

S-08th July, 2014 AC after Circulars from Circular No.84 & onwards

- 14 -

**DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY**

**CIRCULAR NO.ACAD/SU/Sci./Syllabus/93/2014**

It is hereby notified for information of all concerned that, on the recommendations of the Ad-hoc Boards and Dean, Faculty of Science, the **Academic Council at its meeting held on 08-07-2014** has accepted the following revised syllabi as mentioned against their nomenclature for **B.Sc. & M.Sc. under the Faculty of Science :-**

<b>Sr. No.</b>	<b>Revised Syllabus</b>	<b>Semester</b>
[1]	<b>B.Sc. Environment Science [Optional]</b>	<b>I &amp; II</b>
[2]	<b>B.Sc. Sericulture [Optional]</b>	<b>I &amp; II</b>
[3]	<b>B.Sc. Automobile Technology Degree Course</b>	<b>I &amp; II</b>
[4]	<b>B.Sc. Workshop Technology Degree Course</b>	<b>I &amp; II</b>
[5]	<b>B.Sc. Refrigeration &amp; Air Conditioning Degree Course</b>	<b>I &amp; II</b>
[6]	<b>B.Sc. Forensic Science Degree Course</b>	<b>III &amp; IV</b>
[7]	<b>B.Sc. Polymer Chemistry [Optional]</b>	<b>III &amp; IV</b>
[8]	<b>B.Sc. Environment Science [Optional]</b>	<b>III &amp; IV</b>
[9]	<b>M.Sc. Plant Breeding &amp; Molecular Genetics</b>	<b>III &amp; IV</b>

This is effective from the **Academic Year 2014-2015** and onwards.

These **syllabi are available on the University Website.**

All concerned are requested to note the contents of this circular and bring the notice to the students, teachers and staff for their information and necessary action.

University Campus,  
Aurangabad-431 004.  
REF.NO.ACAD/SU/B.Sc. & M.Sc./  
2014/16264-463  
**A.C.S.A.I.No.462[18].**

Date:- 12-08-2014.

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**Director,**  
**Board of College and**  
**University Development.**

S-08th July, 2014 AC after Circulars from Circular No.84 & onwards

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**Copy forwarded with compliments to :-**

- 1] **The Principals, affiliated concerned Colleges,  
Dr. Babasaheb Ambedkar Marathwada University.**
- 2] The Director, University Network & Information Centre, UNIC, with  
**a request to upload the above all syllabi on University Website.**

**Copy to :-**

- 1] The Controller of Examinations,
- 2] The Superintendent, [B.Sc. Unit],
- 3] The Superintendent, [M.Sc. Unit],
- 4] The Superintendent, [Eligibility Unit],
- 5] The Programmer [Computer Unit-1] Examinations,
- 6] The Programmer [Computer Unit-2] Examinations,
- 7] The Director, [E-Suvidha Kendra], in-front of Registrar's Quarter,  
Dr. Babasaheb Ambedkar Marathwada University,
- 8] The Public Relation Officer,
- 9] The Record Keeper,  
Dr. Babasaheb Ambedkar Marathwada University.

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**DR. BABASAHEB AMBEDKAR  
MARATHWADA UNIVERSITY,  
AURANGABAD.**



**Syllabus of**

**M.Sc. SECOND YEAR**

**PLANT BREEDING & MOLECULAR GENETICS**

**THIRD AND FOURTH SEMESTER**

***With Effect From JUNE - 2014.***

## M.Sc. Plant Breeding and Molecular Genetics 2-Year Course SYLLABUS AT GLANCE

1 <sup>st</sup> Year		1 <sup>st</sup> Semester					
Subject code	Subject Name	Hrs/ Week		Exam Hrs	Theory Marks	Practical Marks	Total Marks
		T	P				
PBMG 111	Principles of Genetics and Plant Breeding	4	6	3	50	25	75
PBMG 112	Principle of Cytogenetics	4	6	3	50	25	75
PBMG 113	Plant Biochemistry	4	6	3	50	25	75
PBMG 114	Statistics	4	6	3	50	25	75
					<b>200</b>	<b>100</b>	<b>300</b>
1 <sup>st</sup> Year		2 <sup>nd</sup> Semester					
PBMG 121	Molecular Genetics	4	6	3	50	25	75
PBMG 122	Modern Plant Breeding	4	6	3	50	25	75
PBMG 123	Plant Physiology	4	6	3	50	25	75
PBMG 124	Bioinformatics	4	6	3	50	25	75
					<b>200</b>	<b>100</b>	<b>300</b>
2 <sup>nd</sup> Year		3 <sup>rd</sup> Semester					
PBMG 231	Genetics Engineering	4	6	3	50	25	75
PBMG 232	Principles of Quantitative Genetics	4	6	3	50	25	75
PBMG 233	Plant Functional Genomics	4	6	3	50	25	75
PBMG 234	Population and Developmental Genetics	4	6	3	50	25	75
					<b>200</b>	<b>100</b>	<b>300</b>
2 <sup>nd</sup> Year		4 <sup>th</sup> Semester					
PBMG 241	Molecular Plant Breeding	4	6	3	50	25	75
PBMG 242	Biotechnology for Crop Improvement	4	6	3	50	25	75
PBMG 243	Research Methodology and IPR	4	--	2	50	00	50
PBMG 244	Project		10	3	00	100	100
					<b>150</b>	<b>150</b>	<b>300</b>

## M.Sc.Plant Breeding and Molecular Genetics 2<sup>nd</sup> Year Course Syllabus

2 <sup>nd</sup> Year		3 <sup>rd</sup> Semester					
PBMG 231	Genetics Engineering	4	6	3	50	25	75
PBMG 232	Principles of Quantitative Genetics	4	6	3	50	25	75
PBMG 233	Plant Functional Genomics	4	6	3	50	25	75
PBMG 234	Population and Developmental Genetics	4	6	3	50	25	75
					<b>200</b>	<b>100</b>	<b>300</b>
2 <sup>nd</sup> Year		4 <sup>th</sup> Semester					
PBMG 241	Molecular Plant Breeding	4	6	3	50	25	75
PBMG 242	Biotechnology for Crop Improvement	4	6	3	50	25	75
PBMG 243	Research Methodology and IPR	4	--	2	50	00	50
PBMG 244	Project		10	3	00	100	100
					<b>150</b>	<b>150</b>	<b>300</b>

### PBMG231: Genetic Engineering

#### Theory:

#### UNIT-I Introduction to genetic engineering:

The early development of genetics, Genetic engineering, History of genetic engineering, Genetic engineering in the post-genomic era.

#### UNIT-II Basic techniques used in gene manipulation:

Gel electrophoresis, Blotting—Southern blotting, Northern Blotting, Western Blotting, DNA transformation, Electroporation, PCR, Reverse transcription PCR, Quantitative PCR.

#### UNIT-III Enzymes used for DNA manipulation:

DNA manipulative enzymes—Nucleases, Ligases, Polymerases, DNA modifying enzymes. Enzymes for cutting DNA—restriction endonuclease: The discovery and function of restriction endonucleases, Type II restriction endonucleases cut DNA at specific nucleotide sequences, Blunt ends and sticky ends, The frequency of recognition sequences in a DNA molecule, Mapping the positions of different restriction sites in a DNA molecule, Ligation—joining DNA molecules together: The mode of action of DNA ligase, Sticky ends increase the efficiency of ligation, Putting sticky ends onto a blunt-ended molecule: Linkers, Adaptors, Producing sticky ends by homopolymer tailing, Blunt end ligation with a DNA topoisomerase

#### UNIT-IV Cloning vectors:

Cloning vectors based on E. coli plasmids—pBR322, 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, Cloning vectors based on lambda bacteriophage, Lambda and other high-capacity vectors enable genomic libraries to be constructed, Vectors for yeast and other fungi: Selectable markers for the 2um plasmid, Vectors based on the 2um plasmid—yeast episomal plasmids, A YEp may insert into yeast chromosomal DNA, Artificial chromosomes can be used to clone long pieces of DNA in yeast: YAC, BAC, Cloning vectors for higher plants: Ti plasmid, Ri Plasmid, Agrobacterium tumefaciens—nature's smallest genetic engineer, Caulimovirus vectors, Geminivirus vectors, Cloning vectors for animals: Cloning vectors for insects—P elements as cloning vectors for Drosophila, Cloning vectors based on insect viruses, Cloning in mammals—Viruses as cloning vectors for mammals, Gene cloning without a vector, Others: Expression vectors, RNAi vectors, Gateway-system.

#### UNIT-V Introduction of DNA into Living Cells:

Transformation—the uptake of DNA by bacterial cells, Identification of recombinants: Recombinant selection with pBR322—insertional inactivation of an antibiotic resistance gene, Insertional inactivation does not always involve antibiotic resistance, Introduction of phage DNA into bacterial cells: Transfection, In vitro packaging of 2 cloning vectors, Phage infection is visualized as plaques on an agar medium, Identification of recombinant phages: Insertional inactivation of a lacZ' gene carried by the phage vector, Insertional inactivation of the Lambda cl gene, Selection using the Spi phenotype, Selection on the basis of lambda genome size, Introduction of DNA into non-bacterial cells: Transformation of individual cells, Transformation of whole organisms.

#### UNIT-VI Application of genetic engineering:

Sequencing Genes and Genomes, Studying Gene Expression and Function—Studying the RNA transcript of a gene, Studying the regulation of gene expression, Identifying control sequences by deletion analysis, Identifying and studying the translation product of a cloned gene, Analysis of proteins by in vitro mutagenesis, Production of Protein from Cloned Genes—Expression vectors, Production of recombinant protein by eukaryotic cells, Flavr Savr tomato, Golden Rice, Bt Cotton, Plantibodies, Plant as the vehicle for molecular farming.

### Practicals

1. Introduction to a genetic engineering lab
2. Competent cell preparation of *E. coli*
3. DNA transformation
4. Agarose gel electrophoresis
5. Plasmid isolation
6. Performing a restriction digestion in the laboratory
7. Mapping the positions of different restriction sites in a DNA molecule
8. Polymerase chain reaction
9. Reverse transcription-PCR
10. Gene cloning
11. Genomic library preparation
12. cDNA library preparation

### References:

1. Primerose, S.B. and Twyman, R.M. Principles of Gene Manipulations and Genomics. Blackwell Publisher
2. Old, R.W. and Primrose, S. B. 2001. Principles of Gene Manipulation: An Introduction to Genetic Engineering 5th Edition. Blackwell Science Ltd., USA.
3. Brown, T. A. Gene Cloning & DNA Analysis. Wiley-Blackwell
4. Kathy Wilson Peacock. Biotechnology and Genetic Engineering. ISBN 978-0-8160-7784-7
5. Wennacker, Ernst L. 1987. From Genes to Clones: Introduction to Gene Technology. VCH Publishers, Weinheim (Federal Republic of Germany)
6. Watson et al., Molecular Biology of the gene

### PBMG232: Principles of Quantitative Genetics

#### Theory:

#### UNIT-I Fundamentals of Quantitative Genetics:

Multifactorial Traits, Quantitative Inheritance, Quantitative traits, Multiple gene hypothesis, Genetic variation, Continuous, Meristic, and Threshold Traits, Distributions, Continuous and discrete variations, Expected values and breeding values, Features of polygenic traits, Significance of polygenes, polygenic variation, types of polygenic variations: Phenotypic variation, Genotypic variation and environmental variation, Biometrical techniques, Role of biometrical techniques in crop improvement: Assessment of polygenic variation, Selection of elite genotypes, Choice of parents and breeding procedures, Assessment of varietal adaptability, Eminent Biometricians, Merits and demerits of quantitative genetics.

#### UNIT-II Components of phenotypic variation:

Phenotypic variance is a function of: genetic variance (Additive genetic variance, Dominance genetic variation and Epistatic genetic variation), environmental variance, variance due to GXE interaction and covariance due to Genotype-environment association. Types of epistatic variances: additive X additive, additive X dominance, dominance X dominance

#### UNIT-III Basic statistical tools for quantitative genetic analysis:

Elementary statistics, Probability laws, Elements of matrix algebra, Analysis of variance, Analysis of covariance, Measures of dispersion, Components of genetic variances, Metroglyph analysis, Correlation analysis, path coefficient analysis, discriminant function analysis, partial diallel, line X tester, triallel and quadriallel analysis, Generation mean analysis, Biparental cross analysis, Triple test cross analysis, Stability analysis.

#### UNIT-IV Analysis of Quantitative Traits:

Genetic variances and gene action, Heritability (Broad-Sense & narrow sense Heritability), selection, response to selection, genetic advance, combining ability, Heterosis and inbreeding depression.

#### UNIT-V Resemblances Between Relatives:

Heritability, Genetic Covariance between relatives, Parent-offspring covariances, Full-sib covariance and Half-sib covariance.

#### UNIT-VI Introduction to quantitative trait loci (QTL) analysis:

QTL, QTL mapping, Principle of QTL mapping, Steps involved in QTL mapping, application of QTL mapping.

#### Practicals

1. Analysis of variance
2. Partitioning of total genetic variance in various models
3. Correlation and regression analysis
4. Path coefficient analysis
5. Discriminant function analysis
6. North Carolina Designs: NCD-I
7. North Carolina Designs: NCD-II
8. North Carolina Designs: NCD-III
9. Triple test-cross analysis
10. Diallel analysis

11. Line X Tester analysis
12. General combining ability analysis
13. Specific combining ability analysis
14. Estimation of heritability, selection intensity, selection response.
15. Stability analysis

**References:**

1. Comstock, R.E. 1996, Quantitative Genetics with Special Emphasis on Plant and Animal Breeding. Iowa State University Press, Iowa.
2. Falconer, D.S. and Mackay, J. 1996. Introduction to Quantitative Genetics, Longman Group Ltd., London.
3. Mather, K. and Jinks, J.L. 1971. Biometrical Genetics. Chapman and Hall, London.
4. Sharma, J.R. 1998. Statistical and Biometrical Techniques in Plant Breeding. New Age International Publishers, New Delhi
5. Singh, R.K. and Chaudhary, B.D. 1997. Biometrical Methods in Quantitative Genetic Analysis. Kalyani Publishers, New Delhi.
6. Khalid M., Guenter, K. The Handbook of Plant Genome Mapping: Genetic & physical mapping. WILEY-VCH
7. Karl W. Broman, Saunak Sen. A Guide to QTL Mapping with R/qlt. SPRINGER

<b>PBMG233:Plant Functional Genomics</b>	
<b>UNIT-I</b>	<b>Introduction to Plant Functional Genomics:</b> Basics of genetics, molecular biology, bioinformatics.Genome, Genome products:- Transcriptome, metabolome,Phenome. Genomics, Functional Genomics. Tools and technologies for functional genomics :2D-Gel electrophoresis, Mass spectrometry.
<b>UNIT-II</b>	<b>Transcriptomics – profiling of mRNA transcripts to analyze gene expression:</b> Transcriptomics & the transcriptome, Transcriptomic databases, Transcriptome and differentia gene l expression, Microarray, RNA-Seq, SAGE ( Serial Analysis of Gene Expression).
<b>UNIT-III</b>	<b>Proteomics: analysing the proteome :</b> Proteomics & the proteome, Proteomic databases, Separating the proteins in a proteome ,Identifying the individual proteins after separation,Studying protein–protein interactions:Phage display ,The yeast two hybrid system
<b>UNIT-IV</b>	<b>Metabolomics-profiling the composition of metabolites :</b> Metabolomics, Metabonomics, Metabolic/Metabolite profiling, Metabolomic databases,Targeted metabolite analysis or metabolite target analysis, Metabolite fingerprinting , Metabolite footprinting ,Workflow of plant metabolomics: Sample preparation, Data aquisition, Data mining/Data analysis, Biochemical interpretation.
<b>UNIT-V</b>	<b>Phenomics - phenotypic profiling of mutant collections:</b> Aim of phenomics,Phenomics speeds up plant phenotyping . Phenomics involves cross-disciplinary research and collaboration , Phenomics relieves the ‘genomics bottleneck’. Forward and reverse phenomics. Phenomics technology:Looking inwards: studying leaves and roots with high-tech imaging systems. Looking outwards: studying plant growth in controlled conditions and in the field .
<b>UNIT-VI</b>	<b>Advanced Plant Functional Genomics :</b> Functional genomics of drought tolerance, salinity resistance, quality parameters, disease resistance and insect resistance.
<b>Practical</b>	
1.	Introduction to Functional Genomics lab
2.	Transcriptomic and Proteomic databases
3.	Microarray analysis
4.	SAGE
5.	The yeast two hybrid assay
6.	2D-Gel electrophoresis
7.	Data mining and analysis of highthroughput NGS data
8.	RNA-Seq Data Analysis
9.	Analysis of differential gene expression using quantitative PCR
10.	Comparative analysis of plant proteome under different conditions

References	
1.	Christina Kyriakopoulou. From fundamental genomics to systems biology: understanding the book of life. Isbn: 978-92-79-08004-3 .
2.	Daniel C. Libler. Introduction to proteomics :tools for the new biology .Humana Press Totowa, NJ .
3.	Rune Matthiesen . Mass Spectrometry Data Analysis in Proteomics.ISBN-13: 978-1-58829-563-7 . Humana Press.
4.	Brown, T.A. Gene Cloning & DNA Analysis.ISBN: 9781405181730 . Black Willey Publishers
5.	BASIL J. Nikolau Eve & Syrkin wurtele.concepts in plant metabolomics, ISBN-13: .978-1-4020-5608-6
6.	Australian Plant Phenomics Facility : Plant Phenomics Teacher Resource

### **PBMG234: Population and Developmental Genetics**

#### **Theory:**

#### **UNIT-I Introduction to Population Genetics:**

Population Genetics, Practical application of population genetics, Genetic variation in populations and species, Identification of genetic variation in a population, Explaining the High Level of Genetic Variation in Populations. Tools used for study of population genetics.

#### **UNIT-II The Hardy-Weinberg Law:**

Hardy-Weinberg Law, Allele frequencies and genotypic frequencies in populations, Testing for Hardy-Weinberg equilibrium in a population, Calculating frequencies for multiple alleles in Hardy-Weinberg populations, Calculating allele frequencies for X-linked traits, Calculating Heterozygote frequency.

#### **UNIT-III Factors shaping the dynamics of allele and genotype frequencies in populations:**

Role of natural selection, mutation, gene flow, selection, genetic drift.

#### **UNIT-IV Introduction to Developmental Genetics:**

Developmental biology, Development, specification, commitment, induction, competence, Major questions in developmental biology: question of differentiation, morphogenesis, growth, reproduction, evolution, environmental integration. Signaling pathways involved in cell-cell interaction during development: Wnt-signaling, RTK pathway, SMAD pathway, The Hedgehog pathway, The JAK-STAT pathway

#### **UNIT-V Principles of development : Genes & Development**

The genetic core of development: Differential gene expression, Differential gene transcription, Selective nuclear RNA processing, Selective messenger RNA translation, Differential protein modification.

#### **UNIT-VI Genetic analysis of evolutionary conserved developmental mechanisms:**

Overview of plant development, Genetic basis of plant developmental systems, Arabidopsis as a model organism for studying plant development, Genetics of embryonic development in Drosophila, Genetic analysis of cell-cell interactions in development

#### **Practicals**

1. Estimation of allele frequencies and genotypic frequencies in populations
2. Understanding the genetic variation at nucleotide level
3. Testing for Hardy-Weinberg equilibrium
4. Model organisms and their application in developmental genetics.
5. Understanding the basis of differential gene-expression
6. Analysis of plant development: Use of Arabidopsis as an experimental model
7. Molecular analysis of floral development.

#### **References:**

1. Concepts of Genetics. (10th Editions). William S. Klug, Michael R. Cummings, Charlotte A. Spencer, Michael A. Palladino.
2. Developmental Biology. Scott F. Gilbert
3. Genetics. Monroe W. Strickberger

### **PBMG241: Molecular plant breeding**

#### **Theory:**

#### **UNIT-I**

##### **Introduction to molecular plant breeding:**

Crop Improvement, Crop Domestication, Plant Breeding, Major developments in Plant Breeding, Objectives of Plant Breeding, Molecular Plant Breeding, Scope of molecular plant breeding.

#### **UNIT-II**

##### **Molecular Breeding Tools:Markers**

Genetic markers, Classical markers-Morphological, cytoplasmic and protein markers, DNA markers-RFLP, RAPD, AFLP, SSR, SNP, Genic & Functional markers.

##### **Molecular Breeding Tools:Molecular maps**

Chromosome theory and linkage, Genetic linkage mapping, Developing mapping populations, Interference and mapping functions, Segregation and linkage tests, Maximum likelihood estimation (MLE) of recombinant frequency, Likelihood ratio and linkage test, Multi-point analysis and ordering a set of markers, Linkage mapping in the presence of genotyping errors, Molecular maps in plants, Integration of genetic maps-Integration of conventional and molecular maps, Integration of multiple molecular maps.

#### **UNIT-III**

##### **Marker-assisted Selection:**

Components of Marker-assisted Selection, Selection Schemes for Marker-assisted Selection, Bottlenecks in Application of Marker-assisted Selection, Traits Most Suitable for MAS, Marker-assisted Hybrid Prediction Marker-assisted Gene Introgression, Marker-assisted Gene Pyramiding, Selection for Quantitative Traits.

#### **UNIT-IV**

##### **Molecular Dissection of Complex Traits:**

Single Marker-based Approaches, Interval Mapping, Composite Interval Mapping, Multiple Interval Mapping, Multiple Populations/Crosses, Multiple QTL, QTL Separating, QTL for Complicated Traits, QTL Mapping across Species, QTL across Genetic Backgrounds, QTL across Growth and Developmental Stages, Multiple Traits and Gene Expression, Selective Genotyping and Pooled DNA Analysis.

#### **UNIT-V**

##### **Isolation and Functional Analysis of Genes:**

Comparative Approaches for Gene Isolation, Cloning Based on cDNA Sequencing, Positional Cloning, Identification of Genes by Mutagenesis

#### **UNIT-VI**

##### **Gene transfer & Genetically Modified Plants:**

Culture and Genetic Transformation, Transformation Approaches, Expression Vectors, Selectable Marker Genes, Transgene Integration, Expression and Localization, Transgene stacking

#### **Practicals**

1. RAPD analysis
2. RFLP Analysis
3. Marker-assisted selection
4. QTL analysis
5. Expression vectors and their applications
6. PCR-based gene amplifications
7. Gene cloning
8. Agrobacterium-mediated gene transformation in plants

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**References:**

1. Xu, Yunbi. Molecular Plant Breeding. ISBN: 978 1 84593 392 0, International Maize and Wheat Improvement Center (CIMMYT), Apdo Postal 6-641, 06600 Mexico, DF Mexico.
2. Old, R.W. and Primrose, S. B. 2001. Principles of Gene Manipulation: An Introduction to Genetic Engineering 5th Edition. Blackwell Science Ltd., USA.
3. Klug, W.S. and Cummings, M.R. 1983. Concepts of Genetics, Charles E. Merrill Publishing Company, London
4. V.L. Chopra. Plant Breeding-Theory and Practice. Oxford & IBH
5. Wennacker, Ernst L. 1987. From Genes to Clones: Introduction to Gene Technology. VCH Publishers, Weinheim (Federal Republic of Germany)
6. Plant, Genes & Crop Biotechnology: Maarten J. Creespels & David E. Sadava

### **PBMG242: Biotechnology for Crop Improvement**

#### **Theory:**

#### **UNIT-I**

##### **Fundamentals of Crop Improvement Strategies:**

Conventional crop improvement methods: Hybridization, Selection, Pedigree Breeding, Backcross Breeding, Heterosis breeding, Mutation Breeding. Advent of molecular technologies, Genetic Engineering, Plant Tissue culture, Genome sequencing. Need for deployment of biotechnology-based approaches in crop improvement.

#### **UNIT-II**

##### **Role of tissue culture in crop improvement:**

Micropropagation for virus-free plants, Somaclonal variation, Somatic Hybridization

#### **UNIT-III**

##### **Genetic engineering for Biotic Stress Resistance: Disease Resistance**

Molecular basis of disease resistance in crop plants: Plant disease resistance signaling pathways, R-genes, Genes downstream of R-genes, Gene-for-gene hypothesis, Signal perception and defence activation, Role of pathogen avirulence gene in triggering plant defence response, Cloning and characterization of plant R-genes, Signal transduction events and expression of disease resistance, Evolution of plant disease resistance, Molecular basis and evolution of plant R gene specificity, Bioengineering for novel and stable plant resistance.

#### **UNIT-IV**

##### **Genetic engineering for Biotic Stress Resistance: Insect Resistance**

Expression of insecticidal proteins-Bt Toxins, Proteinase inhibitors, Plant lectins,  $\alpha$ -amylase inhibitors, Insect chitinases, Plant metabolic enzymes. Use of Insecticidal viruses.

#### **UNIT-V**

##### **Engineered Plants for Abiotic Stress Resistance-Drought resistance:**

Abiotic stress, Major Abiotic Stresses-Drought, Salinity, Plant responses to abiotic stress, Water Scarcity and Agriculture, Improving Drought Tolerance in Agricultural Crops, Complexity of Drought and Plant Responses to Drought Stress, Plant Drought Resistance and Response, The Genetic & Molecular Basis of Drought Tolerance, Engineering Improved Drought Avoidance in Crops, Improving Plant Drought Tolerance -Abscisic Acid and Transcriptional Regulation, Signal Sensing, Perception, and Transduction.

##### **Engineered Plants for Abiotic Stress Resistance-Salt tolerance:**

Improving Salinity Tolerance of Agricultural Crops, Physiological Effects of Salinity on Plants and Salinity Tolerance Mechanisms, Salt Tolerance Using Transgenic Approaches - Osmoprotectants, Transporter Genes, Detoxifying Genes, Late Embryogenesis Abundant (LEA) Proteins, Transcription Factors, Signal Transduction Genes.

#### **UNIT-VI**

##### **Bioengineering for Enhanced Nutritional Quality in Crop Plants:**

Genetic engineering of plant storage products: Starch, Protein, Oil. Reduction of deleterious toxic substances. Expression of modified storage protein genes, Engineering of novel carbohydrates, engineering plant genes for modification of fatty acid compositions, Engineering plant genes for longer shelf life of fruits.

### Practicals

1. Micropropagation of virus-free plants
2. Designing of a transgenic plant.
3. Approaches for Plant Genetic Transformations: Agrobacterium-mediated gene transformation
4. Approaches for Plant Genetic Transformations: Gene-gun based biolistic transformation
5. Genetic engineering for disease resistance: List of R-genes, their receptors and Mechanism of action during plant-pathogen interactions.
6. Understanding the molecular basis of drought resistance
7. Bioengineering for salt tolerance in crop plants
8. Biotechnological approaches to modify plant storage products: Protein quality
9. Biotechnological approaches to modify plant storage products: Sugars equality
10. Biotechnological approaches to modify plant storage products: Fatty acid composition

### References:

1. H.S. Chawla: Biotechnology in Crop Improvement. International Book Distributing Company, 1998
2. R.J. Henry: Practical Application of Plant Molecular Biology. Chapman and Hall, 1997
3. P.K. Gupta. Elements of Biotechnology. Rastogi and Co. Meerut. 1996
4. V.L. Chopra. Plant Breeding-Theory and Practice. Oxford & IBH
5. H.S. Chawla, Introduction to Plant Biotechnology.
6. Plant, Genes & Crop Biotechnology: Maarten J. Creespels & David E. Sadava

**PBMG243: Research Methodology and IPR**

- UNIT-I**     **Introduction to Research Methodology:** Definition of research, classification of research: Fundamental research, Applied research, Descriptive research, Analytical research, Qualitative research, Quantitative research, Conceptual research and Empirical research.
- UNIT-II**     **Elements of Research:** Research Problem formulation, Problem selection, Rationale for defining a research problem, Role of review of literature in defining the problem, Sources of literature: Primary & secondary sources, treaties, monographs, patents, internet, scientific journals, Critical analysis of existing literature in the selected research arena, Identification of the research gap, Designing of working research hypothesis.
- UNIT-III**    **Architecture of Research Design & Methods:**  
Basic Principles of research design, Ideal attributes of a good design, Concepts associated with research design: Observations, Facts, Laws, Theories, Prediction and explanation, Induction, Deduction, Model development, Steps involved in designing a research plan – Exploration, Description, Diagnosis, Experimentation Determining appropriate experimental designs.
- UNIT-IV**    **Data collection, analysis & compilation:**  
Implementation of the research–Observation, data collection: data collection methods, sampling methods, Data processing, Data analysis: Role of different statistical packages, Testin of hypothesis, Generalization and interpretation.
- UNIT-V**     **Reporting:** Reports, Anatomy & architecture of scientific reports, Classification of reports: technical reports, thesis, scientific research article, review article. Steps involved in manuscript preparation: Layout, structure and language of reports: Illustrations, tables , bibliography, referencing and footnotes, Thesis manuscript preparation, Making a seminar presentation, Role of effective communication.
- UNIT-VI**    **Basics of Intellectual Property Rights (IPRs):** Concept of intellectual property, Fields of intellectual property protection: Patents, Copyrights & Related Rights, Trademarks, Geographical indications, Licensing and the transfer technology, WIPO: World Intellectual Property Organization, Intellectual Property Rights in India.

**References:**

1. Anthony, M., Graziano, A.M. and Raulin, M.L., 2009. Research Methods: A Process of Inquiry, Allyn and Bacon.
2. Carlos, C.M., 2000. Intellectual property rights, the WTO and developing countries: the TRIPS agreement and policy options. Zed Books, New York.
3. Coley, S.M. and Scheinberg, C. A., 1990, "Proposal Writing", Sage Publications.
4. Day, R.A., 1992. How to Write and Publish a Scientific Paper, Cambridge University Press.
5. Fink, A., 2009. Conducting Research Literature Reviews: From the Internet to Paper. Sage Publications
6. Leedy, P.D. and Ormrod, J.E., 2004 Practical Research: Planning and Design, Prentice Hall.

7. Satarkar, S.V., 2000. Intellectual property rights and Copy right. Ess Ess Publications.
8. WIPO Intellectual Property Handbook :WIPO PUBLICATION No. 489 (E) ISBN 978-92-805-1291-5

**PBMG244:Project**

In the course PBMG244:Project, a project with dissertation for 100 marks will be assigned to two students.The workload of the project will be equivalent to that of 2 theory papers.