

Name of Faculty: Science	Department: Biotechnology
Program: B.Sc. Biotechnology	Type: Theory + Practical
Subject: DSC-1 Introduction to Biotechnology	Semester: 1
Credit: 04 + 02	Total learning hours: 60
Course description: The objectives of this course are to provide students with the theory and practical experience of the use of basic Biotechnological concepts which make them aware about principle and application for human beings.	
Student Learning Outcome:	
<ul style="list-style-type: none"> ● Obtained ideas on various branches of Biotechnology. ● To acquaint students with various fields of Biotechnology and their applications. ● To uncover the fundamental principles, developments and potential applications of Biotechnology ● Able to understand the status of Biotechnology at State and National level viz. DBT, BTIS, ABLE, BIRAC etc. 	

Unit-1 Basic Biotechnology: (5h)

- 1.1 History & Introduction to Biotechnology
- 1.2 Traditional and Modern Biotechnology
- 1.3 Definition of Biotechnology, Traditional and New
- 1.4 The World of Biotechnology- Red, Green, White and Blue Biotechnology

Unit-2 Biotechnology and Understanding: (5h)

- 2.1 Biotechnology-an Interdisciplinary Pursuit
- 2.2 Biotechnology- a three-component central core
- 2.3 Public perception of Biotechnology
- 2.4 Biotechnology and developing world

Unit-3 Scope of Biotechnology-I:(10h)

- 3.1 Recombinant DNA and Genetic Engineering
- 3.2 Vaccines
- 3.3 Monoclonal Antibodies
- 3.4 Diagnostics in Developing Countries

UNIT-4 Scope of Biotechnology-II :(10h)

- 4.1 Fermentation
- 4.2 Bio-fertilizer
- 4.3 Bio-pesticides
- 4.4 Bio-fuels

Unit-5 Scope of Biotechnology-III: (10h)

- 5.1 Bio-catalysis
- 5.2 Mammalian Cell Culture
- 5.3 Plants and Plant Cell Culture
- 5.4 WasteWater and Sewage Treatment

Unit-6 Scope of Biotechnology-IV: (10h)

6.1 Agriculture Products- BT Cotton, Golden Rice

6.2 Food Products- Cheese, Wine

6.3 Industrial Products- Antibiotics, Citric Acid

6.4 Pharma Products- Insulin, Interferon

Unit-7 Biotechnology in India:(5h)

7.1 Biotechnology Research in India.

7.2 Biotechnology Institutions in India (Autonomous, Public and Private Sector)

7.3 Biotech Success Stories- Biocon, Sea6 Energy, Bharat Biotech

7.4 Biotech Policy Initiatives

Unit-8 Biotechnology and India:(5h)

8.1 Introduction to DBT and Other State Agencies

8.2 BTIS-NET

8.3 ABLE & BIRAC

8.4 Biotechnology- Current status of industrial growth in India

References and Textbooks:

- John Smith., (2009). Biotechnology, Cambridge Press. ISBN 9780521711937
- Ratledge, C., & Kristiansen, B., (2006). *Basic Biotechnology*, Cambridge University Press. ISBN 9780521549585
- R.C. Dubey (2014) Advanced Biotechnology S.Chand ISBN 81-219-4290-X
- Sobti and Pachauri (2009) Essential of Biotechnology, Ane Books Pvt. Ltd. ISBN-81-8052-160-5

Practicals:

1. Introduction to LAB and lab environment.
2. Introduction of Common Instruments: Autoclave, Incubator, pH Meter, Hot Air Oven, Weigh Balance, Water Bath, Refrigerator, Spectrophotometer and/or Colorimeter, Microscope, Shaker, Stirrer, Centrifuge, Hemocytometer, Vortex. Laminar air flow
3. Biosafety, Biohazards and Biosafety Management
4. Good Laboratory Practice
5. Field Visit- Local Biotechnology Unit

Reference:

- Verma, Das and Singh (2014) Laboratory Manual For Biotechnology, S.Chand ISBN-978-93-83746-22-4

Name of faculty: Science	Department: Biotechnology
Program: B.Sc. Biotechnology	Type: Theory + Practical
Subject: DSC-2: Cell Structure and Anatomy	Semester: 1
Credit: 04 + 02	Total learning hours: 60 Hours
Course description: <p>The aim of this course is to deliver the basic knowledge about the cells, their types based on diversity of organisms and cellular components. This course deals with fundamental concepts about cells and cellular organization as well as the cellular division and death: the base of the life of cells.</p>	
Student learning outcome: <p>On completion of course students will be able to:</p> <ul style="list-style-type: none"> ● Explain structure of cells and cellular organelles ● Understand the importance of organization of components inside the cell ● Know the processes of cell division and regulation: their significance. 	

Unit-1 Introduction to Cell Biology: (8 h)

- 1.1. Origin and Evolution of Cells (First Cell, Evolution of Metabolism, Origin of Eukaryotes- Endosymbiont Theory, Development of Multicellular Organisms)
- 1.2. Cell Diversity (Prokaryotic Cell v/s Eukaryotic Cells, Viruses)
- 1.3. Discovery of Cells (Cell Theory)
- 1.4. Basic Properties of Cells

Unit-2 Structure and Function of Cell Components-I: (8 h)

- 2.1 Cell Wall: Bacterial (Gram-Positive and Gram-Negative Cell Wall) and Eukaryotic Cell Wall
- 2.2 Plasma Membrane: Structure (Membrane Lipids: Membrane Fluidity, Membrane Carbohydrates, Membrane Proteins and Mobility of Proteins, Glycocalyx)
- 2.3 Nucleus (Nuclear Envelope, Nuclear Pore Complex, Sub-compartments within Nucleus)
- 2.4 Mitochondria (Mitochondrial Membranes, Mitochondrial Matrix)

Unit-3 Structure and Function of Cell Components-II: (8 h)

- 3.1 Chloroplast and other Plastids (Chloroplast Structure and Function, Plant Cell Vacuoles)
- 3.2 Endoplasmic Reticulum (Smooth ER, Functions of Rough ER)
- 3.3 Golgi Complex/Apparatus (Organization of Golgi)
- 3.4 Lysosomes: (Lysosomal Enzymes, Endocytosis and Lysosome Formation)
- 3.5 Peroxisomes (Peroxisome Assembly, Functions of Peroxisomes)
- 3.6 Bacterial Endospore (Introduction and Types)

Unit-4 Structure and Function of Cell Components-III: (10 h)

- 4.1 Cytoskeleton : (Major Functions of Cytoskeleton, Bacterial Cytoskeleton)
- 4.2 Microtubules-(Structure and Composition, Motor Proteins : Kinesin and Dynein, Dynamic Properties of Microtubule)

- 4.3 Intermediate Filaments- (Types and Functions)
- 4.4 Microfilaments (Actin and Myosin)- Structure of Actin Filaments, Myosin: Molecular Motor in Actin Filaments)
- 4.5 Structure Of Cilia And Flagella (Ultrastructure Flagella- Prokaryotic and Eukaryotic)
- 4.6 Centrosomes

Unit-5 Extracellular Matrix and Cell Interactions: (5 h)

- 5.1 ECM: (Matrix Structural Proteins, Polysaccharides, Adhesion Proteins)
- 5.2 Cell-matrix Interactions
- 5.3 Cell-cell Interactions (Adhesion Junctions, Tight Junctions, Gap Junctions, Plasmodesmata)

Unit-6 Cellular Processes: (10 h)

- 6.1 Transport of Small Molecules (Passive Diffusion, Facilitated Diffusion and Carrier Proteins, Ion Channels, Active Transport- Driven by ATP Hydrolysis and Driven by Ion Gradients)
- 6.2 Vesicular Transport (Transport from ER to Golgi Apparatus, Movement of Materials through Golgi Complex)
- 6.3 Role Of Nuclear Pore Complex In Nucleocytoplasmic Trafficking

Unit-7 Cell Cycle And Regulation: (5 h)

- 7.1. Cell Cycle and Phases of Cell Cycle
- 7.2. Regulation Of Cell Cycle
- 7.3. Control Of Cell Cycle

Unit-8 Cell Division: (6 h)

- 8.1. Overview Of Mitosis
- 8.2. Overview Of Meiosis
- 8.3. Stages Of Meiosis
- 8.4. Genetic Recombination During Meiosis

References:

- Karp, G. (2016). *Cell and molecular biology: concepts and experiments*. John Wiley & Sons, ISBN-978-1-118-88614-4
- Cooper, G. M., & Hausman, R. E. (2004). *The cell: a molecular approach*. ISBN-0878932143
- Verma, P. S., & Agarwal, V. K. (2004). *Cell Biology, Genetics, Molecular Biology, Evolution and Ecology: Evolution and Ecology*. S. Chand Publishing. ISBN-978-8121924429
- John P. Harley, Donald A. Klein, Microbiology- Lansing Prescott,, 10th Edition, McGraw Hill Publication. ISBN-13-978-1259281594

Practicals:

1. To perform Staining of DNA by Schiff's reagent.
2. To study Lipid solubility of membranes using hypotonic solution and RBCs.
3. To study and perform staining of bacterial cells. (Monochrome staining, Gram Staining).
4. To study mitosis in onion root tips.

Name of faculty: Science	Department: Microbiology
Program: B.Sc.	Type: Theory
Subject: DSE-1: Biochemistry & Enzymology	Semester: 1
Credit: 02	Total learning hours: 30
<p>Course description: Biochemistry is a division of science that explores the chemical processes within and related to living organisms. Biochemistry in general deals with body substances like carbohydrates, proteins, fats, DNA, RNA, vitamins, enzymes, etc.; thus, plays an important role in nutrition and health. Enzymology is a branch of biochemistry aiming to understand the structure, functions of enzymes and their mechanism. It is a multidisciplinary approach that integrates areas of Biochemistry, Microbiology, Molecular biology and Biophysics.</p>	
<p>Student learning outcome:</p> <ul style="list-style-type: none"> ● Describe the chemistry of biological macromolecules and their significance. ● Classification, structural organization and properties of macromolecules. ● Nomenclature, classification and mechanism of enzyme action. ● Identify the commercial applications of enzymes. 	

Unit-1: Carbohydrates

(Duration: 04 Hrs)

- 1.1 Functions & Classification of Carbohydrate
- 1.2 Monosaccharides- Structure of Glucose and Reactions
- 1.3 Disaccharides
- 1.4 Polysaccharides- Homopolysaccharides, Heteropolysaccharides & Glycoproteins

Unit-2: Proteins

(Duration: 04 Hrs)

- 2.1 Functions & Elemental Composition of Proteins
- 2.2 Amino Acids- General Structure & Classification
- 2.3 Structure of Protein
- 2.4 Classification of Proteins
- 2.5 Biologically Important Peptides

Unit-3: Nucleic acids

(Duration: 04 Hrs)

- 3.1 Nucleotides- Structure and Nomenclature
- 3.2 Structure of DNA- Watson & Crick Model, and Size of DNA molecule
- 3.3 Denaturation and Renaturation of DNA Helix
- 3.4 Structure & Types of RNA

Unit-4: Lipids

(Duration: 04 Hrs)

- 4.1 Lipids- Classification & Functions

- 4.2 Fatty acids & Essential Fatty acids
- 4.3 Triacylglycerols
- 4.4 Phospholipids, Glycolipids & Lipoproteins
- 4.5 Steroids
- 4.6 Amphipathic lipids & Soaps and Detergents

Unit-5: Vitamins

(Duration: 4.5 Hrs)

- 5.1 Vitamins- History, Nomenclature & Classification
- 5.2 Fat-soluble Vitamins- Functions, Sources & Deficiency Disorders
- 5.3 Water-soluble Vitamins- Functions, Sources & Deficiency Disorders

Unit-6: Introduction to Enzymes

(Duration: 04 Hrs)

- 6.1 Historical Background, Nomenclature & Classification
- 6.2 Coenzymes, Isoenzymes, Ribozymes
- 6.3 Chemical Nature & Characteristics of Enzyme
- 6.4 Enzyme Specificity & Units of Enzyme Activity

Unit-7: Enzyme Mechanism

(Duration: 03 Hrs)

- 7.1 Factors Affecting Enzyme Activity & Active Site
- 7.2 Mechanism of Enzyme Action- Lock and Key Model, Induced Fit Theory & Substrate Strain Theory
- 7.3 Enzyme Inhibition- Reversible, Irreversible & Allosteric

Unit-8: Enzyme- Regulation & its Applications

(Duration: 2.5 Hrs)

- 8.1 Regulation of Enzyme Activity- Allosteric & Feedback Regulation
- 8.2 Applications of Enzymes

Reference Book:

- Jain JL, Jain S, Jain N (2005). Fundamentals of Biochemistry, 6th revised edition. (ISBN: 978-81-219-2453-5)
- Naik P (2016). Biochemistry, 4th edition. (ISBN: 978-93-515-2989-7)
- Satyanarayana U & Chakrapani U (2013). Biochemistry, 4th edition. (ISBN: 978-81-312-3601-7)

Further Reading:

- Cohn and Stumph, Outline of Biochemistry. 5th Edition. (ISBN: 978-8126509300)
- Garret & Grisham. Biochemistry. 5th Edition. (ISBN: 978-1133106296)
- Lehninger. Principles of Biochemistry, 7th Edition. (ISBN: 9781464126116)

- Palmer. Enzymes: Biochemistry, Biotechnology and Clinical Chemistry. 2nd Edition. (ISBN 978-1-904275-27-5)
- Stryer. Biochemistry, 7th Edition. (ISBN: 9781429282789)
- Voet & Voet. Fundamentals of Biochemistry 3rd Edition. (ISBN: 978-0470878590)

List of Practicals

- 1) Colorimetric estimation of Protein by Folin and Lowry's method / Biuret method.
- 2) Qualitative analysis of carbohydrates
- 3) Qualitative analysis of protein
- 4) Assaying of various intracellular and extracellular enzymes
