



**TECHNO INDIA UNIVERSITY**  
WESTBENGAL

**Syllabus for 3-year B.Sc (Honours)in Microbiology**  
**2018**

**Choice Based Credit System (CBCS)**

**Department of Microbiology**

**Techno India University, West Bengal**  
**EM-4, EM Block, Sector V, Bidhannagar,**  
**Kolkata, West Bengal 700091**



**B.Sc Microbiology (CBCS)**  
**Course Curriculum for All Semester**

Semester II

Sl. No.	Course Code	Course Title	Contact Hrs. / Week			Credit	Page No.
			L	T	P		
<b>Theory</b>							
1	TIU-HMB-T102	Biochemistry	03	01	00	04	
2	TIU-HMB-T104	Cell Biology	03	01	00	04	
3	TIU-UCH-T102	Chemistry	03	01	00	04	
4	TIU-AEC-T205	Environmental Science	02	00	00	02	
<b>Practical</b>							
1	TIU-HMB-T102	Biochemistry	00	00	02	02	
2	TIU-HMB-L104	Cell Biology	00	00	02	02	
3	TIU-UCH-L102	Chemistry	00	00	02	02	
<b>Total Credit</b>						20	



## CORE COURSES

### SEMESTER –2

#### TIU-HMB-T102: BIOCHEMISTRY (THEORY)

**TOTAL HOURS: 60 CREDITS: 4**

Course Outcome:

After successful completion, this course enables students:

- Be able to understand structure and function of monosaccharide, disaccharide and polysaccharide.
- Be able to know about structure, properties and functions of essential fatty acids, Triacylglycerols, lipid.
- Be able to understand about functions of proteins, Level of organization of proteins, primary, secondary (alpha helix and beta pleated sheet), tertiary and quaternary Forces holding the polypeptide together.
- Be able to understand the Enzyme kinetics, significance of hyperbolic, double reciprocal plots of enzyme activity and  $K_m$ .
- Be able to know about Classification, function and sources of Vitamins.

Contents:

Unit 1 Bioenergetics No. of Hours: 8 First and second laws of Thermodynamics. Definitions of Gibb's Free Energy, enthalpy, and Entropy and mathematical relationship among them, Standard free energy change and equilibrium constant Coupled reactions and additive nature of standard free energy change, Energy rich compounds: Phosphoenolpyruvate, 1,3-Bisphosphoglycerate, Thioesters, ATP

Unit 2 Carbohydrates No. of Hours: 12 Families of monosaccharides: aldoses and ketoses, trioses, tetroses, pentoses, and hexoses. Stereo isomerism of monosaccharides, epimers, Mutarotation and anomers of glucose. Furanose and pyranose forms of glucose and fructose, Haworth projection formulae for glucose; chair and boat forms of glucose, Sugar derivatives, glucosamine, galactosamine, muramic acid, N- acetyl neuraminic acid, Disaccharides; concept of reducing and non-reducing sugars, occurrence and Haworth projections of maltose, lactose, and sucrose, Polysaccharides, storage polysaccharides, starch and glycogen. Structural Polysaccharides, cellulose, peptidoglycan and chitin

Unit 3 Lipids No. of Hours: 12 Definition and major classes of storage and structural lipids. Storage lipids. Fatty acids structure and functions. Essential fatty acids. Triacylglycerols structure, functions and properties. Saponification Structural lipids. Phosphoglycerides:



Building blocks, General structure, functions and properties. Structure of phosphatidylethanolamine and phosphatidylcholine, Sphingolipids: building blocks, structure of sphingosine, ceramide. Special mention of sphingomyelins, cerebroside and gangliosides  
Lipid functions: cell signals, cofactors, prostaglandins, Introduction of lipid micelles, monolayers, bilayers

Unit 4 Proteins No. of Hours: 12 Functions of proteins, Primary structures of proteins: Amino acids, the building blocks of proteins. General formula of amino acid and concept of zwitterion. Titration curve of amino acid and its Significance, Classification, biochemical structure and notation of standard protein amino acids Ninhydrin reaction. Natural modifications of amino acids in proteins hydrolysis, cystine and hydroxyproline, Non protein amino acids: Gramicidin, beta-alanine, D-alanine and D- glutamic acid Oligopeptides: Structure and functions of naturally occurring glutathione and insulin and synthetic aspartame, Secondary structure of proteins: Peptide unit and its salient features. The alpha helix, the beta pleated sheet and their occurrence in proteins, Tertiary and quaternary structures of proteins. Forces holding the polypeptide together. Human haemoglobin structure, Quaternary structures of proteins

Unit 5. Enzymes: Structure of enzyme: Apoenzyme and cofactors, prosthetic group-TPP, coenzyme NAD, metal cofactors, Classification of enzymes, Mechanism of action of enzymes: active site, transition state complex and activation energy. Lock and key hypothesis, and Induced Fit hypothesis. Significance of hyperbolic, double reciprocal plots of enzyme activity,  $K_m$ , and allosteric mechanism Definitions of terms – enzyme unit, specific activity and turnover number, Multienzyme complex : pyruvate dehydrogenase; isozyme: lactate dehydrogenase, Effect of pH and temperature on enzyme activity. Enzyme inhibition: competitive-sulfa drugs; non-competitive-heavy metal salts

Unit 6. Vitamins No. of Hours: 4

Classification and characteristics with suitable examples, sources and importance

### **TIU-HMB-L102: BIOCHEMISTRY (PRACTICAL)**

**TOTAL HOURS: 60 CREDITS: 2**

1. Properties of water, Concept of pH and buffers, preparation of buffers and Numerical problems to explain the concepts
2. Numerical problems on calculations of Standard Free Energy Change and Equilibrium constant
3. Standard Free Energy Change of coupled reactions
4. Qualitative/Quantitative tests for carbohydrates, reducing sugars, non reducing sugars
5. Qualitative/Quantitative tests for lipids and proteins



6. Study of protein secondary and tertiary structures with the help of models
7. Study of enzyme kinetics – calculation of  $V_{max}$ ,  $K_m$ ,  $K_{cat}$  values
8. Study effect of temperature, pH and Heavy metals on enzyme activity
9. Estimation of any one vitamin

#### SUGGESTED READING

1. Campbell, MK (2012) Biochemistry, 7th ed., Published by Cengage Learning
2. Campbell, PN and Smith AD (2011) Biochemistry Illustrated, 4th ed., Published by Churchill Livingstone
3. Tymoczko JL, Berg JM and Stryer L (2012) Biochemistry: A short course, 2nd ed., W.H.Freeman
4. Berg JM, Tymoczko JL and Stryer L (2011) Biochemistry, W.H.Freeman and Company
5. Nelson DL and Cox MM (2008) Lehninger Principles of Biochemistry, 5th Edition., W.H. Freeman and Company,
6. Willey MJ, Sherwood, LM & Woolverton C J (2013) Prescott, Harley and Klein's Microbiology by. 9th Ed., McGrawHill
7. Voet, D. and Voet J.G (2004) Biochemistry 3rd edition, John Wiley and Sons,

#### **TIU-HMB-T104: CELL BIOLOGY (THEORY)**

**TOTAL HOURS: 60 CREDITS: 4**

Course Outcome:

After successful completion, this course enables students:

- To understand various aspects of structure and organization of cell.
- To know various concepts related to protein glycosylation, protein sorting and export.
- To know about regulation of gene expression in prokaryotes and Eukaryotes.

Contents:

Unit 1 Structure and organization of Cell      No. of Hours: 12

Cell Organization – Eukaryotic (Plant and animal cells) and prokaryotic Plasma membrane:  
Structure and transport of small molecules

Cell Wall: Eukaryotic cell wall, Extra cellular matrix and cell matrix interactions, Cell-Cell Interactions -adhesion junctions, tight junctions, gap junctions, and plasmodesmata (only structural aspects) Mitochondria, chloroplasts and peroxisomes



Cytoskeleton: Structure and organization of actin filaments, association of actin filaments with plasma membrane, cell surface protrusions, intermediate filaments, microtubules

Unit 2 Nucleus No. of Hours: 4 Nuclear envelope, nuclear pore complex and nuclear lamina Chromatin – Molecular organization Nucleolus

Unit 3 Protein Sorting and Transport No. of Hours: 12

Ribosomes, Endoplasmic Reticulum – Structure, targeting and insertion of proteins in the ER, protein folding, processing and quality control in ER, smooth ER and lipid synthesis, export of proteins and lipids Golgi Apparatus – Organization, protein glycosylation, protein sorting and export from Golgi Apparatus Lysosomes

Unit 4 Cell Signalling No. of Hours: 8

Signalling molecules and their receptors Function of cell surface receptors

Pathways of intra-cellular receptors – Cyclic AMP pathway, cyclic GMP and MAP kinase pathway

Unit 5 Cell Cell Death and Cell Renewal Cycle No. of Hours: 12

Eukaryotic cell cycle and its regulation, Mitosis and Meiosis Development of cancer, causes and types

Programmed cell death Stem cells

Embryonic stem cell, induced pluripotent stem cells

### **TIU-HMB-L104: CELL BIOLOGY (PRACTICAL)**

#### **TOTAL HOURS: 60 CREDITS: 2**

1. Study a representative plant and animal cell by microscopy.
2. Study of the structure of cell organelles through electron micrographs 3. Cytochemical staining of DNA – Feulgen
4. Demonstration of the presence of mitochondria in striated muscle cells/ cheek epithelial cell using vital stain Janus Green B
5. Study of polyploidy in Onion root tip by colchicine treatment. 6. Identification and study of cancer cells by photomicrographs. 7. Study of different stages of Mitosis.
8. Study of different stages of Meiosis.

#### **SUGGESTED READING**

1. Hardin J, Bertoni G and Kleinsmith LJ. (2010). Becker's World of the Cell. 8th edition. Pearson.
2. Karp G. (2010) Cell and Molecular Biology: Concepts and Experiments. 6th edition. John Wiley & Sons. Inc.



3. De Robertis, EDP and De Robertis EMF.(2006). Cell and Molecular Biology.8th edition.Lipincott Williams and Wilkins, Philadelphia.
4. Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. 5th Edition.ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.