UNIT I

1. The recombinant DNA Technology: General concept and Principle of cloning
2. Enzymes: Nucleases and restriction endonucleases - properties and types; phosphomonoesterases; polynucleotide kinase; DNA ligase; DNA polymerase I; RNA Dependent DNA Polymerase; terminal deoxynucleotidyl transferase; poly A polymerase
3. Prokaryotic host-vector system: Characteristics of E. coli as host; vectors for cloning in E. coli (plasmid, bacteriophage and plasmid-phage)
4. Other Prokaryotic host-vector systems: Characteristics of Gram positive and Gram negative organisms as host and suitable vectors for cloning; Shuttle Vectors

UNIT II

1. Design and characteristics of expression vectors for cloning in prokaryotes, factors that affect expression.
2. Cloning in yeast: Properties of yeast as host for cloning and different types of vectors designed for cloning in yeast.
4. Plant transformation technology: Features of Ti and Ri plasmids, mechanism of DNA transfer

UNIT III

1. Methods for constructing rDNA and cloning: Inserts; vector insert ligation; Infection, Transferring and cloning
2. Methods for screening and selection of recombinant clones
3. DNA Libraries: types, advantages and disadvantages of different types of libraries; Different methods for constructing genomic and full length cDNA libraries
4. Gross anatomy of cloned insert-size, restriction mapping and location

UNIT IV

1. Fine anatomy of DNA segment-General principle of chemical and enzymatic methods of nucleotide sequence analysis and advantages of automatic gene sequencers.
2. Localization of cloned segments in genomes - molecular and chromosomal location
3. Methods for determination of copy number of a cloned gene in genome
4. Mutant construction: Introduction, deletion, insertion and point mutation

UNIT V

1. Principles and applications of Blotting techniques - Southern, Northern, Western and Eastern blotting; Polymerase Chain reaction and types (multiplex, nested, RT, real time, touchdown PCR, hot start PCR, colony PCR), Oligonucleotide synthesis
2. Principle, and applications of Gel Mobility Shift Assay, DNA Fingerprinting and DNA Foot printing, Restriction fragment length polymorphism, Chromosome mapping and chromosome painting
3. Applications of Recombinant DNA Technology in Medicine and Industry

Practical Exercises

1. Bacterial Culture and antibiotic selection media. Preparation of competent cells
2. Isolation of plasmid DNA
3. Isolation of phage DNA
4. Quantitation of nucleic acids
5. Restriction mapping of plasmid DNA
6. Cloning in plasmid/phagemid vectors
7. Preparation of helper phage and its titration
8. Preparation of single stranded DNA template
9. Gene expression in E.coli and analysis of gene product
10. Polymerase Chain Reaction

Reference Books

1. Recombinant DNA - By Watson et al
2. Principles of Gene Manipulation, Old and Primrose
5. Molecular Genetics of Bacteria, Dale
7. Applied Molecular Genetics (1999), Miesfeld
8. Genes and Genome (1991), Singer & Berg
9. Molecular Biotechnology, Glick & Pasternak
10. Plant Molecular Biology (Vol I & II, 2002), Gilman & Bowler

Note: All text books are of latest edition.
UNIT I

1. Objectives, roles and landmarks in plant breeding.
2. Special breeding techniques: Mutational breeding and distant hybridization.
3. Generation of genetically modified crops for resistance against biotic and abiotic stresses and nutritional quality.
4. Seed production techniques: release of new varieties.

UNIT II

1. Introduction to plant tissue culture: Tissue Culture Media preparation.
2. Initiation of callus culture and its maintenance.
3. Cell synchronization

UNIT III

1. Somatic variation and its application for plant improvement
2. Anther culture: haploid and diploid plant cell production and their applications
3. Protoplast isolation and fusion; selection of hybrid cell and cybrids, artificial seed production.
4. Cryopreservation techniques and application

UNIT IV

1. Plant cloning vectors: T\textit{i} Plasmid and viral vectors (CaMV based vectors, Gemini viruses, TMV based vectors, Antisense RNA and ribosome technology
2. Transgenic in crop improvement: Methods for gene transfer, Chloroplast transformation
3. Marker assisted selection: Morphological, Biochemical and Molecular markers, advantages and disadvantages, choice of mapping populations, Association mapping in plants
4. Plant DNA fingerprinting: Hybridization and PCR based markers (RFLP, SSR’s, RAPD, QTLs, SCAR, AFLP etc)

UNIT V

1. Plant Genome mapping: Physical and molecular maps, Gene tagging, classification and types of gene families in plants.
2. Insect resistance: Bt genes, Non-Bt like protease inhibitors, lectins, PR proteins etc.
4. Intellectual property right (IPR) and Patenting of Biological material

Practical Exercises

1. Preparation of media
2. Surface sterilization
3. Organ Culture
4. Callus propagation, organogenesis, transfer of plants to soil
5. Protoplast isolation and culture
6. Anther culture, production of Haploids
7. Agrobacterium culture, selection of transformants, receptor gene (GUS) assays.
8. Genomic DNA isolation from seeds and plant tissues, electrophoretic analysis
9. Restriction digestion of plant genomic DNA
10. Setting up of PCR reactions.

Reference Books

2. Introduction to plant tissue culture by Kalyan Kumar
3. Plant tissue culture by Bhojwani
4. Practical applications of plant molecular biology by Henry et al
5. Principles of Plant Biotechnology by Montell SH et al
6. Plant Genome analysis by PM Gresshoff
7. Essentials of plant breeding by Phundan Singh
9. Genetic engineering by Sandhya Mitra
10. Plant Molecular Biology Vol I & II by Philip M Grinlind & Chris Bowler
303. BIOPROCESS ENGINEERING AND MICROBIAL TECHNOLOGY

UNIT I
1. Introduction and basic principle of Biochemical engineering
2. Isolation, preservation and maintenance of industrially important microbes: Strain improvement of industrially important microorganisms
3. Kinetics of microbial growth and death
4. Media for industrial fermentation, media formulation; Sterilization; Aeration and agitation in bioprocess. Air sterilization

UNIT II
1. Scale of fermentation process: small scale, large scale and pilot scale fermentations
2. Bioreactors: Principle, types, design and applications
3. Types of fermentation processes; batch, fed-batch, and continuous bioreactions.
4. Measurement and control of fermentation: pH, temperature, pressure, media, air, Automation of the monitoring and control process

UNIT III
1. Upstream processing and down stream processing: Introduction and concept.
2. Down stream processing: removal of microbial cells and solid matter, foam separation, precipitation, centrifugation, cell disruption, chromatography, reverse osmosis
3. Extraction: Solvent, two phases, liquid extraction
4. Product recovery process. Crystallization, storage, packaging and quality control

UNIT IV
1. Industrial production of important bioproducts: Vitamins and amino acids (Vit B12 & Glutamic acid)
2. Industrial production of important bioproducts: antibiotics-Penicillin; and streptomycin
3. Enzyme- Amylase, Protease. Production, recovery and scaling up of enzymes and their role in food and other industries
4. Immobilization of enzymes and their industrial applications

UNIT V
1. Microbial production of alcoholic beverages: Distilled alcoholic beverages-Beer, microbial production of Vinegar.
2. Microbial production of organic acids: Citric acid and Acetic acid
3. Microbial production of solvents: Ethanol and acetone
4. Microbial production of food- SCP Mushroom cultivation, Biofertilizers and their applications

Practical Exercises
1. Isolation of industrially important microbes from the environment
2. Determination of TDP and TDT of microorganisms for a design of a sterilizer
3. Determination of growth curve of a industrial organism and compute substrate, degradation profile, specific growth rate and growth yield
4. Screening and enrichment for a primary/secondary metabolite from the environment
5. Strain improvement for higher yield of a product
6. Random and strategic screening for a metabolite
7. Media balancing experiments
8. Alcohol fermentation using different substrates and its downstream processing

Reference Books

2. Biochemical Reactors, Atkinson, B., Pion Ltd. London.
UNIT I
1. Introduction to Biostatistics, Common terms, notions and Applications
2. Statistical population and Sampling Methods
3. Classification and tabulation of data
4. Diagrammatic and graphical presentation
5. Frequency Distribution, Measures and central value
6. Measures of variability, Standard deviation, Standard error, Range, Mean Deviation Coefficient of variation, Analysis of variance

UNIT II
1. Basic tests, Test of Significance, t-test, chi-square test.
2. Regression, Basics of regression, regression analysis, Estimation, Testing, prediction, checking and residual analysis.
3. Multivariate Analysis
4. Design of Experiment, randomization, replication, local control, complimentary randomized, randomized block design

UNIT III
1. Factor Analysis
2. Path Analysis
3. Introduction to data mining
4. Virtuous cycle

UNIT IV
1. Classification and Discriminant Analysis Tools: CART, random forests
2. Fischer's discriminant functions
3. Neural networks
4. Multilayer perception, predictive ANN model building using back propagation Algorithm, exploratory data analysis

UNIT V
1. Introduction to computer basics, concept of hardware windows XP and LINUX
2. Concept of life, folders, directories and their management by windows XP and LINUX
3. Office applications: MS-office, MS-Word, MS-Excel, and MS-PowerPoint
4. Open Office on Linux: Word Processor, spread sheets, Impress
5. Statistical packages: Sigma plot etc.

Reference Books
1. An Introduction to Computational Biochemistry by C Stan T sai
2. Statistics for Agricultural Sciences by Nageswara Rao, G.
3. Fundamentals of statistics by Goon et al, 1962...
4. Methods in Biostatistics by B.K. Mahajan
5. Statistical methods by S.P. Gupta
7. Fundamental of artificial Neural Networks, Prentice-Hall of India, N.Delhi