



**M.Sc., Biochemistry
Choice Based Credit System (CBCS)
Syllabus**

Designed by
**Board of Studies,
Department of Studies and Research in Biochemistry,
Tumkur University, Tumkur-572103
2014**

**Course outline and Syllabus for Master of Science (M.Sc) in
Biochemistry under CBCS Scheme**

I Semester

S. No.	Paper	Title of the paper	Instruction Hrs per Week	No. of Credits	Duration of the Exam.	Marks		
						Internal Assessment	Semester End Examn.	Total Marks
1	CPT-1.1	Fundamentals of Biological Chemistry	4	4	3 Hrs	20	80	100
2	CPT-1.2	Analytical Biochemistry	4	4	3 Hrs	20	80	100
3	CPT-1.3	Biomolecules	4	4	3 Hrs	20	80	100
4	SPT-1.4.A	Physiology and Nutrition	4	4	3 Hrs	20	80	100
	SPT-1.4.B	Microbiology and Toxicology	4	4	3 Hrs	20	80	100
5	CPP-1.5	Fundamentals of Biological Chemistry	2	2	4 Hrs	10	40	50
6	CPP-1.6	Analytical Biochemistry	2	2	4 Hrs	10	40	50
7	CPP-1.7	Biomolecules	2	2	4 Hrs	10	40	50
8	SPP – 1.8.A	Physiology and Nutrition	2	2	4 Hrs	10	40	50
	SPP – 1.8.B	Microbiology and Toxicology	2	2	4 Hrs	10	40	50
Total			24	24				600

II Semester

S. No.	Paper	Title of the paper	Instruction Hrs per Week	No. of Credits	Duration of the Exam.	Marks		
						Internal Assessment	Semester End Examn.	Total Marks
1	CPT- 2.1	Enzymology	4	4	3 Hrs	20	80	100
2	CPT- 2.2	Metabolism of fuel Molecules	4	4	3 Hrs	20	80	100
3	SPT- 2.3.A	Cell Biology and Endocrinology	4	4	3 Hrs	20	80	100
	SPT- 2.3.B	Medical Biochemistry	4	4	3 Hrs	20	80	100
4	OET – 2.4	Fundamental Biochemistry (Offered to other depts)	4	4	3 Hrs	20	80	100
5	CPP-2.5	Enzymology	2	2	4 Hrs	10	40	50
6	CPP-2.6	Metabolism of fuel Molecules	2	2	4 Hrs	10	40	50
7	SPP-2.7.A	Cell Biology and Endocrinology	2	2	4 Hrs	10	40	50
	SPP-2.7.B	Medical Biochemistry	2	2	4 Hrs	10	40	50
8	OEP 2.8	Fundamental Biochemistry (Offered to other depts)	2	2	4 Hrs	10	40	50
Total			24	24				600

III Semester

S. No.	Paper	Title of the paper	Instruction Hrs per Week	No. of Credits	Duration of the Exam.	Marks		
						Internal Assessment	Semester End Examn.	Total Marks
1	CPT- 3.1	Metabolism of Nitrogen Compounds	4	4	3 Hrs	20	80	100
2	CPT- 3.2	Molecular Biology	4	4	3 Hrs	20	80	100
3	SPT- 3.3.A	Clinical Biochemistry and Dietetics	4	4	3 Hrs	20	80	100
	SPT- 3.3.B	Plant Biochemistry	4	4	3 Hrs	20	80	100
4	OET – 3.4	Biochemical Toxicology (Offered to other depts)	4	4	3 Hrs	20	80	100
5	CPP-3.5	Metabolism of Nitrogen Compounds	2	2	4 Hrs	10	40	50
6	CPP-3.6	Molecular Biology	2	2	4 Hrs	10	40	50
7	SPP-3.7.A	Clinical Biochemistry and Dietetics	2	2	4 Hrs	10	40	50
	SPP-3.7.B	Plant Biochemistry	2	2	4 Hrs	10	40	50
8	OEP-3.8	Biochemical Toxicology (Offered to other depts)	2	2	4 Hrs	10	40	50
Total			24	24				600

IV Semester

S. No.	Paper	Title of the paper	Instruction Hrs per Week	No. of Credits	Duration of the Exam.	Marks		
						Internal Assessment	Semester End Examn.	Total Marks
1	CPT- 4.1	Immunology	4	4	3 Hrs	20	80	100
2	CPT- 4.2	Molecular Genetics	4	4	3 Hrs	20	80	100
3	SPT- 4.3.A	Genetic Engineering and Fermentation Technology	4	4	3 Hrs	20	80	100
	SPT -4.3.B	Biostatistics and Bioinformatics	4	4	3 Hrs	20	80	100
4	CPD-4.4	Dissertation-Current topics in Biochemistry	4	4	-	20	80	100
5	CPP-4.5	Immunology	2	2	4 Hrs	10	40	50
6	CPP-4.6	Molecular Genetics	2	2	4 Hrs	10	40	50
7	SPP- 4.7.A	Genetic Engineering and Fermentation Technology	2	2	4 Hrs	10	40	50
	SPP- 4.7.B	Biostatistics and Bioinformatics	2	2	4 Hrs	10	40	50
8	CPDP 4.8	CPD practical	-	2		10	VivoVoce-40	50
Total			24	24				600

CPT: Core Paper Theory

CPP: Core Paper Practical

SPT: Special Paper Theory

SPP: Special Paper Practical

OET: Open Elective Theory

OEP: Open Elective Practical

CPD: Core Practical Dissertation

S.No	Internal Assessment allotment basis	Marks	
		Theory (20)	Practical (10)
1	Average of two tests	15	10
2	Seminar/Assignment/Extra activities	05	-
Total		20	10

4 Credits of Theory = 4 hours of teaching per week 2 Credits of Practical = 4 hours per week

Syllabus for Master of Science (M.Sc) in Biochemistry (CBCS)

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I Semester

CPT-1.1: Fundamentals of Biological Chemistry (4 Credits: 64 h)

Unit 1 16h

Atomic and molecular structure: Electron theory of valence. Hybridization of chemical bonds. Hydrophobic interactions and Vander waals 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 2 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 SN1, SN2, SN1neighbouring group participation. E2, E1, Curtin-Hammett principle. Electrophilic addition to C=O, detailed discussion of all aspects of aldol condensation, related condensations, Michael addition. Esterification and hydrolysis.

Unit 3 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.

Unit 4 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.

CPT-1.2: Analytical Biochemistry

(4 Credits: 64 h)

Unit 1

16h

Techniques of biochemical investigations: Whole organism studies, organ perfusion, tissue slice techniques, cell ad tissue culture, tissue homogenization and subcellular fractionation. Isotopic tracers and enzymatic studies.

Chromatography: Principles, procedure and applications of paper, thin layer, adsorption, ion exchange, gel permeation and affinity chromatography. Chromatofocussing, GLC, HPLC and FPLC.

Unit 2

16h

Spectrophotometry: Principles and applications of Colorimetry, Spectrophotometry and spectrofluometry. Applications of CD, ORD, IR, NMR, ESR, MS Spectroscopy in the study of macromolecular structures.

Radioisotope techniques: Radioactivity, stable and radioactive isotopes. Methods of detection of isotopes. GM counters, liquid scintillation counters and autoradiography. Units of radioactivity, half life of radioisotopes. Radiation monitoring and its hazards. Application of radioactive tracer in biology.

Unit 3

16h

Centrifugation: Principles and applications of sedimentation, velocity and sedimentation equilibrium analysis. Svedberg constant. Types of centrifugation techniques - Differential, isopycnic, density gradient and continuous centrifuges.

Dialysis: Principles and application of equilibrium dialysis and ultracentrifugation. Artificial membranes, semipermeable membranes, Donnan membrane equilibrium and biological significance of osmosis.

Unit 4

16h

Electrophoresis: Principles, procedure and application of paper, cellulose acetate, agar, polyacrylamide gel, SDS-PAGE, isoelectrofocussing, pulse field gel electrophoresis and capillary electrophoresis. Blotting techniques - southern, northern and western. Detection methods - general and specific methods.

References

1. Analytical Biochemistry; D.J.Holme and H. Pick, 3rd Ed.(1998) Longman. Biochemical Calculations, Irvin, H. Segel, 2nd Edn., (1976) Jhon Wiley and sons.
2. Laboratory Techniques in Biochemistry and Molecular Biology, Work and Work (1969) Voil I & II, North Holland. Biochemistry LabFax, Ed. J.A.A. Chambers and D. Rickwood,, (1993), Blackwell Science.
3. Methods of Enzymatic Analysis; Berg Meyer (1974) Vol. 1-X,
4. Practical Biochemistry; Principles and Techniques; K.Wilson and J. Walker (1995) 4 th Edn. Cambridge University Press.
5. Principles of Instrumental Analysis, (1980) 2nd Edn.Holt- Saunders.
6. Principles and Techniques of Practical Biochemistry, Williams and Wilson (1981) 3 rd Edn. Edward Arnold. Protein Purification Applications, S.L.V. Harris and Angal (1990) IRL Press.
7. Protein Purification, Robert, K. Scopes (1988) 2 nd Edn. Springer-Verlag. Protein Purification Methods, S.L.V. Harris and Angal (1989) IRL Press. Techniques in Molecular Biology, Walker and Gastra (1983) Croom Helm.

CPT-1.3: Biomolecules

(4 Credits: 64 h)

Unit 1

16h

Carbohydrates: Classification of carbohydrates. Structure and stereochemistry of monosaccharides, structure and function of oligosaccharides and polysaccharides (starch, glycogen, cellulose, chitin, chitosan and glycosaminoglycans). Importance of homo and heteropolysaccharides, blood group and bacterial polysaccharides. Glycoproteins - Structure and functions. Structural studies of carbohydrates: periodate oxidation, methylation and acetylation. Lectins- characteristics, functions in biological system and other uses.

Unit 2

16h

Amino acids, Peptides and Proteins: Acid-base properties of amino acids. Non-protein and essential amino acids. Structure and conformation of peptide bond. Peptide synthesis- reactive ester method and modified Merrifield solid phase synthesis. Naturally occurring peptides. Structural organization and functions of proteins. **Primary structure of proteins:** Elucidation of Primary structure of proteins- Determination of amino acid composition, end group analysis, cleavage by enzymes and chemicals, separation of fragments. Identification of disulfide bonds and interpretation of overlapping sequences.

Unit 3

16h

Secondary structure- Ramachandran plot, α -helical, β -pleated sheet, and triple helical structure of collagen. **Tertiary structure-** forces involved in the stabilization of tertiary structure. Structure of Insulin, Ribonuclease, Lysozyme, Myoglobin, and Chymotrypsin. **Quaternary structure-** Hemoglobin. Denaturation of proteins, Affinsen experiment, Domain structure.

Unit 4

16h

Lipids: Brief account of the chemistry (without structural elucidation) & biological role of the following: Fatty acids, Acyl glycerols, Phospholipids, Sphingolipids, Glycolipids, Steroids, Prostaglandins, thromboxanes, and Leukotrienes.

Nucleic acids: structure and Physico-chemical properties of nucleosides and nucleotides. **Structure of nucleic acids** - Primary, secondary and tertiary structure of DNA; secondary structure of tRNA. Nucleic acid sequencing- rapid sequencing methods.

References

1. Lehninger- Principles of Biochemistry: DL Nelson and MM Cox [Eds), 6th Edn. Macmillan Publications
2. Biochemistry VI Edition; Jeremy M Berg, John L Toymoczko and Lubert Stryer (2006) W H Freeman and Co.
3. Biochemistry; Voet, D. and Voet, J.G. [Eds.] (1999) 3rd Ed. Jhon Wiley and sons.
4. Biochemistry; David Rawn, J. (1989) Neil Patterson Publishers.
5. Complex Carbohydrates, Sharon, N. (1975) Addison Wisely.
6. Methods of Enzymatic Analysis; Berg Meyer (1974) Vol. 1-X,
7. Nucleic acid Biochemistry and Molecular Biology, Mainwaring et al., (1982) Blackwell Scientific.
8. Principles of Biochemistry; Smith et al., [Ed.] (1986) McGarw Hill.
9. Proteins Structures and Molecular Properties 2nd Edition (1993) Thomas E. Creighton W H Freeman and Co.
10. Principles of Protein Structure, Function, & evolution, Dickerson & Geis (1983) 2nd Ed., Benjamin-Cummings.
11. Text Book of Biochemistry with Clinical correlations; Thomas Devlin [Ed.] (1999), Wiley -Liss.
12. Biochemistry Ed. Donald Voet & Judith G. Voet John Wiley & Sons ,Inc

Physiology**Unit 1****16h**

Digestive secretions - Composition, functions and regulation of saliva, gastric, pancreatic, intestinal and bile secretions. Digestion and absorption of carbohydrates, lipids and proteins.

Excretory system- Structure of nephron, formation of urine – glomerular filtration, tubular reabsorption of glucose, water and electrolytes, tubular secretion. Kidney hormones. Regulation of acid base, electrolyte and water balance. Respiratory and metabolic acidosis and alkalosis.

Unit 2**16h**

Circulatory system - Systemic and pulmonary circulation. Composition and functions of blood. Separation of plasma and serum. Plasma composition and functions. Plasma lipoproteins. Mechanism of blood clotting, role of vit K, clot dissolution and anticoagulants. Hematopoiesis.

Muscular system - Smooth, skeletal and cardiac muscles. Contractile and other proteins of muscle. Fine structure of muscle fibre, neuromuscular junctions. Mechanism of muscle contraction.

Nutrition**Unit 3****16h**

Concepts of Nutrition: Introduction, essential nutrients and their classification.

Macronutrients: Carbohydrates- Digestible and non digestible, dietary fibre. Proteins- Essential amino acids, malnutrition, Kwashiorkor and Marasmus. Lipids-triglycerols, phospholipids, cholesterol and fat soluble vitamins, essential fatty acids.

Micronutrients : Pro-vitamins, antivitamin, sources, requirements, functions and deficiency symptoms of vitamin - C , thiamine, riboflavin, niacin, pyridoxine, folic acid, vitamin B12, pantothenic acid, biotin & Vitamin – A,D,E and K. Absorption, requirements and functions of Zn, Ca, P, Mg, Cl, Fe.

Unit 4**16h**

Basal metabolism: Determination of Basal Metabolic Rate (BMR) - Experimentally and by calculation average BMR for Indians. Factors affecting BMR. Energy requirements for different physical activities, Standard Dynamic Action (SDA) of food.

Recommended Daily Allowance (RDA): Calories from carbohydrates, lipids, proteins.

Special aspects: Nutrition during pregnancy, lactation and old age. Nutrition of infants and children factors affecting nutritional status.

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. 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.
8. A Manual of Laboratory Techniques , National Institute of Nutrition, Hyderabad

SPT-1.4.B: Microbiology and Toxicology

(4 Credits: 64 h)

Unit 1

16h

General Microbiology: Brief study on Discovery and classification. Morphology and reproduction of bacteria, Yeast and Molds. **Bacteriology:** General Classification, Ultrastructure of Gram positive and Gram negative bacteria. Detailed study of bacterial cell-organelles and endospore. Brief study of important groups of bacteria: Coliform, spore formers, photosynthetic bacteria, lactic acid producing bacteria, actinomycetes, ricketisiae, mycoplasmas. **Fungi-** Classification, morphology of yeasts and molds. Brief study of viruses, algae and protozoa.

Unit 2

16h

Microscopy: Compound Microscopy, Scanning Electron Microscopy, Confocal microscopy and their applications. Staining Techniques and their applications. Gram, Acid-fast, Endospore and Flagella staining. **Microbial Nutrition and Growth:** Nutrients for growth and maintenance of microorganisms. Types of microbiological media. Sterilization, Physical and chemical methods. **Pure culture techniques:** Isolation of pure culture, Enrichment culture technique. **Growth behavior of microorganisms:** Growth curve and factors affecting growth, Chemostat, generation time, and growth rate. Enumeration of viable cells. Cultivation of halophyles, psychrophyles and thermophyles.

Unit 3

16h

Food microbiology, Environmental Microbiology and Medical Microbiology

Food and Dairy Microbiology: Microbial contamination and spoilage. Pasteurization and sterilization. Food fermentations. Detection of *Brucella* in milk samples, Microbial food borne diseases. Food preservatives and food preservation. **Environmental:** Microbial contamination of water, Water Contamination by Pesticides and other toxic organic chemicals, detoxification process. Bioremediation of toxic chemicals, industrial effluents and sewage treatment **Medical Microbiology:** Pathogenic microorganisms and diseases. Control of pathogenic organisms, Case study and mechanism of infection- Gastroentitis, Typhoid, Diphtheria, and Tetanus. Bacterial and fungal exotoxins. **Virology:** Human Immunodeficiency Virus (HIV), Foot and mouth disease virus (FMDV) and Tobacco Mosaic Virus (TMV).

Unit 4

16h

Toxicology: Factors influencing toxicity, Biochemical basis for the human toxicity of aromatic hydrocarbons (benzopyrene), food based toxicants, pesticide and heavy metals. Occupational toxicity, Drug and xenobiotic toxicity. Genotoxicity, carcinogenicity, teratogenicity and tissue specific toxicity of toxic chemicals. **Toxicity testing:** Diagnosis of toxic effects in liver, bladder, pancreas and kidney. Pharmacokinetics study. Detection and dose response- LD₅₀, ED₅₀,

References

1. Modern Food Microbiology; James M. Jay (1996) 4th Ed. CBS Publishers.
2. Biology of Microorganisms, Brock (1996) Prentice Hall.
3. Industrial Microbiology; Miller and Litsky [Eds.] (1976) McGraw Hill Publishers.
4. Microbiology, Prescott, Hartley and Klein, (1993) WCB Publications.
5. Microbiology; Essentials and Applications, Larry Mckane and J.Kandel. McGraw Hill Publishers.
6. Microbes in Action, A Laboratory Manual of Microbiology Seley et al., (19) W.H. Freeman.
7. General Microbiology, Stanier, et al., (1975) 4th Edn. McMillan.
8. Microbiology, Pelczar, Reid and Krieg (1996) Tata-McGraw Hill.
9. Biology of Microorganisms, Brock (1996) Prentice Hall.

10. Introduction to Ecotoxicology, Ed. D.W. Connell, (2000) Blackwell Scientific
11. Molecular Pharmacology, ed. T. Kenakin, (1997), Blackwell Science Inc.

CPP-1.5: Fundamentals of Biological Chemistry (2 Credits: 32h)

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. 5th Edn. 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.

CPP-1.6: Analytical Biochemistry (2 Credits: 32 h)

1. **pH - metric titrations:** Strong acid against a strong base, Weak acid against a strong base, Poly basic acid against a strong base, Amino acid (Neutral) against a strong base and acid.
2. **Paper chromatography:** Ascending and Descending, Two –dimensional.
3. Isolation and Estimation of Casein from milk, Starch from potato, Lecithin from egg. Hydrolysis and identification of amino acid, sugar and lipid content in the hydrolysates of the above samples.
4. **Column Chromatography:** Ion exchange chromatography of proteins, Carbohydrates and nucleic acids. Anion and Cation exchange chromatography. Elution of proteins by linear gradient technique. Molecular sieve chromatography - separation of mixture of proteins and molecular weight determination of proteins. Affinity chromatography - Isolation of glycoproteins, antibodies and double anti bodies
5. **Electrophoresis:** Paper electrophoresis - Separation of amino acids and proteins in serum. Polyacrylamide Gel Electrophoresis- Anionic and Cationic PAGE of enzymes and other proteins. SDS-PAGE; Determination of Molecular weight of proteins, Isoelectric focussing - Separation of isoenzymes and isoelectric points of various proteins.

References

1. Biochemical Calculations, Irwin H.Segel (1976) 2 nd Ed. Jhon Wiley and Sons.
2. Methods in Enzymology; Colowick , S.P. et al., [Eds.] (1987) Vol. 152, Academic Press.
3. Modern Experimental Biochemistry R.F.Boyer [Ed.] (1986) Addition Wesley.
4. Methods of Enzymatic Analysis; Berg Meyer (1974) Vol. 1-X,
5. Analytical Biochemistry; D.J.Holme and H. Pick,(1983) Longman.
6. Practical Biochemistry; Principles and Techniques; K.Wilson and J. Walker (1995) 4 th Edn. Cambridge University Press.

CPP-1.7: Biomolecules**(2 Credits: 32h)**

1. Estimation of reducing sugars by DNS method.
2. Quantitative estimation of sugars by phenol-sulfuric acid method.
3. Hydrolysis of starch or glycogen and estimation of its purity by titrimetric method.
4. Determination of Pka value of an amino acid.
5. Analysis of fats: Saponification number, Iodine number and acid value of oil.
6. Estimation of Nitrogen in amino acids, urea and casein by Micro-Kjeldahl Method.
7. Estimation of protein by Lowry's method.
8. Estimation of protein by Biuret method.
9. Isolation of papain from papaya latex.
10. Isolation of cholesterol and lecithin, Isolation of nucleic acids from plant source,

References

1. Biochemical Calculations, Irwin H.Segel (1976) 2 nd Ed. Jhon Wiley and Sons.
2. Modern Experimental Biochemistry R.F.Boyer [Ed.] (1986) Addison Wesley.
3. Analytical Biochemistry; D.J.Holme and H. Pick, (1983) Longman.
4. Protein Purification Applications, S.L.V. Harris and Angal (1990) IRL Press.
5. Principles and techniques of Biochemistey and Molecular Biology; Keith Wilson and John Walker; 6th Edn. (2005) Cambridge University Press.

SPP-1.8.A: Physiology and Nutrition**(2 Credits: 32h)****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.

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

9. Practical clinical Biochemistry. Ranjna Chawlla. 3rdEdn. Jaypee
10. Practical clinical Biochemistry. Harold Varley.
11. Standard methods of Biochemical analysis. S.R.Thimmaiah. Kalyani publishers.
12. Hutchison's Clinical methods. Hunter and Bomford. 15thEdn. BailliereTindall and Cassell. London.
13. Laboratory manual in Biochemistry. T.N.Pattabiraman. 3rdEdn. All India Publishers and distributors.
14. Introduction to practical Biochemistry. S.K.Sawhney and Randir Singh. Narosa Publishing house.
15. Biochemical methods. S.Sadashivam and A.Manikam. 2ndEdn.New Age International (p) Ltd. Press.
16. A Manual of Laboratory Techniques , National Institute of Nutrition, Hyderabad

SPP-1.8.B: Microbiology and Toxicology**(2Credits:32 h)**

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. Microbiological Applications Lab Manual. Benson. 8th Edn. The McGraw–Hill Companies.
- 6.

II Semester**CPT-2.1: Enzymology****(4 Credits: 64 h)****Unit 1****16h**

Introduction to Enzymes: Role of enzymes of in living systems. Nature and characteristic features of enzymes. Nomenclature and classification of enzymes. Intracellular localization of enzymes. Fundamentals of enzyme assay– enzyme units, coupled kinetic assay, presentation of enzyme purification data and criteria of purity of enzymes. Applications of enzymes. Specificity and active site of enzymes.

Kinetics of enzyme – catalyzed reactions: Chemical nature of enzyme catalysis - General acid-base catalysis, electrostatic catalysis, covalent catalysis, intramolecular catalysis and enzyme catalysis. Initial velocity studies, rapid reaction techniques and immuno-assay techniques. Enzyme kinetics of single substrate reactions - Michaelis theory, steady state theory. Kinetic data evaluation - linear transformation of Michaelis-Menten equation. Effect of pH, temperature and substrate concentration.

Unit 2**16h**

Enzyme Inhibition: Types of reversible inhibitors - competitive, non-competitive, un-competitive 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 characterisation of bi-substrate reactions.

Unit 3**16h**

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, trypsin, lysozyme and ribonuclease. Metal-activated and metallo-enzymes-pyruvate kinase & carboxypeptidase-A.

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

Unit 4

16h

Monomeric and oligomeric enzymes: Monomeric enzymes-the serine proteases, zymogen activation. Sulphydryl enzymes-papain. Oligomeric enzymes-isoenzymes (LDH) and multi-enzyme complexes- (Pyruvate dehydrogenase complex).

Allosteric enzymes: Binding of ligands to proteins - Co-operativity, the Hill 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.

References

1. Basic Biochemical Laboratory Procedures and Computing, R. Cecil Jack (1995) Oxford University.
2. Enzymes: Biochemistry, Biotechnology and Clinical Chemistry; Trevor Palmer (Edn) Horwood Chemical Science Series.
3. Enzymes: A Practical Introduction to Structure, Mechanism, and Data Analysis; Robert A. Copeland (2000), Wiley-VCH Publishers.
4. Biochemical Calculations, Irwin H.Segel (1976) 2nd Ed. John Wiley and Sons.
5. Methods in Enzymology; Colowick S.P. et al., [Eds.] (1987) Vol. 152, Academic Press.
6. Methods of Enzymatic Analysis; Berg Meyer (1974) Vol. 1-X,
7. Understanding the Enzymes; Palmer, T. (1981) Ellis Horwood Ltd.
8. Enzyme Kinetics; Roberts, D.V. (1977), Cambridge University Press.
9. The Enzymes; Boyer (1982) Academic Press.
10. Enzyme Kinetics; Irwin H.Segel (1976) Interscience-Wiley.
11. Enzyme Kinetics; The Steady state approach; Engel, P.C.(1981) 2nd Edn. Chapman and Hall.
12. Nature of Enzymology; Foster, (1980), Croom Helm.
13. Principles of Enzymology for Food Sciences; Whitaker, Marcel Dekker (1972) Academic Press.
14. Fundamentals of Enzymology, N.C. Price and Lewis (1989) Oxford University Press.
15. Principles of Enzymology for Food Sciences; Whitaker, Marcel Dekker (1972) Academic Press.
16. Introduction to Enzyme and Co-enzyme Chemistry. Ed. T. Bugg, (2000), Blackwell Science.
17. An Introduction to Enzyme and Coenzyme Chemistry; Timothy B. Bugg, (1997) Jones and Bartlett publishers.

CPT-2.2: Metabolism of fuel molecules

(4Credits:64h)

Unit 1

16h

Introduction: Basic concepts in metabolism: catabolism, anabolism, catabolic, anabolic and amphibolic pathways

Carbohydrate metabolism: Introduction, glycolytic pathway, regulation of glycolysis, Role of PFK, fate of pyruvate, oxidation of pyruvate, TCA cycle, its energetics and regulation. Anapleuratic and amphibolic nature of TCA cycle. Glyoxylate cycle and its significance. Gluconeogenesis and its regulation. Futile cycle, Cori cycle and its significance. Entry of other carbohydrates into glycolysis-fructose and galactose.

Unit 2**16h**

Glycogen and starch metabolism: Biosynthesis and degradation of glycogen and its regulation. Glycogen storage disorders. Lactose intolerance, fructosuria, galactosemia. HMP pathway and its regulation.

Biological oxidation: Biological redox couplers, participation in oxidative metabolism. Free energy changes in electron transfer reactions. Mitochondrial electron transfer system- Chemical nature, topology and thermodynamic design of electron carriers. Sequence of electron carriers - isolation of mitochondrial complexes, reconstitution experiments and study of specific inhibitors of ETC.

Unit 3**16h**

Oxidative phosphorylation- Mechanism of proton pumping. Proton motive force and the Mitchell hypothesis. FoF1-ATPase- structure and mechanism, O¹⁸ exchange experiments. Coupling of electron transfer to ATP synthesis. Uncouplers, inhibitors and ionophores, partial reactions of OP, P/O ratios and their use in localization of sites of ATP synthesis along the chain. Mechanism of oxidative phosphorylation and H⁺ pumping by bacteriorhodopsin.

Unit 4**16h**

Lipid metabolism: Degradation of triacylglycerols and phospholipids. Oxidation of even and odd numbered fatty acids, oxidation of unsaturated fatty acids. Alternate routes for fatty acid oxidation. Energetic of β -oxidation scheme. Formation of ketone bodies and their oxidation. Biosynthesis of triacylglycerols, phospholipids and sphingolipids. Biosynthesis of steroids, related biosynthesis from isoprenoid units. Catabolism of cholesterol. Metabolism of prostaglandins and related compounds. Fatty liver and hypercholesterolemia.

References

1. Biochemistry; Voet , D. and Voet, J.G. [Eds.] (1999) 3 Ed. Jhon Wiley and sons.
2. Biochemistry; David Rawn, J. (1989) Neil Patterson Publishers.
3. Text Book of Biochemistry with Clinical correlations; Thomas Devlin [Ed.] (1997), Wiley -Liss.
4. Principles of Biochemistry; Lehninger et al., [Eds.] (1997) 2nd Edn. Worth Publishers.
5. Principles of Biochemistry; Smith et al., [Ed.] (1986) McGraw Hill.
6. Bioenergetics; A Practical Approach, G.C. Brown and C.E. Cooper (1995) IRL- Oxford University Press.
7. Photosynthesis, D.O. Hall and K.K. Rao, (1999), 6th Edn. Cambridge University Press.
8. Hawk's Physiological Chemistry, Oser (1976) 14th Edn Tata-McGraHill.
9. Photosynthesis. Ed. A.S. Raghavendra, (2000), Cambridge University Press.
10. Recent Advances in Plant Biochemistry; S.L. Mehta, M.L. Lodha, and P.V. Sane, (1992) ICAR, New Delhi.
11. Biochemistry Ed. Donald Voet & Judith G. Voet John Wiley & Sons ,Inc

SPT-2.3.A: Cell Biology and Endocrinology**(4 Credits: 64 h)****Unit 1****16h**

Cell Biology: Types of cells, Extracellular matrix, Cytoskeletal elements and cell-cell interactions-Adhesion. Cell division and Cell cycle-Mitosis and meiosis, Cell cycle phases and Programmed cell death. Biomembranes-Composition of plasma and organelle membranes, technique used to study the membranes structure-FRAP. Preparation and usage of liposomes and erythrocytes ghosts. Membrane assymetry. Protein-protein and protein-lipid interactions in membranes. Protein and lipid trafficking in membranes. Membrane Transport: Passive, facilitated and exchange diffusion, Fick's law of diffusion and active transport. Structure and

function of Na-K ATPase and Ca²⁺ATPase. Receptor mediated endocytosis and exocytosis. **Disorders associated with membrane transport systems**-Cystic fibrosis. Ion channels, ionophores and aquaporins. Bacterial transport system.

Unit 2

16h

Nervous system: Division of nervous system-neuron structure and types. Role of NGF, N-CUM and other specialized proteins. Resting membrane potential of excitable cells. Mechanism of initiation and propagation of action potential. Voltage gated ion channels (sodium, potassium and calcium). Design and use of patch clamp in measuring membrane potential. Depolarization and hyperpolarization in post-synaptic cells. Synaptic transmission, neurotransmitters, biogenic amines, aminoacids and neuropeptides. Storage and exocytosis of neurotransmitters. Termination of neurotransmitters action. Acetylcholine receptors, nicotinic and muscarinic adrenergic receptors, other neurotransmitters receptors. Mechanism of synaptic transmission, receptor integrated ion channels and G-protein mediated ion channels. Use of agonists and antagonists of neurotransmitters in Biochemistry and medicine.

Unit 3

16h

Endocrinology: Location and inter-relationship of endocrine glands in man. Classification, chemistry and estimation of hormones produced by hypothalamus. Hormones secreted by pituitary, thyroid, parathyroid, pancreas, adrenals and gonads. Regulation of hormone production and release, paracrine hormones, prostaglandins, Pineal gland, melatonin and circadian rhythm. Brief account of plant and insect hormones.

Unit 4

16h

Molecular endocrinology: Biosynthesis, transport and degradation of peptide, protein and steroid hormones. Membrane hormone receptors, mechanism of ligand receptor interactions-G dependent and independent. Role of G proteins and protein kinases and their effectors, transmembrane receptors and activators, signaling cascades of MAP kinases, Ras pathways, JAK, STAT. Pathway secondary messengers, cAMP, CREB, phosphoinositides, diacylglycerol, arachidonic acid and Ca⁺⁺.

References

1. The Cell, Cooper, Geoffrey, M., Oxford University Press, 2001.
2. Text Book of Biochemistry with Clinical correlations, Thomas M. Devlin, 7th Ed, 2010.
3. Molecular Biology of the Cell, Alberts, Garland Science, 2002.
4. Molecular Cell Biology, Baltimore, Scientific American Publication, 1995.
5. Principles of Biochemistry, Lehninger, W H Freeman & Company, 5th Ed, 2008.
6. Cellular Physiology of Nerve and Muscle, Gary Mathew G., Blackwell Scientific Inc, 1998.
7. Principles of Biochemistry, McGraw Hill, 2nd Ed, 1986.
8. Principles of Biochemistry; General Aspects, Smith, McGraw Hill, 1st Ed, 1983.
9. Human Biochemistry, Orten & Neuhans, Mosbey International, 10thEd, 1983.
10. Review of Medical Physiology, Gannong W.F., 15th Ed, 1991.
11. Human Physiology; The mechanisms of Body functions, Vander A.J., Mc Graw-Hill, 1985.
12. Text Book of Biochemistry and Human Biology, Talwar, G.P., Prentice Hall, 1980.
13. Harper's Review of Biochemistry, Murray, Lange, 24th Edn 1997.
14. Human Physiology, Stuart Era Fox, McGraw-Hill, 2001.
15. Biochemistry Ed. Donald Voet & Judith G. Voet John Wiley & Sons ,Inc
16. Molecular cell Biology, H. Lodish,A. Berk, S.L. Zipursky, P. Matsudaira ,D. Baltimore , J.Darnell.

SPT-2.3.B: Medical Biochemistry

(4 Credits: 64 h)

Unit 1

16h

Hematology and Hematology disorders: Blood composition: Blood cells, serum and plasma content. Different types of anemias-nutritional and sickle cell anemia. Complete blood count (CBC). Total and differential and platelet counts and their clinical significance. Blood groups, blood group substances, Rhesus factor, nature of blood group antigens and rare blood groups. Hospital-laboratory method of blood grouping and Rh typing. Erythrocyte sedimentation rate (ESR) determination and its importance in the diagnosis of certain diseases.

Unit 2

16h

Enzymes of clinical and diagnostic importance: Enzyme as markers in the diagnosis of diseases. Clinical significance of cholinesterases, alkaline and acid phosphatases, LDH, CPK, SGOT and SGPT.

Biochemical investigations in kidney diseases: Kidney profile in health and disease. Urine analysis for normal and abnormal constituents, urine microscopy culture and antibiotic sensitivity test. Clearance test and its importance in the assessment of kidney function. Kidney diseases like urinary tract infection (UTI) and nephritis. Kidney transplantation and dialysis.

Unit 3

16h

Biochemical investigations in Liver diseases: Liver profile in health and disease. Hepatocellular functions, with special emphasis on its participation in the various detoxification mechanism. Liver function tests (LFT), and their clinical significance in the diagnosis of liver diseases like cirrhosis and jaundice. Gall-bladder stone analysis and its clinical significance. Hepatitis infections.

Cardio-vascular diseases: Brief mention of heart diseases. Atherosclerosis and its complications.

Unit 4

16h

Cancer biology: Clinical and classical signs of cancer. Different stages and types of cancer, diagnostics. Chemotherapy (Natural and synthetic drugs) and radiation therapy. Molecular basis of cancer and mechanism of apoptosis.

Diabetes mellitus: Regulation of blood sugar, classification, stages and diagnosis (urine analysis, GTC/GTT, Glycosylated Hb. Role of antidiabetic oral drugs and different types of insulins.

Gastric profile in health and diseases: Gastric function tests (gastric analysis). Hypo and hyper acidity and Gastric ulcers. Malabsorption syndrome.

References

1. Biochemistry Ed Lubert Stryer . W.H. Freeman & company, New york.
2. Principles of Biochemistry. Ed. Lehninger; Nelson & Cox; CBS Publishers & Distributers.
3. Harpers Biochemistry Ed. R.K. Murray , D.K. Granner, P.A. Mayes & V.W.Rodwell. Appleton & Lange ,Stanford ,Conneticut.
4. Textbook of Biochemistry with clinical correlations. Ed. Thomas M. Devlin. Wiley Liss Publishers.
5. Genes VI Ed. Benjamin Lewin, Oxford University press.
6. Textbook of Clinical chemistry, Ed. Burtis & Ashwood W.B. Saunders Company.
7. Principles & techniques of practical Biochemistry Ed. Keith Wilson & John Walker Cambridge University press.

OET-2.4: Fundamental Biochemistry (Open Elective) (4 Credits: 64 h)

To be offered to students of other departments

CPP-2.5: Enzymology (2 Credits: 32h)

1. Kinetic study of the following enzymes; amylases (from saliva/potato/wheat). Transaminases (from liver/plant embryos), lipase (from castor seeds), urease (from horse gram), esterases (from peas and insects). Acid and alkaline phosphatases (from potato, green gram and serum). Protease and amylase inhibitors from plant sources.
2. Study of enzyme kinetics with respect to substrate, enzyme concentration, time, pH, temperature, activators, inhibitors with at least any three of the above enzymes.
3. Biochemical changes during germination of seeds and the development of embryo/seeds-specifically, the amylase, phosphatase and proteinases and their inhibitors.

References

1. Analytical Biochemistry; D.J.Holme and H. Pick,(1983) Longman.
2. Methods in Enzymology; Colowick , S.P. et al., [Eds.] (1987) Vol. 152, Academic Press.
3. Modern Experimental Biochemistry; R.F. Boyer [Ed.] (1986) Addison Wesley.
4. Principles of Enzymology for Food Sciences; Whitaker, Marcel Dekker (1972) Academic Press.
5. Instrumental Analysis in the Biological Sciences, M.H.Goxdon, R. Macrae (1987), Blackie & Sons.
6. Practical Biochemistry; Principles and Techniques; K. Wilson and J. Walker (1995), Cambridge University

CPP-2.6: Metabolism of Fuel Molecules (2 Credits: 32h)

1. Preparation of mitochondria from rat liver.
2. Isolation of glycogen from the rat liver.
3. Esterase activity of rat liver homogenate.
4. LDH activity of rat liver homogenate.
5. Electrophoretic pattern of rat liver homogenate.
6. Lipase activity of rat liver homogenate.
7. Isolation of chloroplast from spinach leaves.
8. Determination of ATPase activity of mitochondria.
9. Determination of oxygen uptake of mitochondria.
10. Detection of cytochromes

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.

SPP-2.7.A: Cell Biology & Endocrinology**(2 Credits: 32h)**

1. Isolation of sub-cellular organelles.
2. Determination of drug induced hemolysis.
3. Determination of pro/anti coagulant activity of plant proteins.
4. Preparation of RBC ghosts.
5. Determination of blood cell counting.
6. Determination of marker enzymes such as Serum Glutamate-Oxaloacetate Transaminase, Serum Glutamate-Pyruvate Transaminase, Lactate dehydrogenase, Creatine kinase
7. 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. 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.
7. Cell Biology: A laboratory hand Book. Vol-I. Julio E. Celis. Elsevier Publishing.

SPP-2.7.B: Medical Biochemistry**(2 Credits: 32h)**

1. Blood group analysis.
2. Differential count of blood (RBC, WBC and Platelets).
3. Estimation of Hemoglobin and methemoglobin.
4. Isolation and Separation of Hemoglobin by gel permeation chromatography.
5. Estimation of serum and plasma glucose.
6. Separation of hemoglobin using electrophoresis (Demonstration).
7. Estimation of urea and uric acid in biological samples.

References

1. Practical Biochemistry: principles and Techniques. Keith Wilson and John Walker. 5thEdn. Cambridge University press.
2. Practical Biochemistry. David Plummer. Tata McGraw-Hill publishing.
3. Modern Experimental Biochemistry. RodneyBoyer. 3rdEdn. Addison Wesley Longham.
4. Cell Biology: A laboratory hand Book. Vol-I. Julio E. Celis. Elsevier Publishing.
5. Biochemical Calculations, Irwin H.Segel (1976) 2 nd Ed. Jhon Wiley and Sons.
6. Modern Experimental Biochemistry R.F.Boyer [Ed.] (1986) Addison Wesley.

III Semester**CPT-3.1: Metabolism of nitrogen compounds****(4 Credits: 64 h)****Unit 1****16h**

Nitrogen Cycle: Introduction to biological and non-biological nitrogen fixation, brief introduction to *nif* genes, utilization of nitrate and nitrites, regulation of nitrate reductase.

Amino acid Metabolism: General metabolic reaction of amino acids– transamination, pseudotransamination, oxidative deamination, transdeamination, amino acid oxidase, and non –

oxidative deamination. Assimilation of ammonia, formation of amino acid amides by glutamine synthetase and its regulation. Urea cycle– regulation and metabolic disorders. Biosynthesis of creatine and creatine phosphate, polyamines– putrescine, spermidine and spermine, glutathione (γ – glutamyl cycle), physiologically active amines (serotonin. γ – amino butyric acid, histamine, and catecholamines – dopamine, epinephrine and epinephrine).

Unit 2

16h

Catabolism of amino acids: Study of degradation pathways of the individual amino acids in animal, plant and microbial systems – Glucogenic and ketogenic amino acids and their significance. Degradation of amino acids forming pyruvate, oxaloacetate, α – ketoglutarate, succinyl CoA, Fumarate, acetoacetate and/or acetyl CoA, pyruvate, formaldehyde, acetoacetate and/or acetyl CoA and fumarate, acetoacetate and/or acetyl CoA. Inherited disorders associated with glycine, aromatic, branched – chain, basic and sulfur containing amino acid metabolism.

Unit 3

16h

Biosynthesis of amino acids: Biosynthesis of amino acids in animal, plant and microbial systems-Biosynthesis of non -essential amino acids from pyruvate, intermediates of glycolysis, and TCA cycle. Biosynthesis of non – essential and non – essential amino acid biotransformation of serine to glycine and cysteine, Regulation of amino acid biosynthesis by sequential and concerted feedback inhibition.

Unit 4

16h

Nucleotide Metabolism: Biosynthesis of purine and pyrimidine nucleotides and their inter conversion, regulation of biosynthesis. Other pathways of purine nucleotide formation. Biosynthesis of deoxyribonucleotides and coenzymes nucleotides. Chemical inhibition of the biosynthesis of nucleic acid precursors. Degradation of purine and pyrimidines, and disorders associated with their metabolism; gout, Lesch-Nyhan syndrome, oroticaciduria, and xanthinuria.

Heme Metabolism: Biosynthesis and degradation of porphyrin, porphyrias, jaundice and Hemoglobinopathies.

References

1. Biochemistry; Voet , D. and Voet, J.G. [Eds.] (1999, John Wiley and sons.
2. Fundamentals of Biochemistry; Voet , Voet,and Pratt. [Eds.] (1999), John Wiley & Sons.
3. Biochemistry; Geoffrey Zubey, (1998), WCB Publishers.
4. Biochemistry; David Rawn, J. (1989) Neil Patterson Publishers.
5. Biochemistry with Clinical correlations; Thomas Devlin [Ed.] (2002), Wiley-Liss.
6. Principles of Biochemistry; Lehninger et al., [Eds.] (1997), Worth Publishers.
7. Principles of Biochemistry; Smith et al., [Ed.] (1986) McGraw Hill.
8. Frontiers in Nutrition, Ed. T. Wilson and N.J. Temple, (2000), Humana
9. Nutrition and Health in Developing Countries, eds. R. Semba and M.W. Bloem, (2000), Humana.

CPT- 3.2: Molecular Biology

(4 Credits: 64 h)

Unit 1

16h

DNA Replication: Central dogma of Molecular biology. Experimental evidences-DNA as genetic material and semiconservative mode of DNA replication. Detailed mechanism of E. coli DNA replication (trombone model). Fidelity of replication-proofreading and nick translation, Nearest neighbour base frequency analysis. Eukaryotic DNA polymerases, Mechanism of replication of Eukaryotic DNA, and organelle genomes. DNA replication in adenovirus, polyoma

and SV 40. Rolling circle mode of DNA replication. Replication of ss +RNA viruses, ss-RNA viruses, dsRNA- reovirus, and retroviruses. Inhibitors of DNA replication. DNA repair.

Unit 2

16h

Transcription: Structure of gene. E. coli RNA polymerase. Transcription events and mechanism in E. coli. RNA Processing in prokaryotes. Eukaryotic RNA polymerases and Mechanism of transcription. Inhibitors of transcription. Post transcriptional modification of eukaryotic tRNA, and rRNAs. Post transcriptional modification of eukaryotic mRNAs. Intron splicing; Properties and role of snRNPs in splicing, mechanism of splicing by class-I (GU-AG), and class-II (GU-AC) introns, spliceosome, alternative splicing.

Unit 3

16h

Genetic code and translation in prokaryotes and eukaryotes: Genetic code and its significance. Deciphering of the genetic code. Mitochondrial genetic code. Co-linearity of genes and proteins. Coding properties of tRNA; wobble hypothesis. **Ribosomes:** Study of Prokaryotic and eukaryotic ribosomes. **Translation:** Initiation factors, elongation factors and termination factors of translation in prokaryotes and eukaryotes. Detailed study of the processes and mechanism of protein synthesis in prokaryotes and eukaryotes. Inhibitors of prokaryotic and eukaryotic translation. Post-translational modifications of proteins. Mechanism of translational control.

Unit 4

16h

Regulation of gene expression in prokaryotes: Concept of regulation of gene expression. **The operon model;** Regulation of gene expression at transcriptional level. Concept of positive regulation and negative regulation. Operon concept- Detailed study of structure and regulation of Lac operon, tryptophan operon, galactose operon, arabinose operon, and histidine operon. Structure and functions of λ repressor, Cro, and λ cII. **Eukaryotic gene expression:** Levels of control of gene expression in eukaryotes. Regulation of gene expression in yeast (galactose utilization). Regulation of gene expression- β -globin gene, DHFR gene. Histone modification. Brief study of regulation of developmental genes in Drosophila.

References

1. Biochemistry; Edn. Voet, D. and Voet, J.G. [Eds.] (2004) 3 Ed. John Wiley and sons.
2. Genes VIII; Benjamin Lewin, (2004) Pearson-Printice Hall
3. Molecular Biology of the Cell; Bruce Alberts et al., (2002), Garland Publications
4. Molecular Biology; David Freifelder, J. (1997) Narosa publishers.
5. Nuclear Organization; Chromatin Structure and Gene Expression, Roen Van Driel and Arie P. Otte (1997) Oxford University Press.
6. Genome 2; T.A. Brown, (2002) John Wiley & sons.
7. Principles of Biochemistry; Lehninger et al., [Eds.] (1997) 2nd Edn. Worth Publishers.
8. Principles of Biochemistry; Smith et al., [Ed.] (1986) McGraw-Hill.
9. Human Molecular Genetics; Peter Sudbery, (2002) Printice Hall.
10. Molecular Biotechnology; Glick and Pasternak, (1998), ASM Press.

11. Molecular Biology; Current Innovations and Future Trends; Griffin and Griffin, (1995), Horizon Scientific Press.
12. Human Molecular Genetics 2; Stracham Tom & Read Andrew P., Bios Scientific Publishers (1999).
13. Molecular biology and Biotechnology; 4th Edn., J.M. Walker and R. Rapley; RSC (2000).
14. Molecular Biology of Gene; Watson, J.D. et al., 5th Edn. Pearson Education; (2004).

SPT-3.3.A: Clinical Biochemistry and Dietetics (4 Credits: 64 h)

Unit 1 6h

Blood: Blood Haemostasis, Composition, blood count, total, differential and platelet count. Blood group studies, Rhesus factor, ESR- its determination and importance in disease. Blood coagulation factors, mechanism and its regulation. Plasma proteins, profile in health and diseases. Abnormal haemoglobins, Disorders of haemoglobins – thalassaemia, 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 2 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 3 16h

Disorders of carbohydrate metabolism: Diabetes- aetiology, classification, management, laboratory investigations. GTT, GlycatedHb, Diabetic complications, inborn errors of carbohydrate metabolism-Glycogen storage diseases, Galactosemia, Lactose intolerance, Pentosuria. 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, Xanthuria, Oroticaciduria. Cardiovascular disorders- Major cardiovascular system- Atherosclerosis- risk factors, pathogenesis, diagnosis and prognosis. Gastrointestinal disorders: Fractional gastric analysis, Hypo and hyperacidity, Gastric ulcers, Malabsorption syndrome.

Unit 4 16h

Dietetics: Introduction to nutrition. Food pyramid. Diet planning and introduction to diet therapy. Nutritional requirements for different age groups, anaemic child, expectant women, and lactating women. Diet planning for prevention and cure of nutritional anaemia.

Diet therapy: Functional foods, dietary considerations during fever, and typhoid, malaria, influenza and tuberculosis patients. Prevention, and correction of obesity, underweight, and metabolic diseases by diet therapy. Dietary interventions to correct and or manage gastrointestinal diseases (indigestion, peptic ulcer, stomach carcinoma, constipation, diarrhea, steatorrhoea, irritable bowel syndrome. **Diets in liver diseases** - Hepatitis, cirrhosis, cholecystitis and cholelithiasis. Functional foods based diet therapy for diabetes,

cardiovascular disease, nephritis, and genetic disorders (PKU, galactosemia, lactose-intolerance, fructosuria) and cancers.

References

1. Text Book of Biochemistry with clinical correlations. Thomas Devlin. Wiley-Liss. Chatterjee and Rana Sinde. Jaypee Brothers.
2. Fundamentals of Biochemistry. A.C.Deb. 8thEdn. New Central Book Agency
3. Clinical chemistry: principles, procedures, correlations. Lippincot
4. Medical physiology. Guyton and Hall. 10thEdn. Harcourt asia, Pte. Ltd.
5. Text book of Biochemistry and Human Biology .G.P.Talwar. Prentice-Hall , India
6. Clinical Biochemistry: principle, procedures and correlation. Bishop J.L., Duben Von Laufen, E.Fody, J.B.Lippincott Co.
7. Medical Biochemistry. Alfred Burger. 3rdEdn. John wiley and sons
8. Human nutrition and dietetics. J S Garrow, Ann Ralph William, Phillip Trehame Jacus
9. Medical nutrition and disease- Acase based approach. Lisa Hark, Gail Morrison. 2003. John Willey and Sons
10. Nutrition and dietetics for health care. Helene M Barker. 2002. Elsevier Health Sciences
11. Manual of dietetic practice. Briony Thomas, and Jacki Bishop. British Dietetic Association. 2007. Willey-Blackwell
12. Nutritional management of Diabetes mellitus. Robert Moses, anne Dornhostr, Gary Forst. 2003. John Willey and Sons

SPT-3.3.B: Plant Biochemistry

(4 Credits: 64 h)

Unit 1

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-carboxypeptidases, aminopeptidases, dipeptidases and tripeptidases, functional considerations.

Plant proteinases inhibitors -General properties of plant proteinase inhibitors, proteinase inhibitors of serine proteinase, acid proteinase, metalloproteinases. Role of proteinase inhibitors in plants.

Unit 2

16h

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 toxins.

Unit 3

16h

Phenolic metabolism: Shikimate/arginate pathway, phenylalanine/hydroxycinnamate pathway, phenylpropanoid pathways, hydroxycinnamate conjugates, hydroxycoumarins, flavonoids, lignins and neoligninans, 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 4

16h

Isoprenoid metabolism: Nomenclature, classification and occurrence, general pathway of terpenoid biosynthesis, monoterpenoids, sesquiterpenoids, diterpenoids, triterpenoids, carotenoids, polyterpenoids, 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, physicochemical 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, 2nd Edn. Prentice Hall of India Pvt. New Delhi.
3. Plant physiology. R G S Bidwell. 2nd Edn. Mac Millan Publishing C. Inc. New York.
4. The Biochemistry of Plants – A comprehensive treatise. P K Stumpf and E E Conn. Vol 6. Academic press.

OET-3.4: Biochemical Toxicology (Open Elective) (4 Credits: 64 h)

To be offered to students of other departments

CPP-3.5: Metabolism of Nitrogen compounds (2 Credits: 32h)

1. Assay of aminotransferases: (a) Aspartate (b) alanine amino transferases.
2. Assay of phenyl alanine ammoniolyase.
3. Assay of nitrate and nitrite reductase.
4. Assay of Glutamine synthase.
5. Estimation of Allantoin and allantoic 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.

CPP- 3.6: Molecular Biology (2 Credits: 32h)

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.
11. Gene induction and repression beta-galactosidase activity in *E.coli*.
12. Isolation of auxotrophic mutants.
13. Ames Test.
14. Detection plasmid for antibiotic resistance.
15. Effect of UV dose on survival rate of bacteria.
16. Blue or white colony test for lac+/lac-

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.

SPP-3.7.A Clinical Biochemistry and Dietetics

(2 Credits: 32h)

Clinical Biochemistry

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).

Dietetics

1. Food analysis - 1. Moisture, 2. Crude protein, 3. Ash, 4. Crude fat, 5. Energy, 6. Crude and dietary fibre 7. Iron 8. Ascorbic acid 9. Phosphorus
2. Determination of BMR /BMI

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. 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
8. A Manual of Laboratory Techniques , National Institute of Nutrition, Hyderabad

SPP-3.7.B: Plant Biochemistry

(2 Credits: 32h)

1. Extraction, isolation and estimation of polyphenols.
2. Extraction, isolation and estimation of lignin.
3. Extraction and estimation of flavones, tennin 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-3.8: Biochemical Toxicology (Open Elective) (2 Credits: 32h)

To be offered to the students of other departments

IV Semester

CPT-4.1: Immunology (4 Credits: 64 h)

Unit 1 16h

History and scope of immunology. Types of immunity- innate and adaptive. Immune reactive cells. Humoral and cell mediated immunity. Anatomy of lymphoid organs- primary lymphoid organs, secondary lymphoid organs and lymphatic system. Antigens – chemical nature, types, antigenicity, haptens, epitopes, antigenic determinants, adjuvants and superantigens.

Unit 2 16h

Immunoglobulins basic structure, functions, theories of antibody formation, classes and immunoglobulin super family. Antigenic determinants on immunoglobulins. Methods of raising polyclonal antibodies. Monoclonal antibodies – production and application.

Antibody diversity – mechanism contributing to diversity, somatic recombination, rearrangement and generation of antibody diversity. Class switching.

Unit 3 16h

T and B cell lymphocytes: origin, differentiation, characterization and functions. T cell and B cell receptor complexes. Antigen processing and presentation. Cytokines and co-stimulatory molecules. Role in immune response. T and B cell interactions.

Complement system – components, receptors, activation of complement pathways and its biological consequences.

Major histocompatibility complex (MHC) genes and products. Role of MHC antigens in immune response, MHC antigens in transplantation.

Unit 4 16h

Antigen-antibody interactions: agglutination and precipitation techniques, immunodiffusion, radioimmunoassay, ELISA, western blotting, immunofluorescence and flow cytometry.

Transplantation- types, genetics of transplants, graft versus host reactions, tissue matching and immunosuppressive agents.

Immunization practices- killed, attenuated organisms, toxoids, recombinant vaccines, subunit vaccines, DNA vaccines and synthetic peptide vaccines.

Immune disorders- hypersensitivity and immunodeficiency disorder: autoimmunity. Tumor immunology.

References

4. Fundamental Immunology, William E. Paul. Publisher: Lippincott Williams and Wilkins.
5. Immunology: International Edition: Janis Kuby, Thomas J. Kindt, Barbara A. Osborne and Richard A. Goldsby. WH Freeman and Co. Ltd.
6. Immunology Richard A. Goldsby, Thomas J. Kindt, Barbara A. Osborne and Janis Kuby. WH Freeman and Co. Ltd.
7. Immunology Ivan M. Roitt, Jonathan Brostoff and David Male. Publisher: Mosby.
8. Introduction to Medical Immunology Gabriel Virella, Marcel Dekker Inc.
9. Roitt's Essential Immunology Ivan M. Roitt and Peter J. Delves, Blackwell Publishing
10. Understanding Immunology (Cell and Molecular Biology in Action) *Peter* Wood. Publisher: Prentice hall.
11. Basic Immunology: The Functions of the Immune System Abul K. Abbas and Andrew H. Lichtman. Publisher: Saunders.
12. A Handbook of Practical Immunology, G. P. Talwar, Pub: Vikas Publishing House.
13. Fundamental Immunology Robert M. Coleman and M.F. Lombard. Publisher: Brown (William C.) Co, U.S.
14. Atlas of Immunology J.M. Cruse (Author), Robert E. Lewis. CRC Press Inc.
15. Immunology Edwards S Golub. Sinauer Associate, Sunderland.

CPT- 4.2: Molecular Genetics

(4 Credits: 64 h)

Unit 1

16h

Introduction: Nature of genetic material; Prion chromosomes and genes. Mutation, types of mutation, mutagens, mechanism of mutation, induction and isolation of mutants and their role in genetic studies

Classical genetics: Review of classical genetics; work on *Pisum sativum*, *Drosophila melanogaster*, *Neurospora crassa* etc. Inheritance (sex – linked and others), population genetics, extranuclear 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 2

16h

Bacterial genetics: Bacterial chromosome, plasmids ; fertility, resistance, colicinogenic and others. Recombination in bacteria. Mechanism of recombination, transposable genetic elements, transformation and conjugation in bacteria. Linkage map of bacterial chromosomes.

Unit 3

16h

Human Genetics: Biochemical events occurring during mitosis and meiosis. Structure of chromatin; nucleosomes and higher orders of organization. Chromosome banding, Chromosome mapping based on recombination frequency data. Gene structure in eukaryotic organisms, introns, exons, pseudogenes, gene clusters, spacers, repetitive sequences and transposons. Transposition in human chromosomes. Chromosomal abnormalities. Biological databases, Sequence Comparison and Database Search-Biological databases: Contents, structure, annotation, file formats, annotated databases, genomes and organism specific databases. Overview of human genome project, mapping of human genes; techniques used, assignment of important genes.

Unit 4

16h

Viral Genetics: Discovery of viruses, chemical nature and properties of viruses, viroids. Classification, isolation and assay of animal, plant and bacterial viruses. Nature of viral receptors, entry and reproduction of animal viruses. Viral disorders and control, interferons,

tumor viruses. TMV and plant viruses, viroids. Structure of bacteriophages. Lytic cycle; replication of T-phages. Lysogeny and its regulation. Transduction; specialised, generalised and abortive. Fine structure analysis of T-phages ; Benzers work, concept of cistrons.

SPT- 4.3.A: Genetic Engineering and Fermentation Technology

(4 Credits: 64 h)

Unit 1

16h

Gene Cloning: Basic principles and tools and techniques of gene cloning: Characteristics and applications of restriction endonucleases and modifying enzymes. Methods of Isolation of gene/ DNA fragment for cloning. Methods for gene cloning: *in vivo*- cloning in *E. coli*. *In vitro*- polymerase chain reaction. Characteristics and applications of Plasmid, Cosmid, Phagemid, M¹³-phage vector, λ vector, BAC, PAC, and YAC. Selection of suitable vectors for cloning, expression and sequencing of DNA fragments. Methods of introduction of rDNA into host cells and selection of recombinants. Recovery of cloned DNA and its characterization. Isolation of mRNA and cDNA synthesis, cDNA cloning.

Unit 2

16h

Cloning in mammalian cells: Mammalian cloning vectors and selectable markers. Tumor virus expression systems. Stable and transient expressions. Vaccinia and baculovirus expression systems (BEV) for high level expression. Transgenic animals as models for human genetic diseases, gene therapy. **Cloning in plants:** Plant cloning vectors: Ti Plasmid, viral vectors- Gemini virus and CaMV selectable markers and reporter genes. Protoplast for regeneration and transformation. Production of transgenic plants. **Applications of Recombinant DNA Technology:** Methods of construction of DNA libraries; genomic or cDNA. Screening libraries for desired genes. Use of recombinant molecules as diagnostic probes for genetic diseases, identification of SNPs. Antisense RNA synthesis and its applications. Site-directed mutagenesis and its application to study structure and function of genes. Applications of transgenic plants, animals, and microorganisms. Study of methods of production of insulin, interleukins, growth hormone, t-PA, vaccine (HBs) by rDNA technology.

Unit 3

16h

Fermentation Technology: Industrial microorganisms and their characteristics, Primary and secondary metabolites. Fermenter : Design of batch fermenter, CSTR, semicontinuous and continuous feed-batch fermenters. Fermentation types. Bioprocess development. **Organism and strain improvement:** origin of industrial strain, Isolation, and strain improvement. **Medium and growth conditions:** Raw materials and fermentation media, optimization of growth and culture conditions, growth Kinetics and product formation kinetics, Rheological parameters to be considered for scale-up of bioprocess from lab to industrial scale. Methods of cell Immobilization, Fed-batch and continuous fermentations by immobilized systems. Downstream process, Recovery and purification of products.

Unit 4

16h

Fermentation products:

Production of amino acids- glutamic acid, and lysine, organic acids- acetic acid, citric acid, lactic acid, Itaconic acid. Health care products- vitamins, antibiotics. Alcohols- bioethanol, propanol, butanol. Acrylonitrile, anthranilic acid, biogas Biopolymers. **Production of enzymes** (amylase, proteases, cellulases, xylanases,) from bacterial and fungal strains by solid-substrate and submerged fermentation.

Environmental and agriculture Biotechnology: Natural control of insect pests, Production of biopesticides. Development of specialized microorganisms for bioremediation of toxic environmental pollutants (PAHs, pesticides, industrial effluents). Bioremediation of toxic industrial pollutants and pesticide contaminated sites

References

1. Biotechnology; Principles and Application I.J. Higgins et al., [eds.] (1985) Blackwell Scientific Publications.
2. DNA Cloning; A Practical Approach; Gover, D.M. [Ed.] (1985) Vol. 1 and 2, IRL Press.
3. Enzyme biotechnology; Protein Engineering, Structure prediction, and fermentation; Crabbe, M.J.C. [Ed.] (1990) Ellis Harwood.
4. Immobilized Enzymes; Treven M.D. [Ed.] (1980) Jhon Wiley.
5. Industrial Microbiology; Casida, L. [Ed.] (1989) Wiley Eastern.
6. Industrial Microbiology; Miller and Litsky [Eds.] (1976) McGraw Hill Publishers.
7. Industrial Microbiology; Prescott and Dunn [Eds.] (1989) 4 th Ed. CBS Publishers.
8. Molecular Biotechnology; Glick and Pasternak, (1998), ASM Press.
9. Molecular Cloning; A Laboratory Manual; Sambrook and Russel [Eds.] (2001), Cold spring Harbor.
10. Plant Protoplast and Genetic Engineering; Y.P.S. Bajaj [Ed.]Vol. 1 and 2 (1989) Springer Verlag.
11. Recombinant DNA; Watson J D et al., Second edition, Scientific American Books (1992) W H freeman &Co.
12. Basic Biotechnology; 2nd Edn. Colin Ratledge & Bjorn Kristiansen, Cambridge University Press; (2001).

SPT- 4.3.B: Biostatistics and Bioinformatics

(4 Credits: 64 h)

Unit 1

16h

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.

Unit 2**16h**

Bioinformatics Programmes and languages, Scripts and scripting languages, Running programmes over internet, soft ware downloading and installation, database management.

Biological databases, Sequence Comparison and Database Search-Biological databases: Contents, structure, annotation, file formats, annotated databases, genomes and organism specific databases.

Unit 3**16h**

Sequence Comparison and Database Search-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 alignments; multiple sequence alignments, gene and protein families, protein families and pattern data bases, protein domain families. Dynamic programming approach, Progressive alignment, iterative refinement methods, pattern matching in DNA and protein sequences, PAM matrices, BLAST, and FASTA. Molecular Modeling Database at NCBI, Molecular visualization software (RASMOL), Prediction of genes (Gene finder, ORF finder).

Unit 4**16h**

Protein - Structure prediction and modelling - Introduction, secondary structure prediction methods, softwares for secondary structure prediction, Protein families and classification, prediction of transmembrane regions.CATH and SCOP. Methods of protein modelling, homology or comparative modelling model refinement, Evaluation of the model.

Nucleotide sequence analysis and Molecular phylogenetics - Introduction, tools and methods single nucleotide polymorphism. Application of phylogenetic trees, basic terminology- taxa, taxonomy, root, leaf, node, tree, branch, clade, dendogram, cladogram, rooted tree, unrooted tree, scaled tree. Phylip, Clustal.

Microarray analysis: Methods, tools and resources: SAGE, proteomic data analysis, data from 2-D PAGE and protein mass spectra.

References

1. Biostatistics, P. Ramakrishanan, Saras publications, Kanyakumari.
2. Fundamentals of biostatistics, Khan and Khanum.
3. Basic biostatistics-Suresh Kumar and Satyaveri, Campus books
4. Bioinformatics – sequence and genome analysis; David W. Mount, Cold spring Harber laboratory.
5. Structural bioinformatics-Philip E. Bourne and Helgeweissing, John Wiley and Sons.
6. Introduction to Bioinformatics- a therotical and Practical Approach
7. Basic Mathematics for Biochemists; Cornish Bowden, (1998), Oxford University Press.
8. Bioinformatics: Methods and Protocols; Stephen Misner and Stephen A. Krawtz, (2001) Humana Press.
9. Data analysis for Bimolecular Science, Jhon Maber, (1999), Longman.
10. Developing Bioinformatics Computer Skills; Cynthia Gibas et al., (2001) Shroff Publishers.
11. Introduction to Bioinformatics; Lesk, A.M. (2002)
12. Introduction to Computational Biology, Michael S. Waterman (1995) Champman -Hall.
13. Introduction to Proteomics; Daniel C. Liebler, (2002), Humana Press.
14. Introduction to Bioinformatics; T K Attwood & D J Parry-Smith, (2002), Pearson Education.

CPD-4.4 Dissertation-Current topics in Biochemistry (4 Credits)**CPP-4.5: Immunology (2 Credits: 32h)**

1. Production of immune sera: Affinity purification of antibodies.
2. Immuno-diffusion: Ouchterlony double diffusion, Radial immunodiffusion.
3. Immuno-electrophoresis, Rocket Electrophoresis,
4. ELISA: Direct, Indirect, Sandwich and micro ELISA.
5. Conjugation of antibodies to alkaline phosphatase/HRP.
6. Western blotting of proteins and Immunodetection.
7. Determination of human blood groups.
8. Agglutination tests.

References

1. Introduction to practical biochemistry. S K Swahney and Randir Singhr. Narosa Publishing house.
2. Analytical Biochemistry; D.J.Holme and H. Pick,(1983) Longman.
3. Practical Biochemistry; Principles and Techniques; K. Wilson and J. Walker (1995), Cambridge University Protein Purification Methods; SLV Harris and Angal (1989) IRL Press.
4. Practical Biochemistry. David Plummer. Tata Mc Graw Hill Publishing.
5. Modern Experimental Biochemistry. Rodney Bouer. 3rd Edn. Addison Wesley Longham.

CPP- 4.6: Molecular Genetics (2 Credits: 32h)

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 JohnWalker. 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

SPP-4.7.A Genetic Engineering and Fermentation Technology**Genetic Engineering (2 Credits: 32h)**

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.

Fermentation Technology

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.
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. CambridgeUniversitypress.
5. Basic Biochemical Methods. 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.

SPP- 4.7.B Biostatistics and Bioinformatics

(2 Credits: 32h)

1. Biostatistics and Bioinformatics related problems will be worked out and demonstrations will be organized in the laboratory

CPD-4.8 Dissertation-Practical

(2 Credits)

SYLLABUS FOR OPEN ELECTIVES (to be offered to students of other departments of the faculty)

OET-2.4: Fundamental Biochemistry

(4 Credits: 64 h)

Unit 1

16h

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.

Unit 2**16h**

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 3**16h**

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 c_{ot} 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 4**16h**

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.

OEP-2.8: General Biochemistry**(2 Credits: 32h)**

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.

OET-3.4: Biochemical Toxicology

(4 Credits: 64 h)

Unit 1

16h

Definition and scope of toxicology: Eco-toxicology and its environmental significance. Toxic effects: Basic for general classification & nature. Dose-Response relationship: Synergism and Antagonism, Determination of ED50 & LD50. Acute and Chronic exposures. Factors influencing Toxicity, Pharmacodynamics & Chemodynamics.

Diagnosis of toxic changes in liver and kidneys: Metabolism of Haloalkanes, Haloalkenes & Paracetamol with their toxic effects on tissues.

Unit 2

16h

Xenobiotics Metabolism: Absorption & distribution. Phase I reactions. Oxidation, Reduction, Hydrolysis and Hydration. Phase II reaction/Conjugation : Methylation, Glutathione and amino acid conjugation. Detoxification.

Biochemical basis of toxicity: Metabolism of Toxicity : Disturbances of Exitable membrane function. Altered calcium Homeostasis. Covalent binding of cellular macromolecules & Genoatotoxicity. Tissue specificity of Toxicity.

Toxicity testing : Test protocol, Genetic toxicity testing & Mutagenesis assays : In vitro Test systems – Bacterial Mutation Test : Reversion Test, Ames Test, Fluctuation Tests and Eukaryotic Mutation Tests. In vivo Mammalian Mutation tests – Host mediated assay & Dominant Lethal Test. Use of Drosophila in toxicity testing. DNA repair assays. Chromosome damage test. Toxicological evolution of Recombinant DNA – derived proteins.

Unit 3

16h

Pesticide toxicity: Insecticides: Organochlorines, Anti cholinesterases – Organophosphates and Carbamates, Fungicides. Herbicides, Environmental consequences of pesticide toxicity. Biopesticides.

Food Toxicity: Role of diet in cardio-vascular disease and cancer. Toxicology of food additives.

Unit 4

16h

Metal Toxicity: Toxicology of Arsenic, mercury, lead and cadmium. Environmental factors, affecting metal toxicity effect of light, temperature & pH.

Air pollution: Common air Pollutant & their sources. Air pollution & ozone. Air pollution due to chlorofluorocarbons (CFCS) and asbestos.

References

1. Handbook of Clinical Biochemistry R. Swaminathan Oxford Press(2004)
2. Environmental chemistry by Stanley E. Manahan Boca Raton: CRC Press LLC, 2000.
3. Environmental Toxicology. 2002. David A. Wright and Pamela Welbourn. Cambridge University Press, New York, NY. 630 pp.
4. Emergency Toxicology. Second edition. Edited by Peter Viccellio. 1277 pp. Philadelphia, Lippincott Williams. & Wilkins, 1999.

5. Introduction to Food Toxicology by Takayuki Shibamoto and Leonard S. Bjeldknes Acad. Press 2nd edn. 1993.
6. Principles of biochemical toxicology, John A. Timbrell. —4th ed. Informa Healthcare USA, Inc. New York, 2008.
7. Basic Analytical Toxicology RJ Flanagan et al WHO Geneva 1995

OEP-3.8: Biochemical Toxicology

(2 Credits: 32h)

The experiments will be designed in accordance with syllabus.

References

1. Basic Analytical Toxicology RJ Flanagan et al WHO Geneva 1995

THEORY QUESTION PAPER PATTERN

M.Sc. Biochemistry (CBCS Scheme)

Note: Answer Question No. 1 and any FOUR of the remaining.

Max. Marks = 80

- | | |
|--|------------|
| 1. Answer any eight the following questions | 8 X 2 = 16 |
| a. | |
| b. | |
| c. | |
| d. | |
| e. | |
| f. | |
| g. | |
| h. | |
| i. | |
| j. | |
| 2. (a) | 16 |
| (b) | |
| 3. (a) | 16 |
| (b) | |
| 4. (a) | 16 |
| (b) | |
| 5. (a) | 16 |
| (b) | |
| 6. Write short notes on any FOUR of the following | 4 X 4 =16 |
| a. | |
| b. | |
| c. | |
| d. | |
| e. | |

***Note:** Equal weightage to be given to each unit while preparing question paper

PRACTICAL QUESTION PAPER PATTERN

Max. Marks = 40

- | | |
|----------------------------|----------|
| 1. Experiment and spotters | 30 marks |
| 2. Practical record | 05 marks |
| 3. Viva-voce | 05 marks |

**Chairman
BOS in Biochemistry**