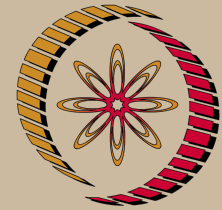


# Genetic Engineering & Applications - Web course



NP-TEL

NPTEL

<http://nptel.ac.in>

Biotechnology

Coordinators:

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## COURSE OUTLINE

### Unit 1

Role of genes within cells, genetic code, genetic elements that control gene expression, Method of creating recombinant DNA molecules, Types, biology and salient features of vectors in recombinant DNA technology–I: Plasmids, Phages, Cosmids, Fosmids, Phagemids, and Artificial chromosomes, Safety guidelines for recombinant DNA research, Control of spills and mechanism of implementation of biosafety guidelines

### Unit 2

Enzymes in genetic engineering: Restriction nucleases: exo & endo nucleases, Enzymes in modification- Polynucleotide phosphorylase, DNase and their mechanism of action, Enzymes in modification- Methylases and phosphatases and their mechanism of action, Enzymes in modification- Polynucleotide kinase, Ligases, RNase and their mechanism of action.

### Unit 3

Methods of nucleic acid detection, Polymerase chain reaction (PCR) and its applications, Variations in PCR and their applications, Methods of nucleic acid hybridization, Probe and target sequences, Nucleic acid mutagenesis in vivo and in vitro

### Unit 4:

Isolation and purification of nucleic acid (genomic/plasmid DNA and RNA), Quantification and storage of nucleic acids, Construction of cDNA library, Construction of Genomic library, Screening and preservation of DNA libraries, DNA Sequencing and cloning strategies.

### Unit 5

Gene transfer techniques: biological methods, Gene transfer techniques: chemical methods, Gene transfer techniques: physical or mechanical methods, *Agrobacterium*- mediated gene transfer in plants, Chloroplast transformation

### Unit 6

Transgenic science in plant improvement, Biopharming - plants as bioreactors, Transgenic science for animal improvement, Biopharming- Animals as bioreactor for recombinant protein, Gene mapping in plants and animals, Marker-assisted selection for plant breeding and livestock improvement

### Unit 7

Microbial biotechnology: Genetic manipulation, Engineering microbes for the production of antibiotics and enzymes, Engineering microbes for the production of insulin, growth hormones, monoclonal antibodies, Engineering microbes for clearing oil spills

### Unit 8

Gene therapy: Introduction and Methods, Gene targeting and silencing, Gene therapy in the treatment of diseases, Challenges and future of gene therapy

## COURSE DETAIL

Sl. No	Topic	No. of Hours
1	<p><b>Lecture 1:</b> Role of genes within cells, genetic code, genetic elements that control gene expression</p> <p><b>Lecture 2:</b> Method of creating recombinant DNA molecules</p> <p><b>Lecture 3:</b> Types, biology and salient features of vectors in recombinant DNA technology–I: Plasmids</p> <p><b>Lecture 4:</b> Phages, Cosmids, Fosmids, Phagemids, and Artificial chromosomes</p> <p><b>Lecture 5:</b> Safety guidelines for recombinant DNA research</p> <p><b>Lecture 6:</b> Control of spills and mechanism of implementation of biosafety guidelines</p>	06

2	<p><b>Lecture 1:</b> Enzymes in genetic engineering: Restriction nucleases: exo &amp; endo nucleases</p> <p><b>Lecture 2:</b> Enzymes in modification- Polynucleotide phosphorylase, DNase and their mechanism of action.</p> <p><b>Lecture 3:</b> Enzymes in modification- Methylases and phosphatases and their mechanism of action.</p> <p><b>Lecture 4:</b> Enzymes in modification- Polynucleotide kinase, Ligases, RNase and their mechanism of action.</p>	04
3	<p><b>Lecture 1:</b> Methods of nucleic acid detection.</p> <p><b>Lecture 2:</b> Polymerase chain reaction (PCR) and its applications</p> <p><b>Lecture 3:</b> Variations in PCR and their applications</p> <p><b>Lecture 4:</b> Methods of nucleic acid hybridization</p> <p><b>Lecture 5:</b> Probe and target sequences</p>	06
4	<p><b>Lecture 1:</b> Isolation and purification of nucleic acid (genomic/plasmid DNA and RNA)</p> <p><b>Lecture 2:</b> Quantification and storage of nucleic acids.</p> <p><b>Lecture 3:</b> Construction of cDNA library</p> <p><b>Lecture 4:</b> Construction of Genomic library</p> <p><b>Lecture 5:</b> Screening and preservation of DNA libraries</p> <p><b>Lecture 6:</b> DNA Sequencing and Cloning Strategies</p>	06
5	<p><b>Lecture 1:</b> Gene transfer techniques: biological methods</p> <p><b>Lecture 2:</b> Gene transfer techniques: chemical methods</p> <p><b>Lecture 3:</b> Gene transfer techniques: physical or mechanical methods</p> <p><b>Lecture 4:</b> Agro- bacterium mediated gene transfer in plants</p> <p><b>Lecture 5:</b> Chloroplast transformation</p>	05
6	<p><b>Lecture 1:</b> Transgenic science in plant improvement</p> <p><b>Lecture 2:</b> Biopharming - plants as bioreactors</p> <p><b>Lecture 3:</b> Transgenic science for animal improvement</p> <p><b>Lecture 4:</b> Biopharming- Animals as bioreactor for recombinant protein</p> <p><b>Lecture 5:</b> Gene mapping in plants and animals</p> <p><b>Lecture 6:</b> Marker-assisted selection for plant breeding and livestock improvement</p>	06
7	<p><b>Lecture 1:</b> Microbial biotechnology: Genetic manipulation</p> <p><b>Lecture 2:</b> Engineering microbes for the production of antibiotics and enzymes</p> <p><b>Lecture 3:</b> Engineering microbes for the production of insulin, growth hormones, monoclonal antibodies</p> <p><b>Lecture 4:</b> Engineering microbes for clearing oil spills</p>	04
8	<p><b>Lecture 1:</b> Gene therapy: Introduction and Methods</p> <p><b>Lecture 2:</b> Gene targeting &amp; silencing</p> <p><b>Lecture 3:</b> Gene therapy in the treatment of diseases</p> <p><b>Lecture 4:</b> Challenges &amp; future of gene therapy</p>	04
	<b>Total</b>	<b>41</b>

**References:**

1. **Introduction to Genetic Engineering** - Nicholl. Cambridge Low Price Edition, 2006.
2. **Principles of gene manipulation and Genomics** - Primrose S.B. and Twyman R.M., Blackwell Scientific Publications, 2008.

3. **Genes IX** - Benjamin Lewis. Oxford University & Cell Press, 2008.