

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

P. G. Diploma course in Tools and Techniques of

Genetic Engineering

(In effect from 2010-2011)

Aim :

The course is designed to enable a science graduate with chemistry and biological sciences acquired sound knowledge in the subject and develop practical skills to contribute effectively in the fields of academics, agriculture, medical, industry, and environment.

Objectives :

1. At the end of one year training in the course, the student is expected to demonstrate sound knowledge concepts and principles of genetic engineering.
2. The student should be able to describe the principles and protocols of different techniques in genetic engineering. He / she should be able to handle the instruments, analyse and interpret the data.
3. Be familiar with literature resources use of bioinformatics and applications of genetic engineering in different fields.

Duration of the course :

The duration of the course will be of one year

Structure of the course :

The course will be operated on the yearly basis. There will be two theory papers(8 hrs/week) and two practicals (12 hrs/week). A small project work of 6 to 8 weeks may be given

Intake of student & fee structure :

Total intake of the students will be 20. 15 students can be admitted with the yearly fees of Rs. 40,000/- and 5 students sponsored by institute/industries with yearly fees of Rs. 60,000/- can be admitted.

Eligibility criteria :

A candidate who has obtained the Bachelor's degree (Biotechnology/Botany/Biochemistry/Chemistry/Microbiology/Pharmacy/Agriculture/Veterinary) of this University or any other University recognized as equivalent shall be eligible for the admission.

Syllabus for P. G. Diploma in Tools & Techniques in Genetic Engineering

Paper – I : Fundamentals of Molecular Biology

DNA Structure : Chemistry of DNA, Forces stabilizing DNA structure, Helix parameters, Forms of DNA (A,B,C,D,T and Z), Watson – Crick and Hoogsteen base pairing, Physical properties of dsDNA (UV absorption spectra, Denaturation and Renaturation, cot curves, DNA hybridization), Chemical that react with DNA.

DNA topology : DNA super coiling, Supercoiled form of DNA, Superhelical density, energetic of supercoiled DNA, Biology of supercoiled DNA (Topological domain of DNA, DNA topoisomerases, Mechanisms of supercoiling in cells, Mechanisms of action of topoisomerase I & II, Effect of supercoiling on structure of DNA and role of supercoiling in gene expression and DNA replication).

Organization of DNA into chromosomes : Packaging of DNA and organization of chromosome in bacteria and eukaryotic cells; packaging of DNA in eukaryotic nucleosome and chromatin condensation assembly of nucleosomes upon replication. Chromatin modification and genome expression.

DNA – Protein Interactions : General features interaction of Helix-turn Helix motif, B-sheet, Zn-DNA binding domain etc with DNA.

DNA Replication : Mechanism of DNA polymerase catalyzed synthesis of DNA, types of DNA polymerases in bacteria and their role. Initiation of chromosomal DNA replication and its regulation in prokaryotes assembly of replisome and progress of replication fork, termination of replication. Types and function of eukaryotic DNA polymerases, initiation of replication in eukaryotes, role of telomerases in replication of eukaryotic chromosomes. Inhibitor of DNA replication (Blocking precursor synthesis nucleotide polymerization, altering DNA structure).

Transcription : RNA polymerases, features of prokaryotic and eukaryotic promoters. Assembly of transcription initiation complex in prokaryotes and eukaryotes and its regulation; synthesis and processing of prokaryotic and eukaryotic transcripts. Transport of RNA within eukaryotic cell.

Synthesis and Processing of Proteome : Structure and role of tRNA in protein synthesis, ribosome structure, basic feature of genetic code and its deciphering, translation (initiation, elongation and termination in detail in prokaryotes as well as eukaryotes), Post translational processing of protein (protein folding, processing by proteolytic cleavage, processing by chemical modification, inteins). Protein degradation.

Regulation of Gene expression in prokaryotes and eukaryotes : positive and negative regulation. Lac-, ara-, his- and trp- operon regulation; antitermination, global regulatory responses; Regulation of gene expression in eukaryotes : Transcriptional, translational and processing level control mechanisms.

Reference Books :

- Genomes : T A Brown
- Genes IX : Lewin
- Molecular biology of gene : Watson et al Vth edition
- Molecular genetics : Stent and Calendar
- Molecular biology of Cell : Alberts et al
- Molecular Cell Biology VIth edition : Lodish et al

Paper II : Techniques of Genetic Engineering

- Scope of Genetic Engineering, Concept and importance of Genetic Engineering
- General strategies and Steps involved in gene cloning
- Extraction and purification of DNA from bacteria, plant and animal cells
- Restriction enzymes, DNA ligase and other enzymes involved in gene cloning
- mRNA and cDNA preparation
- Chemical synthesis of gene/DNA
- Cloning and expression vectors – Plasmids, λ – bacteriophages, M – 13 based vectors, Phagemids, Cosmids, YAC, BAC, HAC/MAC, etc.
- Introduction of DNA into different host systems
- Recombinant selection and screening
 - Southern blotting and hybridization, Northern analysis, Western blot analysis, Agarose gel electrophoresis, Pulse Field Gel Electrophoresis, Rotating Gel Electrophoresis(RGE), PAGE, SDS – PAGE, Isoelectric Focusing, Two Dimensional Electrophoresis, Capillary Electrophoresis, Capillary Gel Electrophoresis, Mapping Regulatory Sequences by *in vivo* expression assay
 - Mapping of Protein Binding Site by DNase I Protection, Electroporation and Mobility Gel Shift Assay
 - Protein Activity Assay – Yeast-one hybrid, Yeast-two hybrid and Yeast-three hybrid system
 - Phage display, Subtractive hybridization and cloning, HRT/HART, Chromosomal walk.
- Characterization of cloned genes
 - Restriction map, S1 mapping, Denaturation mapping, Heterologous mapping
- DNA sequencing, Nucleic acid Microarray
- Molecular markers
 - Linkage mapping using meiotic recombination frequencies
 - Genomic mapping using radiation induced Chromosome rearrangement
 - Genomic mapping using DNA sequence polymorphism as genetic marker
- Expression of cloned gene in heterologous host
- In vitro Mutagenesis
- Genomics and functional genomics
- Metagenomics
- Metabolic engineering
- Gene therapy
- Recombinant products-recombinant hormones, recombinant DNA vaccines
- Polymerase chain reaction
- Transgenic plants
- Transgenic animals

