GUJARAT TECHNOLOGICAL UNIVERSITY
Integrated Master of Science (Biotechnology)
Semester: 3
Subject Name: Genetic Engineering
Subject Code: 1330402

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
4	0	8	8	70	30	30	20	150

Prerequisite:
Student should know fundamentals of nucleic acid, its structure and biochemistry. They have basic knowledge about molecular biology & genetics.

Rationale:
The objectives of this course are to teach various approaches to conducting genetic engineering and its applications in biological research as well as in biotechnology industries. In conjunction with the practicals in molecular biology & genetic engineering, the students should be able to take up biological research as well as placement in the relevant biotech industry.

Course Content:

Unit No.	Content	No. of Hours	Weightage (%)
1	**Basic Concepts and Tools of Gene cloning** Introduction to gene cloning, vehicles of gene cloning, isolation and purification of DNA from bacterial, plant and animal cells, Manipulation of purified DNA, Introduction of DNA into living cells, Different methods of horizontal gene transfer; Transformation, Conjugation and Transduction. Restriction enzymes, ligases, polymerases, alkaline phosphatase, vector and non-vector mediated gene transfer methods	15	25
2	**Cloning Vectors and Host Strains** Vehicles: Plasmids, Bacteriophages and viruses, Phagemids and Cosmids; Bacterial Artificial Chromosomes; Vectors for yeast and other fungi: 2µ plasmid, YEPs, YIPs, YRPs, and YACs; To obtain a clone of a specific gene: Salient features of Host strains	10	16
3	**Methods of Gene Manipulation and Selection of Clones** Screening and selection of clones, Random and site-directed mutagenesis: Primer extension and PCR based methods of site directed mutagenesis, Random mutagenesis, Gene shuffling, production of chimeric proteins, Protein engineering concepts and examples. To obtain a clone of a specific gene: Direct selection, Selection using hybridization from Genomic DNA library, cDNA library; Probe designing and labelling; Identification of clones using alternative methods	11	19
4	**Studying gene location and structure** Gene location: Hybridization techniques – Southern blotting; In situ hybridization, FISH, OFAGE. Studying gene structure; DNA sequencing: Sanger's method of chain termination and Maxam Gilbert's method of chemical degradation; Automated	12	20

	sequencing; Polymerase Chain Reaction and its types; Chemical synthesis of oligonucleotides.		
5	**Applications of Genetic Engineering** Genetic engineering in plants: Use of *Agrobacterium tumefaciens* and *A. rhizogenes*, Ti plasmids, Strategies for gene transfer to plant cells, Direct DNA transfer to plants, Gene targeting in plants, Use of plant viruses as episomal expression vectors. Therapeutic products produced by genetic engineering-blood proteins, human hormones, immune modulators and vaccines (one example each)	12	20
	Total Hours:	60	

Textbook:

1. Brown TA. (2006). Gene Cloning and DNA Analysis. 5th edition. Blackwell Publishing, Oxford, U.K.
2. Clark DP and Pazdernik NJ. (2009). Biotechnology-Applying the Genetic Revolution. Elsevier Academic Press, USA. Delhi.

Reference Books:

1. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington
2. Primrose SB and Twyman RM. (2006). Principles of Gene Manipulation and Genomics, 7th edition. Blackwell Publishing, Oxford, U.K.
3. Sambrook J, Fritsch EF and Maniatis T. (2001). Molecular Cloning-A Laboratory Manual. 3rdedition. Cold Spring Harbor Laboratory Press

Course Outcomes:

No.	Course Outcomes	RBT Level*
1	Gain basic concepts of Genetic engineering	UN.RM,AP,AN
2	Gain basic concepts of Gene Cloning	UN.RM,AP,AN
3	Develop concept of vectors and bacterial transformation	UN.RM,AP,AN

*RM: Remember, UN: Understand, AP: Apply, AN: Analyze, EL: Evaluate, CR: Create

Suggested Course Practical List:

1. Genomic DNA isolation from bacteria
2. Plasmid DNA isolation
3. Assessment of quality and quantity of DNA
4. Agarose gel electrophoresis to visualize DNA
5. Restriction digestion
6. DNA ligation
7. DNA transformation
8. PCR (Demonstration)

List of Laboratory/Learning Resources Required

1. https://onlinecourses.nptel.ac.in/noc22_bt59/preview