MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL
(Formerly West Bengal University of Technology)
Syllabus of B. Sc Genetics
(Effective from 2023-24 Academic Sessions)

Course Name: Biochemistry

Mode: Offline **Credits: 5(3T+2P)**
BMGN 1101

Aim of the Course: To acquaint students with Concepts of Biochemistry and metabolism

Course Objectives: The course is aimed to build knowledge in fundamentals of Biochemistry, their relation to the metabolisms. It also considers different structural and reaction of different simple macromolecules. Upon completion of this course, students should understand the structural, functional and metabolic aspects of carbohydrates, lipids, amino acids and proteins along with nucleic acids, . They should understand the structure and functional details of biological membranes.

Sl	Graduate attributes	Mapped modules
CO1	The student will get an introduction to the discipline of biochemistry and structural organisations of carbohydrates and different reactions etc.	**M1**
CO2	The students will get a clear concept on structure and properties of **Amino acids & Proteins,**	**M2**
CO3	The student shall get a concept of lipids, Biological membrane, and the Membrane Transport.	**M3**
CO4	The details about Biologically important nucleotides are the knowledges students will learn.	**M4**
CO5	The student shall master the Enzymatic Kinetics, including reaction rates and mechanisms. The student will be able to analyze reactions of enzymes.	**M5**
CO6	The students will understand carbohydrate , lipid , amino acids,proteins and nucleic acid metabolisms.	**M6**

Learning Outcome/ Skills:

The candidates should demonstrate fundamental knowledge and insight into Biochemistry in order for the candidate to be able to understand and solve problems related to the macromolecular structures, their function and importance.

Knowledge and understanding should be demonstrated in the areas of: (1) carbohydrate, (2) lipid (3) amino acids, (4) nucleic acids (5) structures, (6) metabolisms and related knowledges.

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Module Number	Content	Total Hours	% of questions	Bloom Level (applicable)	Remarks, if any
THEORY					
M1	Historical perspectives, and carbohydrates	**5**	**7**	**1,2**	**NA**
M2	Amino acids and proteins	**7**	**15**	**1,2,3**	**NA**
M3	Lipids and biological membranes	**5**	**8**	**1,2**	**NA**
M4	Nucleic acids Double helical model of DNA	**5**	**10**	**1,2,3**	**NA**
M5	Chemical and Enzymatic Kinetics	**8**	**20**	**2,3,4**	**NA**
M6	Metabolisms	**15**	**40**	**2,3,4**	**NA**
Total Theory		**45**	**100**		
Practical		**30**			
	TOTAL	**75**			

Detailed Syllabus

Module 1: Introduction to Biochemistry

Introduction to Biochemistry and carbohydrates-
A historical prospective.
Carbohydrates:-–

Introduction & Occurrence, Classification of Carbohydrates, Determination of Structural of Glucose and Fructose, Pyranose and Furanose forms of Glucose, Reducing & Non-reducing Sugars, Oxidation and reduction reaction of glucose and Fructose, Reaction with Phenylhydrazine, Epimerization, Mutarotation, Ascending and Descending the Sugar series, Inter-conversion of Monosaccharides, Determination of ring size of Carbohydrate.

(**Total Hours: 5)**

Module 2:

Amino acids & Proteins:

Structure & Function. Structure and properties of Amino acids, Types of proteins and their classification, Forces stabilizing protein structure and shape. Different Level of structural organization of proteins, Protein Purification. Denaturation and renaturation of proteins. Fibrous and globular proteins.
Total Hours: 7

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Total Hours:

Module 3:

Lipids and Biological membranes

Lipids : Structural aspects – General introduction, Classification & Structure of Simple & Compound lipids, Properties of Lipid aggregates (elementary idea), Biological membrane, Membrane protein – structural aspects, Lipoproteins (elementary idea).
Total Hours: 5

Module 4:

Nucleic Acids:

Nucleic acids: Structure and functions: Physical & chemical properties of Nucleic acids, Nucleosides & Nucleotides, purines & pyrimidines,. Biologically important nucleotides, Double helical model of DNA structure and forces responsible for A, B & Z – DNA, denaturation and renaturation of DNA
Total Hours: 5

Module 5:

Chemical & Enzymatic Kinetics

Chemical & Enzymatic Kinetics - An introduction to enzyme; How enzyme works; Reaction rate; Thermodynamic definitions; Principles of catalytic power and specificity of enzymes, Order of reactions; Enzyme kinetics – Approach to mechanism.
Total Hours: 8

Module 6:

Metabolisms
Carbohydrates Metabolism: Reactions, energetics and regulation. Glycolysis: Fate of pyruvate under aerobic and anaerobic conditions. Pentose phosphate pathway and its significance, Gluconeogenesis, Glycogenolysis and glycogen synthesis. TCA cycle, Electron Transport Chain, Oxidative phosphorylation. ß-oxidation of fatty acids.
Lipid Metabolism – Structures and roles of Fatty acids & Glycerols, beta oxidation of saturated fatty acids, oxidation of unsaturated fatty acids, oxidation of odd chain fatty acids, energy yield, Ketone

bodies.
Amino acid Metabolism – Amino acid breakdown (amino acid deamination, Urea cycle, metabolic breakdown of individual amino acids – glucogenic & ketogenic amino acids), amino acids as biosynthetic precursors (haem biosynthesis & degradation, biosynthesis of epinephrine, dopamine, seretonin, GABA, histamin, glutathione); biosynthesis of essential & non-essential amino acids.
Nucleotide Metabolism – biosynthesis of purine & pyrimidine (de novo & salvage pathway); degradation of purine & pyrimidine.
Total Hours: 15

PRACTICAL

Credit: 2

Total Hours: 30
BMGN1191

[Lab on Biochemistry and Metabolism] Credit 2 (Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

1. Estimation of protein by Folin Lowry method
2. TLC separation of Amino acids /sugars
3. Determination of Iodine number of a fat
4. Estimation of DNA by diphenyl amine method
5. Qualitative tests for Carbohydrates, lipids and proteins
6. Testing of Blood Sugar
7. Testing of Liver Function Test (Bilirubin, SGOT, SGPT, Alkaline Phosphatase, Albumin,
8. Testing of Renal Function Test (Urea, Uric acid, Creatine, Creatinine)

Suggested Readings:

1. Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Biochemistry. VI Edition. W.H Freeman and Co.
2. Buchanan, B., Gruissem, W. and Jones, R. (2000) Biochemistry and Molecular Biology of Plants.American Society of Plant Biologists.
3. Nelson, D.L., Cox, M.M. (2004) Lehninger Principles of Biochemistry, 4th Edition, WH Freeman and Company, New York, USA.
4. Hopkins, W.G. and Huner, P.A. (2008) Introduction to Plant Physiology. John Wiley and Sons.
5. Salisbury, F.B. and Ross, C.W. (1991) Plant Physiology, Wadsworth Publishing Co. Ltd.

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Course Name: Cell Biology

Mode: Offline **Credits: 5(3T+2P)**
BMGN 1102

Aim of the Course: The aim is to achieve Basic knowledge of the fundamentals of cell structure and basic knowledge of different functions.

Course Objectives: The course is aimed to build knowledge in fundamentals of cell Biology, the basic concepts of the components of prokaryotic and eukaryotic cells. It also considers how cells function. Upon completion of this course, students should understand the basic knowledge underlying cell cycle and develop an understanding of apoptosis or cell death. They should be able to characterize properties of different component of cell systems and relate them with different functions

Sl	Graduate attributes	Mapped modules
CO1	To acquaint students with basic knowledge of Cell Biology, Historical perspectives- Discovery of cell and Cell Theory	**M1**
CO2	Students will learn about the structure and organization of Prokaryotic Cell and different cellular organelles.	**M1**
CO3	Students will get a concept on Comparison between plant and animal cells, cell compartmentalization, cell fractionation as well as the basics of Cell Membrane and Permeability .	**M2**
CO4	The student shall get a detailed concept of structure, function biogenesis of Membrane, Vacuolar system, cytoskeleton and cell motility, microtubules, Microfilaments, Intermediate filaments. ER, Golgi complex etc.	**M3**
CO5	Students will be acquainted with the structure, function and biogenesis of Lysosomes and microbodies, Structure and functions Ribosomes,. Mitochondria. Chloroplasts, Nucleus	**M4**
CO6	The student shall master the knowledge about Eukaryotic Cell cycle and its regulation; cell division, Programmed cell death, Apoptosis and its relation with Cancer.	**M6**

Learning Outcome/ Skills:

The candidates should demonstrate fundamental knowledge and insight into cell biology and the will will be also able to understand problems related to the structure of cell organelles, their functions and importance.

Knowledge and understanding should be demonstrated in the areas of: cell membranes , their permeabilities, cell divisions and apoptosis related knowledges.

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Module Number	Content	Total Hours	% of questions	Bloom Level (applicable)	Remarks, if any
THEORY					
M1	Basic knowledge of Cell Biology, Historical perspectives- Discovery of cell and Cell Theory	**3**	**6**	**1**	**NA**
M2	Structure and organization of Prokaryotic Cell and different cellular organelles.	**7**	**10**	**1,2**	**NA**
M3	Comparison between plant and animal cells, cell compartmentalization, cell fractionation, Cell Membrane and Permeability	**5**	**14**	**1,2,3**	**NA**
M4	Structure, function biogenesis of Membrane, Vacuolar system, cytoskeleton and cell motility, microtubules, Microfilaments, Intermediate filaments. ER, Golgi complex.	**9**	**20**	**1,2,3**	**NA**
M5	Structure, function and biogenesis of Lysosomes and microbodies, Structure and functions Ribosomes,. Mitochondria. Chloroplasts, Nucleus	**9**	**25**	**2,3**	**NA**
	Eukaryotic Cell cycle and its regulation; cell division, Programmed cell death, Apoptosis in relation with Cancer	**12**	**25**	**2,3,4**	
Total Theory		**45**	**100**	**1, 2, 3,4**	**NA**
Practical		**30**			**NA**
	TOTAL	**75**			**NA**

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Detailed Syllabus

Module 1:
Basic knowledge of Cell Biology
Basic knowledge of Cell Biology, Historical perspectives- Discovery of cell and Cell Theory
Total Hours: 3

Module 2:
Structure and organization of Prokaryotic Cell

Structure and organization of Prokaryotic Cell: Prokaryotic Cell size, shape and arrangement, glycocalyx: capsule and slime layer, flagella, endoflagella, fimbriae and pili. Cell-wall: Composition and detailed structure of Gram-positive and Gram-negative cell walls, Gram staining mechanisms, Unique cell wall structure of Acid fast bacteria, sphaeroplasts, protoplasts, and L-forms. Composition of Archaebacterial cell wall and cell membranes. Cytoplasm: Ribosomes, mesosomes, inclusion bodies, nucleoid, chromosome and plasmids. Endospore: Structure, formation and stages of sporulation.

Total Hours: 7

Module 3:
Comparison between plant and animal cells

Comparison between plant and animal cells; cytosol, compartmentalization of eukaryotic cells, cell fractionation. Cell Membrane and Permeability: Chemical components of biological membranes, organization and Fluid Mosaic Model, membrane as a dynamic entity, cell recognition and membrane transport. Cell wall; Plasma membrane; Modification of plasma membrane; Extra cellular matrix and cell matrix interactions, Cell Cell Interactions - adhesion junctions, tight junctions, gap junctions, and plasmodesmata (only structural aspects); Protoplasm.
Total Hours: 5

Module 4:
Membranes and organelles:

Membrane, Vacuolar system, cytoskeleton and cell motility : Structure and function of microtubules, Microfilaments, Intermediate filaments. Endoplasmic reticulum: Structure, function including role in protein segregation. Golgi complex: Structure, biogenesis and functions including role in protein secretion.
Total Hours: 9

Module 5:
Ribosomes, Mitochondria, chloroplast, Nucleus

Lysosomes: Vacuoles and micro bodies: Structure and functions Ribosomes: Structures and function including role in protein synthesis. Mitochondria: Structure and function, Genomes, biogenesis. Chloroplasts: Structure and function, genomes, biogenesis, Nucleus: Structure and function, chromosomes and their structure.
Total Hours: 9

Module 6:

Cell cycle, Cell division, Apoptosis
Eukaryotic Cell cycle and its regulation; cell division -Mitosis and Meiosis; Programmed cell death (Apoptosis), intrinsic & extrinsic pathways of cell death, Apoptosis in relation with Cancer.
Total Hours: 12

PRACTICAL

Credit: 2

Total Hours: 30

(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

1. Preparation of Mitotic Chromosome from onion root tip.
2. Preparation of Meiotic Chromosome from Rhoeo discolor or onion sp.
3. Preparation and study of polytene chromosome from *Drosophila* salivary gland.
4. Study of sex chromatin through preparation of Barr body from buccal epithelium .
5. Study of plasmolysis and de-plasmolysis.

Suggested Readings:

1. Gene, 6th edition, Cold Spring Harbour Lab. Press, Pearson Publication
2. Becker WM, Kleinsmith LJ, Hardin J and Bertoni GP (2009) The World of the Cell, 7th edition,Pearson Benjamin Cummings Publishing, San Francisco
3. The Cell: A Molecular Approach (7th Edition), Geoffrey M. Cooper, Robert E. Hausman.
4. Essential Cell Biology, Bruce Alberts, Dennis Bray, Karen Hopkin, Alexander D.Johnson, Julian Lewis, Martin Raff, Keith Roberts, and Peter Walter.
5. Cell Biology, Genetics, Molecular Biology, P.S.Verma