

GULBARGA UNIVERSITY, GULBARGA



Syllabus

For

P.G. Department of studies and research in

BIOCHEMISTRY

Choice Based Credit System

2011-12 & onwards



Gulbarga University

Course Outline and Syllabus for Master of Science (MSc) in Biochemistry under CBCS and CAGP

Semester	Code	Title of the Course	Semester Exam	IA	Total	L	T	P	Credits
		Hard Core							
First	HCT1.1	Analytical Biochemistry and Biostatistics	80	20	100	4	0	0	4
	HCT1.2	Biomolecules	80	20	100	4	0	0	4
	HCT1.3	Enzymology	80	20	100	4	0	0	4
		Soft-Core (Any One)							
	SCT1.1	Microbiology	80	20	100	4	0	0	4
	SCT1.2	Biophysical and Bioorganic chemistry	80	20	100	4	0	0	4
		Practical							
	HCP1.1		40	10	50	0	0		2
	HCP1.2		40	10	50	0	0		2
	HCP1.3		40	10	50	0	0		2
		Soft Core (Any One)							
	SCP1.1		40	10	50	0	0		2
	SCP1.2		40	10	50	0	0		2
		Total for First Semester	480	120	600				24
Second		Hard Core							
	HCT2.1	Cellbiology	80	20	100	4	0	0	4
	HCT2.2	Metabolism- I	80	20	100	4	0	0	4
		Soft Core (Any One)							
	SCT2.1	Metabolism-II	80	20	100	4	0	0	4
	SCT2.2	General Physiology	80	20	100	4	0	0	4
		Open Elective (Any One)							
	OET2.1	General Biochemistry	80	20	100	4	0	0	4
	OET2.2		80	20	100	4	0	0	4
		Practicals							
	HCP2.1		40	10	50	0	0	4	2
	HCP2.2		40	10	50	0	0	4	2
		Soft Core (Any One)							
	SCP2.1		40	10	50	0	0	4	2
	SCP2.2		40	10	50	0	0	4	2
		Open Elective (Any One)							
	OEP2.1		40	10	50	0	0	4	2
	OEP2.2		40	10	50	0	0	4	2
		Total for Second Semester	480	120	600				24

L= Lecture T= Tutorials P = Practicals

4 Credits of Theory = 4 hours of teaching per week

2 Credits of Practicals = 4 hours per week



Gulbarga University

Course Outline and Syllabus for Master of Science (MSc) in Biochemistry under CBCS and CAGP

Third Semester	Code	Title of the Course	Semester Exam	IA	Total	L	T	P	Credits
	HCT3.1	Clinical Biochemistry and Nutrition	80	20	100	4	0	0	4
	HCT3.2	Immunology	80	20	100	4	0	0	4
		Soft Core (Any One)							
	SCT3.1	Microbial Biotechnology	80	20	100	4	0	0	4
	SCT3.2	Plant Biochemistry	80	20	100	4	0	0	4
		Open Elective (Any One)							
	OET3.1	Fundamentals of Enzymes	80	20	100	4	0	0	4
	OET3.2		80	20	100	4	0	0	4
		Practicals							
	HCP3.1		40	10	50	0	0	4	2
	HCP3.2		40	10	50	0	0	4	2
		Soft Core (Any One)							
	SCP3.1		40	10	50	0	0	4	2
	SCP3.2		40	10	50	0	0	4	2
		Open Elective (Any One)							
	OEP3.1		40	10	50	0	0	4	2
	OEP3.1		40	10	50	0	0	4	2
		Total for Third Semester	480	120	600				24
Fourth		Hard Core							
	HCT4.1	Molecular Biology - I	80	20	100	4	0	0	4
	HCT4.2	Molecular Biology - II	80	20	100	4	0	0	4
		Soft-Core (Any One)							
	SCT4.1	Biotechnology and Bioinformatics	80	20	100	4	0	0	4
	SCT4.2	Genetics	80	20	100	4	0	0	4
		Practical							
	HCP4.1		40	10	50	0	0	4	2
	HCP4.2		40	10	50	0	0	4	2
		Soft Core (Any One)							
	SCP4.1		40	10	50	0	0	4	2
	SCP4.2		40	10	50	0	0	4	2
	HCMP 4.3	Major Project (72 Project Evaluation + 48 for Viva Voce + 30 IA = 150)	120	30	150	0	0	6	6
		Total for Fourth Semester	480	120	600				24

L= Lecture T= Tutorials P = Practicals

4 Credits of Theory = 4 hours of teaching per week

2 Credits of Practicals = 4 hours per week

I - SEMESTER

HCT 1.1: ANALYTICAL BIOCHEMISTRY AND BIOSTATISTICS (4 credits: 64 h)**ANLYTICAL TECHNIQUES**

Unit-I, 1 credit, 16 h

Chromatography: Introduction, classification of chromatographic techniques. Principle, theory and applications of paper chromatography, Thin layer chromatography, Column chromatography- Adsorption chromatography, Gel permeation, Ion exchange chromatography, Affinity chromatography, Gas chromatography, FPLC, High performance (pressure) liquid chromatography

Centrifugation Techniques: Introduction, Basic principles and applications of sedimentation.

Centrifuges and their use - Small bench centrifuges, Large capacity refrigerated centrifuges, High speed refrigerated centrifuges, continuous flow centrifuges, Preparative Ultra centrifuges, Analytical ultracentrifuges and Density gradient centrifugation.

Unit-II, 1 credit, 16 h

Electrophoresis Techniques: Introduction. Principles and application of electrophoretic techniques- Paper electrophoresis, starch gel electrophoresis, Polyacrylamide gel electrophoresis, Agarose gel electrophoresis, isoelectric focusing, isotachopheresis, pulse field electrophoresis, two dimensional electrophoresis, capillary electrophoresis, preparative and high voltage electrophoresis.

Radioisotope Techniques: Introduction, Nature of radioactive Decay, Rate of Radioactive Decay, Units of Radioactivity, Measurement of Radioactivity- proportional counters, Scintillation counters, auto radio graphy, isotopic dilution technique. Applications of Radioisotopes in the Biological Sciences

Unit-III, 1 credit, 16 h

Spectroscopy: Introduction, Nature of electromagnetic Radiations. Principles and applications of the following spectroscopic techniques in biochemical investigations- Visible and Ultraviolet spectroscopy, Fluorescence spectroscopy, Infrared spectroscopy, Optical rotation dispersion (ORD), Circular dichroism (CD) spectroscopy, electron spin resonance (ESR), Nuclear Magnetic resonance (NMR) spectroscopy and Mass spectroscopy

Unit-IV, 1 credit, 16 h

BIOSTATISTICS

Statistical methods, scope of statistic. Representation of data- Statistical tables. Diagrammatic representation- bar diagrams, rectangles, squares, pie-diagrams. Graphical presentation- Arithmetic line graph, semi-logarithmic curves, histograms, frequency distribution. Measurement of dispersion. Probability, normal and binominal hypothesis testing, T-test, pared T-test, Chi-square (X²) test. Correlation and repression. Statistical design of experiment. Measure of dispaersion, co-efficient of variation.

REFERENCES

- 1 Modern experimental biochemistry. Rodney Boyer. 3rd Edn. Benjamin Cummings.
- 2 A biologist guide to principles and technique of practical Biochemistry. Keith Wilson, Kenneth H. Goulding. 3rd Edn. Cambridge University Press.
- 3 Practical skills in biomolecular sciences. R.Reed, D. Holmes, J. Weyers and A. Jones., 1998. Longman pub.
- 4 Physical Biochemistry. David Frifielder. 2nd Edn. Freeman and Company, New York.
- 5 Chromatography. Stock and Price. McMillan Pub.
- 6 Spectrometric identification of organic compounds. R.M. Silverstein and F.X. Webster. 6th Edn. John Wiley.
- 7 Biophysical chemistry. Upadya and Upadya
- 8 Spectroscopy. David Frifielder.
- 9 Lehninger. Principles of Biochemistry. Nelson and Cox. 5thEdn.W.H.Freeman and company.
- 10 Biochemistry. Donald Vote, Judith Voet. 4thEdn. John Wiley and Sons, NY.
- 11 Biochemistry. Reginald H. Garret and Charles M. Grisham. 4th Edn. Mary Finch Publication.

HCT 1.2: BIOMOLECULES**(4 CREDITS: 64 h)**

Unit-I, 1 credit, 16 h

Properties of water: Importance of water in biological systems. Ion product of water and its measurement. Biological relevance of pH and pKa, Hendersson-Hesselbach equation. Buffers and their importance in biological systems. Preparation of buffers.

Carbohydrates: Monosaccharides – Classification, stereochemistry, optical isomerism, chirality, enantiomers, diastereomers, DL and RS system of nomenclature, racemization. Sugar derivatives. Disaccharides- structure of sucrose, lactose, maltose and cellobiose. Structure, Properties and importance of homo and hetero- polysaccharides – starch, glycogen, cellulose, dextran, agarose and alginate. Glycosaminoglycans, Glycoproteins, antifreeze glycoproteins, bacterial cell wall structure and function.

Lipids: Classification and structural properties of lipids. Biological role of Fatty acids, Aryl glycerols, Phospholipids, Sphingolipids, Glycolipids. Sterols- Cholesterol and phytosterols. Terpenes, Waxes and Bilesalts, Prostaglandins, Thromboxanes and Leukotrienes. Properties of lipids aggregates-micelles, Bilayer and Liposomes.

Unit-II, 1 credit, 16 h

Amino acids: Classification and acid-base properties of amino acids. Non protein amino acids. Peptide bond-structure and conformation. Peptide-synthesis-reactive ester method and modified Merrifield solid phase synthesis. Naturally occurring peptides. Ionic properties of peptides and proteins. Separation of amino acids mixtures and analysis of amino acids.

Proteins: Introduction, classification and biological functions. Composition of proteins. The size and conformation of proteins. Supramolecular assemblies of proteins. The functional diversity of proteins.

Structure of peptides: Acid-base properties, chemical properties of peptides. Primary structure determination of proteins- general methods of sequencing of a protein, peptide mapping, and chemical evolution.

Unit-III, 1 credit, 16h

Secondary structures of proteins: Features of peptide bond. Helical structures and beta structure with examples. Non repetitive structures. Ramachandran plot and its significance. Fibrous proteins: Alpha keratins, silk fibroin, collagen and elastin. Globular proteins: structural features of myoglobin.

Proteins stability: Various factors influencing protein stability. Electrostatic forces, hydrogen bonding, hydrophobic interactions, disulfide bonding, hydrophobic interactions. Proteins denaturation and renaturation. Protein folding and the roles of proteins folding accessory proteins.

Quaternary structure: Subunit interactions. Symmetry in proteins. Hemoglobin: Structure and functions. Oxygen binding properties. Hill equation. Bhor effect. BPG effect on oxygen binding. Mechanism of oxygen binding cooperatively. Abnormal hemoglobins: Different types of abnormal Hbs. Molecular basis of sickle cell anemia.

Unit-IV, 1 credit, 16 h

Nucleic Acids

Structure and properties of nucleosides and nucleotides. Properties of nucleic acids in solution. Hydrolysis of nucleic acids by acid and base. Enzymatic hydrolysis, Nuclease specificity and restriction endonucleases. Chemical synthesis of oligonucleotides. Major classes of nucleic acids and their biological roles. Isolation and purification of nucleic acids. Different methods of estimation of nucleic acids.

Structure of nucleic acids: Structural properties of DNA. Different models of DNA-A, B and Z. Tm and cot values and their determination. Nucleic acid hybridization. Super coiled DNA, buoyant density of DNA. Super helix topology.

DNA sequencing: Sanger's method, base specific chemical cleavage method. Automated DNA sequencing. Nearest neighbour base sequence analysis
Chemistry of RNAs: Structures and functions of mRNA, tRNA and rRNA.

REFERENCES

- 1 Biochemistry. Donald Vote, Judith Voet. 4thEdn. John Wiley and Sons, NY.
- 2 Lehninger. Principles of Biochemistry. Nelson and Cox. 5th Edn. W.H. Freeman and company.
- 3 Text Book of Biochemistry with clinical correlations. Thomas Devlin. Wiley-Liss.
- 4 Biochemistry. David Rawn. Neil Patterson Publishers.
- 5 Biochemistry. Geoffrey Zubey. 4th Edn. 1998. WMC Brown Publishers.
- 6 Biochemistry. Reginald H. Garret and Charles M. Grisham. 4th Edn. Mary Finch Publication.

HCT 1.3: ENZYMOLOGY**(4 CREDITS: 64 h)**

Unit-I, 1 credit, 16 h

Introduction to Enzymes: History, General characteristics, Nomenclature and Classification of enzymes. Catalytic power, specificity and active site. IUB enzyme classification.

Enzyme purification: Enzyme localization, isolation and purification of enzymes. Methods employed in isolation, purification and characterization of enzymes. Presentation of enzyme purification data and criteria of purity of enzymes. Stabilization of enzymes: stabilization of soluble enzymes, stabilization by cross linking and bonding to carriers. Fundamentals of enzyme assay: Definition of IU, K_m, enzyme turnover number and specific activity. Assay of enzymes by Spectrometric, calorimetric, colorimetric, manometric, fluorimetric, isotopic methods. Methods used in the investigation of the kinetics of enzyme-catalyzed reactions. Initial velocity studies, rapid reaction techniques.

Unit-II, 1 credit, 16 h

Kinetics of enzyme- Catalyzed reactions:

Enzyme kinetics of single substrate reactions- Michaelis theory, steady state theory. Kinetic data evaluation- linear transformation of Michaelis-Menten equation. Pre-steady state kinetics. Integrated velocity equation, King-Altman procedure for deriving the rate equation. Effect of pH and temperature. Enzyme Inhibition- competitive, non-competitive, uncompetitive and mixed inhibitors. Partial inhibition, substrate inhibition and allosteric inhibition. Irreversible inhibition.

Kinetics of bi-substrate reactions: Sequential mechanism, compulsory order and random order mechanism, non-sequential mechanism, ping pong mechanism, distinction between different kinetic pathways using primary and secondary plots. Inhibition studies in the characterization of bisubstrate reactions. Investigations of reaction mechanisms using isotopic-exchange at equilibrium.

Unit-III, 1 credit, 16 h

Chemical nature of enzyme catalysis- General acid-base catalysis, electrostatic catalysis, covalent catalysis, intramolecular catalysis and enzyme-catalysis.

The investigation of active site structure: The identification of binding sites and catalytic sites- trapping the E-S complex, the use of substrate analogs, chemical modification of amino acid side chains, photo-oxidation, enzyme modification by treatment with proteolytic enzymes. The 3-D structural features of active sites as revealed by X-ray, NMR and chemical studies.

Mechanisms of reactions catalyzed by the following enzymes-Chymotrypsin, Lysozyme and Ribonuclease. carboxypeptidase-A.

Coenzymes: The mechanistic role of the following coenzymes in enzyme catalyzed reactions- nicotinamide nucleotides, flavin nucleotides, pyridoxal phosphate, coenzyme A, lipoic acid, thiamine pyrophosphate, biotin, tetrahydrofolate and coenzyme B₁₂.

Unit-IV, 1 credit, 16 h

Monomeric enzymes: The serine proteases, zymogen activation. Sulphydryl enzymes: Papain and alcohol dehydrogenase. Oligomeric enzymes: Isoenzymes- Lactate dehydrogenase (LDH) **Multi-**

enzyme complexes: Pyruvate dehydrogenase (PDH) complex

Allostery of enzyme action

Binding of ligands to proteins- Co-operativity, the Hill equation, the Adair equation, the Scatchard plot and equilibrium dialysis techniques. Sigmoidal kinetics-The MWC and KNF models. Significance of sigmoidal behavior. Allosteric enzymes and metabolic regulation. Study of ATCase as typical allosteric enzyme. Other mechanisms of metabolic regulation.

Regulation of activity of enzymes: Reversible and irreversible covalent modifications, allosteric modifications.

Applications of enzymes. Biosensors.

Industrial, Clinical, Analytical and Biotechnological applications. Enzyme biomarkers.

Immobilized enzymes: Techniques of enzymes immobilizations Adsorption, flocculates, chemical bonding- cross-linking, gelation encapsulation. Advantages and limitation. Application of immobilized enzymes. Enzyme electrodes- biosensors, biochips.

REFERENCES

- 1 Basic Biochemical Laboratory Procedures and Computing, R. Cecil Jack .Oxford University.
- 2 Protein Purification Methods. S.L.V. Harris and Angal. IRL Press.
- 3 Understanding Enzymes. Palmer, T. Ellis Horwood Ltd.
- 4 Enzyme Kinetics. Roberts, D.V. Cambridge University Press.
- 5 The Enzymes. Boyer. Academic Press.
- 6 Enzyme Kinetics. Irwin H. Segel. Interscience-Wiley.
- 7 Enzyme Kinetics; The Steady state approach. Engel, P.C. 2nd Edn. Champman and Hall.
- 8 Nature of Enzymology. Foster. Croom Helm.
- 9 Principles of Enzymology for Food Sciences. Whitaker, Marcel Dekker. Academic Press.
- 10 Fundamentals of Enzymology. N.C. Price and Lewis. Oxford University Press.
- 11 Principles of Enzymology for Food Sciences. Whitaker, Marcel Dekker. Academic Press.
- 12 Biochemistry. Donald Vote, Judith Voet. 4thEdn. John Wiley and Sons, NY.
- 13 Lehninger Principles of Biochemistry. Nelson and Cox.4thEdn. Mcmillan publication.
- 14 Molecular and Cellular Enzymology Volume I. Jeannine Yon-Kahn and Guy Herv'e. Springer

SCT 1.1: MICROBIOLOGY**(4 CREDITS: 64 h)**

Unit-I, 1 credit, 16 h

Introduction to Microbiology: Scope and development of microbiology. Different types of microscopes – electron microscopes – TEM, SEM. Fluorescence and confocal microscopes used in fine structure studies. Staining techniques - Gram, Acid fast and flagella. Basic organization of units of living system- Bacterial size, shapes and pattern of arrangement, Colony Morphology. Detailed study of bacterial cell structures - genetic elements, ribosomes, membranes, cell envelope, capsule, flagella, pili and endospores. Mechanism of bacterial motility.

Classification of Bacteria – Conventional and molecular methods; Identification and classification of microorganisms Eubacteria , Archaeobacteria, Cynobacteria, Brief study of important groups of bacteria: Coliform, spore formers, photosynthetic bacteria, lactic acid producing bacteria, actinomycetes, ricketisiae, mycoplasmas.

Unit II, 1 credit, 16 h

Cultivation of Microorganisms: Different kinds of media, sterilization methods, isolation and characterization and maintenance of pure cultures.

Microbial Growth and Metabolism: culturing of microorganisms, microbial nutrition, bacterial reproduction growth and kinetics, factors influencing growth, Measurement of growth. Continuous culture of microorganisms-chemostat, turbidostat and synchronous growth. Control of microbial growth – Physical and chemical methods- chemotherapy, sterilization, and disinfection.

Unit III, 1 credit, 16 h

Viruses and Other Acellular Microbes: (viruses, viroids, prions) discovery, classification, structure isolation and assay of plant, animal and bacterial viruses. Viral replication.

Environmental Microbiology: concept of microbial ecology, influence of environmental factors on the growth and distribution of microorganisms (temperature, reduction potential, water activity, pressure. pH, radiation) microorganisms in their natural habitats, biogeocycling.

Unit IV, 1 credit, 16 h

Agriculture Microbiology: soil fertility and management of agricultural soils, pesticide microbiology – control of crop diseases and bio control.

Food Microbiology: Food-borne diseases, food spoilage, methods of food preservation, fermented foods, toxins produced by the microorganisms.

Medical Microbiology: Microorganisms and infectious diseases – epidemiology of community and hospital associated diseases human diseases caused by bacteria and viruses, fungal and animal parasite, diseases of humans. Antibiotic assay; Determination of minimum inhibitory concentration (MIC). Bacterial endotoxins.

REFERENCES

- 1 Microbiology – Fundamentals and applications. Ronald M. Atlas. 2nd Edn. Mcmillan publishing
- 2 Brock Biology of microorganisms. Madigan M.T., Martinko J.M., and Parker J. 8th Edn. Prentis Hall, Int. Publishers.
- 3 General Microbiology. Robert F. Boyed 2nd Edn. Mosby College publishing Co.
- 4 Microbiology – Essentials and applications. Mackeny and Kandel
- 5 Text Book of Microbiology. Pelczar M.J., Chan E.C., and Kreig N.R. Tata McGraw–Hill publishing
- 6 Microbiology. Lansing M. Prescott, Harle Klein. 5th Edn. The McGraw–Hill Companies.
- 7 General microbiology. Stainer R.Y., Ingrahm J.L., Wheelis M.N., and painter P.R., MacMillan Press Ltd.
- 8 General microbiology. H.C. Schlegel. Cambridge University Press
- 9 Modern Food Microbiology. James M. Jay, Martin J. Loesnner and David A. Golden 7th Edn. Springer.
- 10 Review of medical Microbiology and Immunology. Waren levinson 10th Edn. The McGraw–Hill Companies.

SCT 1.2: BIOORGANIC AND BIOPHYSICAL CHEMISTRY**(4CREDITS:64 h)**

Unit-I, 1-credit, 16h

Atomic and molecular structure: Electron theory of valence. Hybridization of chemical bonds. Hydrophobic interactions and Vander walls interaction. Aromaticity.

Stereochemistry: Origin of stereochemistry, Optical isomerism, chirality, symmetry elements, properties of enantiomers, diastereomers, DL and RS notations, racemization, stereoisomerism and geometrical isomerism, *cis- trans* and E-Z conventions. Biological importance of chiral molecules.

Unit-II, 1-credit, 16h

Mechanism of Bioorganic reactions: Characteristic aspects of ionic, radical and concerted reactions, substitution, addition, elimination and rearrangements. Energy profiles of reactions, transition state theory. Reactions SN^1 , SN^2 , SN^1 neighbouring group participation. E_2 , E_1 , Curtin-Hammett principle. Electrophilic addition to C=O, detailed discussion of all aspects of aldol condensation, related condensations, Michael addition. Esterification and hydrolysis.

Unit-III, 1-credit, 16h

Heterocyclic systems: Occurrence in biological systems, structure and properties of furon, pyrrole. Indole, thiazole, imidazole, pyridine, pyrimidine, purine, quinine, pteridine and isoalloxazine.

Bioinorganic Chemistry: Ligand field theory of complexes, stability of complex ions in solution, kinetics and mechanism of reactions of complexions. Ligand replacement reactions and electron transfer reactions of organometallic moieties of biological macromolecules (Specific examples will be discussed under appropriate sections).

Unit-IV, 1-credit, 16h

Free Radicals: introduction, generation, reaction with biological materials and their adverse effects.

Thermodynamics: Basic concepts of entropy, free energy changes, standard free energy change and its relation to equilibrium constant, oxidation-reduction reactions, oxidation reactions in biological systems.

REFERENCES

- 1 Physical biochemistry. Kansal Edward Van Halde. Prentice Hall.
- 2 Physical biochemistry. David Frifielder. 2ndEdn. W.G.Freeman and Co.
- 3 Organic chemistry. Vol.I. Fundamental principles. I.L.Finar. 6thEdn. ELBS
- 4 Inorganic biochemistry. G.L.Eicharn. Elsevier.
- 5 Organic chemistry. R.T.Morrison and R.N.Boyd. 6thEdn. Prentice Hall of India.
- 6 Biostatistics: A foundation for analysis in the health. W.V.DavidJhon. 7thEdn. Willey and sons
- 7 Lehninger. Principles of Biochemistry. Nelson and Cox. 4thEdn. Mcmillan publication.
- 8 Principles and techniques of practical biochemistry. K.Wilson and J. Walker. 4thEdn. Cambridge University press.

HCP 1.1: PRACTICALS: ANALYTICAL TECHNIQUES

- 1 Chromatographic analysis of amino acids, carbohydrates and lipids by paper and TLC
- 2 Qualitative analysis of amino acids and carbohydrates by paper and TLC
- 3 Separation of plant pigments by column chromatography.
- 4 Separation of amino acids by ion exchange chromatography.
- 5 Separation of proteins by gel permeation chromatography.
- 6 Determination of molecular mass of proteins by SDS-PAGE
- 7 Characterization of DNA by agarose gel electrophoresis
- 8 UV spectra of proteins
- 9 Fluorescence spectra of proteins
- 10 Dialysis

REFERENCES

- 1 Introduction to practical Biochemistry. S.K.Sawhney and Randir Singh. Narosa Publishing house.
- 2 Biochemical methods. S.Sadashivam and A.Manikam. 2ndEdn. New Age International (p) Ltd. Press.
- 3 Practical Biochemistry: Principles and Techniques. Keith Wilson and John Walker. 5thEdn. Cambridge University press.
- 4 Basic Biochemical methods. R.R.Alexander. J.M.Griffith. 2ndEdn. Wiley-Liss. publications.
- 5 Practical Biochemistry. David Plummer. Tata McGraw-Hill publishing.
- 6 Modern experimental Biochemistry. Rodney Boyer. 3rdEdn. Addison Wesley Longham

HCP 1.2: PRACTICALS: BIOMOLECULES

- 1 Preparation of buffer solutions.
- 2 Qualitative and tests for identification of carbohydrates, amino acids, lipids and oils.
- 3 Quantitative estimation of sugars, amino acids and proteins.
- 4 Titration curve of amino acids.
- 5 Determination of saponification number, iodine number and acid value of fatty acids.
- 6 Estimation of cholesterol.
- 7 Isolation and estimation of nucleic acids.

REFERENCES

- 1 Introduction to practical Biochemistry. S.K.Sawhney and Randir singh. Narosa Publishing house.
- 2 Biochemical methods. S.Sadashivam and A.Manikam. 2ndEdn. New Age International (p) Ltd. Press.
- 3 Practical Biochemistry: Principles and Techniques. Keith Wilson and John Walker. 5thEdn. Cambridge University press.
- 4 Basic Biochemical methods. R.R.Alexander. J.M.Griffith. 2ndEdn. Wiley-Liss. publications.
- 5 Practical Biochemistry. David Plummer. Tata McGraw-Hill publishing.
- 6 Modern experimental Biochemistry. Rodney Boyer. 3rdEdn. Addison Wesley Longham

HCP 1.3: PRACTICALS: ENZYMOLOGY

- 1 Assay of enzyme activities- amylase, invertase, Lipase, papian, urease and phosphatase
- 2 Isolation and partial purification of amylase from sweet potato and saliva, urease from horse gram, Lysozyme from egg white.
- 3 Determination of K_m and V_{max} of alpha amylase
- 4 Effect of pH, temperature on amylase activity
- 5 Study of enzyme inhibition

REFERENCES

- 1 Introduction to practical Biochemistry. S.K.Sawhney and Randir Singh. Narosa Publishing house.
- 2 Biochemical methods. S.Sadashivam and A.Manikam. 2ndEdn. New Age International (p)Ltd. Press.
- 3 Practical Biochemistry: Principles and techniques. Keith Wilson and J Walker. 5thEdn. Cambridge University Press.
- 4 Basic Biochemical methods. R.R.Alexander. J.M.Griffith. 2ndEdn. Wiley-Liss. publications.
- 5 An introduction to Practical Biochemistry. David Plummer. 4thEdn. Tata McGraw Hill pub.
- 6 Modern experimental Biochemistry. Rodney Boyer. 3rdEdn. Addison Wesley Longham

SCP 1.1: PRACTICALS: MICROBIOLOGY

- 1 Preparation of liquid and solid media for the growth of microorganisms.
- 2 Isolation of microorganisms by plating, streaking and serial dilution methods.
- 3 Preparation of slants and stab cultures.
- 4 Preservation and maintenance of microorganisms.
- 5 Growth curve of bacterium, measurement of bacterial population, effect of temperature, pH, carbon and nitrogen sources on the growth.
- 6 Study of microorganisms by Gram stain, acid fast stain and staining of spores.
- 7 Assay of antibiotics and demonstration of antibiotic resistance.
- 8 Analysis of water for potability and determination of MPN.

REFERENCES

- 1 Microbes in action. Sheeley and vanDeMark
- 2 Microbiology: A laboratory Manual. J.G. Cappuccino and N. Sherman. 4th Edn. Addison Wesley Publishers.
- 3 Microbiological applications- A laboratory manual. Benson, H.J.WMC – Brown Publishers.
- 4 Microbiology and K.R. Aneja
- 5 Gunashekar
- 6 Microbiological Applications Lab Manual. Benson. 8th Edn. The McGraw–Hill Companies.

SCP 1.2: PRACTICALS: BIOORGANIC AND BIOPHYSICAL CHEMISTRY

- 1 Measurement of pH by pH meter
- 2 Titration curve of weak acids and determination of pKa
- 3 Preparation of buffers
- 4 Titration curve of amino acids.
- 5 Polari metric analysis of carbohydrates.
- 6 Acid hydrolysis of sucrose and starch.
- 7 Hydrolysis of proteins.

REFERENCES

- 1 Practical Biochemistry: principles and Techniques. Keith Wilson and John Walker. 5thEdn. Cambridge University press.
- 2 Basic Biochemical methods. R.R.Alexander, J.M.Griffith. 2ndEdn.Wiley-Lisspublications.
- 3 Standard methods of Biochemical analysis. S.R.Thimmaiah. Kalyani publishers.
- 4 Practical Biochemistry. David Plummer. Tata McGraw-Hill publishing.
- 5 Introduction to practical Biochemistry. S.K.Sawhney and Randir Singh. Narosa Publishing house.
- 6 Biochemical methods. S.Sadashivam and A.Manikam. 2ndEdn.New Age International (p)Ltd. Press.

II - SEMESTER

HCT 2.1: CELL BIOLOGY**(4 CREDITS: 64 h)**

Unit-I, 1 credit, 16 h

Structural Organization Of Prokaryotic And Eukaryotic Cells: The ultra-structure of nucleus, mitochondria, endoplasmic reticulum (rough and smooth), Golgi apparatus, lysosomes, and peroxisomes and their functions. The cytoskeletons-microtubules and microfilaments (Motor Proteins). Sub-cellular fractionation-differential and density gradient centrifugation.

Cell-Division: Mitosis and meiosis. Cell-cycle and its regulation. Classification, Structure and Characteristics of Protein Kinases.

Biomembrane: physic-chemical properties of biological membranes, composition, Singer-Nicolson model: membrane asymmetry-lipids, proteins, carbohydrates and functional asymmetry, lateral diffusion. Organization of proteins in membrane- integral, peripheral and glycosyl anchored proteins.

Unit-II, 1 credit, 16 h

Transport Across The Membrane: Simple diffusion, Fick's law of diffusion, Kinetics of diffusion, Passive transport and active transport. Transport ATPases- P-type, V-type, F-type and ABC-transporter. Endocytosis and exocytosis.

Nutrient Transport: voltage gated ion channels, ligand gated ion channels (acetyl choline receptor), structure and functioning of K^+ and Na^+ channel, Acetyl choline receptor, Na^+/K^+ -ATPase. Transport of glucose, amino acids, water and chloride bicarbonate transport.

Unit-III, 1 credit, 16 h

BioChemistry Of Hormones: structure, function, mechanism of action, regulation and disorders of hormones of hypothalamus, pituitary, thyroid, pancreas, adrenals steroid hormones ecdydsone, intestinal hormones.

Biosignalling: Introduction, types of transduction-, receptor enzymes, serpentine receptors, gated ion channels and steroid receptors. General mechanisms of cell signalling. Second messengers: cAMP, cGMP, Ca^{+2} , calmodulin, Inositol 1,4,5-Triphosphate, Diacyl glycerol.

Cancer and programmed cell death: Biochemistry of cancer: carcinogenesis, characteristics of cancer cell, agents promoting carcinogenesis. Transforming virus, proto-oncogenes, oncogenes and tumour suppressor genes. Apoptosis, characteristics of apoptotic cell, role of caspases, role of mitochondria, The Fas/CD95 and Tumour Necrosis Factor-Receptor Signalling Pathway, p53 and bcl2.

Unit-IV, 1 credit, 16 h

Sensory Systems: Structure of rod and cone cells, sensory transduction in vision. Molecular mechanism of olfaction. Nerve impulse transmission, neurotransmitters.

Muscle Contraction: skeletal muscle structure, ultra structural organization of protein components of myofibrils, molecular organization of thick and thin filaments, mechanism of muscle contraction, regulation of contraction, cardiac muscle contraction.

Plant Hormones: Plant growth regulating substances, biosynthesis and their mode of action. Molecular effects of auxin in regulation of cell extension. Gibberlic acid, abscisic acid cytokinins, ethylene.

REFERENCES

- 1 Molecular Biology of the Cells. Alberts, Johnson. 4th Edn. Garland Publications Inc. NY.
- 2 Molecular Cell Biology. Harvey Lodish, Berk, Zippursky L. 5th Edn. W. H. Freeman and Company.
- 3 Biochemistry of Signal Transduction and Regulation. Gerhard Krauss. 3rd Edn. Wiley- Vch Verlag
- 4 The World of Cell. Jeff Hardin, Gregory Bertoni, Lewis j. Kleinsmith. Pearson Benjamin Cummings.
- 5 Molecular and Cell Biology – Baltimore
- 6 Plant Biochemistry. Hans-Walter Heldt. 3rd Edn. Elsevier Academic Press
- 7 Biochemistry. Donald Vote, Judith Voet. 4th Edn. John Wiley and Sons, NY.
- 8 Lehninger. Principles of Biochemistry. Nelson and Cox. 5th Edn. W.H. Freeman and company.

HCT 2.2: METABOLISM – I**(4 CREDITS: 64 h)**

Unit-I, 1 credit, 16 h

Introduction: basic concepts in metabolism; catabolism, anabolism, catabolic anabolic and amphibolic pathways.

Metabolism of carbohydrate – Glycolysis its energetics and regulation, role of PFK .Glycerol-3-phosphate and Malate-Aspartate shuttle system. Pathways of utilization of pyruvate. Entry of other carbohydrates in to glycolysis. Fructose urea, galactosemia. lactate, Cori cycle, and its significance and ethanol. Metabolism of hexoses.

Unit-II, 1 credit, 16 h

Citric acid cycle: Reactions, regulation and its energetics. Amphibolic nature of citric acid cycle, anaplerotic reactions. Alternative pathways of carbohydrate metabolism – Pentose phosphate pathway, E D pathway, Glucuronate pathway, Glyoxylate pathway.

Gluconeogenesis: energetics and regulation. Futile cycle.

Glycogen metabolism: Biosynthesis and degradation, its regulation including hormonal control. Glycogen storage diseases.

Biosynthesis of disaccharides: Sucrose, lactose. Regulation of lactose biosynthesis. Biosynthesis of Starch, cellulose and Peptidoglycan.

Unit-III, 1 credit, 16 h

Bioenergetics- Basic concepts of thermodynamics, free energy charge, standard free energy, oxidation reduction reactions in biological systems, Redox potentials, thermodynamics of phosphate compounds, Group transfer reactions of ATP, high energy phosphate donors. Mitochondrial electron transport – organization of respiratory chain complexes, structure and function of the components, specific inhibitors of ETC, oxidative phosphorylation, theories and mechanisms, couplers and uncouplers, ATP synthesis, Mitchell hypothesis, Fo F1-ATPase- structure and mechanism.

Unit-IV, 1 credit, 16 h

Photosynthesis- chloroplast and thylakoid structure, photosynthesis reaction centres, photolytic apparatus in plants, light harvesting antenna complex, Hill reaction, light reactions, Mechanism of phosphorylation – cyclic and non – cyclic photophosphorylation, dark reactions, RUBISCO photorespiration in C3 and C4 plants, Crassulacean acid metabolism, Bacterial photosynthesis.

REFERENCES

- 1 Biochemistry. Donald Voet, Judith Voet. 4thEdn. John Wiley and Sons, NY.
- 2 Lehninger. Principles of Biochemistry. Nelson and Cox. 5th Edn.W.H.Freeman and company.
- 3 Text Book of Biochemistry with clinical correlations. Thomas Devlin. Wiley-Liss.
- 4 Biochemistry. David Rawn. Neil Patterson Publishers.
- 5 Biochemistry. Geoffrey Zuby. 4th Edn. 1998. WMC Brown Publishers.
- 6 Biochemistry. Jeremy M. Berg, John L. Tymoczko. LubertStryer. Gregory J. Gatto, Jr. 7th Edn. W. H. Freeman and Company.
- 7 Text Book of Biochemistry. Mathews.

SCT 2.1: METABOLISM-II**(4 CREDITS: 64h)**

Unit-I, 1 credit, 16 h

Lipid Metabolism: Degradation of tri-acyl glycerides. Fatty acid degradation; beta oxidation, knoop's experiment, oxidation of even and odd number of fatty acids, oxidation of saturated and unsaturated fatty acids, alpha and omega oxidation, energetics of fatty acid oxidation. Biosynthesis of fatty acids: fatty acid synthase complex, chain elongation and desaturation. Biosynthesis of tri acyl glycerides and phospholipids, sphingolipids. Cholesterol biosynthesis and its regulation. Catabolism of cholesterol, bile acids and bile salts.

Unit-II, 1 credit, 16 h

Nitrogen Cycle: Introduction, excretion of nitrogen an overview, nitrogen fixation-Symbiotic and non-symbiotic, nif genes, nitrogenase complex, utilization of nitrates and nitrites, assimilation of NH₃, regulation of nitrate reductase.

Amino Acid Metabolism: General metabolic reactions of amino acids- transmutation, deamination, oxidative deamination, decarboxylation and racemization. Role of PLP in amino acid metabolism. Catabolism of amino acid: metabolic fate of aminonitrogen, trans deamination, Kreb's urea cycle, ketogenic and glycolytic amino acids. Degradation of individual aminoacids- C2, C3, C4, AND C5 family, brached chain amino acids, aromatic amino acids. Inborn errors of amino acid metabolism-phenylketoneuria, alcaptonurea, albinism, maple syrup urine disease. Biosynthesis of non- essential and essential amino acids. Regulation of amino acid biosynthesis by sequential, concerted and cumulative feedback control mechanisms.

Unit-III, 1credit, 16 h

Other products of amino acid metabolism:Biosynthesis of creatine, creatine phosphate, Polyamines-putrescine, spermin spermidine, glutathione (gama-glutamyl cycle), physiologically active amines – serotonin, gama- amino butyric acid, histamine, catechol.

Amines - dopamine, epinephrine, non epinephrine. Tetrahydrofolate derivatives Interconversion, antifolate drugs, urea cycle- regulation and disorders.

Metabolism of Heme: Biosynthesis and degradation of heme porphyrine, regulation, formastion of bile pigments.

Unit-IV, 1 credit, 16 h

Nucleotide Metabolism: Biosynthesis of Purine and pyrimidine nucleotides by De novo and Salvage pathways, regulations of biosynthesis. Interconversions of mono, di and triphosphates. Biosynthesis of deoxyribonucleotides and deoxythymidylate. Inhibitors of nucleotide biosynthesis – mechanism action of azaserine, acivicin, 5-fluorouracil and methotrexate as anticancer drugs.

Degradation of purine and pyrimidines, and geetic disorders- Gout, Lesch – Nyhan syndrome immunodeficiency syndrome.

Biosynthesis of nucleotide coenzymes: NAD⁺, NADP⁺, FAD and Coenzyme A.

Orotic acid urea, xanthuria.

REFERENCES

- 1 Biochemistry. Donald Vote, Judith Voet. 4thEdn. John Wiley and Sons, NY.
- 2 Lehninger. Principles of Biochemistry. Nelson and Cox. 5thEdn.W.H.Freeman and company.New York
- 3 Text Book of Biochemistry with clinical correlations. Thomas Devlin. Wiley-Liss.
- 4 Biochemistry. David Rawn. Neil Patterson Publishers.
- 5 Biochemistry. Geofery Zubby .4th Edn.. WMC Brown Publishers.
- 6 Biochemistry. Jeremy M. Berg, John L. Tymoczko. LubertStryer. Gregory J. Gatto, Jr. 7th .Edn. W. H. Freeman
- 7 Text Book of Biochemistry. Mathews.

SCT 2.2: GENERAL PHYSIOLOGY**(4CREDITS:64 h)**

Unit-I, 1-credit, 6h

Homeostasis: Overview , Positive and negative feedback, Path ways altering the homeostasis. Homeostasis Throughout the Body : Nervous System, Endocrine System, Skeletal System, Muscular System , Cardiovascular System, Lymphatic System, Respiratory System, Digestive System, Urinary System, Reproductive system. Thermoregulation, Body Composition, Body Fluid Distribution, Dehydration and Volume Depletion, Water Balance, Sodium Balance, Potassium Balance, Calcium and Phosphate Balance.

Unit-II, 1-credit , 16h

The Nervous System: Overview of the entire nervous system: General functions of the CNS, Types, structure and function of neurons,, Excitatory and inhibitory process, Generation and propagation of an action potential. The Nerve Impulse.

Brain - Medulla, Pons, Cerebrum, Cerebellum.

The Limbic System: Structures of the Limbic System and functions. Diseases of the Limbic System: Schizophrenia, Depression, Bipolar Disorder.

Hippocampus, Amygdala, Thalamus, Hypothalamus, the Fornix and Parahippocampal, The Cingulate Gyrus.

Memory and Learning: Sensory Memory, Short Term Memory, Long Term Memory, Long-term Potentiation , Early Phase, Late Phase, Retrograde Signaling.

The Peripheral Nervous System ; Lateral cord, Posterior cord, Medial cord, Other thoracic spinal nerves (T3-T12).

The Autonomic System: The Sympathetic and Parasympathetic Systems, Organization Information transmission, Relationship to sympathetic, Receptors.

Unit-III, 1-credit, 16h

Blood physiology: Overview of Blood , Blood Composition, Plasma makeup.

Red Blood Cells, Functions and Gas Exchange. White Blood Cells; Platelets and Functions. Hemostasis (Coagulation or Clotting). ABO Group System; Surface Antigens, Inheritance, Compatibility in Blood/Plasma Transfusions. Hemolytic Disease of the Newborn.

Diseases of the Blood: Von Willebrand Disease, Disseminated Intravascular Coagulation, Hemophilia, Factor V Leiden , Anaemia, Sickle cell, Polycythaemia and Leukaemia.

The Urinary System: Introduction, Functions of the Urinary System, Organs in the Urinary System Kidneys and Their Structure.

Formation of Urine: Filtration, Reabsorption, Secretion. Maintaining Water-Salt Balance, Reabsorption of water, Reabsorption of Salt, Hyponatremia, Diuretics.

Diseases of the Kidney: Diabetes insipidus, Urinary tract infections (UTI's), Dialysis and Kidney Transplant.

The Respiratory System: Breathing and Lung Mechanics. The Pathways of Air Inspiration and Expiration. Lung Compliance, Control of respiration; Central control and Peripheral control. Respiratory System: Upper and Lower Respiratory Tracts; Upper Respiratory and Lower Respiratory Tract.

Homeostasis and Gas Exchange: Gas Exchange by External and Internal Respiration. The Passage Way From the Trachea to the Bronchioles, Right and Left Lungs, Cellular Respiration. Lung Capacity, Stimulation of Breathing and Regulation of Blood pH.

Problems Associated With the Respiratory Tract and Breathing. Upper Respiratory Tract Infections. Lower Respiratory Tract Disorders. Respiratory Distress Syndrome. Sleep Apnoea. Chronic Obstructive Pulmonary Disease (COPD) Patients and Nutrition.

Genetics and inheritance: Introduction; Genetic material, DNA, genes, transcription and translation. Inheritance of genetic material, mechanisms of inheritance, Sex-linked Inheritance, cytoplasmic and mitochondrial inheritance.

Inherited Genetic Diseases and their treatments: Hemochromatosis, Cystic Fibrosis (CF), Sickle cell anaemia, Hemophilia.

Non-heritable Genetic Disorders: Down syndrome, Chromosomal Abnormalities, Genetic Regulation of Development and Homeostasis.

REFERENCES

- 1 Essentials of Anatomy and Physiology. Valerie C. Scanlon and Tina Sanders. 5th Edn. F. A. Davis Company.
- 2 Essential Physiological Biochemistry and organ-based approach. Stephen Reed. Wiley-Black well publishing.
- 3 Fundamentals of Anatomy and Physiology. Donald C. Rizzo. 3rd Edn.
- 4 Medical physiology. Guyton and Hall. 10th Edn. Harcourt Asia Pte. Ltd.
- 5 Ganong's Review of Medical Physiology. Kim E. Barrett, Scott Boitano, Susan M. Barman Heddwen L. Brooks. 20th Edn. McGraw Hill publishing.

OET 2.1: GENERAL BIOCHEMISTRY (OPEN ELECTIVE)**(4 CREDITS: 64 h)**

Unit-I, 1 credit, 16 h

Properties of water: Importance of water in biological systems. Ion product of water and its measurement Biological relevance of pH and pKa, Henderson-Hasselbach equation. Buffers and their importance in biological systems. Preparation of buffers.

Carbohydrates: Monosaccharides – Classification, stereochemistry, optical isomerism, chirality, enantiomers, diastereomers, DL and RS system of nomenclature, racemization. Sugar derivatives. Disaccharides- structure of sucrose, lactose, maltose and cellobiose. Structure, Properties and importance of homo and hetero- polysaccharides – starch, glycogen, cellulose, dextran, agarose and alginate. Glycosaminoglycans, glycoproteins, antifreeze glycoproteins, bacterial cell wall structure and function.

Unit-II, 1 credit, 16 h

Amino acids and proteins: Classification and structure of amino acids. Acid-base properties of amino acids. Non protein amino acids. Peptide bond-structure and conformation. Peptide-synthesis-reactive ester method and modified Merrifield solid phase synthesis. Naturally occurring peptides. Ionic properties of peptides and proteins. Separation of amino acids mixtures and analysis of amino acids.

Proteins: Introduction, classification and biological functions. Composition of proteins. The size and conformation of proteins. Supramolecular assemblies of proteins. The functional diversity of proteins.

Unit-III, 1 credit, 16 h

Nucleic Acids: Structure and properties of nucleosides and nucleotides. Properties of nucleic acids in solution. Hydrolysis of nucleic acids by acid and base. Enzymatic hydrolysis, Nuclease specificity and restriction endonucleases. Chemical synthesis and oligonucleotides. Structure of nucleic acids: Structural properties of DNA. Different models of DNA-A, B and Z. T_m and cot values and their determination. Nucleic acid hybridization. Super coiled DNA, buoyant density of DNA. Super helix topology. DNA sequencing: Sanger's method, base specific chemical cleavage method. Automated DNA sequencing. Nearest neighbour base sequence analysis

Chemistry of RNAs: Structures and functions of mRNA, tRNA and rRNA.

Unit-IV, 1 credit, 16 h

Lipids: Brief account of the chemistry and classification of lipids (without structural elucidation). Biological role of the following: Fatty acids, Aryl glycerols, Cholesterol, Terpenes, Waxes and Bile salts, Phospholipids, Sphingolipids, Glycolipids, Steroids, Prostaglandins, Thromboxanes and Leukotrienes. Properties of lipids aggregates-micelles, Bilayer and Liposomes.

REFERENCES

- 1 Biochemistry. Donald Vote, Judith Voet. 4thEdn. John Wiley and Sons, NY.
- 2 Lehninger. Principles of Biochemistry. Nelson and Cox. 5thEdn. W.H. Freeman and company.
- 3 Text Book of Biochemistry with clinical correlations. Thomas Devlin. Wiley-Liss.
- 4 Biochemistry. David Rawn. Neil Patterson Publishers.
- 5 Biochemistry. Zubay 4th Edn. WMC Brown Publishers.
- 6 Text Book of Biochemistry. Mathews.
- 7 Biochemistry. Jeremy M. Berg, John L. Tymoczko. Lubert Stryer. Gregory J. Gatto, Jr. 7th Edn. W. H. Freeman and Company.
- 8 Biochemistry. R.H. Garret and C.M. Grisham. 4th Edn. Saunders College Publication.

HCP 2.1 PRACTICALS: CELL BIOLOGY

- 1 Isolation of cellular organelles.
- 2 Preparation of liposomes.
- 3 Demonstration of active transport in liposomes.
- 4 Estimation of steroid hormones.
- 5 Determination of acetyl choline esterase activity.

REFERENCES

- 1 Introduction to practical Biochemistry. S.K.Sawhney and Randir Singh. Narosa Publishing house.
- 2 Biochemical methods. S.Sadashivam and A.Manikam. 2ndEdn.New Age International (p)Ltd. Press
- 3 Practical Biochemistry: principles and Techniques. Keith Wilson and John Walker. 5thEdn. Cambridge University press.
- 4 BasicBiochemicalmethods.R.R.Alexander,J.M.Griffith.2ndEdn.Wiley-Lisspublications.
- 5 Practical Biochemistry. David Plummer. Tata McGraw-Hill publishing.
- 6 Modern Experimental Biochemistry. RodneyBoyer. 3rdEdn. Addison Wesley Longham.
- 7 Cell Biology: A laboratory hand Book. Vol-I. Julio E. Celis. Elsevier Publishing.

HCP 2.2: PRACTICALS: METABOLISM-I

- 1 Preparation of mitochondria from rat liver.
- 2 Determination of oxygen uptake of mitochondria.
- 3 Detection of cytochromes.
- 4 Determination of ATPase activity of mitochondria.
- 5 Isolation of glycogen from the rat liver.
- 6 Esterase activity of rat liver homogenate.
- 7 Isolation and spectral properties of photosynthetic pigments.
- 8 Isolation of chloroplast from spinach leaves.
- 9 Assay of Hill reaction from chloroplast.
- 10 Measurement of PEP-carboxylase activity in leaves

REFERENCES

- 1 Introduction to practical Biochemistry. S.K.Sawhney and Randir Singh. Narosa Publishing house.
- 2 Biochemical methods. S.Sadashivam and A.Manikam. 2ndEdn. New Age International (p)Ltd.Press.
- 3 Practical Biochemistry: principles and Techniques. Keith Wilson and John Walker. 5thEdn. Cambridge University press.
- 4 Basic Biochemical methods. R.R.Alexander, J.M.Griffith. 2ndEdn.Wiley-Lisspublications.
- 5 Practical Biochemistry. David Plummer. Tata McGraw-Hill publishing.
- 6 Modern Experimental Biochemistry. RodneyBoyer. 3rdEdn. Addison Wesley Longham.

SCP 2.1 PRACTICALS: METABOLISM-II

- 1 Assay of aminotransferases: (1) Aspartate (2) alanine amino transferases.
- 2 Assay of phenyl alanine ammonialyase.
- 3 Assay of nitrate and nitrite reductase.
- 4 Assay of Glutamine synthase.
- 5 Estimation of Allantoin and allantoinic acid.
- 6 Assay of nitrogenase.
- 7 Estimation of plant hormones.

REFERENCES

- 1 Introduction to practical Biochemistry. S.K.Sawhney and Randir Singh. Narosa Publishing house.
- 2 Biochemical methods. S.Sadashivam and A.Manikam. 2ndEdn. New Age International (p) Ltd.Press.
- 3 Practical Biochemistry: principles and Techniques. Keith Wilson and John Walker. 5thEdn. Cambridge University press.
- 4 Basic Biochemical methods. R.R.Alexander, J.M.Griffith.2ndEdn.Wiley-Lisspublications.
- 5 Practical Biochemistry. David Plummer. Tata McGraw-Hill publishing.
- 6 Modern Experimental Biochemistry. Rodney Boyer. 3rdEdn. Addison Wesley Longham.

SCP 2.2: PRACTICALS: GENERAL PHYSIOLOGY

- 1 Blood group analysis.
- 2 Isolation of liver mitochondria.
- 3 RBC and WBC count.
- 4 Estimation of Hemoglobin.
- 5 Isolation and Separation of Hemoglobin by gel permeation chromatography.

REFERENCES

- 1 Practical clinical Biochemistry. Ranjna Chawla. 3rdEdn. Jaypee
- 2 Practical clinical Biochemistry. Harold Varley.
- 3 Standard methods of Biochemical analysis. S.R.Thimmaiah. Kalyani publishers.
- 4 Hutchison's Clinical methods. Hunter and Bomford. 15thEdn. BailliereTindall and Cassell. London.
- 5 Laboratory manual in Biochemistry. T.N.Pattabiraman. 3rdEdn. All India Publishers and distributers.
- 6 Introduction to practical Biochemistry. S.K.Sawhney and Randir Singh. Narosa Publishing house.
- 7 Biochemical methods. S.Sadashivam and A.Manikam. 2ndEdn.New Age International (p)Ltd. Press.

OEP 2.1: PRACTICALS: GENERAL BIOCHEMISTRY (OPEN ELECTIVE)

- 1 Preparation of buffer solutions.
- 2 Qualitative and tests for identification of carbohydrates, amino acids, lipids and oils.
- 3 Quantitative estimation of sugars, amino acids and proteins.
- 4 Titration curve of amino acids.
- 5 Determination of saponification number, iodine number and acid value of fatty acids.
- 6 Estimation of cholesterol.
- 7 Isolation and estimation of nucleic acids.

REFERENCES

- 1 Introduction to practical Biochemistry. S.K.Sawhney and Randir Singh. Narosa Publishing house.
- 2 Biochemical methods. S.Sadashivam and A.Manikam. 2ndEdn.New Age International (p)Ltd. Press
- 3 Practical Biochemistry: principles and Techniques. Keith Wilson and John Walker. 5thEdn. Cambridge University press.
- 4 Basic Biochemical methods. R.R.Alexander, J.M.Griffith. 2ndEdn.Wiley-Lisspublications.
- 5 Practical Biochemistry. David Plummer. Tata McGraw-Hill publishing.
- 6 Modern Experimental Biochemistry. Rodney Boyer. 3rdEdn. Addison Wesley Longham.

III - SEMESTER

HCT 3.1: CLINICAL BIOCHEMISTRY AND NUTRITION**(4 CREDITS:64 h)****CLINICAL BIOCHEMISTRY**

Unit-I, 1-Credit, 16h

Blood: Composition, blood count, total, differential and platelet count. Blood group studies, Rhesus factor, ESR- its determination and importance in certain diseases. Blood coagulation factors, mechanism and its regulation. Plasma proteins, profile in health and diseases. Abnormal hemoglobins, Disorders of hemoglobins – thalassemia, sickle cell anaemia. Anaemias-Microcytic, macrocytic and normocytic, CSF analysis.

Diagnostic enzymology: Clinical significance of enzymes like SGOT, SGPT, LDH, CPK, Alkaline and acid phosphatase, amylase.

Unit-II, 1-Credit, 16h

Kidney profile: Assessment of renal function-clearance tests and their importance in assessment of kidney functions. Laboratory investigations of kidney disorders- UTI, kidney stones, Nephritis, Urolithiasis, Dialysis, Uremia, Hypouricemia

Liver profile: Biochemical indices of hepatobiliary diseases, Bile pigments- Formation of bilirubin, urobilinogen, bile acids, Jaundice- pre-hepatic, hepatic, post hepatic. Diagnosis Liver function tests, Diseases of liver-Hepatitis, Cholestasis Cirrhosis, Gall stone.

Unit-III, 1-Credit, 16h

Disorders of carbohydrate metabolism- Diabetes – etiology, classification, management, laboratory investigations. GTT, Glycated Hb, Diabetic complications, Inborn errors of carbohydrate metabolism-Glycogen storage diseases, Galactosemia, Lactose intolerance, Pentoseurea.

Disorders of Lipid metabolism- Plasma lipoproteins and their functions, Hyperlipoproteinaemia-classification, Primary and secondary, Hypercholesterolemia, Ketosis and its significance.

Disorders of amino acid and protein metabolism- Inborn errors of amino acid metabolism- PKU, Alkaptonuria.

Disorders of purine and pyrimidine metabolism-Gout, Lesch-Nyhan syndrome, Xanthurea, Oroticacidurea.

Cardiovascular disorders- Major cardiovascular system- Atherosclerosis- risk factors, pathogenesis, diagnosis and prognosis.

Gastrointestinal disorders: Fractional gastric analysis, Hypo and hyperacidity, Gastric ulcers, Mal absorption syndrome.

Unit-IV, 1-Credit, 16h

NUTRITION

Basic concepts of nutrition- Introduction, Nutrients-Macro, micro. Energy value of nutrients-sources, their determination. Role of dietary fibres, Cholesterol, Essential fatty acids, PUFA, Phryoderma. Essential amino acids, Nitrogen balance studies, Evaluation of nutritive values of proteins by different methods. Improvement of protein quality by supplementation, fortification, PCM- Kwashiorkar and Marasmus.

Food metabolism: BMR - determination, Factors affecting BMR, Average BMR for Indians. Energy requirement for different physical activities. SDA of food.

Vitamins: Sources, Structure, functions and deficiency symptoms of fat soluble and water soluble vitamins, pro-vitamins, anti-vitamins.

Minerals: Absorption, requirement and functions of Ca, P, Mg, Na, K, Cl, Fe and trace elements.

Water metabolism: Distribution of water in body fluids. Regulation of water, Dehydration, Rehydration, ORS. Special aspects of nutrition- nutrition during infancy, childhood, adolescence, pregnancy, lactation and old age.

REFERENCES

- 1 Text of food and Nutrition. Dr. Swaminathan, Vol-I and Vol-II, 2ndEdn. The Bangalore Printing and publishing Co.
- 2 Text book of Nutrition. M.S.Bamji, PRalhadRao, Vinidini Reddy. Oxford and IBH publisher.
- 3 Introductory Nutrition. Helen Andrews Guthrie. 3rdEdn. C.V.Mosby. St. Louis.
- 4 Human Nutrition and Dietetics. Stanley Davidson. 8thEdn. ELBS.
- 5 Nutrition. M.S.Chaney, M.L.Ross. 8thEdn. Surjeet publication. New Delhi.
- 6 Text Book of Biochemistry with clinical correlations. Thomas Devlin. Wiley-Liss.
- 7 Text book of medical Biochemistry. M.N.Chatterjee and Rana Sinde. Jaypee Brothers.
- 8 Text book of Biochemistry, Molecular and clinical aspects. S.Nagini. Scitech publications.
- 9 Fundamentals of Biochemistry. A.C.Deb. 8thEdn. New Central Book Agency.
- 10 Clinical chemistry: principles, procedures, correlations. Lippincot
- 11 Medical physiology. Guyton and Hall. 10thEdn. Harcourt asiaPte. Ltd.
- 12 Ganong's Review of Medical Physiology. Kim E. Barrett, Scott Boitano, Susan M. Barman Heddwen L. Brooks. 20th Edn. McGraw Hill publishing.
- 13 Text book of Biochemistry and Human Biology .G.P.Talwar. Prentice-Hall of India.
- 14 Applied biochemistry of clinical disorders. Alan Gornall. 2ndEdn. J.B.Lippincott company
- 15 Clinical Biochemistry: principle, procedures and correlation. Bishop J.L., Duben Von Laufen, E.Fody, J.B.Lippincott company.
- 16 Principles of medical chemistry. William O. Foye. 3rdEdn. Varghese publishing house.
- 17 Medical Biochemistry. Alfred Burger. 3rdEdn. John wiley and sons.

HCT 3.2: IMMUNOLOGY**(4 CREDITS:64 h)**

Unit-I, 1-Credit, 16h

Overview of the Immune system: Active and passive immunity, Innate and nonspecific immunity. Humoral and cellular immunity. Integration humoral and cellular immunity.

Cells and tissues of immune system: Lymphocyte development and heterogeneity. Morphological changes associated with lymphocyte activation. Mononuclear phagocytes: development, activation and function. Dendritic cells, granulocytes

Unit-II, 1-Credit, 16h

Antigens: Identification and characterization of different antigens. Antigenicity, haptanes, epitopes, types of antigens: bacterial, cell surface antigens. Blood group substances Antibodies: Distribution, and purification of antibody molecules. Classes and subclasses of antibodies. Structure and functions of antibodies. Hypervariable regions- isotopic, allotypic and idiotypic variations.

Antigen-Antibody Reactions: Detection and measurement of Antigen-antibody interactions. Precipitin reactions, Agglutination reactions, western blotting, immunoelectrophoresis, immunofluorescence, biotin-avidin assay, RIA, ELISA, immune complex disorders. **Complement system:** Components of complement and their activation. Biological consequences of complement activation Hypersensitive reactions: Factors causing hypersensitive reactions. Types of hypersensitive reactions and their effects.

Unit-III, 1-Credit, 16h

Cellular Basis of immunity: Maturation of B and T lymphocytes. Antigen processing and presentation. The roles T and B cells in the formation of antibodies. Cytokines-role and their importance in immune system.

Immunoglobulin genes: Genomic organization of immunoglobulin genes. Immunoglobulin gene arrangement and their mechanisms. Generation of antibody repertoire. Co-expression of IgM and IgD. Somatic mutations in immunoglobulin genes.

Unit-IV, 1-Credit, 16h

Monoclonal antibodies: Myeloma cells, fusion, screening, growth of hybridomas, production and applications of monoclonal antibodies.

Transplantation: Histocompatibility complex in man, tissue haplotype analysis. Structure of class I and II of MHC. Tissue and organ grafting. Graft rejection, immuno suppress agents. Vaccines and their preparation. Immune deficiency disorders.

REFERENCES

- 1 Immunology. Janis Kubay. W.H. Freeman and Co. Ltd, USA.
- 2 Immunology. Ivan Roitt, J. Beneseroff, David Male. 4thEdn. International publication Ltd. UK
- 3 Roitt's Essential Immunology. Ivan M. Roitt. Peter J. Delves. 10thEdn. Blackwell Science.
- 4 Fundamentals of Immunology. R.M. coleman, M.I. Lambard, Wm. C. Brown Pub.
- 5 Cellular and Molecular Immunology. A.K. Abbas, A.H. Lichtman, J.S. Pober. W.B. SaundersPub
- 6 Fundamental Immunology. William E. Paul. 6thEdn. Lippincott Williams and Wilkins.

SCT 3.1: MICROBIAL BIOTECHNOLOGY**(4 CREDITS:64 h)****Unit-I, 1 credit 16 h,**

Development and scope of microbial biotechnology, Industrial microorganisms, properties of useful industrial microorganisms, primary and secondary metabolites and their pathways. Industrial fermentation: Principles of fermentation, Laboratory scale and large scale production, design and operation of fermenters. Solid state fermentation, surface, submerged and continuous culture operations. Conditions of fermentation, origin of industrial strain, selection of organisms, choice of raw materials and fermentation media, foam control, growth and product formation in industrial processes. Downstream process, Recovery and purification of products.

Unit-II, 1 credit, 16 h

Microbial production of food additives: Amino acids - glutamic acid, and lysine, vitamins, acid. Production of single cell protein, microbial enzymes. Health care products – Antibiotics – isolation and screening of antibiotic produces, production and applications and mode of action of penicillin, streptomycin, chloramphenicol, tetracycline and peptide antibiotics. Steroid biotransformation.

Unit-III, 1 credit, 16 h

Production of organic acids and industrial alcohol and biofuels: acetic acid, citric acid, lactic acid, butanol, methanol, and hydrogen. Production of wine and alcoholic beverages-ethanol and vinegar. Methanogenic microbes, biofuels, production of biogas. Metabolic end products: Bioconversions and microbial polysaccharides. Microbiological mining, microbial insecticides and biofertilizers.

Unit-IV, 1 credit, 16 h

Industrial microbial enzymes: Production of enzymes, immobilized enzymes and cells – principle, advantages, methods of immobilization and applications. Biofilters and biosensors.
Environmental Microbiology: Environmental pollution, use of microbes in pollution control. Waste treatment-primary, secondary and advanced methods. Waste management. Bioremediation of environmental pollutants-degradation of xenobiotics- hydrocarbons, pesticides and surfactants and their ecological considerations.

REFERENCES

- 1 Brock Biology of Microorganisms. Madigan, Martinco, Dunlap. 12thEdn. Pearson Benjamin Cummings.
- 2 Microbiology. Prescott, Harley, Klein. 7thEdn. McGraw-Hill International.
- 3 Microbiology: Essentials and applications. McKane and Kandel, McGraw-Hill Publishers.
- 4 Industrial Microbiology. Waites, Morgan, Rockey and Higton. Blackwell Publishing.
- 5 Modern Biotechnology Connecting Innovations in Microbiology and Biochemistry to Engineering Fundamentals. Nathan S. Mosier, Michael R. Ladisch. A John Wiley and sons, Inc., publication.
- 6 Molecular Biology and Bio technology. John M. Walker and Ralph Rapley. 4thEdn. Royal society of chemistry.

SCT 3.2: PLANT BIOCHEMISTRY**(4 CREDITS:64 h)**

Unit-I, 1 credit, 16h

The Plant, the cell and its molecular components-Cell wall, cytoplasm and its components, techniques of cell fractionation.

Plant proteinases-Introduction, Endopeptidases-sulfahydryl proteinases, Serine proteinases, Acid proteinases; Exopeptidases-corboxypeptidases, aminopeptidases, dipeptidases and tripeptidases. Functional considerations.

Plant proteinase Inhibitors- General properties of plant proteinase inhibitors, proteinase inhibitors of seine proteinase, acid proteinase, metalloproteinases. Role of proteinase inhibitors in plants.

Unit-II, 1 credit, 16 h

Biochemistry of plant-pathogen interaction: Introduction. Major groups of plant pathogens, susceptibility and resistance, Host-pathogen interactions. Mechanism of pathogenicity and resistance. Elicitors, systemic acquired resistance, pathogen related protein/enzymes. Plant responded to environment and herbivory, plant roxis,

Unit-III, 1 credit, 16 h

Phenolic metabolism: Shikimate/arginate pathway, phenylalanine/hydroxycinnamate pathway, phenylpropanoid pathways, hydroxycinnamate conjugates, hydroxycoumarins, flavonoids, lignins, lignans and neolignans, tannins, quinones.

Plant growth substances : structural and physiological effects: Hormone concept, auxins, gibberlins, cytokinins, ethylene, abscisic acid, other plant constituents with biological activity, biosynthesis of plant growth substances, mechanism of action of IAA, gibberlins, abscisic acid, ethylene, growth retardation chemicals.

Unit-IV, 1 credit, 16 h

Isoprenoid metabolism; Nomenclature, classification and occurrence, general pathway of terpenoid biosynthesis, monoterpenoids, sesquiterpenoids, diterpenoids, triterpenoids, carotenoids, polytepenoids, control and compartmentation of isoprenoid biosynthesis.

Seed storage proteins: -Storage proteins in cereal and legume seeds their characterization and biosynthesis.

Lectins in higher plants: Introduction, distribution of lectins in plants, isolation and purification, physiochemical properties, biological activities, cytotoxicity of lectins, nutritional significance and applications.

REFERENCES

- 1 Plant Biochemistry. P.M.Dey, J.B.Harborne. Academic press.
- 2 Introductory plant physiology. G. Ray Noggle, and George J, Fritz. 2ndEdn. Prentice Hall of India Pvt, New Delhi.
- 3 Plant physiology. R.G.S. Bidwell. 2ndEdn. Macmillan publishing Co. Inc. New York.
- 4 The Biochemistry of Plants-A comprehensive treatise. P.K. Stumpf and E.E. Conn Vol 6. Academic press.

OET 3.1: FUNDAMENTALS OF ENZYMOLOGY.**(4 CREDITS: 64 h)**

Unit-I, 1 credit, 16 h

Introduction to Enzymes: History, General characteristics, Nomenclature and Classification of enzymes. Catalytic power, specificity and active site. IUB enzyme classification. Definition of IU, Ketal, enzyme turnover number and specific activity.

Enzyme purification: Enzyme localization, isolation and purification of enzymes. Methods employed in isolation, purification and characterization of enzymes. Presentation of enzyme purification data and criteria of purity of enzymes. Fundamentals of enzyme assay. Assay of enzymes by Spectrometric, colorimetric, manometric, fluorimetric, isotopic methods.

Unit-II, 1 credit, 16 h

Kinetics of enzyme- Catalyzed reactions:

Enzyme kinetics of single substrate reactions- Michaelis theory, steady state theory. Kinetic data evaluation- linear transformation of Michaelis-Menten equation. Pre-steady state kinetics. Integrated velocity equation, King-Altman procedure for deriving the rate equation. Effect of pH and temperature. Enzyme Inhibition- reversible; competitive, non-competitive, uncompetitive, irreversible inhibition.

Distinction between different kinetic pathways using primary and secondary plots. Inhibition studies.

Unit-III, 1 credit, 16 h

Chemical nature of enzyme catalysis- General acid-base catalysis, electrostatic catalysis, covalent catalysis, intramolecular catalysis and enzyme-catalysis.

The investigation of active site structure: The identification of binding sites and catalytic sites- trapping the E-S complex- the use of substrate analogs, chemical modification of amino acid side chains, photo-oxidation, enzyme modification by treatment with proteolytic enzymes.

Mechanisms of reactions catalysed by the following enzymes- Chymotrypsin, and Ribonuclease.

Coenzymes: The mechanistic role of the following coenzymes in enzyme catalysed reactions- nicotinamide nucleotides, flavin nucleotides, pyridoxal phosphate, coenzyme A, lipoic acid, thiamine pyrophosphate, biotin, tetrahydrofolate.

Unit-IV, 1 credit, 16 h

Monomeric, oligomeric and multienzyme complexes; The serine proteases and alcohol dehydrogenase. Isoenzymes- Lactate dehydrogenase (LDH) , Pyruvate dehydrogenase (PDH) complex.

Regulation of activity of enzymes: Reversible and irreversible covalent modifications, allosteric modifications.

Applications of enzymes: Industrial, Clinical, Analytical and Biotechnological applications. Immobilized enzymes: Principle, advantages and limitation, methods of enzymes immobilizations- Adsorption, flocculates, chemical bonding- cross-linking, gelatin encapsulation. Applications of immobilized enzymes.

REFERENCES

- 1 Basic Biochemical Laboratory Procedures and Computing. R. Cecil Jack. Oxford University.
- 2 Protein Purification Methods. S.L.V. Harris and Angal. IRL Press.
- 3 Understanding Enzymes. Palmer. T. Ellis Horwood Ltd.
- 4 Enzyme Kinetics. Roberts. D.V. Cambridge University Press.
- 5 The Enzymes. Boyer. Academic Press.
- 6 Enzyme Kinetics. Irwin H. Segel. Interscience-Wiley.
- 7 Enzyme Kinetics: The Steady state approach. Engel, P.C. 2nd Edn. Chapman and Hall.
- 8 Nature of Enzymology. Foster. Croom Helm.
- 9 Principles of Enzymology for Food Sciences. Whitaker, Marcel Dekker. Academic Press.
- 10 Fundamentals of Enzymology. N.C. Price and Lewis. Oxford University Press.

- 11 Principles of Enzymology for Food Sciences. Whitaker, Marcel Dekker. Academic Press.
- 12 Biochemistry: Voet D and Voet J.G.4thEdn. Jhon Wiley and Sons.
- 13 Lehinger's Principles of Biochemistry. Nelson and Cox.5thEdn, W.H.Freemaann DC company New York.
- 14 Molecular and Cellular Enzymology Volume I. Jeannine Yon-Kahn · Guy Herv'e. Springer

HCP 3.1: PRACTICALS: CLINICAL BIOCHEMISTRY AND NUTRITION.

- 1 **Urine analysis:** Qualitative analysis of urine for abnormal constituents- glucose, albumin, ketone bodies quantitative analysis of urine- Titratable acidity, creatine, creatinine, urea, uric acid, glucose
- 2 **Blood analysis:** Blood glucose, urea, uric acid, creatinine, A/G ratio, Cholesterol, Hb
- 3 **Assay of serum enzymes:** SGOT, SGPT, LDH, creatine kinase, acid and alkaline phosphatase. Electrophoresis of lipoproteins, Hb (Demonstration).

Nutrition

- 1 Determination of moisture, fibre and ash contents of some biological samples.
- 2 Determination of carbohydrate, protein and fat contents of some biological samples.
- 3 Estimation of I, Ca, P and Fe of some biological samples.
- 4 Estimation of Vit A Vit C of some biological samples.

REFERENCES

- 1 Practical clinical Biochemistry. Ranjna Chawlla. 3rdEdn. Jaypee
- 2 Practical clinical Biochemistry. Harold Varley.
- 3 Standard methods of Biochemical analysis. S.R.Thimmaiah. Kalyani publishers.
- 4 Hutchison's Clinical methods. Hunter and Bomford. 15thEdn. BailliereTindall and Cassell. London.
- 5 Laboratory manual in Biochemistry. T.N.Pattabiraman. 3rdEdn. All India Publishers and distributors.
- 6 IntroductiontopracticalBiochemistry. S.K.Sawhney and Randir Singh. Narosa Publishing house.
- 7 Biochemical methods. S.Sadashivam and A.Manikam. 2ndEdn.New Age International (p)Ltd. Press

HCP 3.2: PRACTICALS: IMMUNOLOGY

- 1 Rising of antibodies to antigens in rabbits.
- 2 Immuno diffusion.
- 3 Single and double radial immune diffusion.
- 4 Immuno electrophoresis.
- 5 Enzyme li linked immune assay.
- 6 Determination of human blood groups.
- 7 Agglutination tests.

REFERENCES

- 1 Introduction to practical Biochemistry. S.K.Sawhney and Randir Singh. Narosa Publishing house.
- 2 Laboratory manual in Biochemistry. TN. Pattabhiraman. 2nd Edn. All India publishers and distributers.
- 3 Biochemical methods. S.Sadashivam and A.Manikam. 2ndEdn. New Age International(p)Ltd.Press.
- 4 Practical Biochemistry: principles and Techniques. Keith Wilson and John Walker. 5thEdn. Cambridge University press.
- 5 BasicBiochemicalmethods.R.R.Alexander,J.M.Griffith.2ndEdn.Wiley-Lisspublications.
- 6 Practical Biochemistry. David Plummer. Tata McGraw-Hill publishing.
- 7 Modern Experimental Biochemistry. Rodney Boyer. 3rdEdn. Addison Wesley Longham.
- 8 Standard methods of Biochemical analysis. S.R.Thimmaiah. Kalyani publishers.

SCP3.1: PRACTICALS: MICROBIAL BIOTECHNOLOGY

- 1 Determination of fungal biomass
- 2 Production and assay of extra and intracellular enzymes
- 3 Assay of antibiotics for microbial cultures
- 4 Alcoholic fermentation
- 5 Immobilization of bacterial cells and enzymes
- 6 Production of citric and lactic acids from fermentation broth
- 7 Determination of mode of ring cleavage of catechol
- 8 Demonstration of SSF and submerged fermentations.

REFERENCES

- 1 Introduction to practical Biochemistry. S.K.Sawhney and Randir Singh. Narosa Publishing house.
- 2 Laboratory manual in Biochemistry. TN. Pattabhiraman. 2nd Edn. All India publishers and distributors.
- 4 Biochemical Methods. S. Sadashivam and A. Manikam. 2ndEdn. New Age International (p)Ltd.Press.
- 5 Practical Biochemistry: principles and Techniques. Keith Wilson and John Walker.5thEdn. CambridgeUniversitypress.
- 6 Basic Biochemical Methods. R.R.Alexander, J.M.Griffith.2ndEdn.Wiley-Lisspublications.
- 7 Practical Biochemistry. David Plummer. Tata McGraw-Hill publishing.
- 8 Modern experimental Biochemistry. Rodney Boyer. 3rdEdn. Addison Wesley Longham
- 9 Standard methods of Biochemical analysis. S.R.Thimmaiah. Kalyani publishers.

SCP 3.2: PRACTICALS: PLANT BIOCHEMISTRY

- 1 Extraction, isolation and estimation of polyphenols.
- 2 Extraction, isolation and estimation of lignin.
- 3 Extraction and estimation of flavones, tannins and quinolones.
- 4 Estimation of indole-3-acetic acid and gibberellin from plants.
- 5 Demonstration of systemic acquired resistance in plants.
- 6 Identification of pathogen related proteins in plants infected by pathogens.

REFERENCES

- 1 An introduction to Practical Biochemistry. David Plummer. 4thEdn. Tata McGraw Hill pub.
- 2 Practical Biochemistry: Principles and techniques. Keith Wilson and J Walker. 5thEdn. Cambridge University Press.
- 3 Introduction to practical Biochemistry. S.K.Sawhney and Randir Singh. Narosa Publishing house.
- 4 Standard methods of Biochemical analysis. S.R.Thimmaiah. Kalyani publishers.

OEP 3.1: PRACTICALS: ENZYMOLOGY

- 1 Assay of enzyme activities- amylase, invertase, Lipase, papian, urease and phosphatase
- 2 Isolation and partial purification of amylase from sweet potato and saliva, urease from horse gram, Lysozyme from egg white.
- 3 Determination of K_m and V_{max} of alpha amylase
- 4 Effect of pH, temperature on amylase activity
- 5 Study of enzyme inhibition

REFERENCES

- 1 Introduction to practical Biochemistry. S.K.Sawhney and Randir Singh. Narosa Publishing house.
- 2 Biochemical methods. S.Sadashivam and A.Manikam. 2ndEdn. New Age International (p)Ltd. Press.
- 3 Practical Biochemistry: Principles and techniques. Keith Wilson and J Walker. 5thEdn. Cambridge University Press.
- 4 Basic Biochemical methods. R.R.Alexander. J.M.Griffith. 2ndEdn. Wiley-Liss. publications.
- 5 An introduction to Practical Biochemistry. David Plummer. 4thEdn. Tata McGraw Hill pub.
- 6 Modern experimental Biochemistry. Rodney Boyer. 3rdEdn. Addison Wesley Longham

IV - SEMESTER

HCT 4.1: MOLECULAR BIOLOGY-I**(4 CREDITS:64 h)**

Unit-I, 1-Credit, 16h

Molecular basis of life: Information pathways. Central dogma of molecular Biology. Genome: Genome diversity, Chargaff's discovery. Nucleic acid as genetic material. Significance of chemical differences between DNA and RNA. Dynamic nature of the DNA double helix in solution.

Genetic organization: Structure and organization of nucleosomes, structure of chromosomes-Centromere, telomere. Repetitive sequences and tandem gene clusters. Histone genes. rRNA and tRNA genes in prokaryotes and eukaryotes. Structure and functions of mitochondrial DNA, chloroplast DNA.

Lampbrush and polytene chromosomes. Biochemical significance of chromosomal puffing and polyteny.

Bacterial genetics: Bacterial chromosome, structure and functions of plasmids – fertility, resistance, colicins, virulent, metabolic and other factors, transposons. Conjugation, transformation, transfection and transduction – generalized and specialized transduction. The molecular mechanism of genetic recombination: Holiday model. Enzymology of general recombination. Rec-A protein, Rec BCD enzyme complex.

Unit-I, 1-Credit, 16h

DNA Replication In Prokaryotes: Semiconservative mode of DNA replication. Mathew Meselson-Franklin Stahl and Cairns isotopic experiments. Replication fork. Leading and Lagging Strand DNA synthesis. Evidence for okazaki - fragment. RNA primers.

The enzymes of DNA replication: DNA polymerase I, II, & III, gyrases, helicases, primases, ligases, telomerases, SSB proteins primosome complex. Mechanism of DNA replication. Initiation, elongation and termination. Inhibitors of DNA replication. Regulation of DNA replication.

Model of DNA replication: Rolling circle mode of replication of ϕ X-174 DNA, Bacteriophage M 13 DNA.

Unit-III, 1-Credit, 16h

DNA replication in eukaryotes: The eukaryotic cell cycle. Replicons, Autonomous replication sequences (ARS). Eukaryotic DNA polymerases – α , β , γ , δ and ϵ . SV40 DNA replication. Yeast plasmid replication. Mitochondrial DNA replication. Terminators and fidelity of DNA replication.

Mutataion: Molecular basis of mutation, types of mutation e.g. transition, transversion, frame shift, insertion, deletion, suppressor sensitive, germinal and somatic backward and forward mutations. Dominant and recessive mutations, spontaneous and induced mutations.

Lederberg's replica plating experiment, mutagenicity-testing correlation of mutagenicity and carcinogenicity, Ames testing, Random and site directed mutagenesis and applications.

DNA Damage and Repair: Single-strand breaks, double-strand breaks and alterations of DNA molecules. Effect of UV radiation on replicating/resting DNA. Biological indication of DNA damage.

Unit-IV, 1-Credit, 16h

DNA Repair: Repair of pyrimidine dimers. Biochemical mechanism for repair of thymine dimers. I Direct repair- Photoreactivation II. Indirect repair- AP endonuclease pathway, base excision repair (BER), nucleotide excision repair (NER), mismatch- repair and recombination repair.

SOS Repair system: SOS operon system in bacteria, Trans dimer synthesis, LexA, uvr complex, UmuD& C, rec BCD complex.

Eukaryotes: Regulation of DNA repairs by Ubiquitylation, Base Excision Repair (BER), and Nucleotide Excision Repair (NER). Xeroderma Pigmentosum.

Autonomously replicating sequence (ARS) binding factor 1 (ABF1), RAD7 and RAD16 genes in yeast. Double strand break repair and chromatin remodelling. Repair of DNA interstrand cross-links (ICLs). Ubiquitylation in the Fanconi Anemia (FA) pathway.

REFERENCES

- 1 Molecular Biology. David Freifelder. 2nd Edn. Narosa publication.
- 2 Genes- X. Benjamin Lewin. Oxford University press, London.
- 3 Biochemistry. Jeremy M. Berg, John L. Tymoczko. Lubert Stryer. Gregory J. Gatto, Jr. 7th .Edn. W. H. Freeman and Company. New York
- 4 Lehninger. Principles of Biochemistry. Nelson and Cox. 5thEdn. W.H. Freeman and company New York
- 5 Biochemistry. Donald Voet, Judith Voet. 4thEdn. John Wiley and Sons, NY.
- 6 Molecular Biology Of The Gene. Watsons J, N. H. Hopkin, J. W. Roberts, J.P. Stertz, A. M. Weiner. 4thEdn. Freeman publication, San Francisco.
- 7 Molecular Biology Academic Cell Update. David Clark. Elsevier publisher
- 8 Molecular Biology. Robert F. Weaver. 5th Edn. The McGraw-Hill Companies, Inc

HCT 4.2: MOLECULAR BIOLOGY- II**(4 CREDITS:64 h)**

Unit-I, 1-Credit, 16h

Transcription: Principle of transcription, prokaryotic RNA polymerase-structure and properties, Prokaryotic promoters, mechanism of transcription. Eukaryotic RNA polymerases, Conserved sequences of eukaryotic promoters, Transcriptional factors and basal eukaryotic transcription complex. Enhancers, Transcriptional termination in eukaryotes. Inhibitors of transcription. Post-transcriptional processing of prokaryotic and eukaryotic mRNA, tRNA and rRNA. RNA editing. Mechanism of intron removal and exon splicing. RNA Interference, Reverse transcription.

Genetic Code: Deciphering of genetic code, methods employed for deciphering of genetic code, contribution of Nirenberg and Khorana. General features of the code, Co-linearity of genes and proteins. Coding properties of tRNA, wobble hypothesis. Mitochondrial genetic code.

Unit-II, 1-Credit, 16h

Translation: Protein synthesis, Steps in protein synthesis, amino acid activation, exchange of ribosomal subunits, binding of mRNA to ribosome. Direction of protein synthesis and reading of mRNA. Protein chain initiation, elongation and termination. Comparative account of eukaryotic and prokaryotic translation. Inhibitors of prokaryotic and eukaryotic translation, Post-translational modification of proteins, Synthesis of secretory and membrane proteins, signal hypothesis, Mechanism of translational control.

Unit-III, 1-Credit, 16h

Regulation Of Gene Expression: Regulation in prokaryotes. Extra and intra cellular signals of gene expression. Transcriptional control-enzyme induction, repression, constitutive synthesis of enzymes. Study of lac operon, catabolite repression, role of cAMP in gene regulation. Study of Arabinose, Galactose and tryptophan operon models.

Unit-IV, 1-Credit, 16h

Regulation Of Gene Expression In Eukaryotes: Transcriptionally active puffs and lambrush chromosomes. DNA-binding domain motifs-Helix-turn-helix. Zinc finger, basic leucine zipper,, basic helix-loop-helix. Chromatin modification complexes, Histone acetyl transferases, histone methyl transferases, chromatin remodelling complexes. Eucaryotic promoters and regulatory protins. Galactose metabolism in yeast. Gene amplification, gene rearrangement, hormonal regulation. Translational repression. Developmental regulation in drosophila.

REFERENCES

- 1 Biochemistry. Donald Vote, Judith Voet. 4thEdn. John Wiley and Sons, NY.
- 2 Genes VIII. Benzamin Lewin. 10thEdn. Pearson- PrintceHall.
- 3 Molecular Biology of cell. Bruce Alberts. Garland Publications
- 4 Molecular Biology. David Freifelder. Narosa publishers
- 5 Lehninger. Principles of Biochemistry. Nelson and Cox.5thEdn. W.H.Freemanand company New York.
- 6 Molecular Biology. Watson JD et al. 5thEd. Pearson Education.
- 7 Fundamental Molecular Biology. L.A Allison. Black well publishing
- 8 Molecular Biology Academic Cell Update. David Clark. Elsevier publisher
- 9 Molecular Biology. Robert F. Weaver. 5thEdn. The McGraw-Hill Companies, Inc
- 10 Essential genes. Benjamin Lewin. Pearson Education, Inc.Pearson Prentice Hall.

SCT 4.1: BIOTECHNOLOGY AND BIOINFORMATICS**(4 CREDITS:64 h)****BIOTECHNOLOGY**

Unit-I, 1-credit, 16 h

Molecular cloning: Basic principles of gene cloning, characteristics and application of restriction enzymes. DNA modifying enzymes-ligase, terminal transferase, DNA kinases, DNA phosphorylase, exo and endo nucleases. Cloning vectors: characteristics and applications of plasmids, use of viral and bacteriophage DNA, plasmid- pBR 322 and related vectors, pUCvectors, Cosmids, phagemids, BAC, PAC, YAC vectors. Hosts for cloning: bacteria, yeast, and mammalian cells. Introduction of recombinant DNA into host cells: chemical methods, transfection, electroporation, transduction, biolistics and microinjection. Recovery of cloned DNA and its characterization by restriction mapping, southern blotting and sequencing. Analysis of transcript by Northern blotting, and *in situ* hybridization, Expression vectors.

Unit-II, 1 credit, 16 h

Methods of cloning in plasmids, construction of genomic libraries, making cDNA from eukaryotic genes, and construction of library. Screening of libraries for desired genes using labelled probes, identification of positive clones by colony hybridization. Components of PCR, and amplification of desired genes. DNA finger printing, RFLP. Chromosomal walking, insertion sequences and transposable genetic elements Expression of cloned genes in appropriate hosts, characterization of gene products, native and fusion proteins in bacteria and yeast.

Applications of Recombinant Technology: Cloning and expression of commercially important proteins. Use of recombinant molecules as diagnostic probes for genetic diseases, Site-directed mutagenesis and its application to study structure and function of genes.

Unit-III, 1 credit, 16 h

Cloning in Animals: Introduction, cells and cell lines, media for cell culture, selection of markers for gene transfer in mammalian cells, cloning in mammalian cells. Transgenic animals as models for human genetic diseases.

Cloning in plants: Plant cloning vectors: T-DNA of *Agrobacterium tumifaciens* and CaMV promoters for expression of heterologous genes in plants. Report genes; GUS, GFP methods. Protoplast regeneration and transformation. Generation of transgenic plants and their applications.

Unit-IV, 1 credit, 16 h

BIOINFORMATICS

Introduction, scope and basic principles of bioinformatics. Bioinformatics programmes and languages, Scripts and scripting languages. Running programmes over internet, soft ware downloading and installation, database management.

Biological databases: Contents, structure, annotation, file formats, annotated databases, genomes and organism specific databases.

Retrieval and analysis of biological data: Entrez and DBGET/Link DB, SRS. Searching sequence databases by similarities criteria (sequence search, amino acid substitution matrices), FASTA and BLAST searches. Sequence alignment, multiple sequence alignments, gene and protein families, and pattern data bases, protein domain families.

Phylogenetics, genomics and proteomics: Cladistics and ontology, building trees and evolutionary relationships. Microarray analysis. Methods, tools and resources: SAGE, proteomic data analysis, data from 2-D PAGE and protein mass spectra.

REFERENCES

- 1 Molecular Biotechnology. Glick and Pasternak. ASM Press.
- 2 Molecular Cell Biology. Harvey, Berk, Ziursky, Matsufaira, Baltimore, Durnel. W.H.Freeman and Co.
- 3 Molecular Cloning: T.A. Brown. Stanley Thornes Ltd.,
- 4 Principles of Genetics. Simmons, Snustard, Wiley and Sons.
- 5 Practical Skills in Bimolecular Sciences. Reed, Hoolmes, Weyers and Jones. Wesely Longman Press.
- 6 An Introduction to Genetic Engineering. Desmond S. T. Nicholl.3rd Edn.
- 7 Gene Cloning. Julia Lodge, Pete Lund and Steve Minchin. Taylor and Francis Group.
- 8 Bioinformatics. Andreas D. Baxevanis, B.F.Francis Ouellette. A John Wiley and Sons, Inc., publication.
- 9 Bioinformatics. David W. Mount.

SCT 4.2: GENETICS**(4 CREDITS:64 h)**

Unit-I, 1-credit, 16h

Classical genetics: Review of classical genetics; work on Evolution: Description of evolution by Darwin and Dobzhansky, Life creation models, Darwinism, contributions of Charles Darwin, Linnaeus, Charles Lyell Malthus, Thomas and Lamarck, Jean Baptiste to the biological evolution concept. Diversity of life, Flow of matter and energy between living beings, Molecular evolution.

Population genetics: extra nuclear inheritance,. Sex determination, Morgan's discovery of sex linked inheritance, pattern of inheritance of sex linked genes, X linked traits in humans. Identification of sex chromosomes, XX, XY, mechanism of sex determination.

Unit-II, 1-credit, 16h

Quantitative genetics: Human quantitative traits, discontinuous traits and continuous traits, Breeding analysis, genetic basis of quantitative variation, Multiple factor hypothesis and analysis of polygenes. Genotype – Environment interaction and models for their measurement. Heritability index estimation.

Non-Mendelian inheritance – Evidences for Cytoplasmic factors, cytoplasmic inheritance, extranuclear inheritance (mitochondrial, chloroplast), non-chromosomal inheritance, maternal inheritance, uniparental inheritance.

Unit-III, 1-credit, 16h

Chromosome Mapping - Haploid mapping (2 point & 3 point cross), Diploid mapping (Tetrad analysis), determination of linkage groups, determination of map distance, determination of gene order, cytological mapping.

Human Cyto-Genetics – Human karyotype, Banding techniques, classification, use of Human Cyto-genetics in Medical science, Chromosomal abnormalities in spontaneous abortions, viable monosomies & trisomies, chromosomal deletions & duplications, genetics of chromosomal inversions & translocations, human traits, Genomic position effects on Gene expression.

Unit-IV, 1-credit, 16h

Chromosomal variation in Number and Structure – Euploidy, Non-disjunction and Aneuploidy, Aneuploid segregation in plants, Aneuploidy in Human, Polyploidy in Plants and Animals, Induced Polyploidy, applications of Polyploidy, Chromosomal Mosaics, Polytene chromosome in Diptera, Deletion, Duplication, Inversion, Translocation, Position Effect, Centromeric and Non-centromeric breaks in chromosomes, chromosomal rearrangements in Human being, Chromosomal aberrations and evolution.

Pedigree analysis – Symbols of Pedigree, Pedigrees of Sex-linked & Autosomal (dominant & recessive), Mitochondrial, Incomplete dominance & Penetrance.

Formulating & Testing Genetic Hypothesis –problems of Sex-linkage, problems of genes with Multiple alleles, problems of gene interactions, Chi-square, t-test.

REFERENCES

- 1 Principles of Genetics. D. Peter Snustad, Michael J. Simmons. 6th Edn. John Wiley & Sons, Inc.
- 2 Genetics. M.W.Strickberger. 3rdEdn. Prentice Hall of India
- 3 Genes X. Benzamin Lewin. 10th Ed. Pearson- PrintceHall.
- 4 Molecular Biology of cell. Bruce Alberts et al. Garland Publications
- 5 Molecular Biology. David FreifelderJ. Narosa publishers
- 6 Lehninger Principles of Biochemistry. Nelson and Cox.4thEdn. Mcmillan publication.
- 7 Molecular Biology. Watson JD et al. 5thEd. Pearson Education.
- 8 Fundamental Molecular Biology. L.A. Allison. Black well publishing
- 9 Concepts of Genetics. William S. Klug. Michael R. Cummings. Pearson publishers.

HCP 4.1: PRACTICALS: MOLECULAR BIOLOGY-I

- 1 Isolation of nuclei
- 2 Isolation of chromosomal DNA and characterization.
- 3 Isolation plasmid DNA.
- 4 Purification of plasmid DNA.
- 5 Agarose gel electrophoresis of plasmid DNA.
- 6 Isolation of mutants.
- 7 Effect of uv dose on survival rate of bacteria.
- 8 Assay of DNase
- 9 Assay of RNase
- 10 Assay of phosphatase.

REFERENCES

- 1 An introduction to Practical Biochemistry. David Plummer. 4thEdn. Tata McGraw Hill pub.
- 2 Practical Biochemistry: Principles and techniques. Keith Wilson and J Walker. 5thEdn. Cambridge University Press.
- 3 Introductory Practical Biochemistry. S.K. Sawhney and Ranbhir Singh. Narosa Pub.
- 4 Molecular cloning laboratory manual. Joseph Sambrook and David W. Russel. 3rd Edn. Cold Spring Harbor Laboratory Press.

HCP 4.2: PRACTICALS: MOLECULAR BIOLOGY-II

- 1 Gene induction and repression beta-galactosidase activity in *E.coli*.
- 2 Isolation of auxotrophic mutants.
- 3 Ames Test.
- 4 Detection plasmid for antibiotic resistance.
- 5 Effect of UV dose on survival rate of bacteria.
- 6 Blue or white colony test for lac^+/lac^-

REFERENCES

- 1 An introduction to Practical Biochemistry. David Plummer. 4th Edn. TataMcgrw Hill pub.
- 2 Practical Biochemistry: Principles and techniques. Keith Wilson and J Walker .5thEdn. Cambridge University Press.
- 3 Introductory Practical Biochemistry. SK. Sawhney and Ranbhir Singh. Narosa Pub.
- 4 Molecular cloning laboratory manual. Joseph Sambrook and David W. Russel. 3rd Edn. Cold Spring Harbor Laboratory Press.

SCP 4.1: PRACTICALS: BIOTECHNOLOGY AND BIOINFORMATICS

- 1 Preparation of bacterial culture for plasmid DNA isolation
- 2 Isolation of plasmid DNA from bacterial cells
- 3 Characterization of plasmid DNA by UV spectroscopy
- 4 Agarose gel electrophoresis of plasmid DNA
- 5 Transformation of DNA by CaCl₂ method.
- 6 Restriction digestion of isolated plasmid DNA.
- 7 Preparation of competent cells.
- 8 DNA ligation demonstration.

REFERENCES

- 1 Introduction to practical Biochemistry. S.K.Sawhney and Randir Singh. Narosa Publishing house.
- 2 Biochemical methods. S.Sadashivam and A.Manikam. 2ndEdn. New Age International (p)Ltd. Press.
- 3 Practical Biochemistry: Principles and Techniques. Keith Wilson and John Walker. 5thEdn.Cambridge University press.
- 4 Basic Biochemical methods. R.R.Alexander. J.M.Griffith. 2ndEdn. Wiley-Liss. publications.
- 5 Practical Biochemistry. David Plummer. Tata McGraw-Hill publishing.
- 6 Modern experimental Biochemistry. Rodney Boyer. 3rdEdn. Addison Wesley Longham
- 7 Bioinformatics. Andreas D. Baxevanis, B.F.Francis Ouellette. A John Wiley and Sons, inc., publication.
- 8 Bioinformatics. David W. Mount.

SCP 4.2: PRACTICALS: GENETICS

- 1 Mounting of different stages of mitosis and meiosis.
- 2 Isolation of DNA from plant source.
- 3 Isolation of polytene chromosome from chironomus larva.
- 4 Staining of chromosomes.
- 5 Chromosomal abnormality identification.

REFERENCES

- 1 Introductory Practical Biochemistry. S.K. Sawhney and Ranbhir Singh. Narosa Pub.
- 2 Laboratory manual in Biochemistry. TN. Pattabhiraman. 2ndEdn. All India publishers and distributors.
- 3 Biochemical methods. S.Sadashivam and A.Manikam. 2ndEdn. New Age International (p) Ltd. Press.
- 4 Practical Biochemistry: principles and Techniques. Keith Wilson and John Walker. 5thEdn. Cambridge University press.
- 5 Basic Biochemical methods. R.R.Alexander. J.M.Griffith .2ndEdn. Wiley-Liss publications.
- 6 Practical Biochemistry. David Plummer. Tata McGraw-Hill publishing.
- 7 Modern experimental Biochemistry. Rodney Boyer. 3rdEdn. Addison Wesley Longham