

<b>Programme</b>	BS Biotechnology	<b>Course Code</b>	<b>BT. 305</b>	<b>Credit Hours</b>	2 + 1
<b>Course Title</b>	Biochemistry II				
<b>Course Introduction</b>					
<p>This course provides an in-depth exploration of the chemical nature and structure of proteins and nucleic acids. Students will learn about amino acid properties, protein structures, and the techniques used for protein separation, purification, and characterization. The course also covers the structure and functions of nucleic acids, including DNA and RNA, and their role in cellular organization. Additionally, it delves into the principles of metabolic integration, enzyme functions, kinetics, and the factors influencing enzyme activity, offering a comprehensive understanding of these critical biomolecules and their roles in biochemical processes.</p>					
<b>Learning Outcomes</b>					
<p>On the completion of the course, the students will:</p> <ul style="list-style-type: none"> <li>• Understand the chemical nature of nucleic acids and proteins.</li> <li>• Explain the biochemical principles of metabolic integration and regulation.</li> <li>• Understand enzymes, enzyme activity and kinetics and their role in biochemical and metabolic reactions.</li> </ul>					
<b>Course Content</b>					
<b>Theory Unit</b>					
<ul style="list-style-type: none"> <li>• Introduction to amino acids, amino acids share common structural features, amino acids with L-stereoisomers</li> <li>• Classification of amino acids based on R groups, important functions of uncommon amino acids.</li> <li>• Amphoteric behavior of amino acids, Titration curves of amino acids, Prediction of electric charge from titration curves of amino acids</li> <li>• Introduction to peptides, Chemical Nature of Peptides and Proteins, Differentiation of peptides based on ionization behavior, Biologically active peptides and polypeptides</li> <li>• Characteristic composition of polypeptides, Chemical groups of proteins other than amino acids</li> <li>• Levels of Protein Structure: Primary, secondary, tertiary and quaternary</li> <li>• Techniques used for separation, purification and characterization of proteins</li> <li>• Covalent Structure of Proteins: Determination of amino acids sequence</li> <li>• Protein Functions: Oxygen binding proteins, Immune system and immunoglobulins and proteins as molecular motors</li> <li>• Chemical Nature of Nucleic Acids: Introduction to nucleic acids, Components and structure of nucleic acids, Difference between purines and pyrimidines, Tautomeric forms of purines and pyrimidines, Minor bases found in nucleic acids, Nucleoside mono-, di- and tri-phosphates</li> <li>• Chargaff rule of DNA composition, Salient features of DNA double helix, Confirmations of DNA double helix</li> <li>• Types of DNA structure: Bent, kinked, triple standard and four stranded DNA. Size of DNA molecules, DNA denaturation, Organization of DNA in cell.</li> <li>• Structure and types of RNA. Functions of nucleic acids.</li> </ul>					

- Biosynthesis of essential amino acids and non-essential amino acids, Regulation of amino acids biosynthesis
- Metabolism of Nucleic acids: Chemical nature and Synthesis of purines and pyrimidines
- Enzymes: Introduction, How enzymes work? Classification of enzymes, enzymes specificity, role of binding energy in reaction specificity and catalysis, types of catalysis.
- Enzyme kinetics as an approach to understanding mechanism: Substrate conc. and rate of reaction, quantitative presentation of relation between substrate conc. and reaction rate, Michaelis-Menten kinetics, pre-steady state kinetics.
- Enzyme inhibition, Factors affecting enzyme activity. Role of enzymes in biochemical and metabolic reactions.

#### **Practical Unit**

- Biochemical tests for protein identification
- Quantification of proteins using standard graph
- Quantification of proteins using UV method
- Extraction of glycogen from liver
- Acid and enzymatic hydrolysis of glycogen
- Effect of pH and substrate concentration on the properties of enzymes
- Effect of temperature on the properties of enzymes
- Extraction of DNA from blood sample by organic method
- Extraction of RNA from blood sample
- Estimation of DNA and RNA by different methods
- Extraction of proteins from bacterial cells.
- Trypsinization of protein sample extracted from bacterial cells
- Extraction of polar and non-polar metabolites from bacterial pellet
- Identification of protein samples using LC-MS analysis
- Use of Mascot software for identification of peptides from LC-MS spectra
- Identification of metabolites from GC-MS spectra

#### **Textbooks and Reading Material**

- Nelson, D.L. and Cox, M.M. (2017). *Lehninger Principles of Biochemistry. 7th Edition.* W.H. Freeman, New York, 1328.
- Voet, D.J. Voet, G.J. and Pratt, C.W. (2014). *Fundamentals of Biochemistry. 5th Edition.* J Wiley & Sons Inc. ISBN: 9781118918401
- Berg, J.M. Tymoczko, J.L. and Stryer, L. (2007). *Biochemistry. 6th Edition.* WH Freeman & Co.
- Richard, A. H. Denise, R.F. (2014). *Biochemistry. Lippincott's Illustrated Reviews Series. 6th Edition.* Williams and Wilkins.
- Kennelly, P. J., & Rodwell, V. W. (2015). *Enzymes: Regulation of activities. Harper's Illustrated Biochemistry 30th Edition.* United States: McGraw Hill, 87-96.

#### **Teaching Learning Strategies**

- Lecturing
- Written Assignments
- Class activities and discussion
- Quizzes

<b>Assignments: Types and Number with Calendar</b>			
<ul style="list-style-type: none"> <li>• 1<sup>st</sup> Quiz in 4<sup>th</sup> Week of 5 marks</li> <li>• 2<sup>nd</sup> Quiz in 10<sup>th</sup> Week of 5 marks</li> <li>• 3<sup>rd</sup> Quiz in 14<sup>th</sup> Week of 5 marks</li> <li>• 1<sup>st</sup> Assignment in 8<sup>th</sup> Week of 10 marks</li> </ul>			
<b>Assessment</b>			
<b>Sr. No.</b>	<b>Elements</b>	<b>Weightage</b>	<b>Details</b>
<b>1</b>	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
<b>2</b>	Formative Assessment	25%	Continuous assessment includes: Classroom participation, assignments, presentations, viva voce, attitude and behavior, hands-on-activities, short tests, projects, practical, reflections, readings, quizzes etc.
<b>3</b>	Final Assessment	40%	Written Examination at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.