**Approval: 9th Senate Meeting**

**Course Name: Molecular Biotechnology**
**Course Number:** BY515

**Credit:** 3-0-0-3

**Prerequisites:** IC 136 - Understanding Biotechnology & its Applications or Consent of Faculty member

**Students intended for:** B. Tech. 3rd and 4th year, MS/M. Tech., Ph.D.

**Elective or Compulsory:** Core for M. Tech. Biotechnology, Elective for others

**Semester:** Odd/Even

**Course Objective:**

This course will give basic and advanced description of molecular biology and recombinant DNA Technology. Genetic engineering techniques have been applied in several areas of Life Sciences and Biotechnology. By the end of this course, the students are expected to know how to apply genetic principles in order to understand the applications of biotechnology products such as enzymes, therapeutic proteins etc.

**Course Content:**

**Module 1** [6 Lectures]
Molecular Structure of Genes and Chromosomes: Chromosomal organization genes and non-coding DNA; Mobile DNA; Structural organization of eukaryotic chromosomes; DNA Replication.

**Module 2** [9 Lectures]
Transcriptional Control of Gene Expression: Eukaryotic gene control and RNA polymerase; regulatory sequences in protein coding genes; activators and repressors of transcription; mechanism of transcription activation and repression. Processing of eukaryotic pre-mRNA; transport across nuclear envelope; cytoplasmic mechanism of post-transcriptional control; processing of rRNA and tRNA.

**Module 3** [10 Lectures]
Principles of gene cloning and DNA analysis: The early development of genetics leading the invention of tools and techniques for gene cloning. Polymerase chain Reaction. DNA Manipulative Enzymes: Nucleases, ligases, polymerases, DNA modifying enzymes. Enzymes for cutting DNA: restriction endonucleases. The discovery and function of restriction endonucleases. Type II restriction endonucleases. Blunt ends and sticky ends. Ligation: Joining DNA molecules together. The mode of action of DNA ligase sticky ends, blunt ends, linkers and adaptors.

**Module 4** [10 Lectures]
Vectors for gene cloning: Bacteriophages: The phage infection cycle, Lysogenic phages. Gene organization in the λ DNA molecule, the linear and circular forms of λ DNA. M13—a filamentous phage. Viruses as cloning vectors for other organisms. Introduction of phage DNA into bacterial cells: Transfection, In vitro packaging of λ cloning vectors. Introduction of DNA into non-bacterial cells: Transformation of individual cells. Cloning Vectors for E. coli: Cloning vectors based on E. coli plasmids. More sophisticated E. coli plasmid cloning vectors: pUC8—a Lac selection plasmid, pGEM3Z—in vitro transcription of cloned DNA, cloning vectors based on M13 bacteriophage, how to construct a phage cloning vector, hybrid plasmid–M13 vectors. Insertion and replacement vectors. Cloning of long DNA fragments using a cosmid and other high-capacity vectors. Cloning vectors for animals and insects. Viruses as cloning vectors for mammals. Identification methods based on detection of the translation product of the cloned gene. A tutorial will follow this module on Software and online/freeware tools for analyzing restriction sites in DNA sequence.

**Module 5** [7 Lectures]
Applications of Genetic Engineering in Biotechnology: The Applications of Gene Cloning and DNA Analysis in Biotechnology. Production of Protein from Cloned Genes. General problems with the production of recombinant protein in E. coli. Problems resulting from the sequence of the foreign gene. Problems caused by E. coli. Production of recombinant protein by eukaryotic cells. Recombinant protein from Saccharomyces cerevisiae. Using animal cells for recombinant protein production. Protein production in mammalian and insect cells. Gene Cloning and DNA Analysis in Agriculture: The gene addition approach to plant genetic engineering. The δ-endotoxins of Bacillus thuringiensis as an example. Gene Cloning and DNA Analysis in Medicine. Production of recombinant pharmaceuticals. Recombinant insulin: Synthesis and expression of artificial insulin genes. Synthesis of other recombinant human proteins and vaccines.

**Text and Reference books:**
•Molecular Cell Biology, by Lodish et al (5th edition or recent), W.H. Freeman and Company, New York
•Molecular Biology of the Cell, by Alberts et al (4th edition or later), Garland Sciences, New York
•Genes XIII, by Benjamin Lewin. 8/e Pearson Prentice Hall, 2004.
•Sandy Primrose And Richard Twyman. Principles of Gene Manipulation and Genomics, 7/e Wiley-Blackwell, 2006.