POOL OF GENERIC ELECTIVES

GENERIC ELECTIVE (BOT-GE-18)

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Genetic Engineering Technologies & Applications BOT-GE-18	4	2	0	2	Class XII pass with Science	**Nil**

Learning Objectives:

- To illustrate the use of modern techniques for the manipulation and analysis of DNA sequences
9. To understand the applications of recombinant DNA technology for the generation of commercial biotechnological products of diverse usage.
10. To gain knowledge about biosafety and ethical concerns associated with recombinant DNA technology.
11. To train students in strategizing research topics employing genetic engineering techniques.

Learning Outcomes: At the end of this course students would be able to:

- understand methods and techniques involved in manipulation and analysis of nucleic acids, gene cloning and creation of genetically modified organisms (GMOs).
- understand the commercial application of rDNA technology in research, agriculture and human health
- comprehend biosafety and ethical issues associated with rDNA technology

Unit 1: Introduction **01 Hours**

Introduction to rDNA technology and gene cloning.

Unit 2: Enzymes and Vectors in genetic engineering **07 Hours**

Restriction endonucleases, exonucleases, polymerases, RNAses, kinases, ligases; Plasmids (pBR322, pUC18, pUC19); Lambda based vectors and derivatives (Insertion vectors, replacement vectors, cosmids, phagemids); Artificial Chromosomes (YACs, BACs); Bacterial transformation, strategies for selection and screening (α complementation, antibiotic resistance); Plant Transformation vectors (Ti plasmid), Protein Expression Vectors for use in *E. coli*; introduction to marker and reporter genes (GUS, GFP).

Unit 2: Gene transfer methods **04 Hours**

Agrobacterium mediated transformation, Electroporation, Microinjection, Particle Bombardment, PEG mediated

Unit 3: DNA libraries construction and screening **04 Hours**

Procedures for construction of genomic and cDNA libraries, screening methods for locating the desired gene (Replica plating, Complementation screening, heterologous gene probe-based hybridizations)

Unit 4: PCR, nucleic acid hybridization and DNA sequencing **08 Hours**

PCR technique and its applications, RT-PCR, qPCR, Hybridization based assays (Southern and Northern blotting), Sanger's di-deoxy chain termination method of sequencing – gel-based electrophoresis (semi-automated) and capillary-based gel electrophoresis (automated sequencing).

Unit 5: Applications of rDNA technology **06 Hours**

Applications in basic research (identify, map, clone, and sequence genes and to determine their functions); applications in agriculture (biotic and abiotic stress tolerant transgenic plants, improved Nitrogen fixation, and plant growth); applications in human health (Disease diagnosis (heritable diseases and acquired infectious diseases) and therapeutics (production of recombinant vaccines, protein therapies: production of Insulin, Interferons, and human growth hormone). Human genome project and sequencing of plant genomes by taking *Arabidopsis* genome as an example. Safety and Ethical Issues related to rDNA research.

Practicals **60 hours**

- Isolation of genomic/plasmid DNA from bacteria.
- Quantification of extracted DNA by DPA (Diphenylamine) method.
- Restriction digestion and AGE (Agarose gel electrophoresis) of DNA.
- Restricting Mapping of linear and circular DNA.
- Study of direct and indirect gene transfer methods by photographs: Electroporation, Microinjection and Particle Bombardment, Ti-plasmid mediated gene transfer.
- Demonstration of techniques by photographs: PCR, RT-PCR, qPCR, Southern and Northern blotting and hybridization.
- Study of applications of rDNA technology by photographs: recombinant insulin, interferon and human growth hormone, Bt Cotton, Golden rice, and Flavr Savr tomato.
- Demonstration of working of equipments used in rDNA technology: Thermocycler, Laminar air flow cabinet, Autoclave, Incubator shaker, Refrigerated centrifuge.

Suggested Readings:

11. M. R. Green, J. Sambrook. Molecular Cloning: A Laboratory Manual (Cold Spring Harbor, ed. 4, 2012).

12. M. Wink. An Introduction to Molecular Biotechnology: Molecular Fundamentals, Methods and Applications in Modern Biotechnology (Wiley, ed. 2, 2011).
13. Glick, B.R., & Patten C. (2022). Molecular Biotechnology: Principles and Applications. 6thedn. Washington, U.S.: ASM Press.
14. Snustad, D.P.,Simmons, M.J. (2019). Principles of Genetics, 7th edition. Chichester, England: John Wiley and Sons.
15. Brown, T. A. 2020. Gene Cloning & DNA Analysis: An Introduction. 8thedn. UK: Wiley Blackwell.
16. Primrose, S. B., Twyman, R. (2009). Principles of gene manipulation and genomics. Wiley. com.
17. Howe, C. J. (2007). Gene cloning and manipulation. Cambridge University Press.

Additional Resources:

1. M. M. Burell. (1993) Enzymes of Molecular Biology, Humana Press.
2. H.M. Eun. (1996) Enzymology: Primer for Recombinant DNA Technology, Academic Press.
3. S. B. Primrose, R. Twyman. (2006) Principles of Gene Manipulation and Genomics (Wiley-Blackwell, ed. 7).

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.