



JYOTI NIVAS COLLEGE AUTONOMOUS BANGALORE – 560 095

DEPARTMENT OF BIOCHEMISTRY

B.Sc. III SEMESTER BIOCHEMISTRY PAPER III SYLLABUS (2024 SEP BATCH)

BIOCHEMISTRY OF MACROMOLECULES

COURSE TITLE	BIOCHEMISTRY OF MACROMOLECULES
COURSE CODE	24IIBC3T
COURSE CREDITS	3
TOTAL CONTACT HOURS	56 HOURS
DURATION OF ESA	3 HOURS
FORMATIVE ASSESSMENT MARKS	20 MARKS
SUMMATIVE ASSESSMENT MARKS	80 MARKS

Learning outcomes:

The course introduces students to chemical nature and biological importance of biological macromolecules. It enables the students become conversant with the basic structures and properties of macromolecules and to understand the concepts of structure–activity relationships in Biochemistry.

UNIT I CARBOHYDRATES

14 hours

Monosaccharides: Definition, classification, occurrence, structure and biological roles of monosaccharides (glucose and fructose). General properties with reference to glucose, anomers, epimers, enantiomers and mutarotation. Elucidation of open chain and ring structure of glucose, conformation of glucose (structures only). Structure of galactose, mannose, ribose and fructose.

Disaccharides: Structure, occurrence, properties and biological importance of disaccharides (sucrose, and lactose).

Polysaccharides: Storage polysaccharides (starch, glycogen) with partial structure, Structural polysaccharides (cellulose, chitin). Structure, occurrence, and biological roles of heteropolysaccharides (hyaluronic acid, heparin) and bacterial cell wall polysaccharides.

UNIT II AMINO ACIDS AND PROTEINS

15 hours

Classification of Amino acids- Definition, Structure, properties and classification based on structure, chemical nature, and polarity. Reactions of the amino groups with HNO_2 ,

Ninhydrin, Phenylisothiocyanate, Dansyl chloride. Reaction of carboxyl group– NaOH, Hydrazine.

Acid base properties of amino acids: Zwitterionic properties. pKa values, D- & L- notation. Essential and non essential amino acids.

Peptides: Peptide bond, geometry and characteristics, Ramachandran Plot. Structure and biological importance of peptides; glutathione, valinomycin, Leu-enkephalins and Endorphins. Synthetic peptides- polyglutamic acid, and polylysine.

Proteins: Definition, classification based on solubility, composition and functions. Introduction to structural organization; Primary, Secondary (alpha helix, beta pleated sheet and beta bends), tertiary (including factors stabilizing the structure) and quaternary structure eg. Hemoglobin and myoglobin. Denaturation and renaturation of proteins; Anfinsen's experiment.

UNIT III LIPIDS

14 hours

Structure, function and classification: Simple lipids, compound lipids–glycolipids, phospholipids, spingolipids and derived lipids - steroids. Fatty acids- definition, structure, classification– saturated and unsaturated fatty acids. Essential and non-essential fatty acids. Physical and Chemical properties-emulsification, saponification number, rancidity, acid value, iodine number and Reichert – Meissl number.

Phosphoglycerides: structure of lecithin (phosphatidyl choline), cephalins, phosphatidyl inositol, plasmalogens, and cardiolipin. Biological role of phosphoglycerides. Sphingolipids; Structure and importance of sphingomyelin. Glycosphingolipids; Composition and importance of gangliosides and cerebroside.

Eicosanoids: Prostaglandins - types, structure (PGE₂, PGI₂, PGD₂ and PGF₂α), biological roles. Thromboxanes, and leukotrienes.

UNIT IV NUCLEIC ACIDS

13 hours

Chemistry of nucleic acids: Bases, nucleosides and nucleotides, phosphodiester linkage. Types of Nucleic acids – DNA; Double helical structure of DNA, forms of DNA : A, B, Z, properties and functions. Denaturation and renaturation, melting of DNA (T_m).

RNA – types - mRNA, tRNA, rRNA – structure and functions, secondary structure of tRNA – clover leaf model. Isolation of DNA and RNA (from biological sources). UV absorption, hypochromic and hyperchromic effects. Effect of alkali and acid on DNA. Chemical reactions of RNA and DNA.

REFERENCES:

1. Fundamentals of Biochemistry; Jain JL, Sunjay Jain and Nitin Jain, (2020), Updated edition. S. Chand Publishers, New Delhi.
2. Vasudevan DM. Biochemistry. 9th edn. (2018), Aypee Brothers Medical Publishers, New Delhi.
3. Fundamentals of Biochemistry, Ambika Shanmugam, 8th Edn. 2016, Wolters Kluwer India Pvt Ltd
4. Lehninger Principles of Biochemistry, D. Nelson and M. Cox 8th edn, (2021) Macmillan and Co.
5. Biochemistry R. Garrett and C. Grisham 6th Edn (2016) Brooks/Cole.
6. ISE Harper's Illustrated Biochemistry V. Rodwell, D. Bender, et al 31st Edn., (2018) McGraw Hill.

- Fundamentals of Biochemistry: Life at the Molecular Level, Donald Voet, Judith G. Voet, Charlotte W. Pratt 5th Edn, (2016) Wiley.
- Biochemistry J. Berg L. Stryer et al 9th edn., (2019) W H Freeman.
- Biochemistry-the chemical reactions of living cells, David E Metzler, 2nd Edn, Elsevier Academic Press.
- Zubay's principles of Biochemistry, V. B Rastogi and K. R Aneja revised and enlarged edn (2016) Medtech.
- Textbook of Biochemistry with Clinical Correlations, Thomas Devlin, 7th Edn, (2022), Wiley.

BIOCHEMISTRY PRACTICALS SEMESTER – III

COURSE TITLE	QUALITATIVE AND QUANTITATIVE ANALYSIS OF MACROMOLECULES- PRACTICAL
COURSE CODE	24IIBC3P
COURSE CREDITS	2
TOTAL CONTACT HOURS	48 HOURS
DURATION OF ESA	3 HOURS
FORMATIVE ASSESSMENT MARKS	10 MARKS
SUMMATIVE ASSESSMENT MARKS	40 MARKS

Learning outcomes:

The course introduces students to chemical basis of identification and quantification of biological macromolecules and their component. The emphasis will be on the skills essential to understand the chemistry of macromolecules and relate the chemical principles to biological properties.

- Qualitative analysis of carbohydrates (Colour reactions of Glucose, fructose, lactose, maltose and sucrose) Molisch, Benedict's, Fehling's, picric acid, Barfoed's, Bial's, Seliwanoff's, Osazone tests.
- Qualitative analysis of amino acids: Colour reactions of amino acids; tryptophan, tyrosine, cysteine, methionine, arginine, proline and histidine.
- Qualitative analysis of proteins: Colour reactions of proteins– Biuret, xanthoproteic, Millon's. Precipitation reactions of proteins.
- Qualitative analysis of lipids– solubility, acrolein test, Salkowski test, Lieberman-Burchard test.
- Qualitative analysis of nucleic acids.
- Estimation of reducing sugar by dinitrosalicylic acid (DNS) method.
- Determination of total sugars by anthrone method.
- Estimation of glycine by formal titration method.
- Estimation of amino acid by ninhydrin method.
- Estimation of tyrosine by Millon's method.

11. Estimation of DNA by diphenylamine method.

REFERENCES

1. Biophysical Chemistry – Principles and Techniques by Upadhaya, Upadhaya and Nath, 2016 Himalaya Publishing House
2. Tools of Biochemistry by T. Cooper Wiley Publishers
3. Principles and techniques in biochemistry and molecular biology by Walker and Wilson 8th edition, Cambridge University Press
4. Biochemical Calculations by I. Segel 2nd edn (1971) Wiley Publishers
5. Analytical biochemistry, David J Holme, Hazel Peck, 3rd Edn. (1998) Prentice Hall.
6. Bioanalysis of Pharmaceuticals, Steen Honoré Hansen and Stig Pedersen-Bjergaard (2015), Wiley.
7. Biochemical Methods, S.Sadasivam and A.Mannickam, (1993) New Age International.
8. Biophysics, Pattabhi. V. and Gautham.N. (2002) Narosa Publishing House, India.
9. L. Finar: *Organic Chemistry* (Vol. I & II), E. L. B. S. (2002)

Subject Discipline Elective for Biochemistry

Course title	Introduction to Forensic Sciences
Course Code	24IIBC1TDSE
Course credits	2
Total contact hours	30 Hours
Duration of ESA	1.5 Hours
Formative assessment marks	10 Marks
Summative assessment marks	40 Marks

Learning outcomes

This elective paper will enable the students to understand the fundamental aspects of forensic science, including historical development of forensic science, the organizational structure of forensic laboratories. the various agencies involved in crime detection and investigation.

UNIT I Understanding Forensic Science: A Comprehensive Overview **6 hours**

Definition, History & Development, Scope, Ethics in Forensic Science. Role and functions of Organization of Forensic Science Laboratories of Centre and State, National Crime Records Bureau (NCRB), and National Institute of Criminal Justice and Forensic Science (NICFS). Different branches of forensic sciences.

UNIT II Documentation, Collection and Preservation of Evidence **9 hours**

The role of forensic laboratory, Collection and preservation of evidence along with control samples and standards: blood, urine, saliva, semen, tissue, hair, soil, paint, glass, bullet, cartridge case, clothing, weapons (knife, firearm), documents, drugs, fingerprints, tool marks, explosive material, bite marks; General safety considerations while handling evidence in the crime scene.

UNIT III Forensic drug analysis and toxicology

15 hours

Introduction, Overdose of drugs. Classification of drugs based on their mode of action. Lethal dose 50 and effective dose 50. Classification of poisons. Physico-chemical characteristics and mode of action of poisons Commonly used drugs (analgesics, cannabis, antihistamines, antidepressants, benzodiazepines and non-benzodiazepine ("Z" drugs), stimulants, alcohol) Poisons: Arsenic, Strychnine, Oleander, Cyanide, Carbon monoxide, Snake venom.

REFERENCES

1. Brenner, J. C. (2004). Forensic Science: an Illustrated Dictionary. CRC Press.
2. Eckert, W. G. (1997). Introduction to Forensic Sciences (2nd Edition). CRC Press.
3. James, S. H., Nordby, J. J., Bell, S. (2014). Forensic Science: An Introduction to Scientific and Investigative Techniques (4th Edition). CRC Press.
4. S Nath, R. C. (2013). Forensic Science and Crime Investigation: Abhijeet Publications.
5. Saferstein, R. (2017). Criminalistics: An Introduction to Forensic Science. Pearson.
6. Sharma, B. R. (2019). Forensic Science in Criminal Investigation & Trails. Universal Law Publishing Company.
7. Yount, L. (2006). Forensic Science: From Fibers to Fingerprints (Milestones in Discovery and Invention). Chelsea House publications