

BHARATHIAR UNIVERSITY : COIMBATORE- 641 046

M.Phil./Ph.D. in Molecular Biology and Biotechnology  
(w.e.f. 2008-2009 and onwards)

PART-I SYLLABUS

PAPER I : Teaching / Pedagogical Techniques in Life Sciences

PAPER II : Research Methodology

PAPER III : Special Papers

1. Plant Biotechnology

2. Molecular Biology

## Paper-I : Teaching Techniques / Pedagogical Techniques in Life Sciences

### **UNIT I - Teaching Techniques**

Meaning, Concept and Scope – Instructional Designs – Objective based, Skill Based, Competency based, Learning Style base and Model Based. Instructional Media, Concept, Selection and Use; Variety of Learning; e-Learning; e-Book, e-Journals, Web - based learning.

### **UNIT II - Thesis Writing**

Format of Thesis and dissertation; Research article; Reviews; Monographs; Bibliography; Literature search; Citation literature; Significance of research, Research methods versus methodology, Research and Scientific Methods; Defining the research problem; Research Design.

### **UNIT III - Interpretation and Report Writing**

Meaning of interpretation; Techniques of interpretation; Precautions in Interpretation; Significance of Report writing; Different steps in Report writing; Layout of Research Project; Types of Reports; Patent writing and filing and Oral presentation.

### **UNIT IV - Data Processing**

Data acquisition and Management : DNA, RNA and Protein sequence; Protein Structure data; Gene and Protein expression data; Sequence analysis with acquired data sequence comparison; Alignment, Building Phylogenetic Trees; Use of Micro-array to study gene expression and protein expression; Molecular visualization tool study, Protein Structure Bioinformatics and Drug discovery.

### **UNIT V - Statistical Methods**

Definition and Scope; Types of data; Collection and presentation of Data (Tables, Graphs, Diagrams); Measure of Central Tendency; Dispersion; Skewness and Kurtosis; Testing of significance; Goodness of fit ( $\chi^2$  Test); Students t-test; Simple Regression; Correlation Coefficient; ANOVA (One way and Two way analysis)

### **References:**

1. Kumar K. L.' (1997), Educational Technology, New Age International (P) Ltd., New Delhi.
2. Kothari, C.R; II ed. (2004), Research Methodology, Methods and techniques; New Age Internartional (p) Ltd., Publishers, New Delhi.
3. Jerrald H. Zar (1999), Biostatistical analysis of Prentice Hall International, Inc. Press, London
4. Atttwood, T.K. and Pary Smith, D. J. (2002); Introduction to Bioinformatics, Pearson Education, Singapore.
5. Tony Bates A.W. Technology, (2005), e-Learning and Distance Education, New York, Routledge.

## Paper-II : Research Methodology

### **Unit – I INTRODUCTION TO METHODOLOGY**

Format of thesis and dissertation, Research article, Reviews, Monographs, Bibliography, Literature search, Citation literature Principles of Chromatography Ion exchange, size exclusion, and Affinity column, HPLC and Gas chromatography, GLC: GCMS significance of research, research methods versus methodology, research and scientific methods. Defining the research problem, research design.

### **Unit –II PRINCIPLES OF INSTRUMENTATION**

Principles and applications of the following: Microscope- Fluorescence, Confocal, Phase contrast, Electron (Scanning and transmission)- Centrifugation high speed and ultra, Eelectrophoresis- Polyacrylamide, Agarose, Pulsed field electrophoresis, Denaturing gradient gel electrophoresis, Immunoelectrophoresis. Isoelectric focussing: NMR, CD, IR, DSC, Spectrophotometry- Principle and application of Spectrophotometer- Visible, UV, Atomic absorption spectrophotometer- Spectrofluorimetry, Floweytometry, Immunotechniques- ELISA, Immunoblotting. Characterization of Chromosomes by various banding techniques. RIA.

### **Unit –III CELL CULTURE, AND MOLECULAR BIOLOGICAL TECHNIQUES**

PREPARATION OF Culture media, Modes of sterilization, Culture of microbes. Plant and animal cell and Tissue Bioprocess Engineering : Operation types, Continuous, Batch, Fed batch. Designs: Fluidized bed, Packed bed, Immobilization of enzyme and cells. Nucleic acid isolation- Isolation of genomic DNA, RNA, Plasmid DNA, PCR and blotting techniques and Hybridization technique.

### **Unit- IV BIostatISTICS**

Definition and scope. Types of biological data- Collection and presentation of data (Table, Graphs, Diagrams). Measures of central tendency, Dispersion, Skewness and Kurtosis: Probability analysis- Testing of significance- Goodness of fit (X<sup>2</sup> test)- Student 's t-test-Simple regression- Correlation coefficient- ANOVA (One way and two way analysis).

### **Unit- V BIOINFORMATICS**

Data acquisition and management DNA, RNA and Proteins sequences, Protein structure data, Gene and protein expression data. Sequence analysis with acquired data: Sequence comparison, alignment, building Phylogenetic trees, Use of Micro arrays to study gene expression and Protein expression, Molecular visualization tools study protein structure, Bioinformatics and Drug discovery.

### **Reference**

1. C.R. Kothari, IInd edition (2004) Research methodology, Methods and techniques, New Age Internation (P) Ltd, Publishers, New Delhi.
2. Jerrod H. Zar (1999) Biostatistical analysis by, Prentice Hall International, Inc. Press, London.
3. Attwood.T.K & Parry-Smith D.J.(2002) Introduction to Bioinformatics, Pearson education Singapore.
4. M.K. Razdan (2003) Plant tissue culture, Oxford and IBH Publishing Co. Pvt, Ltd, New Delhi.
5. Stanbury, P.F.and Whitaker,A.,Principles of Fermentation technology,PergamonPress,Oxford.

## Special Paper - 2 : Plant Biotechnology

### **Unit – I GENOME ORGANIZATION AND ENGINEERING**

Plant genome organization, structure of plant gene, Gene family, Chloroplast genome, Mitochondrial genome. Importance of RELP and RAPD in plant breeding Construction of cDNA library. Protein targeting to chloroplast and mitochondria, heat shock proteins.

### **Unit –II TISSUE CULTURE TECHNIQUES**

Brief historical account: Laboratory organization: Preparation of media: Aseptic manipulation: Sterilization of media, Culture vessels and explants: Single cell culture, Suspension culture. Cellular totipotency, Somatic embryogenesis: Synthetic seeds: Somaclonal and gameticclonal variation. Shoot tip culture, Haploid production: Anther and Pollen culture: Triploid production: In vitro pollination and Fertilization, Embryo culture.

### **Unit- III APPLICATION OF TISSUE CULTURE**

Protoplast isolation and culture: Somatic hybridization, Cybrid technology, Micropropagation: Gemplasm conservation: Production of secondary metabolites: Genetic engineering of metabolic pathways, Production of secondary metabolites in Bioreactors and downstream procession.

### **Unit – IV MOLECULAR BIOLOGY OF PLANT MICROBIAL INTERATION AND TRANSFORMATION**

Biofertilizers: Symbiotic and Non-symbiotic nitrogen fixation, Biochemistry and Molecular biology of biological nitrogen fixation, Genetic engineering of nif genes and nod genes. Mycorrhizae: Ecto and Endo Mycorrhizae, Agrobacterium and Crown gall tumours, Mechanism of T- DNA transfer. Ti and Ri plasmid vectors Agro infection. Direct transfer of plants by physical methods. Selectable marker and reporter genes, Chloroplast transformation.

### **Unit- V TRANSGENIC PLANTS AND THEIR APPLICATIONS**

Transgenic plants: Genetic engineering of plants for herbicide resistance, Pest resistance, Virus resistance, Disease resistance, Stress tolerant. Cytoplasmic male sterility, Delayed fruit ripening. Genetic engineering in flower industries, Genetic engineering of seed storage proteins. Vaccine production in plants, Edible vaccine, Transgenic plants as bioreactors.

### **References**

1. Chrispeels M.J & Sadava D.E. (2002).Plants, genes and agriculture.The American Scientific publishers.
2. Chawla H.S. (2004) Biotechnology in crop improvement. International book Distribution Co.,
3. Donal Grierson & Convey S.V. (1984). Plant Molecular Biology by Blackie & Son Ltd, Newyork.
4. Hammond J. Mc Garvey P. and Usibov V. Y (Eds) (2000). Plant Biotechnology Springer Verlag.
5. Moncia, A. Hughes. (1999). Plant Molecular genetics by Pearson education limited, England.
6. Razdan M.K. (2003) . Introduction to plant tissue culture Oxford- IBH publishing Co. Pvt.Ltd.
7. Slater, A. Scott, N and Fowler, M. (2003). Plant Biotechnology: The genetic manipulation of plants. Oxford press.

## Special Paper - 2 : Molecular Biology

### **Unit 1: Molecular Cloning**

Vectors in Molecular Biology- Modifying Enzyme- Polymerase chain reaction- DNA/Protein sequencing – Mutagenesis- Transposable Elements- rRNA/ Genomic/ c DNA Library construction and screening – Map based cloning

### **Unit-II: Cloning in Microorganisms**

Cloning Techniques: cloning in E-coli- Cloning in *Bacillus subtilis*- Cloning in Yeast  
Specialized vectors: Artificial chromosomes- Operons- Expression of cloned genes- site directed mutagenesis- fusion proteins- Degradative plasmids.

### **Unit III: Cloning in higher Organisms:**

DNA mediated transformation – Gene transfer by viral transduction – Genetic manipulation of mammals- DNA transfer to other vertebrates- Gene transfer in plants- Direct and indirect gene delivery systems- plant viruses as vectors.

### **Unit IV: Applications of Genetic Engineering**

Nucleic acid sequences as diagnostic tools- New drugs/ Therapies for genetic disease- combating infectious diseases- Protein engineering- Metabolic Engineering- Molecular Breeding of plants- Production of interferon's- DNA vaccines

### **Unit V Recent advances in Biotechnology**

DNA/ Protein micro arrays- DNA/ Protein Markers- DNA finger printing- Gene knock out – RNAi and Gene silencing – Metagenomics- Bioethics and IPR

### **Reference:**

1. Bowtell, D and Sambrook, J. DNA Microarray: A Molecular cloning manual. CSHL press
2. Glick, BR., Pasternak, JJ (1998) Molecular Biotechnology: Principles and Applications of recombinant DNA, ASM Press.
3. Grandi, G (2004) Genomics, Proteomics and Vaccines. Wiley press.
4. Hannon, GJ, RNAi: A guide to gene silencing. CSHL Press
5. Kirby, LT (1990) DNA finger printing: An introduction,. Stockton press.
6. Lewin, B (2004). Genes VIII. Pearson- Prentice Hall Press
7. Primrose, S.B., Twyman, R.M., Old. R.W. (2001) Principles of Gene Manipulation Blackwell Science Limited.

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