INSTITUTE	**FACULTY OF SCIENCE**
PROGRAM	**MASTER OF SCIENCE (MICROBIOLOGY)**
SEMESTER	**3**
COURSE TITLE	**ADVANCE MOLECULAR BIOLOGY**
COURSE CODE	**02MB0506**
COURSE CREDITS	**4**

Objective:

1 To provide students with in-depth knowledge of advanced molecular biology and its applications, enabling them to utilize concepts in research and biotechnology.

Course Outcomes: After completion of this course, student will be able to:

1 Demonstrate advanced molecular biology techniques used in gene manipulation, expression analysis, and genome study.

2 Explain the use of different host systems, vectors, and expression strategies for recombinant protein production and functional studies.

3 Utilize molecular biology tools and approaches to study gene structure, function, regulation, and interactions.

4 Describe the role of mutations, molecular markers, and gene mapping methods in genetic variation and genome organization.

Pre-requisite of course:NA

Teaching and Examination Scheme

Theory Hours	Tutorial Hours	Practical Hours	ESE	IA	CSE	Viva	Term Work
4	0	0	50	30	20	0	0

Contents : Unit	Topics	Contact Hours
1	**Molecular cloning and rDNA technology** Vectors, specialized vectors, Restriction enzymes and other DNA modifying enzymes, Cloning vectors, Prokaryotic and Eukaryotic host systems, Basic steps in genetic engineering, Objectives of genetic engineering, Screening and selection of recombinants. DNA ligation using: cohesive-ended and bluntended DNA fragments; linkers, adaptors; homopolymeric tailing. Molecular cloning for gene expression studies, Inducible gene expression, Factors influencing gene expression.	14

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Contents : Unit	Topics	Contact Hours
2	**Recombinant Gene Expression in Eukaryotic Hosts** Gene Expression in Yeast to produce proteins from other organisms (heterologous expression), Yeast for studying proteins and interactions, Yeast two-hybrid and three-hybrid systems for detecting protein-protein and protein-RNA interactions, Saccharomyces as hosts for producing recombinant proteins Gene Expression in Insects, Plants, and Animal Cells Methods for introducing foreign genes into insect, plant, and animal cells, Factors influencing gene expression in plants and animals Strategies for creating knockout (KO) cells and transgenic animals	15
3	**Gene Expression Analysis, and Genome Editing** Insertion of foreign DNA into host cells; transformation, electroporation, transfection; construction of libraries; cDNA and genomic libraries; Microarray technology. Various types of PCR (Conventional PCR, RT-PCR, Nested PCR, Multiplex PCR). Hybridization techniques: northern, southern, and western blotting Study of protein-DNA interactions: electrophoretic mobility shift assay; DNA foot-printing, chromatin immunoprecipitation, fluorescence in situ hybridization (FISH), genome editing by CRISPR-CAS	15
4	**Mutations, Molecular markers and gene mapping Methods** Site-Directed Mutagenesis (SDM) – Principles and Applications, Mutational Hotspots and their Biological Significance, Epigenetic Modifications and their Role in Mutation Interpretation Restriction Fragment Length Polymorphism (RFLP), Random Amplified Polymorphic DNA (RAPD), Amplified Fragment Length Polymorphism (AFLP), Simple Sequence Repeats (SSR)/Microsatellites, Single Nucleotide Polymorphism (SNP) and Applications of Molecular Markers. Mapping in Model Organisms, Fine Mapping using Next Generation Sequencing (NGS), Role of Bioinformatics in Mapping	16
Total Hours		**60**

Textbook :

1 Genomes 4, Brown, T. A. , Garland Science, 2017

2 Principles of Gene Manipulation and Genomics, Primrose, S. B., & Twyman, R. M., Wiley-Blackwell, 2013

3 Molecular Biology of the Cell , Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. , Garland Science., 2014

References:

1 Molecular Biotechnology: Principles and Applications of Recombinant DNA, Molecular Biotechnology: Principles and Applications of Recombinant DNA, Glick, B. R., & Patten, C. L., ASM Press., 2017

2 Molecular Cell Biology, Molecular Cell Biology, Lodish, H., Berk, A., Kaiser, C. A., Krieger, M., Bretscher, A., Ploegh, H., & Amon, A. , W.H. Freeman and Company., 2021

Suggested Theory Distribution:

The suggested theory distribution as per Bloom's taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery and evaluation					
Remember / Knowledge	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Higher order Thinking / Creative**
5.00	10.00	30.00	30.00	20.00	5.00

Instructional Method:

1. The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, etc.
2. The internal evaluation will be done on the basis of continuous evaluation of students in the class-room in the form of attendance, assignments, verbal interactions etc.
3. Students will use supplementary resources such as online videos, NPTEL videos, e-courses, Virtual Laboratory.

Supplementary Resources:

1. https://microbenotes.com/category/molecular-biology/
2. https://onlinecourses.nptel.ac.in/noc24_bt07/preview

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