



# Mahatma Phule Krishi Vidyapeeth Rahuri-413 722, Dist. Ahmednagar (MS)

## Master's Programme In Agricultural Biotechnology

### Course Layout

#### 1. M.Sc. (Agricultural Biotechnology)

#### Minimum Credit Requirements

Sr. No.	Subject	Minimum credit(s)
1.	Major	20
2.	Minor	09
3.	Supporting	05
4.	Seminar	01
5.	Research	20
	<b>Total Credits</b>	<b>55</b>
	Compulsory Non Credit Courses	06

#### A) Major Subjects (Min. 20 credits)

Sr. No.	Course No.	Course Title	Credits
1.	MBB 501	Principles of Biotechnology	3(2+1)
2.	MBB 502	Fundamentals of Molecular Biology	3(3+0)
3.	MBB 503	Molecular Cell Biology	3(3+0)
4.	MBB 504	Plant Tissue Culture & Genetic Transformation	3(1+2)
5.	MBB 505	Techniques In Molecular Biology	3(0+3)
6.	MBB 508	Genomics and Proteomics	2(2+0)
7.	MBB 555	Introduction to Bioinformatics	3(2+1)

**B) Minor Subjects (Min. 09 credits)**

Sr. No.	Course No.	Course Title	Credits
1.	MBB 507	Molecular Breeding	2(2+0)
2.	MBB 510	Biosafety, IPR & Bioethics	2(2+0)
3.	MBB 512	Immunology and Molecular Diagnostics	3(2+1)
4.	MBB 553	Biostatistics and Computers	3(2+1)

**C) Supporting Subjects (Min. 5 credits)**

Sr. No.	Course No.	Course Title	Credits
1.	PP 503	Physiological and Molecular Responses of Plants to Abiotic Stresses	3 (2+1)
2.	BIOCHEM 510	Carbon and Nitrogen Metabolism	3(2+1)

**C) Seminar (1 credit)**

Sr. No.	Course No.	Course Title	Credits
1.	MBB 591	Masters Seminar	1(0+1)

**D) Masters Research (20 credits)**

Sr. No.	Course No.	Course Title	Credits
1.	MBB 599	Masters Research	20(0+20)

**E) Non Credit Compulsory Courses\***

Sr. No.	Course No.	Course Title	Credits
1.	PGS 501	Library and Information Services	1(0+1)
2.	PGS 502	Technical Writing and Communications Skills	1(0+1)
3.	PGS 503 (e-Course)	Intellectual Property and its Management in Agriculture	1(1+0)
4.	PGS 504	Basic Concepts in Laboratory Techniques	1(0+1)
5.	PGS 505 (e-Course)	Agricultural Research, Research Ethics and Rural Development Programmes	1(1+0)
6.	PGS 506 (e-Course)	Disaster Management	1(1+0)

# Course Contents

## Major Subjects:

### **MBB 501 PRINCIPLES OF BIOTECHNOLOGY 2+1**

**Objective:** To familiarize the students with the fundamental principles of Biotechnology, various developments in Biotechnology and its potential applications.

**Theory:** UNIT I History, scope and importance; DNA structure, function and metabolism. UNIT II DNA modifying enzymes and vectors; Methods of recombinant DNA technology; Nucleic acid hybridization; Gene libraries; PCR amplification; Plant and animal cell and tissue culture techniques and their applications. UNIT III Molecular markers and their applications; DNA sequencing; Applications of gene cloning in basic and applied research; Genetic engineering and transgenics; Genomics, transcriptomics and proteomics. UNIT IV General application of biotechnology in Agriculture, Medicine, Animal husbandry, Environmental remediation, Energy production and Forensics; Public perception of biotechnology; Bio-safety and bioethics issues; Intellectual property rights in biotechnology.

**Practical** i. Isolation of genomic and plasmid DNA ii. Gel electrophoresis techniques iii. Restriction enzyme digestion, ligation, transformation and screening of transformants iv. PCR and molecular marker analysis v. Plant tissue culture: media preparation, cell and explant culture, regeneration and transformation.

### **MBB 502 FUNDAMENTALS OF MOLECULAR BIOLOGY 3+0**

**Objective:** To familiarize the students with the basic cellular processes at molecular level.

**Theory:** UNIT I Historical developments of molecular biology; Nucleic acids as genetic material; Chemistry, structure and properties of DNA and RNA. UNIT II Genome organization in prokaryotes and eukaryotes; Chromatin structure and function; DNA replication; DNA polymerases, topoisomerases, DNA ligase, etc; Molecular basis of mutations; DNA repair mechanisms. 4 UNIT III Transcription process; RNA processing; Reverse transcriptase; RNA editing; Ribosomes structure and function; Organization of ribosomal proteins and RNA genes; Genetic code; Aminoacyl tRNA synthases. UNIT IV Translation and post-translational modifications; Operon concept; Attenuation of trp operon; important features of gene regulation in eukaryotes.

### **MBB 503 MOLECULAR CELL BIOLOGY 3+0**

**Objective:** To familiarize the students with the cell biology at molecular level.

**Theory:** UNIT I General structure and constituents of cell; Similarities and distinction between plant and animal cells; Cell wall, cell membrane, structure and composition of biomembranes, cell surface related functions. UNIT II Structure and function of major organelles: Nucleus, Chloroplasts, Mitochondria, Ribosomes, Lysosomes, Peroxisomes, Endoplasmic reticulum, Microbodies, Golgi apparatus, Vacuoles, etc. UNIT III Organellar genomes and their manipulation; Ribosomes in relation to cell growth and division; Cytoskeletal elements. UNIT IV Cell division and regulation of cell cycle; Membrane transport; Transport of water, ion and biomolecules; Signal transduction mechanisms; Protein targeting.

### **MBB 504 PLANT TISSUE CULTURE & GENETIC TRANSFORMATION 1+2**

**Objective:** To familiarize the students and provide hands on training on various techniques of plant tissue culture, genetic engineering and transformation.

**Theory:** UNIT I History of plant cell and tissue culture; Culture media; Various types of culture; callus, suspension, nurse, root, meristem, etc.; In vitro differentiation: organogenesis

and somatic embryogenesis; Plant growth regulators: mode of action, effects on in vitro culture and regeneration; Molecular basis of plant organ differentiation. UNIT II Micropropagation; Anther and microspore culture; Somaclonal variation; In vitro mutagenesis; In vitro fertilization; In vitro germplasm conservation; Production of secondary metabolites; Synthetic seeds. UNIT III Embryo rescue and wide hybridization; Protoplast culture and regeneration; Somatic hybridization: protoplast fusion, cybrids, asymmetric hybrids, etc. UNIT IV Methods of plant transformation; Vectors for plant transformation; Genetic and molecular analyses of transgenics; Target traits and transgenic crops; Biosafety issues, testing of transgenics, regulatory procedures for commercial approval.

**Practical:** i. Laboratory set-up. ii. Preparation of nutrient media; handling and sterilization of plant material; inoculation, subculturing and plant regeneration. iii. Anther and pollen culture. iv. Embryo rescue. v. Suspension cultures and production of secondary metabolites. vi. Protoplast isolation, culture and fusion. vii. Gene cloning and vector construction viii. Gene transfer using different methods, reporter gene expression, selection of transformed tissues/plants, molecular analysis.

### **MBB 505 TECHNIQUES IN MOLECULAR BIOLOGY-I 0+3**

**Objective:** To provide hands on training on basic molecular biology techniques.

**Practical:** UNIT I Good lab practices; Biochemical techniques: Preparation of buffers and reagents, Principle of centrifugation, Chromatographic techniques (TLC, Gel Filtration Chromatography, Ion exchange Chromatography, Affinity Chromatography). UNIT II Gel electrophoresis- agarose and PAGE (nucleic acids and proteins); Growth of bacterial culture and preparation of growth curve; Isolation of plasmid DNA from bacteria; Growth of lambda phage and isolation of phage DNA; Restriction digestion of plasmid and phage DNA; Isolation of high molecular weight DNA and analysis. UNIT III Gene cloning – Recombinant DNA construction, transformation and selection of transformants; PCR and optimization of factors affecting PCR. UNIT IV Dot blot analysis; Southern hybridization; Northern hybridization; Western blotting and ELISA; Radiation safety and non-radio isotopic procedure.

### **MBB 555 INTRODUCTION TO BIOINFORMATICS 2+1**

**Objective:** To impart an introductory knowledge about the subject of bioinformatics to the students studying any discipline of science.

**Theory** UNIT I Introduction, biological databases – primary, secondary and structural, Protein and Gene Information Resources – PIR, SWISSPROT, PDB, genbank, DDBJ. Specialized genomic resources. UNIT II DNA sequence analysis, cDNA libraries and EST, EST analysis, pairwise alignment techniques, database searching, multiple sequence alignment. UNIT III Secondary database searching, building search protocol, computer aided drug design – basic principles, docking, QSAR. UNIT IV Analysis packages – commercial databases and packages, GPL software for Bioinformatics, web-based analysis tools.

**Practical** i. Usage of NCBI resources ii. Retrieval of sequence/structure from databases iii. Visualization of structures iv. Docking of ligand receptors v. BLAST exercises.

## **A) Minor Subjects**

### **MBB 507 MOLECULAR BREEDING 2+0**

**Objective:** To familiarize the students about the use of molecular biology tools in plant breeding.

**Theory:** UNIT I Principles of plant breeding; Breeding methods for self and cross pollinated

crops; Heterosis breeding; Limitations of conventional breeding; Aspects of molecular breeding. UNIT II Development of sequence based molecular markers - SSRs and SNPs; Advanced methods of genotyping; Mapping genes for qualitative and quantitative traits. UNIT III QTL mapping using structured populations; AB-QTL analysis; Association mapping of QTL; Fine mapping of genes/QTL; Map based gene/QTL isolation and development of gene based markers; Allele mining by TILLING and Eco-TILLING; Use of markers in plant breeding. UNIT IV Marker assisted selection (MAS) in backcross and heterosis breeding; Transgenic breeding; Foreground and background selection; MAS for gene introgression and pyramiding; MAS for specific traits with examples.

#### **MBB 510 BIOSAFETY, IPR AND BIOETHICS 2+0**

**Objective:** To discuss about various aspects of biosafety regulations, IPR and bioethics concerns arising from the commercialization of biotech products.

**Theory:** UNIT I Biosafety and risk assessment issues; Regulatory framework; National biosafety policies and law, The Cartagena protocol on biosafety, WTO and other international agreements related to biosafety, Cross border movement of germplasm; Risk management issues - containment. UNIT II General principles for the laboratory and environmental biosafety; Health aspects; toxicology, allergenicity, antibiotic resistance, etc; Impact on environment: gene flow in natural and artificial ecologies; Sources of gene escape, tolerance of target organisms, creation of superweeds/superviruses, etc. UNIT III Ecological aspects of GMOs and impact on biodiversity; Monitoring strategies and methods for detecting transgenics; Radiation safety and nonradio isotopic procedure; Benefits of transgenics to human health, society and the environment. UNIT IV The WTO and other international agreements; Intellectual properties, copyrights, trademarks, trade secrets, patents, geographical indications, etc; Protection of plant variety and farmers right act; Indian patent act and amendments, patent filing; Convention on biological diversity; Implications of intellectual property rights on the commercialization of biotechnology products.

#### **MBB 512 IMMUNOLOGY AND MOLECULAR DIAGNOSTICS 2+1**

**Objective:** To discuss the application of various immunological and molecular diagnostic tools.

**Theory:** UNIT I History and scope of immunology; Components of immune system: organs, tissues and cells, Immunoglobulin chemistry, structure and functions; Molecular organization of immunoglobulins and classes of antibodies. UNIT II Antibody diversity; antigens, haptens, antigens- antibody interactions; immuno-regulation and tolerance; Allergies and hypersensitive response; Immunodeficiency; Vaccines; Immunological techniques. UNIT III Immunological application in plant science, monoclonal antibodies and their uses, molecular diagnostics. Introduction to the basic principles of molecular technology and techniques used in pathogen detection, Principles of ELISA and its applications in viral detection. UNIT IV Basics and procedures of PCR, Real time PCR, PCR based and hybridization based methods of detection, microarrays based detection, multiplexing etc, detection of soil borne and seed born infections, transgene detection in seed, planting material and processed food, molecular detection of varietal impurities and seed admixtures in commercial consignments.

**Practical:** i. Preparation of buffers and reagents. ii. Immunoblotting, immunoelectrophoresis and fluorescent antibody test. iii. Enzyme immunoassays including ELISA western blotting. iv. Extraction and identification of DNA/RNA of pathogenic organisms. v. Restriction hybridoma technique and production of monoclonal antibodies. vi. Immunogenic proteins, expression and immunogenicity studies, purification of immunogenic protein and immunization of laboratory animals.

### **MBB 553 BIOSTATISTICS AND COMPUTERS 2+1**

**Objective:** This is the special course for M.Sc. students of Biotechnology. They are exposed to various statistical methods to analyze their experimental data. Theory UNIT I Aims, scope and idea of elementary statistics; Measures of central tendency and dispersion, skewness and kurtosis. UNIT II Concept of probability and probability laws, mathematical expectation, moments, moments generating function; Standard probability distributions- Binomial, Poisson and Normal distributions. UNIT III Tests of significance based on Z,  $\chi^2$ , t and F statistics; Correlation and regression, curve fitting by least squares methods. UNIT IV Basic principles, organization and operational aspects of computers, operating systems. Introduction to MS-Office, MS-Word, MS-Excel. Statistical Data analysis based on above topics through MS-Excel.

**Practical:** i. Data analysis using probability, test of significance ii. Correlation and regression analysis iii. Usage of MS-Windows iv. Exercises on test processing, spreadsheet and DBMS v. SPSS

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