, fabrication technology of nano size, fullerenes, colloidal gold, carbon - nano tube, quantum dots, nano wires.
- 2.2. Classification of nano structure materials.
- 2.3. Bacterial magnetosome, S-Layer, Bacteriorhodopsin, PHA, Cyanophycin inclusion, biological nano pore, nano motors and its applications, nano capsules, mediated drug delivery.
- 2.4. Principles of pharmco nano medicine, nano robotics and its application, usage of gold nano particles in bio medical application.

UNIT III

- 3.1. Nano Bio-Chip, biosensor, nano circuitry.
- 3.2. Nano medicine for cancer cell destruction, molecular-beacons.
- 3.3. nano ink, nano base architecture, nano in field bio mimetics, nano conjugate chemistry.
- 3.4. Neuronal network – micro fluidics concepts.

UNIT IV

- 4.1. Recent trends and application of nano particles,
- 4.2. Omni presents in different fields of research and development,
- 4.3. Environmental impact – dangerous, sudden and unexpected risk, economic impact, bioterrorism, nanopathology, nano toxicology,
- 4.4. Implication of nanotechnology – sandwiched culprits of nano world.

REFERENCES BOOKS

1. Jain, K.K, Nanobiotechnology in Molecular Diagnostics, Current Techniques and application, Taylor and Francis Publications, 2006.
2. Salata O.V., Applications of Nanoparticles in Biology and Medicine, Journal of Nanobiotechnology, 2004.

**M.Sc (Biochemistry) Syllabus under CBCS pattern
(With effect from 2015-2016) - Theory Syllabus
M.Sc. Biochemistry IV-Semester
PAPER-IV (Biochem-404): Plant Biochemistry**

UNIT-I

- 1.1. Structure and functions of plant cell - including cell wall, plasmodesmata, meristematic cells, vacuoles, secretory systems and root quiescent zone,
- 1.2. isolation of cell organelles, absorption, adsorption and transport of water and ions in plant, evapotranspiration
- 1.3. Plant genome organization, plant nuclear genome organization, biogenesis of organelles,
- 1.4. Development of chloroplast, interaction between nuclear and organelle genome

UNIT-II

- 2.1. Photosynthesis-structure of organelles involved in photosynthesis in plants and bacteria. Proton gradients and electron transfer in chloroplasts of plants and in purple bacteria- differences from mitochondria. Light receptors – chlorophyll, light harvesting complexes, bacteriorhodopsin, rhodopsin as ion pump
- 2.2. Photosystems I and II, their location, mechanisms of quantum capture and energy transfer between photosystems – ferridoxin, plastocyanin, plastoquinone, carotenoids
- 2.3. The Hill reaction, photophosphorylation and reduction of CO₂
- 2.4. C₃, C₄ and CAM metabolism, light and dark reactions, light activation of enzymes, regulation of photosynthesis, photorespiration

UNIT- III

- 3.1. N₂ fixation – molecular and enzymology of N₂ fixation, symbiotic N₂ fixation, Non-symbiotic fixation.
- 3.2. Interaction between nitrate assimilation of carbon metabolism,
- 3.3. Sulphur chemistry and function, reductive sulfate assimilation pathway.
- 3.4. Synthesis and function of glutathione and its derivatives

UNIT-IV

- 4.1. Special features of secondary plant metabolism, formation of phenolic acids, tannins, lignins, lignans, pigments, terpenes, terpenoids, plant phenolics, alkaloids and surface waxes – their biosynthesis and functions
- 4.2. Plant hormones-growth regulating substances and their mode of action.
- 4.3. Molecular effects of auxin in regulation of cell extension and of gibberellic, abscisic acids and cytokinins in the regulation of seed dormancy, germination, growth and development, and embryogenesis.
- 4.4. Biochemistry of seed development and fruit ripening, defence system in plants

Recommended Books

1. Genes VII (2000)- Benjamin Lewin (oxford University Press).
2. Text Book of Molecular Biology by K.S.Sastry, G. padmanabhan and C.subramanyam – McMillan India Ltd.
3. Cell and Molecular biology (8th Edition) - E.D.P. De Robertis& E.M.F. De Robertis, Jr.-(Lippincott Willkins).
4. Biochemistry (2nd Edition) =- Mathews and Van Holde (Benjamin/Cummings Publishing Company).
5. Molecular Biology and Biotechnology (3rd Edition) – J.M. Willkar and E.B. Gingold – (Panima Publishing Corporation, New Delhi).
6. Molecular Biology of the cell – B. Albert, W. Bray, J. Lewis, M. Raff, K.Roberts and J.D Walsion (GarlandPublishing, Newyork and London)

**M.Sc (Biochemistry) Syllabus under CBCS pattern
(with effect from 2015-2016)**

**M.Sc. Biochemistry IV-Semester - Practical- I
Bioinformatics and Biostatistics and Nutritional Biochemistry**

Bioinformatics and Biostatistics

1. Problems on mean, median and mode
2. Problems on variance, coefficient of variance, standard deviation (SD) and standard error
3. Probability distribution: Normal, binomial and poisson
4. Test of hypotheses: Students t-test, X² distribution (Chi square), correlation coefficient and analysis of variance (ANOVA).
5. Blast practical - NCBI blast via the NCBI web server
6. A brief visit to Ensembl
7. Translating sequences – getorf; ESTScan
8. Construction of phylogenetic trees

Nutritional Biochemistry

1. Estimation of moisture and ash content of foodstuffs
2. Estimation of acid value of fats and oils
3. Estimation of vitamin-C by titrimetric method
4. Qualitative testing of food adulterants – metanil yellow in turmeric, arhar dal and yellow sweets; vanaspati in pure ghee; chalk powder and sand in wheat flour; lead chromate in turmeric powder; starch in milk.
5. Paper chromatography

**M.Sc (Biochemistry) Syllabus under CBCS pattern
(with effect from 2015-2016)**

**M.Sc. Biochemistry IV-Semester - Practical- II
Nanotechnology and Plant Biochemistry**

Nanotechnology

- 1.Nanostructured DNA Templates
- 2.Probing DNA structure with Nanoparticles
- 3.Fluoroimmunoassays using Antibody- conjugated Quantum Dots
- 4.Surface- Functionalized Nanoparticles for controlled Drug Delivery
- 5.Quantum Dot- encoded Beads
- 6.Ultrasensitive DNA sequence detection using nanoscale ZnO sensor arrays
- 7.Electrochemical Biosensors for the Detection of Pesticides.

Plant Biochemistry

1. Micropropagation of plants
2. Callus culture
3. Anther / pollen culture
4. Embryo culture
5. Somatic embryogenesis
6. Synthetic seeds
7. Protoplast Isolation and culture
8. Preparation of tissue culture media
9. Surface sterilization of explants
10. Organ culture
11. Callus propagation, organogenesis, transfer of plants to soil
12. Encapsulation of somatic embryos and synseed production
13. Protoplast isolation and culture
 14. Cytological examination of regenerated plants
 15. Agrobacterium culture, selection of transformants