



JSS COLLEGE OF ARTS, COMMERCE AND SCIENCE
(An autonomous College of University of Mysuru)
Re-accredited by NAAC with 'A' grade
Ooty road, Mysuru-570 025, Karnataka

DEPARTMENT OF BIOCHEMISTRY

SYLLABUS

CHOICE BASED CREDIT SYSTEM

FOR
B.Sc. PROGRAMME

Biochemistry, Microbiology, Biotechnology

Botany, Biochemistry, Microbiology

2017-2018

Programme: Biochemistry, Microbiology, Biotechnology

Year	Semester	Course code	Title of the Paper	Credits	Total credits	Total Hours	
				L:T:P		Th	Pr
I BSc	I	CMA21006	FUNDAMENTALS OF CHEMISTRY AND MOLECULES OF LIFE	4:0:2	06	60	60
	II	CMB21006	PHYSIOLOGY	4:0:2	06	60	60
II BSc	III	CMC21006	METABOLISM	4:0:2	06	60	60
	IV	CMD21006	ENZYMOLGY & BIOENERGETICS	4:0:2	06	60	60
III BSc	V	CME21006 CME21206	No. Of course 1 DSE 1- NUTRITIONAL BIOCHEMISTRY DSE 2- MOLECULAR BASIS OF INFECTIOUS DISEASES	4:0:1.0	4.0	60	30
		CME21406 CME21606	No. Of course 1 SEC 1- TOOLS AND TECHNIQUES IN BIOCHEMISTRY SEC 2- CLINICAL BIOCHEMISTRY	2:0:0	02	30	00
	VI	CMF21006 CMF21206	No. Of course 1 DSE 1- ADVANCED CELL BIOLOGY AND ENDOCRINOLOGY DSE 2- PLANT BIOCHEMISTRY	4:0:1.0	4.0	60	30

Scheme of Study

Programme: Botany, Biochemistry, Microbiology

Scheme of Study

Year	Semester	Course code	Title of the Paper	Credits	Total credits	Total Hours		Total Hours
				L:T:P		Th	Pr	
I BSc	I	CMA21006	FUNDAMENTALS OF CHEMISTRY AND MOLECULES OF LIFE	4:0:2	06	60	60	8
	II	CMB21006	PHYSIOLOGY	4:0:2	06	60	60	8
II BSc	III	CMC21006	METABOLISM	4:0:2	06	60	60	8
	IV	CMD21006	ENZYMOLGY & BIOENERGETICS	4:0:2	06	60	60	8
III BSc	V	CME21006 CME21206	No. Of course 1 DSE 1- NUTRITIONAL BIOCHEMISTRY DSE 2- MOLECULAR BASIS OF INFECTIOUS DISEASES	4:0:1.0	4.0	60	30	6
		CME21406 CME21606	No. Of course 1 SEC 1- TOOLS AND TECHNIQUES IN BIOCHEMISTRY SEC 2- CLINICAL BIOCHEMISTRY	2:0:0	02	30	00	2
	VI	CMF21006 CMF21206	No. Of course 1 DSE 1- ADVANCED CELL BIOLOGY AND ENDOCRINOLOGY DSE 2- PLANT BIOCHEMISTRY	4:0:1.0	4.0	60	30	6

Programme: Biochemistry, Microbiology, Biotechnology

Scheme of Assessment

Year	Sem	Course code	Title of the Paper	Credits	Percentage			Maximum Marks						Exam Duration		
					L:T:P	Th	Pr	IA	Th	Pr	IA-1		IA-2		Th	Pr
											Th	Pr	Th	Pr		
I BSc	I	CMA21006	FUNDAMENTALS OF CHEMISTRY AND MOLECULES OF LIFE	4:0:2	50	20	30	70	70	10	05	10	05	3H	3H	
	II	CMB21006	PHYSIOLOGY	4:0:2	50	20	30	70	70	10	05	10	05	3H	3H	
II BSc	III	CMC21006	METABOLISM	4:0:2	50	20	30	70	70	10	05	10	05	3H	3H	
	IV	CMD21006	ENZYMOLGY & BIOENERGETICS	4:0:2	50	20	30	70	70	10	05	10	05	3H	3H	
III BSc	V	CME21006 CME21206	No. Of course 1 DSE 1- NUTRITIONAL BIOCHEMISTRY DSE 2- MOLECULAR BASIS OF INFECTIOUS DISEASES	4:0:1.0	50	20	30	70	70	10	05	10	05	3H	3H	
		CME21406 CME21606	No. Of course 1 SEC 1- TOOLS AND TECHNIQUES IN BIOCHEMISTRY SEC 2- CLINICAL BIOCHEMISTRY	2:0:0	70	-	30	50	-	10	05	10	05	2H	-	
	VI	CMF21006 CMF21206	No. Of course 1 DSE 1- ADVANCED CELL BIOLOGY AND ENDOCRINOLOGY DSE 2- PLANT BIOCHEMISTRY	4:0:1.0	50	20	30	70	70	10	05	10	05	3H	3H	

Programme: Botany, Biochemistry, Microbiology

Scheme of Assessment

Year	Sem	Course code	Title of the Paper	Credits	Percentage			Maximum Marks						Exam Duration		
					L:T:P	Th	Pr	IA	Th	Pr	IA-1		IA-2		Th	Pr
											Th	Pr	Th	Pr		
I BSc	I	CMA21006	FUNDAMENTALS OF CHEMISTRY AND MOLECULES OF LIFE	4:0:2	50	20	30	70	70	10	05	10	05	3H	3H	
	II	CMB21006	PHYSIOLOGY	4:0:2	50	20	30	70	70	10	05	10	05	3H	3H	
II BSc	III	CMC21006	METABOLISM	4:0:2	50	20	30	70	70	10	05	10	05	3H	3H	
	IV	CMD21006	ENZYMOLGY & BIOENERGETICS	4:0:2	50	20	30	70	70	10	05	10	05	3H	3H	
III BSc	V	CME21006 CME21206	No. Of course 1 DSE 1- NUTRITIONAL BIOCHEMISTRY DSE 2- MOLECULAR BASIS OF INFECTIOUS DISEASES	4:0:1.0	50	20	30	70	70	10	05	10	05	3H	3H	
		CME21406 CME21606	No. Of course 1 SEC 1- TOOLS AND TECHNIQUES IN BIOCHEMISTRY SEC 2- CLINICAL BIOCHEMISTRY	2:0:0	70	-	30	50	-	10	05	10	05	2H	-	
	VI	CMF21006 CMF21206	No. Of course 1 DSE 1- ADVANCED CELL BIOLOGY AND ENDOCRINOLOGY DSE 2- PLANT BIOCHEMISTRY	4:0:1.0	50	20	30	70	70	10	05	10	05	3H	3H	

SCHEME OF VALUATION FOR PRACTICAL EXAMINATION

- A candidate appearing for the first time should submit a duly signed and certified practical record
- Each candidate has to perform one experiment in the specified duration of three hours for ***FORTY FIVE*** marks
- Practical record has to be valued for ***TEN*** marks by examiners at the time of examination
- Viva-voce for ***FIFTEEN*** marks in practical is awarded by continuous assessment in the lab

Sl no	Component	Marks
1	Write up of the experiment	15
2	Conducting experiment	25
3	Result	05
4	Viva-voce	15
5	Practical record	10
TOTAL		70

Core papers -Credit: 06 each

Sl. No	Sem	Course Code	Title of the paper	Total credits	
				Th	Pr
1	I	CMA21006/ CMA21007	Fundamentals of Chemistry and Molecules of Life	04	02
2	II	CMB21006/ CMB21007	Physiology	04	02
3	III	CMC21006/ CMC21007	Metabolism	04	02
4	IV	CMD21006/ CMD21007	Enzymology & Bioenergetics	04	02

Discipline Specific Electives (Credit: 05 each)

Sl. No	Sem	Course Code	Title of the paper	Total credits	
				Th	Pr
1	V	CME21006 / CME21007 CME21206 / CME21207	No. of course 1 DSE 1- Nutritional Biochemistry DSE 2- Molecular Basis of Infectious Diseases	04	1
2	VI	CMF21006/ CMF21007 CMF21206/ CMF21207	No. of course 1 DSE 1- Advanced Cell Biology and Endocrinology DSE 2- Plant Biochemistry	04	1

Skill Enhancement Course: (Credit: 02)

Sl. No	Course Code	Title of the paper	Total credits
			Th
1	CME21406/ CME21407 CME21606/ CME21607	No. of course 1 SEC 1- Tools and Techniques in Biochemistry SEC 2- Clinical Biochemistry	02

Programme Outcome for Bachelor of Science in Biochemistry, Microbiology, Biotechnology

After completing the graduation in the Bachelor of Science the students are able to:

- PO1. Demonstrate the ability to justify and explain their thinking and/or approach
- PO2. Develop state-of-the-art laboratory and professional communication skills
- PO3. Apply the scientific method to design, execute, and analyze an experiment
- PO4. Explain scientific procedures and their experimental observations
- PO5. Demonstrate an understanding of fundamental biochemical principles, structure and function
- PO6. Work as a laboratory technician, biochemists or medical scientist
- PO7. Explain the processes used by microorganisms for the growth
- PO8. Explain the theoretical basis of tools, technologies and methods of microbiology
- PO9. Design and develop solution to Biotechnology problems
- PO10. Applying appropriate tools keeping in mind safety factor for environment & society
- PO11. Create, select, and apply appropriate techniques, resources, and modern tools
- PO12. Support biotechnology research activity with strong technical background

Programme Specific Outcome

Bachelor of Science in Biochemistry, Microbiology, Biotechnology

After completing the graduation in the Bachelor of Science the students are able to;

- PSO1. Gain and understand biochemical and molecular processes
- PSO2. Communicate scientific information effectively, relating to microbes and their role in ecosystem and health
- PSO3. Acquire, articulate, retain and demonstrate laboratory safety skills
- PSO4. Demonstrate applications of biochemical and biological sciences
- PSO5. Apply appropriate tools and techniques in biotechnological manipulation
- PSO6. Understand the responsibilities of biotechnological practices

Programme Outcome for Bachelor of Science in Botany, Biochemistry, Microbiology

After completing the graduation in the Bachelor of Science the students are able to:

- PO1. Identify the taxonomic position of plants using principles and methods of nomenclature and classification in Botany
- PO2. Understand the impact of the plant diversity in societal and environmental context
- PO3. Demonstrate the knowledge of, and need for sustainable development
- PO4. Use interdisciplinary approaches with quantitative skills to work on biological problems
- PO5. Demonstrate the ability to justify and explain their thinking and/or approach
- PO6. Develop state-of-the-art laboratory and professional communication skills
- PO7. Apply the scientific method to design, execute, and analyze an experiment
- PO8. Explain scientific procedures and their experimental observations
- PO9. Demonstrate an understanding of fundamental biochemical principles, structure and function
- PO10. Work as a laboratory technician, biochemists or medical scientist
- PO11. Explain the processes used by microorganisms for the growth
- PO12. Explain the theoretical basis of the tools, technologies and methods of microbiology

Programme Specific Outcome

Bachelor of Science in Botany, Biochemistry, Microbiology

After completing the graduation in the Bachelor of Science the students are able to;

- PSO1. Demonstrate applications of biochemical and biological sciences
- PSO2. Inculcating proficiency in all experimental techniques and methods of analysis
- PSO3. Acquire, articulate, retain and demonstrate laboratory safety skills
- PSO4. Communicate scientific information effectively, relating to microbes and their role in ecosystem and health
- PSO5. Gain proper procedures and regulations in handling and disposal of chemicals
- PSO6. Understand biochemical and molecular processes that occur in and between the cells

SEMESTER I

CORE: FUNDAMENTALS OF CHEMISTRY AND MOLECULES OF LIFE

(Credits: Theory – 04, Practical – 02)

Theory: 60 Hrs

Course Outcome:

After completion of the course the student is able to:

- CO1: Understand in detail with examples stereochemistry
- CO2: Specify the characteristics of carbohydrates & glycobiology
- CO3: Learn the characteristics of proteins
- CO4: Understand the classification and characteristics of vitamins

Unit : 1	THE FOUNDATIONS OF BIOCHEMISTRY : Cellular and chemical foundations of life	2 Hrs
Unit : 2	WATER: Unique properties, weak interactions in aqueous systems, ionization of water, buffers, water as a reactant and fitness of the aqueous environment.	4 Hrs
Unit : 3	CONCENTRATION UNITS: Mole, Mole fraction, Molality, Molarity and Normality (problems to be worked out).	1 Hrs
Unit : 4	STEREOCHEMISTRY: Stereoisomerism, types. Geometrical Isomerism- Cis Trans & E/Z nomenclature. Optical Isomerism- asymmetric carbon atom, Optical activity, plane polarized light, Chirality, Specific molecular rotation, Projection formula- Fischer & Newman projection formulae, optical isomerism in Glyceraldehyde, Lactic acid, and Tartaric acid. Nomenclature of enantiomers - D and L system, Racemisation and resolution (biochemical method)	4 Hrs
Unit : 5	REACTION MECHANISM: Concept of inductive, mesomeric and resonance effect. Concept of the reaction intermediates- carbanions, carbocations, free radicals, carbenes. Nucleophiles and Electrophiles.	3 Hrs
Unit : 6	CARBOHYDRATES & GLYCOBIOLOGY: Monosaccharides - structure of aldoses and ketoses, ring structure of sugars, conformations of sugars, mutarotation, anomers, epimers and enantiomers, structure of biologically important sugar derivatives, oxidation of sugars. Formation of disaccharides, reducing and nonreducing disaccharides. Polysaccharides – homo- and heteropolysaccharides, structural and storage polysaccharides. Structure and role of proteoglycans, glycoproteins and glycolipids (gangliosides and lipopolysaccharides). Carbohydrates as informational molecules, working with carbohydrates	12 Hrs
Unit : 7	LIPIDS: Building blocks of lipids - fatty acids, glycerol, and ceramide. Storage lipids - triacyl glycerol and waxes. Structural lipids in membranes- glycerophospholipids, galactolipids and sulpholipids, sphingolipids and sterols, structure, distribution and role of membrane lipids. Saponification value, Iodine value, Peroxide value, Acid value and their significance. Ecosinoids: Definition,	12 Hrs

types, Prostaglandins: Definition, biological functions, structure of PGE1 & E2 and PGF1&F2.

Throboxans and leukotrienes- Biological roles.

Plant steroids. Lipids as signals, cofactors and pigments

Unit : 8 AMINO ACIDS & PROTEINS: Structure and classification, physical, chemical and optical properties of amino acids. Peptide bond - Formation and structure. Structure and biological importance of Glutathione, Oxytosine, Vasopressine, Endorphine. Synthetic peptides – importance of polyglutamic acid, polylysine. **8 Hrs**

Classification of proteins based on structure with examples. Primary structure of proteins – Determination of amino acid composition, determination of N- and C-terminal amino acids, sequencing by Edman's degradation method. Secondary structure: - a Helix, b- sheet, b barrel and b turn. Tertiary structure- Fibrous proteins (collagen) and Globular proteins (Myoglobin). Quaternary Structure – hemoglobin, Denaturation and renaturation of proteins by Anfinsen's experiment.

Unit : 9 NUCLEIC ACIDS: Nucleotides - structure and properties. Nucleic acid structure -Watson-Crick model of DNA. Structure of major species of RNA - mRNA, tRNA and rRNA. Nucleic acid chemistry - UV absorption, effect of acid and alkali on DNA. Other functions of nucleotides - source of energy, component of coenzymes, second messengers. **8 Hrs**

Unit : 10 VITAMINS : Structure and active forms of water soluble and fat soluble vitamins, deficiency diseases and symptoms, hypervitaminosis. **6 Hrs**

PRACTICALS

- 1 Safety measures in laboratories.
- 2 Preparation of normal and molar solutions.
- 3 Preparation of buffers.
- 4 Determination of pKa of acetic acid and glycine.
- 5 Qualitative tests for carbohydrates.
- 6 Qualitative tests for lipids.
- 7 Qualitative tests for amino acids, proteins.
- 8 Qualitative tests for nucleic acids.
- 9 Separation of amino acids/ sugars/ bases by thin layer chromatography.
- 10 Estimation of vitamin C by iodometric method
- 11 Preparation of ZnSO₄ standard solution, standardization of approximately N/10 EDTA solution and estimation of total hardness of water using Erichrome black –T indicator.
- 12 Preparation of standard sodium carbonate solution. Standardization of approximately N/10 NaOH and estimation of HCl in the given solution.
- 13 Determination of density the given protein solution or liquid using specific gravity bottle and viscosity by using ostwald's viscometer.
- 14 Conductometric titration of Amino acid against a strong base.

Note: Minimum of ten experiments to be done.

Reference:

- 1. Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W.H.Freeman and Company (New York), ISBN:13: 978-1-4641-0962-1 / ISBN:10:1-4292-3414-8.**
- 2. Textbook of Biochemistry with Clinical Correlations (2011) 7th ed., Devlin, T.M., JohnWiley & Sons, Inc. (New York), ISBN:978-0-470-28173-4.**

SEMESTER II

CORE: PHYSIOLOGY

(Credits: Theory – 04, Practical – 02)

Theory: 60 Hrs

Course Outcome:

After completion of the course the student is able to:

CO1: Understand in depth cardiovascular physiology

CO2: Specify the characteristics of renal physiology

CO3: Deliberate the detail of musculoskeletal system

CO4: Learn the detail of reproductive physiology

Unit : 1 HOMEOSTASIS & THE ORGANIZATION OF BODY FLUID 8 Hrs

COMPARTMENTS: Intracellular, extracellular and interstitial fluid. Homeostasis, control system and their components. Plasma as an extracellular fluid, RBC, molecular mechanism of blood coagulation, role of vitamin K in coagulation, anticoagulant and fibrinolytic systems. Anemias, polycythemia, haemophilia and thrombosis

Unit: 2 CARDIOVASCULAR PHYSIOLOGY: 8 Hrs

Anatomy of heart. Physiology of the cardiac muscle, Pressure, flow and resistance. Ventricular volumes and the ECG, control of cardiac function and output. The arterial system, venous system, the microcirculation and mechanics of capillary fluid exchange. Control of blood flow to the tissues. Portal circulations. Hypertension, congestive heart disease, atherosclerosis and myocardial infarction.

Unit: 3 RESPIRATION: 6 Hrs

Mechanism of respiration. Principles of gas exchange and transport. Regulation of respiration. Pulmonary oedema and regulation of pleural fluid. Hypoxia, hypercapnea, pulmonary distress, emphysema, ARDS.

Unit: 4 RENAL PHYSIOLOGY: 7 Hrs

Anatomy of the kidney and the nephron. Regulation of renal blood flow. Cell biology of the bowmans' capsule. Physiology of glomerular filtration and GFR. Tubular processing of the glomerular filtrate. Blood buffer systems, renal and pulmonary control of blood pH, renal clearance. Assessment of kidney function. Acidosis and alkalosis. Glomerular nephritis, renal failure, dialysis and diuretics.

Unit: 5 GASTROINTESTINAL & HEPATIC PHYSIOLOGY: 6 Hrs

Propulsion and motility of food and digested material. Digestion and absorption of macro and micronutrients. Peptic ulcer, Sprue, celiac disease, IBD, regurgitation, diarrhoea and constipation. Anatomy of the hepatic lobule and blood flow into the liver. Formation and secretion of bile. Enterohepatic cycle, reticuloendothelial system, metabolic importance of liver. Liver function tests. Jaundice, liver cirrhosis and fatty liver.

Unit :6 MUSCULOSKELETAL SYSTEM: 4 Hrs

Bone structure and formation. Physiology of muscle contraction in striated and non-striated muscle.

Unit: 7 REPRODUCTIVE PHYSIOLOGY: 7 Hrs

Sex determination and differentiation.

Development of female and male genital tracts.
Spermatogenesis, capacitation and transport of sperm, blood testis barrier.
Ovarian function and its control. Uterine changes, fertilization and implantation. Placenta as a feto- maternal unit, gestation and parturition.

Unit: 8 NEUROCHEMISTRY & NEUROPHYSIOLOGY: Central Nervous system. Peripheral Nervous system. Blood brain barrier and CSF. Membrane potentials. Synaptic transmission. Neurotransmitters. Sensory receptors and neural pathways.
Somatic sensation, EEG, sleep, coma, learning and memory. **6 Hrs**

Unit: 9 PLANT RESPIRATION: Overview of glycolysis, Alternative reactions of glycolysis, Regulation of plant glycolysis, Translocation of metabolites across mitochondrial membrane, TCA cycle, Alternative NAD(P)H oxidative pathways; Cyanide resistant respiration. **8 Hrs**

PRACTICALS

- 1 Hematology.
- 2 a. RBC and WBC counting
- 3 b. Differential leucocytes count.
- 4 c. Clotting time.
- 5 Estimation of haemoglobin.
- 6 Separation of plasma proteins.
- 7 Determination of total iron binding capacity.
- 8 Pulmonary function tests, spirometry and measurement of blood pressure.
- 9 Separation of isoenzymes of LDH by electrophoresis.
- 10 Histology of connective tissue, liver and/ brain permanent slides.
- 11 Case studies (Renal clearance, GFR, ECG).
- 12 Estimation of serum phospholipids
- 13 Demonstration of ELISA
- 14 Identification of PMN leucocytes from human peripheral blood sample by staining

Note: Minimum of ten experiments to be done.

Reference:

1. Vander's Human Physiology (2008) 11th ed., Widmaier, E.P., Raff, H. and Strang, K.T., McGraw Hill International Publications (New York), ISBN: 978-0-07-128366-3.
2. Harper's Biochemistry (2012) 29th ed., Murray, R.K., Granner, D.K., Mayes and P.A., Rodwell, V.W., Lange Medical Books/McGraw Hill. ISBN:978-0-07-176-576-3.
3. Textbook of Medical Physiology (2011) 10th ed., Guyton, A.C. and Hall, J.E., Reed Elseviers India Pvt. Ltd. (New Delhi). ISBN: 978-1-4160-4574-8.
4. Fundamental of Anatomy and Physiology (2009), 8th ed., Martini, F.H. and Nath, J.L., Pearson Publications (San Francisco), ISBN: 10:0-321-53910-9 / ISBN: 13: 978-0321-539106.

SEMESTER III

CORE: METABOLISM

(Credits: Theory – 04, Practical – 02)

Theory: 60 Hrs

Course Outcome:

After completion of the course the student is able to:

CO1: Specify the detail of metabolism of lipids

CO2: Understand the detail of metabolism of carbohydrates

CO3: Deliberate the characteristics of metabolism of proteins

CO4: Understand the detail of metabolism of nucleic acids

- | | | |
|-----------------|--|---------------|
| Unit : 1 | INTRODUCTION TO METABOLISM: Anabolism and catabolism, compartmentalization of metabolic pathways. | 02 Hrs |
| Unit : 2 | METABOLISM OF CARBOHYDRATES: Glycolysis - reactions, regulation and energetics. Entry of other carbohydrates (Fructose, Galactose and Mannose) into glycolytic pathway.
Fates of pyruvate – Under aerobic and anaerobic conditions (conversion of pyruvate to lactate, alcohol and acetyl coA | 10 Hrs |
| Unit: 3 | CITRIC ACID CYCLE: Reactions, regulation and energetics. Amphibolic and integrating roles of TCA cycle. Anaplerosis. Pentose Phosphate pathway and its significance. Cori cycle - its significance. Rapoport and luebering cycle, Gluconeogenesis pathway & their significance. | 10 Hrs |
| Unit: 4 | Uronic acid pathway –Reactions and its significance.
Glyoxalate pathway – Reactions and its significance.
Glycogen metabolism – glycogenolysis and glycogen synthesis and its regulation | 06 Hrs |
| Unit: 5 | METABOLISM OF LIPID: Oxidation of fatty acid α , β and ω - oxidation of saturated fatty acids, Energetics of β - oxidation.
Biosynthesis of even number saturated fatty acids, ketone bodies- formation and its significance. | 08 Hrs |
| Unit: 6 | Bio synthesis of triglycerides, glycolipids, phospholipids and spingolipids
Cholesterol - Outline of biosynthesis and its degradation | 08 Hrs |
| Unit:7 | METABOLISM OF AMINO ACIDS: General reaction of amino acid degradation – Transamination, deamination and decarboxylation (oxidative and non oxidative). Ketogenic and glucogenic amino acids. Urea cycle and its significance. Biosynthesis of amino acids (Phenyl alanine and Glutamic acid) and their degradation. | 08 Hrs |
| Unit: 8 | NUCLEIC ACID METABOLISM: Degradation of Nucleic acids by DNase I & II, pancreatic RNase and phosphodiesterases. Biosynthesis and degradation of purine and pyrimidine nucleotides, salvage pathways, regulation of purine and pyrimidine synthesis. | 08 Hrs |

PRACTICALS

- 1 Glucose by DNS method.
- 2 Amino acid by Ninhydrine method.
- 3 Protein by Lowry's method.
- 4 Urea by DAMO or nitroprusside method.
- 5 Creatinine by Jaffe's method.
- 6 Phosphorous by Fiske and Subbarow's method.
- 7 Iron by Wong's method.
- 8 Ketoacids by DNPH method
- 9 Glycogen by anthrone method
- 1 Cholesterol by Zak's method
- 0
- 11 Isolation of lecithin, identification by TLC, and its estimation.
- 1 Isolation of cholesterol from egg yolk and its estimation.
- 2
- 1 Assay of serum transaminases – SGOT and SGPT.
- 3

Note: Minimum of ten experiments to be done.

Reference:

1. Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W.H. Freeman and Company (New York), ISBN: 13:978-1-4641-0962-1 / ISBN: 10:1-4641-0962-1.
2. Textbook of Biochemistry with Clinical Correlations (2011) 7th ed., Devlin, T.M., John Wiley & Sons, Inc. (New York), ISBN: 978-0-470-28173-4 / BRV ISBN: 978-0-470-60152-5.

SEMESTER IV

CORE: ENZYMOLOGY & BIOENERGETICS

(Credits: Theory – 04, Practical – 02)

Theory: 60 Hrs

Course Outcome:

After completion of the course the student is able to:

CO1: Learn the characteristics of enzyme kinetics

CO2: Learn in depth enzyme inhibitions

CO3: Specify in detail with examples enzyme activity

CO4: Understand the classification and characteristics of bioenergetics

Unit : 1	INTRODUCTION TO ENZYMES: Nature of enzymes - protein and non-protein (ribozyme). Cofactor and prosthetic group, apoenzyme, holoenzyme. IUBMB classification of enzymes.	02 Hrs
Unit : 2	FEATURES OF ENZYME CATALYSIS: Factors affecting the rate of chemical reactions, collision theory, activation energy and transition state theory, catalysis, reaction rates and thermodynamics of reaction. Catalytic power and specificity of enzymes (concept of active site), Fischer's lock and key hypothesis, Koshland's induced fit hypothesis.	06 Hrs
Unit : 3	ENZYME KINETICS: Relationship between initial velocity and substrate concentration, steady state kinetics, equilibrium constant - monosubstrate reactions. Michaelis-Menten equation, Lineweaver-Burk plot, Eadie-Hofstee and Hanes plot. K_m and V_{max} , K_{cat} and turnover number. Effect of pH, temperature and metal ions on the activity of enzyme.	07 Hrs
Unit : 4	ENZYME INHIBITION: Reversible inhibition (competitive, uncompetitive, non-competitive, mixed and substrate). Mechanism based inhibitors - antibiotics as inhibitors	06 Hrs
Unit : 5	MECHANISM OF ACTION OF ENZYMES: General features - proximity and orientation, strain and distortion, acid base and covalent catalysis (chymotrypsin, lysozyme).	05 Hrs
Unit : 6	REGULATION OF ENZYME ACTIVITY: Control of activities of single enzymes (end product inhibition) and metabolic pathways, feedback inhibition (aspartate transcarbamoylase). Occurrence and isolation, phylogenetic distribution and properties (pyruvate dehydrogenase, fatty acyl synthase) Isoenzymes - properties and physiological significance (lactate dehydrogenase).	06 Hrs
Unit : 7	INVOLVEMENT OF COENZYMES IN ENZYME CATALYSED REACTIONS: TPP, FAD, NAD, Pyridoxal Phosphate, Biotin, Coenzyme A, Tetrahydrofolate, Lipoic Acid.	06 Hrs
Unit: 8	APPLICATIONS OF ENZYMES: Application of enzymes in	06 Hrs

diagnostics (SGPT, SGOT, creatine kinase, alkaline and acid phosphatases), enzyme immunoassay (HRPO), enzyme therapy (Streptokinase). Immobilized enzymes.

Unit : 9 INTRODUCTION TO BIOENERGETICS: Laws of thermodynamics, state functions, equilibrium constant, coupled reactions, energy charge, ATP cycle, phosphorylation potential, phosphoryl group transfers. Chemical basis of high standard energy of hydrolysis of ATP, other phosphorylated compounds and thioesters. Redox reactions, standard redox potentials and Nernst equation. Universal electron carriers. 08 Hrs

Unit: 10 OXIDATIVE PHOSPHORYLATION: Mitochondria. Electron transport chain - its organization and function. Inhibitors of ETC and uncouplers. Peter Mitchell's chemiosmotic hypothesis. Proton motive force. Fo F1ATP synthase, structure and mechanism of ATP synthesis. Metabolite transporters in mitochondria. Regulation of oxidative phosphorylation. ROS production and antioxidant mechanisms. Thermogenesis. Alternative respiratory pathways in plants. 08 Hrs

PRACTICALS

- 1 Partial purification of acid phosphatase from germinating mung bean.
- 2 Assay of enzyme activity and specific activity, e.g. acid phosphatase.
- 3 Effect of pH on enzyme activity
- 4 Determination of K_m and V_{max} using Lineweaver-Burk graph.
- 5 Enzyme inhibition - calculation of K_i for competitive inhibition.
- 6 Continuous assay of lactate dehydrogenase.
- 7 Coupled assay of glucose-6-phosphate dehydrogenase
- 8 Determination of specific activity of Salivary amylase by DNS (2 practicals)
- 9 Determination of pH optimum of Salivary amylase.
- 10 Determination of K_m and V_{max} of Salivary amylase
- 11 Determination of initial velocity (time Kinetics) of Salivary amylase.
- 12 Determination of optimum temperature and energy of activation of Salivary amylase.
- 13 Separation of photosynthetic pigments by TLC

Note: Minimum of ten experiments to be done.

Reference:

1. Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W.H.Freeman and Company (New York), ISBN:13: 978-1-4641-0962-1 / ISBN:10:1-4292-3414-8.
2. Biochemistry (2011) 4th ed., Donald, V. and Judith G.V., John Wiley & Sons Asia Pvt.Ltd. (New Jersey), ISBN:978-1180-25024.
3. Fundamentals of Enzymology (1999) 3rd ed., Nicholas C.P. and Lewis S., Oxford University Press Inc. (New York), ISBN:0 19 850229 X.

SEMESTER V

DSE -1: NUTRITIONAL BIOCHEMISTRY

(Credits: Theory – 04, Practical – 01)

Theory: 60 Hrs

Course Outcome:

After completion of the course the student is able to:

CO1: Understand the characteristics of energy metabolism

CO2: Specify the characteristics of dietary carbohydrates

CO3: Identify in detail with examples dietary lipid & health

CO4: Understand the characteristics of minerals

- Unit : 1 INTRODUCTION TO NUTRITION & ENERGY METABOLISM 08 Hrs**
Defining Nutrition, role of nutrients. Unit of energy, Biological oxidation of foodstuff. Measurement of energy content of food, Physiological energy value of foods, SDA.
Measurement of energy expenditure. Direct and Indirect Calorimetry, factors affecting thermogenesis, energy utilization by cells, energy output – Basal and Resting metabolism, physical activity, factors affecting energy input - hunger, appetite, energy balance Energy expenditure in man. Estimating energy requirements, BMR factors Recommended Nutrient Intakes (RNI) and Recommended Dietary Allowances for different age groups.
- Unit: 2 DIETARY CARBOHYDRATES & HEALTH: 08 Hrs** Review functions of carbohydrates. Digestion, absorption, utilization and storage, hormonal regulation of blood glucose. Dietary requirements and source of carbohydrates, Dietary fiber, role of fibre in lipid metabolism, colon function, blood glucose level and GI tract functions.
- Unit :3 DIETARY LIPID & HEALTH: 08 Hrs** Review of classification, sources, functions, digestion, absorption, utilization and storage.
Essential Fatty Acids; Functions of EFA, RDA, – excess and deficiency of EFA. Lipotropic factors, role of saturated fat, cholesterol, lipoprotein and triglycerides. Importance of the following: a) Omega – fatty acids. Omega 3/ omega 6 ratio b) Phospholipids c) Cholesterol in the body d) Mono, Polyunsaturated and Saturated Fatty Acids. Dietary implications of fats and oils, Combination ratios of n6 and n3, MUFA, PUFA and SFA.
- Unit: 4 DIETARY PROTEINS & HEALTH: 08 Hrs** Review of functions of proteins in the body, Digestion and absorption. Essential and Nonessential amino acids. Amino Acid Availability Antagonism, Toxicity and Imbalance, Amino acid Supplementation. Effects of deficiency. Food source and Recommended Dietary Allowances for different age group. Amino acid pool. NPU, Biological Value, Nitrogen balance. PEM and Kwashiorkor.
- Unit :5 FAT & WATER SOLUBLE VITAMINS: 08 Hrs** Vitamin A, C, E, K and D Dietary sources, RDA, Adsorption, Distribution, Metabolism and excretion (ADME), Deficiency. Role of Vitamin A as an antioxidant, in Visual cycle, dermatology and immunity. Role of Vitamin K in Gamma carboxylation. Role of Vitamin E as an antioxidant. Extra-skeletal role of Vitamin D and its effect on bone physiology.

Hypervitaminosis. Vitamin C role as cofactor in amino acid modifications. Niacin- Metabolic interrelation between tryptophan, Niacin and NAD/ NADP. Vitamin B6-Dietary source, RDA, conversion to Pyridoxal Phosphate. Role in metabolism, Biochemical basis for deficiency symptoms. Vitamin B12 and folate; Dietary source, RDA, absorption, metabolic role Biochemical basis for deficiency symptoms.

- Unit: 6 MINERALS:** Calcium, Phosphorus and Iron - Distribution in the body digestion, Absorption, Utilization, Transport, Excretion, Balance, Deficiency, Toxicity, Sources, RDA. Calcium: Phosphorus ratio, Role of iron in prevention of anemia. Iodine and iodine cycle. Iodine, Fluoride, Mg, Cu, Zn, Se, Manganese, Chromium, Molybdenum Distribution in the human body, Physiology, Function, deficiency, Toxicity and Sources. **12 Hrs**
- Unit: 7 ASSESSMENT OF NUTRITIONAL STATUS:** Anthropometric measurements; Z scores, BMI, skinfold, circumference ratios. Biochemical assessment; Basal metabolic panel, Comprehensive metabolic panel, CBC, Urine Analysis, Assessment of Anemia, ROS assessment, GTT and glycosylated Hb, Differential diagnosis of B12 and folate. **04 Hrs**
- Unit: 8 FOOD & DRUG INTERACTIONS & NUTRICEUTICALS:** Nutrient interactions affecting ADME of drugs, Alcohol and nutrient deficiency, Antidepressants, psychoactive drugs and nutrient interactions, Appetite changes with drug intakes and malnutrition. Food as medicine. **04 Hrs**

PRACTICALS

- 1 Bioassay for vitamin B12/B1.
- 2 Homocystiene estimation.
- 3 Serum/ urine MMA estimation.
- 4 Anthropometric identifications for Kwashiorkor, Marasmus and Obesity.
- 5 Determination of oxidative stress: TBARS, antioxidant enzymes in hemolysate.
- 6 Vitamin A/E estimation in serum.
- 7 Bone densitometry /bone ultrasound test demonstration (visit to a nearby clinic)
- 8 Proximate analysis of food samples- Moisture, fibre, protein fat and carbohydrate (by difference) (3 practical)
- 9 Detection of adulterants in food.
- 1 Estimation of Calcium in ragi.
- 0
- 11 Estimation of Vitamin – C in lemon or gooseberries by DPPH method
- 1 Estimation of Lactose in milk by Benedict's method
- 2
- 1 Estimation of Vitamin – E by alpha- alpha bipyridyl method in a given sample (Cod liver oil)
- 3

Note: Minimum of eight experiments to be done.

Reference:

1. Textbook of Biochemistry with Clinical Correlations (2011) Devlin, T.M. John Wiley & Sons, Inc. (New York), ISBN: 978-0-4710-28173-4.
2. Nutrition for health, fitness and sport (2013) Williams.M.H,Anderson,D.E, Rawson,E.S. McGraw Hill international edition. ISBN-978-0-07-131816-7.
3. Krause's Food and Nutrition Care process (2012); Mahan, L.K Strings,S.E, Raymond,J. Elsevier's Publications. ISBN- 978-1-4377-2233-8.
4. The vitamins, Fundamental aspects in Nutrition and Health (2008); G.F. Coombs Jr. Elsevier's Publications. ISBN-13- 978-0-12- 183493-7.
5. Principles of Nutritional Assessment (2005) Rosalind Gibson. Oxford University Press.

SEMESTER V

DSE -2: MOLECULAR BASIS OF INFECTIOUS DISEASES

(Credits: Theory – 04, Practical – 01)

Theory: 60 Hrs

Course Outcome:

After completion of the course the student is able to:

CO1: Deliberate in depth infectious agents

CO2: Learn the detail of bacterial diseases

CO3: Understand the detail of viral diseases

CO4: Learn the characteristics of fungal diseases

- Unit : 1 CLASSIFICATION OF INFECTIOUS AGENTS:** Bacteria, Viruses, protozoa and fungi. Past and present emerging and re-emerging infectious diseases and pathogens. Source, reservoir and transmission of pathogens, Antigenic shift and antigenic drift. Host parasite relationship, types of infections associated with parasitic organisms. Overview of viral and bacterial pathogenesis. Infection and evasion **12 Hrs**
- Unit: 2 OVERVIEW OF DISEASES CAUSED BY BACTERIA:** Detailed study of tuberculosis: History, causative agent, molecular basis of host specificity, infection and pathogenicity, Diagnostics, Therapeutics, inhibitors and vaccines. Drug resistance and implications on public health. Other bacterial diseases including Typhoid, Diphtheria, Pertussis, Tetanus, Typhoid and Pneumonia. **18 Hrs**
- Unit: 3 OVERVIEW OF DISEASES CAUSED BY VIRUSES:** Detailed study of AIDS, history, causative agent, pathogenesis, Diagnostics, Drugs and inhibitors. Other viral diseases including hepatitis, influenza, rabies, chikungunya and polio. **12 Hrs**
- Unit: 4 OVERVIEW OF DISEASES CAUSED BY PARASITES:** Detailed study of Malaria, history, causative agents, Vectors, life cycle, Host parasite interactions, Diagnostics, Drugs and Inhibitors, Resistance, Vaccine development. Other diseases including leishmaniasis, amoebiasis. **08 Hrs**
- Unit :5 OVERVIEW OF DISEASES CAUSED BY OTHER ORGANISMS:** Fungal diseases, General characteristics. Medical importance of major groups, pathogenesis, treatment. **10 Hrs**

PRACTICALS

- 1 WIDAL test
- 2 Gram staining
- 3 Acid fast staining
- 4 PCR based diagnosis
- 5 Amino acid by Ninhydrine method.
- 6 Protein by Lowry's method.

- 7 Urea by DAMO or nitroprusside method.
- 8 Creatinine by Jaffe's method.
- 9 Phosphorous by Fiske and Subbarow's method.
- 10 Iron by Wong's method.
- 11 Ketoacids by DNPH method
- 12 Ammonia by nitroprusside method
- 13 Glycogen by anthrone method
- 14 Cholesterol by Zak's method

Note: Minimum of eight experiments to be done.

Reference:

1. Prescott, Harley, Klein's Microbiology (2008) 7th Ed., Willey, J.M., Sherwood, L.M., Woolverton, C.J. Mc Graw Hill International Edition (New York) ISBN: 978-007-126727.
2. Mandell, Douglas and Bennett.S, Principles and practices of Infectious diseases, 7th edition, Volume, 2. Churchill Livingstone Elsevier.
3. Sherris Medical Microbiology: An Introduction to Infectious Diseases by Kenneth J.Ryan, C. George Ray, Publisher: McGraw-Hill.
4. Medical Microbiology by Patrick R. Murray, Ken S. Rosenthal, Michael A. Pfaller, Elsevier Health Sciences

SEMESTER V

SEC-1: TOOLS AND TECHNIQUES IN BIOCHEMISTRY

(Credits: Theory – 02)

Theory: 30 Hrs

Course Outcome:

After completion of the course the student is able to:

CO1: Understand in depth chromatography

CO2: Learn in depth electrophoresis technique

CO3: Deliberate the characteristics of centrifugation

CO4: Understand in detail with examples spectrophotometry

Unit : 1 BIOCHEMICAL REAGENTS & SOLUTIONS: Safety practices in the laboratory. Preparation and storage of solutions. Concepts of solution concentration and storing solutions. Quantitative transfer of liquids. Concept of a buffer, Henderson-Hasselbach equation, working of a pH meter.

07 Hrs

Exercise

Preparation of a buffer of given pH and molarity.

Unit : 2 Chromatography- Definition, types, Principles of Adsorption and Partition chromatography. Techniques of circular, 2D chromatography, Thin Layer Chromatography- and its advantages
Column chromatography – Principle and applications of Gel Filtration chromatography, HPLC and GLC

06 Hrs

Unit : 3 Electrophoresis: Principle and applications of electrophoresis technique- PAGE, SDS - PAGE

03 Hrs

Unit : 4 Centrifugation: Principle of differential and density gradient centrifugation. Ultra centrifuge – construction and applications

03 Hrs

Unit: 5 SPECTROPHOTOMETRIC TECHNIQUES: Principle and instrumentation of UV-visible and fluorescence spectroscopy.

05 Hrs

Exercises

Determination of the absorption maxima and molar extinction coefficient (of a relevant organic molecule). Measurement of fluorescence spectrum.

Determination of concentration of a protein solution by Lowry/BCA method.

Unit :6 Introduction and importance of virtual labs in biochemistry

06 Hrs

Reference:

1. Physical Biochemistry: Principles and Applications (2010) 2nd ed., Sheehan, D., Wiley Blackwell (West Sussex), ISBN:978-0-470-85602-4 / ISBN:978-0-470-85603-1.
2. Physical Biochemistry: Applications to Biochemistry and Molecular Biology (1982) 2nd ed., Freifelder, D., W.H. Freeman and Company, ISBN:0-7167-1315-2/ISBN:0-7167-1444-2.
3. An Introduction to Practical Biochemistry (1998) 3rd ed., Plummer D. T., Tata McGraw Hill Education Pvt. Ltd. (New Delhi), ISBN:13: 978-0-07-099487-4 / ISBN:10: 0-07-099487-0.

SEMESTER V

SEC-2: CLINICAL BIOCHEMISTRY

(Credits: Theory – 02)

Theory: 30 Hrs

Course Outcome:

After completion of the course the student is able to:

CO1: Specify the characteristics of clinical laboratory

CO2: Identify in depth blood glucose

CO3: Deliberate the detail of lipid profile

CO4: Learn in detail with examples cardiovascular diseases

- Unit : 1 INTRODUCTION:** Organization of clinical laboratory, Introduction to instrumentation and automation in clinical biochemistry laboratories safety regulations and first aid. General comments on specimen collection, types of specimen for biochemical analysis. Precision, accuracy, quality control, precautions and limitations. **04 Hrs**
- Exercises**
Collection of blood and storage.
Separation and storage of serum.
- Unit :2 EVALUATION OF BIOCHEMICAL CHANGES IN DISEASES:** **04 Hrs**
Basic hepatic, renal and cardiovascular physiology. Biochemical symptoms associated with disease and their evaluation. Diagnostic biochemical profile.
- Unit: 3 ASSESSMENT OF GLUCOSE METABOLISM IN BLOOD:** Clinical significance of variations in blood glucose. Diabetes mellitus. **04 Hrs**
- Exercises**
Estimation of blood glucose by glucose oxidase peroxidase method.
- Unit :4 LIPID PROFILE:** Composition and functions of lipoproteins. Clinical significance of elevated lipoprotein. **04 Hrs**
- Exercises**
Estimation of triglycerides.
- Unit :5 LIVER FUNCTION TESTS** **04 Hrs**
- Exercises**
Estimation of bilirubin (direct and indirect).
- Unit: 6 RENAL FUNCTION TESTS & URINE ANALYSIS:** Use of urine strip / dipstick method for urine analysis. **06 Hrs**
- Exercises**
Quantitative determination of serum creatinine and urea.
- Unit: 7 TESTS FOR CARDIOVASCULAR DISEASES:** Involvement of enzymes in diagnostics of heart disease including aspartate transaminase, isoenzymes of creatine kinase and lactate dehydrogenase and troponin. **04 Hrs**
- Exercises**
Estimation of creatine kinase MB.

Reference:

1. Medical Laboratory Technology - a Procedure Manual for Routine Diagnostic Tests Vol.I (2010), Mukherjee, K.L., Tata Mc Graw–Hill Publishing Company Limited (New Delhi). ISBN: 9780070076594 / ISBN: 9780070076631.
2. Medical Laboratory Technology - a Procedure Manual for Routine Diagnostic Tests Vol. II (2010), Mukherjee, K.L., Tata Mc Graw – Hill Publishing Company Ltd. (New Delhi), ISBN: 9780070076648.
3. Medical Biochemistry (2005) 2nd ed., Baynes, J.W. and Dominiczak, M.H., Elsevier Mosby Ltd. (Philadelphia), ISBN:0-7234-3341-0.

SEMESTER VI

DSE-1: ADVANCED CELL BIOLOGY AND ENDOCRINOLOGY

(Credits: Theory – 04, Practical – 01)

Theory: 60 Hrs

Course Outcome:

After completion of the course the student is able to:

CO1: Learn the detail of cell membrane

CO2: Understand in detail with examples cell-cell interactions

CO3: Identify in depth endocrine organs

CO4: Deliberate the detail of immunohistochemistry

- | | | |
|-----------------|---|---------------|
| Unit : 1 | PLASMA MEMBRANE & NUCLEAR TRANSPORT: Properties and Composition of Cell Membrane; Structure of Nuclear Envelope; Nuclear Pore Complex; Transport Across Nuclear Envelope; Regulation of Nuclear Protein Import and Export. | 08 Hrs |
| Unit: 2 | CELL-CELL INTERACTION: Cell-Cell Interactions and Cell-Matrix Interactions; Components of Extracellular Matrix: Collagen and Non-Collagen Components; Tight Junctions; Gap Junctions; Desmosomes; Hemidesmosomes; Focal Adhesions And Plasmodesmata; Cell Wall; Role Of Cell Interaction In Development. | 10 Hrs |
| Unit :3 | CELL CYCLE & PROGRAMMED CELL DEATH: Overview of The Cell Cycle; Eukaryotic Cell Cycle; Events Of Mitotic Phase; Cytokinesis; Events Of Meiosis And Fertilization; Regulation Of Cell Division And Cell Growth; Apoptosis And Necrosis, Stem Cells And Maintenance of Adult Tissues, Hematopoiesis, Embryonic Stem Cells and Therapeutic Cloning. | 12 Hrs |
| Unit :4 | CANCER BIOLOGY: Development and causes Of Cancer; Genetic Basis of Cancer; Oncogenes, Tumor Viruses; Molecular Approach to Cancer Treatment. | 10 Hrs |
| Unit: 5 | ADVANCED METHODS IN CELL BIOLOGY: Ultracentrifugation, Fluorescence Microscopy- FACS, Confocal Microscopy, Electron Microscopy, Plant and Animal Cell Culture, Immunohistochemistry. | 10 Hrs |
| Unit: 6 | ENDOCRINE SYSTEM: Endocrine organs, hormones- classification, Hierarchy, interplay, dynamic balance and regulation of their secretions. Functions of the hormones of Hypothalamus, Pituitary, Adrenal, Thyroid, pancreas and Gonads. Concept of receptors- Membrane and cytosolic. Mechanism of hormone action - Steroid hormone and Peptide hormone (second messengers hypothesis. Eg: cAMP, DAG, IP3). | 10 Hrs |

PRACTICALS

- 1 Isolation of organelles by sub-cellular fractionation.
- 2 Study of cell viability /death assay by use of trypan blue and MTT assay.
- 3 Study of apoptosis through analysis of DNA fragmentation patterns in mitochondria.

- 4 Identification and study of cancerous cells using permanent slides and photomicrographs.
- 5 Isolation of organelles by sub-cellular fractionation.
- 6 Cell counting methods: counting using Haemocytometer.
- 7 Calibration of ocular micrometer and Measurement of average cell size using Stage micrometer
- 8 Separation of cell organelles by differential centrifugation and assay of marker enzymes. (2 Practicals)
- 9 Study of different types of cells.
- 10 Isolation of chloroplast by differential centrifugation & its identification.
- 11 Buccal smear- barr bodies
- 12 Identification of normal & abnormal karyotype

Note: Minimum of eight experiments to be done.

Reference:

1. Cooper, G.M. and Hausman, R.E. 2009 The Cell: A Molecular Approach. 5th edition ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
2. Karp, G. 2010 Cell and Molecular Biology: Concepts and Experiments. 6 edition. JohnWiley & Sons. Inc.
3. Alberts, B., Johnson,A., Lewis, J., and Enlarge, M. 2008 Molecular Biology of the Cell.5th ed., Garland Science (Princeton).
4. Lodish, H., Berk, A., Zipursky, S.L., Matsudaira, P., Baltimore, D. and Darnell. J. 2012. Molecular Cell Biology. 7th ed., W.H. Freeman & Company (New York).

SEMESTER VI

DSE-2: PLANT BIOCHEMISTRY

(Credits: Theory – 04, Practical – 01)

Theory: 60 Hrs

Course Outcome:

After completion of the course the student is able to:

CO1: Specify the characteristics of plant cell structure

CO2: Deliberate in detail with examples photosynthesis

CO3: Understand the detail of nitrogen metabolism

CO4: Learn in detail with examples secondary metabolites

Unit : 1	INTRODUCTION TO PLANT CELL STRUCTURE: Plasma membrane, Vacuole and tonoplast membrane, cell wall, plastids and peroxisomes.	05 Hrs
Unit :2	PHOTOSYNTHESIS & CARBON ASSIMILATION: Structure of PSI and PSII complexes, Light reaction, Cyclic and non cyclic photophosphorylation, Calvin cycle and regulation; C ₄ cycle and Crassulacean acid metabolism (CAM), Photorespiration.	14 Hrs
Unit :3	NITROGEN METABOLISM: Biological Nitrogen fixation by free living and in symbiotic association, structure and function of enzyme Nitrogenase. Nitrate assimilation: Nitrate and Nitrite reductase. Primary and secondary ammonia assimilation in plants; ammonia assimilation by Glutamine synthetase-glutamine oxoglutarate amino transferase (GS-GOGAT) pathway. Seed storage proteins in legumes and cereals.	14 Hrs
Unit :4	REGULATION OF PLANT GROWTH: Introduction to plant hormones and their effect on plant growth and development, Regulation of plant morphogenetic processes by light.	07 Hrs
Unit :5	SECONDARY METABOLITES: Representatives alkaloid group and their amino acid precursors, function of alkaloids, Examples of major phenolic groups; simple phenylpropanoids, Coumarins, Benzoic acid derivatives, flavonoids, tannins and lignin, biological role of plant phenolics, Classification of terpenoids and representative examples from each class, biological functions of terpenoids.	12 Hrs
Unit :6	PLANT TISSUE CULTURE: Cell and tissue culture techniques, types of cultures: organ and explants culture, callus culture, cell suspension culture and protoplast culture. Plant regeneration pathways: organogenesis and somatic embryogenesis. Applications of cell and tissue culture and somoclonal variation.	08 Hrs

PRACTICALS

- 1 Induction of hydrolytic enzymes proteinases /amylases/lipase during germination
- 2 Extraction and assay of Urease from Jack bean
- 3 Estimation of carotene/ascorbic acid/phenols/tannins in fruits and vegetables
- 4 Separation of photosynthetic pigments by TLC
- 5 Culture of plant plants (explants).

Note: Minimum of eight experiments to be done.

Reference:

1. Plant Biochemistry (2008), Caroline Bowsher, Martin steer, Alyson Tobin, Garland science ISBN 978-0-8153-4121-5.
2. Biochemistry and molecular Biology of plant-Buchanan. (2005) 1 edition. Publisher: IK International. ISBN-10: 8188237116, ISBN-13: 978-8188237111.
3. Plant Biochemistry by P.M Dey and J.B. Harborne (Editors) (1997) Publisher: Academic Press ISBN-10:0122146743, ISBN-13:978-01221467.

Pattern of Question Paper
Semester I to VI
Paper I to V and VII (DSC and DSE)

Time : 3 Hrs

Max Marks: 70

1. Answer all the questions

5 X 1 = 5

- a -----
- b -----
- c -----
- d -----
- e -----

2. Answer any five of the following questions

5 X 3 = 15

- a -----
- b -----
- c -----
- d -----
- e -----
- f -----
- g -----

3. Answer any four of the following questions

4 X 5 = 20

- a -----
- b -----
- c -----
- d -----
- e -----
- f -----

4. Answer any three questions of the following

3 X 10 = 30

- a -----
- b -----
- c -----
- d -----
- e -----

(Note- 10 Marks may be divided in to 6+4 or 5+5)

**Pattern of Question Paper
Semester V
Paper VI (SEC)**

Time : 2 Hrs

Max Marks: 50

1. Answer all the questions

5 X 1 = 5

- a. -----
- b. -----
- c. -----
- d. -----
- e. -----

2. Answer any five of the following questions

5 X 3 = 15

- a. -----
- b. -----
- c. -----
- d. -----
- e. -----
- f. -----
- g. -----

3. Answer any four of the following questions

4 X 5 = 20

- a. -----
- b. -----
- c. -----
- d. -----
- e. -----
- f. -----

4. Answer any one question of the following

1 X 10 = 10

- a. -----
- b. -----

(Note- 10 Marks may be divided in to 6+4 or 5+5)