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

THIRD SEMESTER

Course Name: Molecular Biology

Mode: Offline **Credits: 5(3+2)**
BMBT3201

Aim of the Course: The aim is to achieve basic knowledge about DNA structure, replication, Transcription, DNA damage and repair as well as regulation and gene expression and gene cloning.

Course Objectives: The course is aimed to build knowledge in fundamentals of molecular biology and the underlying mechanisms of it. To impart basic knowledge about DNA structure, replication, Transcription and DNA damage and repair as well as regulation and gene expression. It also considers different applications of molecular techniques. To acquaint students with the procedure of gene cloning with important enzymes and vectors.

Sl	Graduate attributes	Mapped modules
CO1	The student will get an introduction to the discipline of molecular biology with details of DNA structure and replication	**M1**
CO2	The students will get a clear concept on DNA damage, repair, non-homologous and homologous recombination	M2
CO3	The student shall get a concept of Transcription mechanism and RNA processing	**M3**
CO4	To acquaint students with the details about concepts of Regulation of gene expression and translation	**M4**
CO5	The student shall be master to know the procedure to clone a gene with important enzymes and vectors	**M5**

Learning Outcome/Skills: To impart basic knowledge and the underlying mechanisms of the followings

- Details of DNA structure
- Mechanism of DNA replication
- DNA damage and their repair mechanisms
- Mechanism of non-homologous recombination
- Mechanism of homologous recombination
- Mechanism of Transcription
- Mechanism of RNA processing
- Regulation of gene expression
- Mechanism of translation
- Gene cloning

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Module Number	Content	Total Hours	% of questions	Bloom Level (applicable)	Remarks, if any
THEORY					
M1	DNA structure and replication	**8**	**18**	**1,2,3**	**NA**
M2	DNA damage, repair, non-homologous and homologous recombination	**10**	**22**	**1,2,3,4**	**NA**
M3	Transcription mechanism and RNA processing	**8**	**18**	**1,2,3,4**	**NA**
M4	Regulation of gene expression and translation	**8**	**18**	**1,2,3,4**	**NA**
M5	How to clone a gene	**11**	**24**	**1,2,3,4**	**NA**
Total Theory		**45**	**100**		
Practical		**30**			
	TOTAL	**75**			

Detailed Syllabus

Module 1:

DNA structure and replication

DNA as genetic material, structure of DNA, Types of DNA, Replication of DNA in prokaryotes and Eukaryotes, Semi-conservative nature of DNA replication, Bi-directional replication, DNA polymerases, The replication complex: Pre-primming proteins, primosome, replisome, Rolling circle replication, Unique aspects of eukaryotic chromosome replication, Fidelity of replication.

(Total Hours:8)

Module 2:

DNA damage, repair, non-homologous and homologous recombination

DNA damage and repair: causes and types of DNA damage, mechanism of DNA repair: Photo-reactivation, base excision repair, nucleotide excision repair, mismatches repair, translation synthesis, recombinational repair, non-homologous end joining. Homologous recombination: models and mechanism.

(Total Hours:10)

Module 3:

Transcription and RNA processing

RNA structure and types of RNA, Transcription in eukaryotes: Eukaryotic RNA polymerases, transcription factors, promoters, enhancers, mechanism of transcription initiation, promoter clearance and elongation RNA splicing and processing: processing of pre-mRNA: 5' cap formation, polyadenylation, splicing, rRNA and tRNA splicing.

(Total Hours:8)

Module 4:

Regulation of gene expression and translation

Regulation of gene expression in prokaryotes: Operon concept (inducible and system), Genetic code and its characteristics, Prokaryotic and eukaryotic translation: ribosome structure and assembly, Charging of tRNA, aminoacyl tRNA synthetases, Mechanism of initiation, elongation and termination of polypeptides, Fidelity of translation, Inhibitors of translation, Posttranslational modifications of proteins.

(Total Hours:8)

Module 5:

How to clone a gene

What is clone, overview of the procedure, Gene library, hybridization Cutting and Joining DNA- Restriction Endonucleases, Ligation, Alkaline phosphate, Modification of Restriction fragment ends, and Other ways of joining DNA molecules. Plasmid vectors, Vectors based on the lambda bacteriophage, cosmids, M13 vectors, Expression vectors, Vectors for cloning and expression in Eukaryotic cells, Super vectors- YACs and BACs

(Total Hours:10)

PRACTICAL

BMBT 3291

Paper Name-Lab on Molecular Biology

(Whereverwetlabexperimentsarenotpossibletheprinciplesandconceptscanbedemonstratedthroughany other material or medium including videos/virtual labs etc.)

Credit:2

Total Hours:30

1. Preparation of buffers and solutions for molecular biology experiments
2. DNA isolation from Cabbage leaves/ goat liver/Human blood and Microbes
3. Plasmid DNA isolation
4. Agarose gel Electrophoresis of genomic DNA and plasmid DNA
5. Preparation of restriction digestion of DNA samples
6. Gel Documentation and photography

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. De Robertis EDP and De Robertis EMF (2006) Cell and Molecular Biology, 8th edition. Lippincott Williams and Wilkins, Philadelphia
4. Karp G (2010) Cell and Molecular Biology: Concepts and Experiments, 6th edition, John Wiley & Sons. Inc.
5. Sambrook J and Russell DW. (2001). Molecular Cloning: A Laboratory Manual. 4th Edition, Cold Spring Harbour Laboratory press.

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Course Name: Enzymology and Enzyme Technology

Mode: Offline **Credits: 5(3+2)**
BMBT 3202
Aim of the Course: The aim is to achieve basic knowledge about Enzymology and Enzyme technology

Course Objectives: To impart basic knowledge about history of enzymes and their use. To acquaint students with the basic concept of Enzyme structure, Classification and functions. To acquaint students with an overview of Enzyme specificity and its catalytic activity, Purification and characterization procedure of enzymes. To impart students with the basic knowledge of Enzyme Technology, Process of Industrial Production of Enzymes and Application of Enzyme technology in different fields

Sl	Graduate attributes	Mapped modules
CO1	To acquaint students about the Introduction and history of enzymes	**M1**
CO2	To acquaint students with the basic concept of Enzyme structure, Classification and functions	**M2**
CO3	To acquaint students with an overview of Enzyme specificity and catalysis activity	**M3**
CO4	To acquaint students with different Purification and characterization procedure of enzymes	**M4**
CO5	To acquaint students with the basic knowledge of Enzyme Technology	**M5**
CO 6	To acquaint students with the Process of Industrial Production of Enzymes	**M6**
CO7	To acquaint students with the Application of Enzyme technology in different fields	**M7**

Learning Outcome/Skills: To impart basic knowledge about the following

- Introduction and history of enzymes
- Enzyme structure, Classification and functions
- Enzyme specificity and catalysis activity
- Purification and characterization of enzymes
- Enzyme Technology
- Process of Industrial Production of Enzyme
- Application of Enzyme technology in different fields

Module Number	Content	Total Hours	% of questions	Bloom Level (applicable)	Remarks, if any

THEORY					
M1	Introduction and history of enzymes	**3**	**7**	**1,2**	**NA**
M2	Enzyme structure, Classification and functions	**6**	**13**	**1,2,3**	**NA**
M3	Enzyme specificity and catalysis	**6**	**13**	**1,2,3,4**	**NA**
M4	Purification and characterization of enzymes	**6**	**13**	**1,2,3,4**	**NA**
M5	Enzyme Technology	**8**	**18**	**1,2,3,4**	**NA**
M6	Industrial Production of Enzyme	**8**	**18**	**1,2,3,4**	**NA**
M7	Application of Enzyme technology in different fields	**8**	**18**	**1,2,3,4**	**NA**
Total Theory		**45**	**100**		
Practical		**30**			
TOTAL		**75**			

Detailed Syllabus

Module 1:
Introduction and history of enzymes
Introduction and history of enzymes. Properties of enzymes, sources and application of enzymes.
(Total Hours: 3)

Module 2:
Enzyme structure, Classification and Function
Basic enzyme structure. Chemical nature of enzymes, classification and naming of enzymes, classes of enzymes, Functions of enzymes, Artificial enzymes, recombinant enzymes etc. Denaturation of enzymes
(**Total Hours: 6)**

Module 3:
Enzyme specificity and catalysis
enzyme mechanism models, Mechanisms of enzyme catalysis,
(Total Hours: 6)

Module 4:
Purification and characterization of enzymes
Purification and characterization process of enzymes- Methods of enzyme isolation
(Total Hours: 6)

Module 5:

Enzyme Technology

Methods for large scale production of enzymes. Immobilized enzyme and their comparison with soluble enzymes, Methods for immobilization of enzymes. Immobilized enzyme reactors. Application of Immobilized and soluble enzyme in health and industry.

(Total Hours: 8)

Module 6:

Industrial Production of Enzyme

Production of industrial chemicals, biochemical and chemotherapeutic products. Propionic acid, butyric acid, 2-3 butanediol, gluconic acid, itaconic acid, Biofuels: Biogas, Ethanol, butanol, hydrogen, biodiesel, microbial electricity, starch conversion processes; Microbial polysaccharides; Microbial insecticides; microbial flavours and fragrances, newer antibiotics, anti cancer agents, amino acids.

(Total Hours: 8)

Module 7:

Application of Enzyme technology in different fields

Microbial products of pharmacological interest, steriod fermentations and transformations. Over production of microbial metabolite, Secondary metabolism – its significance and products. Metabolic engineering of secondary metabolism for highest productivity. Enzyme and cell immobilization techniques in industrial processing, enzymes in organic synthesis, proteolytic enzymes, hydrolytic enzymes, glucose isomerase, enzymes in food technology/organic synthesis.

(Total Hours: 8)

PRACTICAL

BMBT 3292

Paper Name- Lab on Enzymology and Enzyme Technology

(Whereverwetlabexperimentsarenotpossibletheprinciplesandconceptscanbedemonstratedthroughany other material or medium including videos/virtual labs etc.)

Credit:2

TotalHours:30

1. Estimation of absolute and specific activity of alkaline phosphatase from crude cell extract
2. Determination of activity in presence of activators/inhibitors.
3. Determination of optimum pH and temperature
4. Determination of Km & Vmax
5. Determination of Competitive, non-competitive inhibitors
6. Isolation and separation of enzymes

Suggested Readings:

1. Biochemistry, Lubert Stryer, 6th Edition, WH Freeman, 2006.
2. Harper's illustrated Biochemistry by Robert K. Murray, David A Bender, Kathleen M.Botham, Peter J. Kennelly, Victor W. Rodwell, P. Anthony Weil. 28th Edition, McGrawHill, 2009.
3. Biochemistry, Donald Voet and Judith Voet, 2nd Edition, Publisher: John Wiley and Sons, 1995.
4. Biochemistry by Mary K.Campbell & Shawn O.Farrell, 5th Edition, Cenage Learning,2005.
5. Fundamentals of Enzymology Nicholas Price and Lewis Stevens Oxford University Press 1999
6. Fundamentals of Enzyme Kinetics Athel Cornish-Bowden Portland Press 2004
7. Practical Enzymology Hans Bisswanger Wiley–VCH 2004
8. The Organic Chemistry of Enzyme-catalyzed Reactions Richard B. Silverman Academic Press 2002