GANPAT UNIVERSITY

FACULTY OF ENGINEERING & TECHNOLOGY

Programme	Bachelor of Technology		Branch/Spec.	Biotechnology	
Semester	VII		Version	1.0.0.0	
Effective from Academic Year	2025-2026		Effective for the batch Admitted in		July 2022
Subject code	2BT7102	Subject Name	Genetic Engineering		

Teaching scheme						Examination scheme (Marks)			
(Per week)	Lecture(DT)		Practical(Lab.)		Total		CE	SEE	Total
	L	TU	P	TW					
Credit	3	-	1	-	4	Theory	40	60	100
Hours	3	-	2	-	5	Practical	30	20	50

Pre-requisites

Basic knowledge of molecular biology and foundation in structure and functions of DNA, RNA and proteins.

Course Outcomes

On successful completion of the course, the students will be able to:

CO1	**Understand** fundamental concepts of molecular biology tools and techniques
CO2	**Demonstrate** knowledge of cloning vectors and their applications
CO3	**Perform** cloning methodologies for molecular and functional studies
CO4	**Apply** PCR and other advanced molecular techniques
CO5	**Explore** genetic engineering in plants and animals
CO6	**Evaluate** real-world applications of genetic engineering

Theory syllabus

Unit	Content	Hrs.
1	BASICS CONCEPTS: DNA Structure and properties; Restriction Enzymes; DNA ligase, Klenow enzyme, T4 DNA polymerase, Polynucleotide kinase, Alkaline phosphatase; Cohesive and blunt end ligation; Linkers; Adaptors; Homopolymeric tailing; Labeling of DNA: Nick translation, Random priming, Radioactive and non-radioactive probes, Hybridization techniques: Northern, Southern, western and Colony hybridization, Fluorescence in situ hybridization	12
2	CLONING VECTORS: Plasmids; Bacteriophages; M13 mp vectors; PUC19 and Bluescript vectors, Phagemids; Lambda vectors; Insertion and Replacement vectors; Cosmids; Artificial chromosome vectors (YACs; BACs); Animal Virus derived vectors-SV-40; vaccinia/bacculo & retroviral vectors; Methodologies to reduce formation of inclusion bodies; Baculovirus and pichia vectors system, Plant based vectors, Ti and Ri as vectors, Yeast vectors, Shuttle vectors	10
3	CLONING METHODOLOGIES: Insertion of Foreign DNA into Host Cells; Transformation; Construction of libraries; Isolation of mRNA and total RNA; cDNA and genomic libraries; cDNA and genomic cloning; Expression cloning;DNA sequencing and sequence assembly: Maxam-Gilbert's and Sanger's methods, Shot gun sequencing, Next generation sequencing strategies for large genomes. DNA mapping and DNA fingerprinting: Physical and molecular mapping, Hybridization and PCR based methods of fingerprinting. Site directed mutagenesis: Methods and applications. Polymerase Chain Reaction: Principle and basic types of PCR; Reverse Transcription and Real Time PCRs.	8
4	GENETIC ENGINEERING OF PLANTS AND ANIMALS: Plant transformation, Reversible male sterility in plants, antisense RNA, Agricultural applications of Genetic Engineering. Genetic engineering & crop improvement *In vitro* fertilization (IVF) and embryo transfer (ET), Sex determination in animals, Assisted reproductive technology (ART), Somatic cloning of animals, Microinjection technology, Knock in and knock out animal, Stem cell technology, Hybridoma technology, Vaccine production, Gene therapy	8
5	APPLICATIONS:	7

	Applications of Genetic engineering in improvement of plants, animals and microbes; Gene editing and its applications; Metagenomics and Metabolic engineering; Gene therapy; Biosafety and levels of Physical and Biological containment; The Indian Guidelines for release and use of GM organisms.	

Practical content	
Term Work and Practical shall be based on the above syllabus.	
Text Books	
1	Principles of Gene Manipulation and Genomics by Sandy B. Primrose, Richard Twyman. Pub.: Wiley
2	Acquiring Genomes: A theory on the origins of species by Lynn Margulis and Dorian Sagan. Pub.: Basic Books
Reference Books	
1	Gene Cloning and DNA Analysis: An Introduction by T. A. Brown. Pub.: Wiley-Blackwell.
2	A Passion for DNA: Genes, Genomes and Society by James. D. Watson. Pub.: CSHL Press.
3	Abraham Lincoln's DNA and other adventures in genetics by Philip R. Reilly. Pub.: CSHL Press.
ICT References	
1	https://archive.nptel.ac.in/courses/102/103/102103013/
2	https://archive.nptel.ac.in/courses/102/103/102103074/

Mapping of CO with PO and PSO:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	1	2	2	0	1	0	0	0	0	1	3	2	1
CO2	3	2	3	3	3	0	1	0	0	0	0	2	3	3	2
CO3	3	3	3	3	3	1	2	1	1	1	2	2	3	3	2
CO4	3	3	2	3	3	0	2	0	0	1	1	3	3	2	1
CO5	3	3	3	3	3	2	3	1	2	1	2	2	3	3	3
CO6	3	3	2	2	2	3	3	2	2	2	2	3	3	3	3