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)

THIRD SEMESTER

Course Name: Molecular Biology

Mode: Offline **Credits: 5(3+2)**
BMGN3201 & BMGN3291

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 mechanism 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

BMGN 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: Model Organism in Human Genome Project

Mode: Offline **Credits: 5**
BMGN 3202

Aim of the Course: To acquaint students with different model organisms and basics of Human genome project

Course Objectives: To impart basic knowledge about human genome, human genome project and model organisms as well as their relation with human genome project and related technologies..

Sl	Graduate attributes	Mapped modules
CO1	To acquaint students about the genomes of different model organisms and their genomic variation and evolution	**M1**
CO2	To acquaint students with the basic concept of genomics, its history, functional and comparative genomics	**M2**
CO3	To acquaint students with an overview of genome projects of human and other model organisms of Human Genome Project	**M3**
CO4	To acquaint students with the different mechanism of Human genome mapping	**M4**
CO5	To acquaint students with Technologies used in Human Genome Project	**M5**

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

- The genomes of different model organisms
- Genomic variation of model organisms
- Genomic evolution in model organism
- Basic concept of genomics
- History of Genomics
- Functional genomics
- Comparative genomics
- Overview of genome projects of human
- Model organisms of Human Genome Project
- Different mechanism of Human genome mapping
- Technologies used in Human Genome Project

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

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THEORY					
M1	The genomes of different model organisms and their genomic variation and evolution	**12**	**20**	**1,2,3,4**	**NA**
M2	The basic concept of genomics, its history, functional and comparative genomics	**8**	**13**	**1,2,3,4**	**NA**
M3	An overview of genome projects of human and other model organisms of Human Genome Project	**20**	**33**	**1,2,3,4**	**NA**
M4	How Human genome was mapped	**10**	**17**	**1,2,3**	**NA**
M5	Technologies used in Human Genome Project	**10**	**17**	**1,2,3,4**	**NA**
Total Theory		**60**	**100**		
Tutorial		**15**			
TOTAL		**75**			

Detailed Syllabus

Module 1:
Genome – About genomes of model organisms (*E. coli*, Yeast, *Arabidopsis thaliana*, *C. elegans*, *Drosophila melanogaster*, laboratory mouse, Zebra fish), types of genomes, genomes & genetic variation, comparison of different genomes, genome evolution.
(Total Hours: 12)

Module 2:
Genomics – About the genomics, history, comparative genomics, comparative genomic hybridization, functional genomics.
(**Total Hours: 8)**

Module 3:
Genome projects – An overview of genome projects of human and other model organisms of Human Genome Project. Human Genome Project (HGP) an overview, goals of the project, major scientific strategies & approaches used in HGP, expected scientific & medical benefits of this project, about the organizations behind this project.
(Total Hours: 20)

Module4:
How Human genome was mapped – physical mapping, genetic mapping, gene ontology, gene annotation
(Total Hours: 10)

Module5:
Technologies used in HGP – RFLP, microsatellite markers, STS, EST, DNA sequencing, DNA microarray.
(Total Hours: 10)

TUTORIAL

BMGN 3202
Paper Name- Model Organism in Human Genome Project

(The principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

Credit:1
TotalHours:15

1. ***E. coli***- life cycle study, isolation and identification of mutants.
2. **Yeast**- life cycle study, isolation and identification of mutants
3. **Drosophila**- life cycle study, isolation and identification of mutants
4. **Arabidopsis**- life cycle study, isolation and identification of mutants
5. **Zebra Fish**- life cycle study, isolation and identification of mutants
6. **Laboratory Mouse**- life cycle study, isolation and identification of mutants

Suggested Readings:

1. The Human Genome Project: Cracking the Genetic Code of Life By Thomas F Lee, Springer, 1st Ed. 1991
2. Understanding the Human Genome Project (2nd Edition) by Michael Palladino