JYOTI NIVAS COLLEGE AUTONOMOUS BANGALORE – 560 095
DEPARTMENT OF BIOCHEMISTRY
B.Sc. V SEMESTER BIOCHEMISTRY PAPER V SYLLABUS (2021 NEP BATCH)
BIOCHEMISTRY OF MACROMOLECULES

COURSE TITLE	**BIOCHEMISTRY OF MACROMOLECULES**
COURSE CODE	**21VBC5 (T)**
COURSE CREDITS	**04**
TOTAL CONTACT HOURS	**60**
DURATION OF ESE	**2 ½ Hours**
CONTINUOUS INTERNAL ASSESSMENT (CIA)	**40 Marks**
END SEMESTER EXAMINATION (ESE)	**60 Marks**

Course Objectives: Through this course, the student is imparted with:

1. The familiarization of biomolecules for living systems
2. Detailed knowledge to understand the molecular concepts and mechanisms of life processes
3. The fundamental insights into the types of macromolecules; and the unique structural features, chemical properties, and biological importance of each.

Course Learning Outcomes: On completion of this course, the student should be able to:

1. Comprehend the role of biochemistry of macromolecules in life processes
2. Identify the structure of important biological molecules such as Carbohydrates, Proteins, Lipids and Nucleic acids.
3. Understand the functions, properties and biological roles of carbohydrates, amino acids, lipids and nucleic acids.
4. Identify the biomolecules in the laboratory by qualitative test methods.
5. Imply the knowledge on biomolecules in various industrial applications namely cosmetics, therapeutic, pharmacy, textile, biofuels, pulp and paper industries, waste water treatment, etc

CO NO.	Course outcomes statement	Knowledge level
1	Comprehend the role of biochemistry of macromolecules in life processes	K1 & K2
2	Identify the structure of important biological molecules such as Carbohydrates, Proteins, Lipids and Nucleic acids.	K2
3	Understand the functions, properties and biological roles of carbohydrates, amino acids, lipids and nucleic acids.	K1, K2 & K5
4	Identify the biomolecules in the laboratory by qualitative test methods.	K2, K3 & K4
5	Imply the knowledge on biomolecules in various industrial applications namely cosmetics, therapeutic, pharmacy, textile, biofuels, pulp and paper industries, waste water treatment, etc	K3, K4, K5 & K6

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6- Create

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	√	√					√			√
CO2	√	√					√		√	√
CO3	√	√					√		√	√
CO4	√	√	√			√	√		√	
CO5	√	√	√			√	√	√	√	

Programme Objectives aligned with Graduate attributes
PO1- Knowledge
PO2- Scientific thinking
PO3- Entrepreneurial skills
PO4- Analytical skills
PO5- Communication skills
PO6- Social commitment
PO7- Research and Inquiry
PO8- Conservation of Environment
PO9- Employability
PO10- Academic orientation

UNIT I: Carbohydrates **15 hours**

Definition, empirical formulae, classification, biological importance. **Monosaccharides**: Configuration relationship of D-aldoses, D-ketoses. General properties of aldoses and ketoses. Oxidation, reduction, reducing property, formation of glycosides, acylation, methylation, condensation – phenyl hydrazine, addition –HCN. Interconversion of aldoses and ketoses by chemical method. Ascending and descending series by chemical methods. Stereochemistry of monosaccharides, (+) and (-), D and L, epimers, anomers, and diastereoisomers. Elucidation of open chainstructure and ring structure of glucose. Conformation of glucose (only structures), mutarotation. Structure of galactose, mannose, ribose, and fructose. Structure and biological importance of deoxy sugars and sugar acids.

Disaccharides: Establishment of structures of Sucrose and Lactose, Biological Importance and structure of Isomaltose, Trehalose, and Maltose.

Polysaccharides: Partial structure, occurrence, and importance of Starch, Glycogen, Inulin, Cellulose, Chitin, and Pectin.

Glycosaminoglycans: Structure of amino sugars, neuraminic and muramic acid. Occurrence, importance, and the structure of the repeating units of heparin, hyaluronic acid, teichoic acid, dermatan sulfate, and chondroitin sulfate. Bacterial cell wall polysaccharide, peptidoglycans.

UNIT II : Lipids **15 hours**

Classification and biological function, classification of lipids (simple, compound, and derived lipids). Saturated and unsaturated fatty acids (C12 to C20), and its nomenclature.

Acylglycerols: Mono, di and triacylglycerols. Saponification, saponification value, iodine value, acid value, and significance. Rancidity, hydrolysis.

Phosphoglycerides: Structure of lecithin (phosphatidylcholine), cephalins, phosphatidyl inositol, plasmalogens, and cardiolipin. Biological role of phosphoglycerides.

Sphingolipids: Structure and importance of sphingomyelin.

Glycosphingolipids: Composition and importance of gangliosides and cerebrosides.

Prostaglandins: An overview of biological roles, and structure of primary prostaglandins: PGE1, PGE2, PGE3, PGF1α, PGF2α, PGF3α. Structure of PGI2 and PGD2. Biological roles of thromboxanes, leukotrienes, and prostaglandins.

Plasma lipoproteins -HDL, LDL, VLDL and chylomicrons: composition and functions.

UNIT III: Amino acids and Proteins **15 hours**

Amino acids: Structure and classification of amino acids based on polarity. Reactions of the amino groups with HNO_2, $LiAlH_4$. Ninhydrin, Phenyl iso thiocyante, DANSYL Chloride, Flurodinitro benzene. Reaction of carboxyl group – Hydrazine. Zwitterionic properties. pKa

values, D & L notation.

Peptides: Peptide bond, structure and biological importance of glutathione, Valinomycin. Synthetic peptides- polyglutamic acid, polylysine.

Proteins: Classification of proteins based on solubility, structure and functions with examples. Forces that stabilise the structure of proteins, Primary structure of proteins, methods of determining N- and C- terminal aminoacids, amino acid composition, sequencing by Edman's degradation method. Secondary Structure – α helix. β-sheet, β-bend. Tertiary and quaternary structures- hemoglobin, denaturation, and renaturation of proteins. Anfinsen's experiment.

UNIT IV: Nucleic acid **15 hours**

Nucleic acids: Composition of DNA and RNA. Structure of purines and pyrimidines, Nucleosides and Nucleotides. Other functions of nucleotides – the source of energy, component of coenzyme and second messengers. Chargaff's rule. Watson and Crick model of DNA. Nucleic acid chemistry- UV absorption, Chemical reactions of RNA and DNA, Melting of DNA (Tm), Effect of alkali and acid on DNA. Types of RNA (mRNA, tRNA, and rRNA), Secondary structures of tRNA – clover leaf model.

REFERENCES

Principles of Biochemistry, Donald Voet, Judith G Voet, Charlotte W. Pratt, 4th Edition, John Wiley and Sons Inc, 2012

1. Lehninger- Principles of Biochemistry; DL Nelson and MM Cox [Eds), 6th Edn. Macmillan Publications 2012
2. Biochemistry- the chemical reactions of living cells, David E Metzler, 2nd Edition, Elsevier Academic Press,
3. Fundamentals of Biochemistry, Jain, J.L, S.Chand publication 6th Edition, 2005.
4. Biochemistry, Jeremy M. Berg, John L. Tymoczko, Lubert Stryer, Freeman and company, 7th Edition, 2010.
5. Harper's Illustrated Biochemistry, Victor W Rodwell, *et.al*,31st edition, McGraw Hill Education Lange ® 2018.
6. Biochemistry , Lubert Stryer 5th edition 2015

BIOCHEMISTRY PRACTICAL PAPER 5

COURSE TITLE	**BIOCHEMISTRY OF MACROMOLECULES**
COURSE CODE	**21VBC5 (P)**
COURSE CREDITS	**02**
TOTAL CONTACT HOURS	**4 hours/week**
DURATION OF ESE	**03 hours**
CONTINUOUS INTERNAL ASSESSMENT (CIA)	**25**
END SEMESTER EXAMINATION (ESE)	**25**

EXPERIMENTS:

1. Carbohydrates:

Qualitative analysis: monosaccharides (glucose, fructose, galactose) disaccharides (lactose, maltose, sucrose) and polysaccharides (starch, glycogen), ribose, deoxy ribose- Molisch Test, Iodine Test, Benedict's Test, Barfoed's Test, Seliwanoff's test, Bial's test, DPA Test, Tollen's Test, Fehling's Test, Picric Acid Test, Osazone Test.

2. **Proteins:**

Qualitative analysis: Biuret Test, Ninhydrin Test, Precipitation reactions of proteins- Precipitation by salts (half-saturation test), precipitation by organic solvents, precipitation by acidic reagents, precipitation by heavy metal ion, precipitation by heat; colour reactions of proteins (gelatin and albumin) and any five amino acids (tryptophan, tyrosine, cysteine, methionine, arginine, proline and histidine)- Xanthoproteic test, Millon's Test, Sakaguchi Test, Hopkins- Cole Test, Lead acetate test, Sullivan and McCarthy's Test, Isatin Test, Pauly's Diazo Test.

3.Lipids Qualitative analysis: solubility, acrolein test, Salkowski test, Lieberman-Burchard test.

4.Nucleic acids: Qualitative analysis: Diphenylamine test, orcinol test.

REFERENCES:

1. Practical Biochemistry, Geetha Damodaran, Jaypee, 2011
2. Biochemical methods, S. Sadasivam, A. Manickam, 3rd Edition, New Age International Pvt Ltd, 2007
3. An Introduction to Practical Biochemistry, David Plummer, 3rd edition 2017
4. Laboratory manual in Biochemistry, J. Jayaraman 2011