Jodhpur National University

M.Phil. Biotechnology Syllabus

First Semester

Paper – I – Biotechnology

(Major Elective): BCE 203 : Outlines of Biotechnology

Marks: 100

1. Plant genetic engineering and prospects of improving crop productivity, gene isolation, gene transfer systems, Ti plasmid, plant virus vectors, electroporation, microinjection, microprojectile technology, gene expression, regeneration. Application in relation to protein quality, photosynthetic efficacy, nitrogen fixation efficiency and resistance to environmental stresses. (10)
2. Tissue culture – Plant tissue culture, anther and pollen culture, protoplast culture, protoplast fusion, embryo rescue, animal cell lines and organ culture. (8)
3. Transgenic plants and animals (3)
4. Fermentation technology – Fermentors, general design of fermentor, fermentation processes, production of alcohols, antibiotics, steroids and enzymes; biotransformation, biomass & production of single cell protein. (8)
5. Hybridoma technology – Monoclonal antibodies, selection of hybrids, hybridomas, purification and application of monoclonal antibodies. (5)
6. Xenobiotics metabolism – Biodegradation, detoxification of xenobiotics by microorganisms, biodegradation of hydrocarbons, pesticides, surfactants, polyaromatic hydrocarbons, dyes; role of Cytochrome P450 in detoxification. (6)
7. Proteomics- Genome to Proteome, Steps and tools for proteome analysis. (3)
8. Enzyme Technology - Large scale production of enzymes, enzyme reactors, immobilization of enzymes by chemical and physical methods. Effect of partition on kinetics and on changes in pH and hydrophobicity. Applications: fundamental studies of biochemistry, synthetic organic chemistry, industry, food technology, medicines. Synzymes, enzyme electrodes & biosensors. (10)

PAPER II

PLANT AND ANIMAL BIOTECHNOLOGY

Credits: 5 Hours: 5/Wk

Unit I

Plant tissue culture - Nutritional requirements, plant growth hormones, genetic variation and chromosome stability. Protoplast isolation, culture and Somatic hybridization. Production of haploid plants. Germplasm conservation.

Unit II

Transformation, Transgenic plants - Pest and Disease resistance. Recombinant proteins and edible vaccines. Molecular Markers- RAPD, RFLP, SNPs. Production of secondary metabolites.

Unit III

Development of cell line, Separation of viable and non - viable cells. Cell cultures, cytotoxicity of cultured cells. Tissue culture techniques. Recombinant subunit and DNA vaccines. Monoclonal antibody production. Nucleic acid probes and hybridization. Tissue typing.

Unit IV

Embryo transfer technology. In-vitro fertilization. Transfer of genes: micro injection, electroporation and liposome mediated transformation. Stem cells – Embryonic and adult. Molecular pharming: Production of pharmaceuticals and biomolecules – Hormones and Steroids.

Unit V

Intellectual Property rights (IPR), General agreement on tariff and trade (GATT), Trade related intellectual property (TRIP), Patents for plants, animals, transgenic organisms and DNA sequences. Plant breeder's and farmer's rights. Biosafety and ethical issues.

Recommended Books

- Ralf Pörtner, 2007. Animal Cell Biotechnology: Methods and Protocols (Methods in Biotechnology). 2nd Edition. Humana Press.
- R.Spier and J.Griffiths, 1994. Animal Cell Biotechnology.. Academic Press.
- D.C. Darling and S.J. Morgan, 1994. Animal Cells Culture and media, BIOS Scientific
- Publishers Limited.
- Jennie P. Mather and David Barnes, 1998. Methods in Cell Biology, Volume 57: Animal Cell Culture Methods Academic Press.
- Ann Harris, 1996. Epithelial Cell Culture, Cambridge University Press.
- M .M. Ranga, 2000.Animal Biotechnology ,Agrobios (India),
- Kalyan Kumar De, 1992. Plant Tissue Culture , New Central Book Agency ,Calcutta
- Robert N. Trigiano, Dennis J. Gray, 1996. Plant Tissue Culture Concept and Laboratory Exercises , CRC Press , London.
- P.S. Srivasta, 1998. Plant Tissue Culture and Molecular Biology , Narosa Publishing House ,New Delhi.
- David W. Galbraith, Hans J. Bohnert and Don P. Bourque, 1995. Methods in Plant Cell Biology, Academic Press, New York.
- John H. Dodds and Lorrin W. Roberts , 1995. Experiments in Plant Tissue Culture, Cambridge University Press , USA.
- Singh, S.K. & Srivastava, Seema. 2006.Plant Tissue Culture Eastern Book Corporation, India
- Narayanaswamy, S, 1994. Plant Cell And Tissue Culture Tata McGraw Hill Publishers

Paper III : BIOSTATISTICS & COMPUTER APPLICATION

Unit I: Probability theory: Classical, Statistical and Axiomatic definitions; Theorems of Probability: Addition and Multiplication theorems, conditional probability, Bayes' Theorem. Probability Distribution Functions: Binomial, Poisson and Normal Distribution, Area under normal curve.

Unit II: Descriptive Statistic: Location and Scale Parameters, Criteria for best measure of Central Tendency and Dispersion; Measures of Central Tendency: Mode, Median, Arithmetic, Geometric and Harmonic Means, Relationship among different means; Measures of Dispersion: Range, Quartile Deviation, Mean Deviation, Variance, Standard Deviation, Coefficient of Variation; Standard Error, Confidence limits of Mean.

Unit III: Inferential Statistic: Test of Significance and Hypotheses, one and two tail tests, errors in test of Hypotheses; Student't' statistic: tests of independent and dependent means, sample size; Analysis of Variance: One and Two way classification, Completely Randomized Design, Randomized Block Design, Multiple Comparisons; Factorial Design; Analysis of Covariance.

Unit IV: Correlation and regression: Scatter and Regression diagrams, Coefficient of Correlation, determination and non-determination; Least Square Analysis: Coefficient of Regression, Regression Equation, Lines of Regression; Curve fitting: Linear relationship, Power Laws, Exponential Laws; Chi-square statistics for continuous and enumeration data.

Unit V: Computer System: Definition; Components (Input/Output unit, Control Unit, Primary Storage Unit, Arithmetic and Logic Unit); Generations of Hardware and Software; Number Systems (Decimal , Binary, Hexadecimal and Octal Number Systems); Architecture of the Modern Computer; Bioinformatics: Concept and Applications, Biological databases, Tools like BLAST, FASTA, Clustal, etc.

Paper – IV : ADVANCES IN BIOTECHNOLOGY

UNIT I: INVESTIGATION OF ENZYMES AND THEIR APPLICATIONS

Principles of enzymatic analysis- handling enzymes and coenzyme, Biotechnological application of enzymes: Large- scale production of enzymes- Immobilized enzymes - Enzyme utilization in industry- Enzymes and recombinant DNA technology- Applications in medicine. Applications in industry.

UNIT-II: MICROBES IN PHARMACEUTICAL AND FOOD INDUSTRIES: production, harvest, recovery, uses and mode of action- enzymes, antibiotics, vitamins (812, 82) organic acids (acetic acid, lactic acid, citric acid), alcohol (ethanol), organic solvents (acetone- butanol), amino acids, beverages (beer, wine, brandy), microbial supplements (Lactic acid bacteria) as medicine, biopolymer, biofertilizers, biocides, Sterodi biotransformatoin.

Improvement in production - improved strains by protoplast fusion, recombination, Alteration in metaboilic pathway; immobilization of cells.

UNIT- III: BIOREMEDIATION: Xenobiotics -microbial mechanism; Microbial mining, ore leaching, oil recovery; solid waste treatment- composting, vermicomposting, biofuel, animal feed, mushroom cultivation, oil spill remediation, biomedical waste treatment; Wastewater treatment primary, secondary and tertiary (Biological), heavy metal removal, artillery industrial waste treatment.

UNIT-IV: TRANSGENIC PLANTS AND THEIR APPLICATIONS : Transgenic plants: Genetic engineering of plants for herbicide resistance, Pest resistance, virus resistance, Disease resistance, Stress tolerance, Cytoplasmic male sterility, Delayed fruit ripening. Genetic engineering in floral industries, Genetic engineering of seed storage proteins. Vaccine production in plants, Edible vaccine, Transgenic plants as bioreactors.

UNIT- V: TRANSGENIC ANIMALS AND THEIR APPLICATIONS

Transgenics: Transgenic animal, production, and application, Transgenic animals as Models for human disease, Transgenic animals in live- stock improvement, expression of the bovine growth hormone, Transgenics in industry, Ethical issues in animal biotechnology.

Second Semester

DISSERTATION

The candidate shall submit the dissertation on problem connected with any one disciplines of his papers.