JYOTI NIVAS COLLEGE AUTONOMOUS BANGALORE – 560 095

DEPARTMENT OF BIOTECHNOLOGY

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

BIOMOLECULES AND BIOANALYTICAL TECHNIQUES

COURSE TITLE	**BIOMOLECULES AND BIOANALYTICAL TECHNIQUES**
COURSE CODE	**24IIIBT3T**
COURSE CREDITS	**3**
TOTAL CONTACT HOURS	**56 HOURS**
DURATION OF ESA	**3 HOURS**
FORMATIVE ASSESSMENT MARKS	**20 MARKS**
SUMMATIVE ASSESSMENT MARKS	**80 MARKS**

COURSE OBJECTIVES

By the end of the course, students should be able to:

- Demonstrate proficiently the various types of Biomolecules correlated with their metabolism.
- Compare and contrast about various tools and techniques used for the isolation and assessment of various Biomolecules
- Summarize acorrelative aspect about enzymes, metabolism of various disorders.
- Illustrate a contemporary approach towards techniques used in bio-analytical techniques.

COURSE LEARNING OUTCOMES

On completion of this course, the students will be able to:

- Explore on the different types of Biomolecules and its importance in cellular composition.
- Comprehend the importance of foundation knowledge on biomolecules along with bio analytical tools for their analysis.
- Assess the importance of various metabolic pathways along with metabolic and life style disorders.

- Critically analyze and perform range of laboratory exercises, demonstrating the development of practical scientific skills.

Title: BIOMOLECULES AND BIOANALYTICAL TECHNIQUES	**60 HRS**
UNIT 1 - CARBOHYDRATES, AND LIPIDS	**15 HRS**
Introduction to chemical bonding, water and its properties. **a. Carbohydrates:** Introduction, sources, classification, structure, functions and properties of carbohydrates: Monosaccharides – isomerism and ring structure, Sugar derivatives – amino sugars and ascorbic acid. Oligosaccharides – Sucrose. Polysaccharides – Classification as homo- and heteropolysaccharides. Homopolysaccharides – storage polysaccharides (starch and glycogen – structure, reaction, properties), structural polysaccharides (cellulose and chitin – structure and properties), Heteropolysaccharides – glycoproteins and proteoglycans (Brief study) **b.Metabolism of carbohydrates** – glycolysis and gluconeogenesis, Kreb's cycle, oxidative phosphorylation. Pentose Phosphate (PP) pathway. **c. Lipids:**introduction, biological functions, Classification and function of lipids, Saturated and unsaturated fatty acids. Properties of lipids (saponification value, acid value, iodine number, rancidity), hydrogenation of fats and oils. General structure and biological functions of phospholipids, sphingolipids, glycolipids, lipoproteins, prostaglandins, cholesterol, ergosterol. **d. Metabolism of lipids**: Beta oxidation of fatty acids, Biosynthesis of cholesterol. Steroids and glycoconjugates as therapeutic agents.	
UNIT 2 - AMINO ACIDS, PROTEINS AND ENZYMES	**15 HRS**
a. Amino acids: Introduction, classification and structure of amino acids**.** Properties of amino acids (isomerism, zwitter ion concept, isoelectric point and pK values), Essential and non-essential amino acids, b. **Peptide and proteins:** Peptide bond formation, naturally occurring peptides. Classification of proteins (based on function and structure). Factors stabilizing protein structure protein structural organization, (primary, secondary and quaternary structure), denaturation and renaturation of proteins, Molecular chaperons and protein misfolding.Structural-functional aspects of proteins (Example: carboxypeptidase). **c. General aspects of amino acid metabolism** – Transamination, deamination, decarboxylation and urea cycle. **d. Enzymes:** Introduction, nomenclature and classification, enzyme kinetics, factors influencing enzyme activity, metalloenzymes, activation energy and transition state, enzyme activity, specific activity. Coenzymes and their functions (one reactions involving FAD, FMN, NAD). Enzyme inhibition – irreversible and reversible (competitive, uncompetitive, non – competitive inhibition with an example each). Zymogens (trypsinogen, chymotrypsinogen and pepsinogen). Isozymes (LDH, Creatine	

kinase, alkaline phosphatase and their clinical importance).	
UNIT 3- VITAMINS, NUCLEIC ACID AND HORMONES	**15 HRS**
a. Vitamins and hormones: Water- and fat-soluble vitamins, dietary sources and biological role of vitamins, deficiency manifestation of vitamin A, B, C, D, E and K. **b. Nucleic acids:** Structure of purines and pyrimidines,nucleosides and nucleotides in DNA, Types of nucleic acids: DNA (A, B, and Z) and RNA (mRNA, tRNA and rRNA), Oligonucleotides and its applications. De novo and salvage pathway of purine and pyramidine synthesis. **c. Hormones:** Classification of hormones based on chemical nature and mechanisms of action, chemical structure and functions of the following hormones: Glucagon, Cortisone, Epinephrine, Testosterone and Estradiol. **d. Metabolic disorders:** Body Mass index (BMI) and its importances.Basal metabolic Rate, Resting energy expenditure.Classification of metabolic disorder based on biomolecules -*Diabetes mellitus, phenylketonuria*, Lifestyle, stress and metabolic disorders (PCOD, Obesity, fatty liver associated problem).	
UNIT4 - BIOANALYTICAL TECHNIQUES	**15 HRS**
a. Chromatography: Principle, procedure and applications of adsorption chromatography, ion exchange chromatography, gel filtration chromatography, Gas liquid chromatography, high performance liquid chromatography (HPLC). **b. Electrophoresis:**Definition, Principle, Procedure and applications of Electrophoresis, Isolectric focusing (IEF), **c. Centrifugation:** introduction, centrifugal force, Svedberg unit, types of rotors and centrifuge. Concept of differential and density gradient centrifugation. Overview about analytical centrifugation. **d.Spectroscopy:** Electromagnetic radiation, Jablonski diagram. Absorption and emission spectra, Fluorescence and phosphorescence, Stoke's shift, hypo and hyperchromicity, Beer- Lambert's law. Principles, instrumentation and applications of UV visible spectrophotometry.	

REFERENCES:

1. Lehinger's principles of Biochemistry, Nelson and Cox. 7th edition, W. H. Freeman Publishers. (2017).
2. Biomolecules – Mohan P. Arora. Himalaya Publishing House, (2016).
3. Molecular Biology of Cell – Bruce Alberts *et.al.*, **Publisher:** Garland Publications, 7th Edition (2019).
4. Principles of Biochemistry and Biophysics by Dr. B.S. Chauhan University Science Press, New Delhi, (2008).

5. Biophysics: Tools and Techniques by Mark C. Leake, CRC Press, (2016).
6. Principles of Medical Biochemistry by Gerhard Meisenberg, William H. Simmons, 4th edition, Elsevier publishers. (2016).
7. Text-book of Biochemistry with clinical correlations by Thomas M. Devlin, 7th Edition, J. Wiley and Sons. (2015).
8. Fundamentals of Enzymology: The Cell and Molecular Biology of Catalytic Proteins, Nicholas C. Prince, Lewis Stevens, 3rd Edition, Oxford University Press. (2005).
9. Biophysics: Searching for Principles by William Bialek, Princeton University Press, (2012).

Blue print or Grid for the question paper

UNIT	2 MARKS	5 MARKS	10 MARKS	TOTAL
UNIT 1 - CARBOHYDRATES, AND LIPIDS	3	2	3	60
UNIT 2 - AMINO ACIDS, PROTEINS AND ENZYMES	2	2		
UNIT 3 - VITAMINS, NUCLEIC ACID AND HORMONES	2	2	1	24
UNIT4 - BIOANALYTICAL TECHNIQUES	3	2	1	26
	20	40	50	110

BIOTECHNOLOGY PRACTICAL PAPER - 3

COURSE TITLE	**BIOMOLECULES AND BIOANALYTICAL TECHNIQUES**
COURSE CODE	**24IIIBT3P**
COURSE CREDITS	**2**
TOTAL CONTACT HOURS	**45 HOURS**
DURATION OF ESA	**3 HOURS**
FORMATIVE ASSESSMENT MARKS	**10 MARKS**
SUMMATIVE ASSESSMENT MARKS	**40 MARKS**

Calibration of Glasswares and colorimeter.	1 unit
Preparation of solutions and buffer.	2 units
Qualitative analysis of carbohydrates and amino acids.	2 units
Quantitative estimation of Glucose by DNS method	1 unit
Quantitative estimation of Fructose by Roe's (Resorcinol) method.	1 unit
Estimation of glycine by formal titrimetric method.	1 unit
Quantitative estimation of protein by Lowry's method.	1 unit
Extraction of amylase and amylase assay	1 unit
Study on effect of time and temperature on amylase enzyme activity.	2 units
Paper chromatography and TLC	2 units

PAPER 3 BIOMOLECULES AND BIOANALYTICAL TECHNIQUES

SCHEME FOR PRACTICAL EXAMINATION

Examination duration: 3 hours **Max. Marks: 40**

1. **Preparation of solutions or buffer (calculation only)** **4 Marks**

   (Calculation 4 Marks)

2. **Qualitative analysis of carbohydrates (sample A)** **10 Marks**

   (Procedure 4 Marks; Performance 4Marks; Result 2 Marks)

3. **Estimation of Glucose or Fructose or protein (Sample B) 12 Marks**

   *(Principle 3 Marks; Procedure 3 Marks; calculation and graph 4 Marks; result 2 Marks***).**

   Or

   Estimation of amino acids by formal titrimetric method (Sample B)

   *(Principle 3 Marks; performance – 3 Marks; calculation 4 Marks; result 2 Marks***).**

4. **Identify and comment on the spotters C, D and E 9 Marks**

   (Identification 1 Mark; comment 2Marks for each spotters)

5. **Viva 5 Marks**