COURSE TITLE	**MOLECULAR BIOLOGY AND RECOMBINANT DNA TECHNOLOGY**
COURSE CODE	**01CB0107**
COURSE CREDITS	**4**

Objective:

1. This course will give basic and advanced description of molecular biology and recombinant DNA Technology.
2. It aims to familiarize students with essential molecular tools and methodologies used for DNA manipulation, cloning, and gene expression analysis, and to explore their applications in modern biotechnology and biomedical research.

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

1. Apply concepts of molecular and functional dynamics of genomes, gene regulation, and replication strategies in prokaryotes and eukaryotes.
2. Analyze the coordination between transcriptional and post-transcriptional mechanisms in eukaryotic gene regulation.
3. Evaluate different cloning strategies and tools for research and industrial applications.
4. Analyze the principles and effectiveness of selection and screening techniques for identifying recombinant clones.
5. Apply the principles and methodologies of recombinant DNA technology in experimental design and problem-solving.

Pre-requisite of course:NA

Teaching and Examination Scheme

Theory Hours	Tutorial Hours	Practical Hours	ESE	IA	CSE	Viva	Term Work
3	0	2	50	30	20	25	25

Contents : Unit	Topics	Contact Hours
1	**Introduction to molecular biology** Molecular Structure of Genes and Chromosomes, Chromosomal organization genes and noncoding DNA, Mobile DNA, Structural organization of eukaryotic chromosomes, DNA Replication	7
2	**Transcriptional Control of Gene Expression** Eukaryotic gene control and RNA polymerase; regulatory sequences in protein coding genes; activators and repressors of transcription; mechanism of transcription activation and repression, Processing of eukaryotic pre-mRNA; transport across nuclear envelope; cytoplasmic mechanism of post-transcriptional control; processing of rRNA and tRNA	8

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Contents : Unit	Topics	Contact Hours
3	**Principles of gene cloning and DNA analysis** Tools and techniques for gene cloning, Polymerase chain Reaction, DNA Manipulative Enzymes: Nucleases, ligases, polymerases, DNA modifying enzymes, Enzymes for cutting DNA: restriction endonucleases. The discovery and function of restriction endonucleases. Type II restriction endonucleases. Blunt ends and sticky ends, Ligation: Joining DNA molecules together. The mode of action of DNA ligase sticky ends, blunt ends, linkers and adaptors, Vectors for gene cloning: Bacteriophages	10
4	**Selection and screening methods** Prokaryotic and eukaryotic expression systems, Gene silencing by RNA interference, DNA sequencing, Ligation, Antibiotic and non-antibiotic selection markers, Reporter genes and their applications, GFP RFP and screening methods, Importance and in vitro bio assay	7
5	**Introduction to Recombinant DNA Technology** Steps of making recombinant DNA, Restriction and modifying enzymes, Cloning vectors, Principle of total RNA extraction, Purification of bacterial and eukaryotic mRNA, Enrichment of mRNA, Separation of RNA by gel electrophoresis and Bioanalyzer, Northern Blotting, Labelling of DNA, Nick translation, Random priming, 5' and 3' end labelling, Preparation of labelled single stranded DNA and RNA probes, Hybridization and various methods of detection, Application of Genetic Engineering in Biotechnology	10
Total Hours		**42**

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
1	**Experiment 1** To isolate genomic DNA from bacterial cells.	2
2	**Experiment 2** To quantify DNA using UV spectrophotometry and agarose gel electrophoresis	2
3	**Experiment 3** To isolate total RNA from eukaryotic cells.	2
4	**Experiment 4** To perform reverse transcription to synthesize cDNA from RNA.	2
5	**Experiment 5** To amplify a gene of interest using Polymerase Chain Reaction (PCR).	2
6	**Experiment 6** To analyse PCR products by agarose gel electrophoresis.	2
7	**Experiment 7** To perform restriction digestion of DNA and analyse the fragments.	2
8	**Experiment 8** To ligate DNA fragments into a plasmid vector.	2

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Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
9	**Experiment 9** To transform recombinant plasmids into E. coli.	2
10	**Experiment 10** To screen recombinant colonies using blue-white screening.	2
11	**Experiment 11** To isolate plasmid DNA from transformed bacteria (mini-prep).	2
12	**Experiment 12** To confirm recombinant plasmids using restriction mapping.	2
13	**Experiment 13** To perform SDS-PAGE to analyse protein expression.	2
14	**Experiment 14** To perform Northern blotting for RNA detection.	2
Total Hours		**28**

Textbook :

1 Principals of Molecular biology, Rastogi V.B., MedTech Science Press, 2023

References:

1 Molecular Cell Biology (5th edition), Molecular Cell Biology (5th edition), Lodish Harvey; Berk Arnold; Matsudaira Paul; Kaiser Chri , W.H. Freeman and Company, New York, 2004

2 Molecular Biology of the Cell (7th edition), Molecular Biology of the Cell (7th edition), Bruce Alberts; Rebecca Heald; Alexander Johnson; David Morgan; Martin Raff; Keith Roberts; Peter Walter, Garland Sciences, New York, 2023

3 Principles of Gene Manipulation and Genomics (7th edition), Principles of Gene Manipulation and Genomics (7th edition), Primose S.B. and Twyman R.M., Wiley-Blackwell, 2006

4 Gene cloning and DNA analysis (8th edition), Gene cloning and DNA analysis (8th edition), Brown T.A., Wiley Blackwell, 2020

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					
Remember / Knowledge	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Higher order Thinking / Creative**
0.00	0.00	35.00	35.00	30.00	0.00

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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, MOOCs etc.
2. The internal evaluation will be done on the basis of continuous evaluation of students in the laboratory and class-room.
3. Practical examination will be conducted at the end of semester for evaluation of performance of students in laboratory.

Supplementary Resources:

1. https://www.ncbi.nlm.nih.gov/books/NBK9950/
2. https://bio.libretexts.org/Bookshelves/Genetics/Genetics_Agriculture_and_Biotechnology_%28Suza_and_Lee%29/01%3A_Chapters/1.11%3A_Recombinant_DNA_Technology
3. https://ocw.mit.edu/courses/7-01sc-fundamentals-of-biology-fall-2011/pages/recombinant-dna/
4. https://alison.com/course/understanding-molecular-biology

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