M.Sc. Agricultural Biotechnology

Semester - I

Theory
Core Paper 101 : Cell Biology
Core Paper 102 : Genomes and Genes
Core Paper 103 : Basics of Agriculture and Plant Breeding
Core Paper 104 : Molecular Biology

Practicals
Practical 101 : Corresponding to papers 101 and 102
Practical 102 : Corresponding to papers 103 and 104

Semester - II

Theory
Core Paper 201 : Plant Tissue Culture
Core Paper 202 : Tools and Techniques of Genetic Engineering
Core Paper 203 : Agricultural Microbiology
Core Paper 204 : Microbial and Molecular Genetics

*Non-core Paper 205 : - - - - - - - - - - (To be opted by the student from among the papers offered by other Departments)

Practicals
Practical 201 : Corresponding to papers 201 and 202
Practical 202 : Corresponding to papers 203 and 204

Semester - III

Theory
Core Paper 301 : Metabolic Engineering
Core Paper 302 : Crop Protection and Integrated Pest Management
Core Paper 303 : Agricultural Economics
Core Paper 304 : Biostatistics

*Non-core Paper 305 : - - - - - - - - - - (To be opted by the student from among the papers offered by other Departments)

Practicals
Practical 301 : Corresponding to papers 301 and 302
Practical 302 : Corresponding to papers 303 and 304

Semester - IV

Theory
Core Paper 401 : Biodiversity and Intellectual Property Rights
Core Paper 402 : Bioinformatics
Core Paper 403 : Seed Technology
Core Paper 404 : Agricultural applications of Genetic Engineering

Practicals
Practical 401 : Corresponding to papers 401 and 402
Practical 402 : Corresponding to papers 403 and 404
M.Sc. Agricultural Biotechnology – Semester I

Core Paper 101: Cell Biology

1. Structural organization of plant cell, specialized plant cell types, Chemical foundation, Biochemical energetics.
2. Cell Wall: Structure, Organisation growth and functions of cell wall
5. Plant vacuole: Structure and function, tonoplast membrane, Atpases, transporters and storage organelle
6. Cell organella I: Mitochondria and Chloroplasts structure and function, genome organization bio genesis.

Suggested Laboratory Exercises:

1. Karyotype analysis and idiogram preparation: Allium and Vicia or other material with symmetric and Asymmetric karyotypes.
2. Feulgen staining of chromosomes
3. Computer assisted chromosome analysis
4. Meiosis in diploids-Maize, Allium
5. Meiosis in structural heterozygotes
6. Meiosis in trisomics and polyploids

Suggested Books:

M.Sc. Agricultural Biotechnology – Semester I

Core Paper 102: Genomes and Genes

1. Chromatin structure, Molecular organization of Centromers and telomers, nucleolus, r RNA genes eu-and heterochromatin.

2. Karyotype analysis, computer assisted chromosome analysis; chromosome banding; in situ hybridization.

3. Genome organization – C-Value paradox, Cot curves & significance.

4. Chromosome behaviour: Chromosome pairing and breeding behaviour in (i) Structural heterozygotes, (ii) Trisomics, monosomics and nullisomics (iii) haploids and (iv) Auto polyploids.

5. Allopolyploids; genome analysis in tobacco, wheat, Bressica and cotton.

6. Concept of Genetic makers; gene interaction, multiple alleleism, pleiotropism and multiple factor inheritance.

7. Genetic, Chromosomal and Molecular map construction.

8. Extra nuclear inheritance, male sterility and applications.

Suggested Laboratory Exercises:

1. Assignments on gene interaction, Multiple factor and multiple allelic inheritance and construction of genetic and chromosomal maps.

2. Isolation of nuclei, Chloroplasts and mitochondria.

3. Isolation of Plant DNA & quantification by spectrophotometric method.

4. Histone separation by SDS – PAGE.

5. Special cell types.

6. In situ Hybridization – FISH & GISH.

Suggested Books :


2. SRB Edger & Ower : General Genetics

3. E.W. Burns : Genetics

5. G.S. Khush: Cytogenetics of Aneuploids.
7. C.R. Burnham: Discussions in Cytogenetics.
M.Sc. Agricultural Biotechnology – Semester I

Core Paper 103: Basics of Agriculture and Plant Breeding

1. Factors effecting agriculture and agricultural classification of plants.
2. Origin of cultivated plants and plant indication.
3. Methods of breeding self pollinated and vegetatively propagated plants.
5. Heterosis – Genetic and Molecular basis.
6. Apomixis – Mechanism and significance in crop improvement.
7. Mutations – Molecular basis and use in crop improvement.
8. Role of polyploidy in crop improvement.
9. Origin evolution and cultivation practices of the following major crop plants:
   (a) Wheat  (b) Maize  (c) Rice  (d) Sugar
   (e) Sugarcane  (f) Cotton and  (g) Tobacco

Suggested Laboratory Exercises:

1. Floral Biology and pollination mechanism in rice, maize, sorgum, bajra, cotton, chilli, solanum, wheat, sugar cane and tobacco.

Suggested Books:

2. SRB Edger & Ower : General Genetics.
3. E.W. Burns : Genetics
5. G.S. Khush: Cytogenetics of Aneuploids
7. C.R. Burnham: Discussions in Cytogenetics.
M.Sc. Agricultural Biotechnology – Semester I

Core Paper 104: Molecular Biology


6. Assignments on the topics mentioned in the syllabus.

7. Significant figures, drawings, tables etc., from books and other sources for display.

Suggested Books


M.Sc. Agricultural Biotechnology – Semester II

Core Paper 201: Tissue Culture

1. Seed Vs. Soma; Basic concepts of tissue of culture: Totipotency. Tissue culture cycle, types of cultures.

2. Culture media – composition and effects of media components; Phytohormones – biosynthesis, structure, detection and estimation, effects in tissue culture; sterilization methods.


4. Methods of androgenic and genomic haploid production-dihaploids and application in agriculture embryo rescue.


6. Protoplasts: Isolation, viability tests; Somatic hybridization and selection system; cybrids; uses of protoplasts in crop improvement.

7. Micropropagation of horticulture and fruit-yielding plants.

8. Soma clonal variation and its application.


Suggested Laboratory Exercises :

1. General outlay of PTC laboratory.
2. Preparation of media.
5. Establishment of cell cultures and determination of growth pattern and plating efficiency.
6. Protoplast isolation.
7. Observing stages of Somatic Embryogenesis.
Suggested Books:

7. Kasha, K.J. (Ed.) Haploids in higher plants – Advances and potential.
M.Sc. Agricultural Biotechnology – Semester II

Core Paper 202: Tools and Techniques of Genetic Engineering


2. Tools of genetic engineering: Enzymes to be used – restriction concept, types and mechanism, endo-nucleases, ligases, alkaline phosphatases, polynucleotide kinase, SI nuclease, Dnase I, Rnase H, Klenow fragment.

3. Techniques in genetic engineering-1, Southern, Northern and Western Blotting, dot and slot blots colony and plaque hybridizations.

4. Techniques in genetic engineering – 2, Polymerase chain reaction (PCR) – modifications and applications, C-DNA and genomic libraries – their construction and screening.


Suggested Laboratory Exercises:

1. Culture and Bacterial strains
2. Phage growth on E.coli
3. Plasmid DNA isolation
4. Preparation of competent cells.
5. Southern, Northern and Western blotting.
6. Polymerase chain reaction.
7. Restriction digestion and ligation
Suggested Books:

M.Sc. Agricultural Biotechnology – Semester II

Core Paper 203: Agriculture Microbiology


Suggested Laboratory Exercises:

1. Gram staining of bacteria.
2. Sterilization methods.
3. Preparation of media and stains.
4. Staining of nodule bacteria and their culture.
5. Culture of cyanobacteria.
6. Examination of root knot nematodes infesting vegetable crops/crop plants.
Suggested Books:

1. Y.P.S. Bajaj: Biotechnology in Agriculture and forestry, Vol. 22 Springer Verlas.
M.Sc. Agricultural Biotechnology – Semester II

Core Paper 204: Microbial and Molecular Genetics

10. General account of structural and reproductive diversity and life cycle patterns in bacteria and viruses, fungi and unicellular algae, representative forms for detected study – E.coli, Bacillus, T₄, M₁₃ Phage, λ phage, ϕ x 174 TMV, Cu MV, Neurospora yeast and Chalmy domoney.


3. Genetics of bacteria – Mutant phenotypes in bacteria; Cajugatin – Plasmids, and their role – sex duction - gene mapping through conjugation.


5. Genetics of yeast and neurospora – Tested analysis and gene mapping.

6. Transposable elements in pro and eukaryotes - types, organization and mechanism of transposition. Significance and applications of transporus.


8. Regulation of gene expression in pro and eukaryotes detailed study of Lac, trp, are operons, DNA inversions in genetic regulation; sporulation in bacteria in bacteria; spatial temporal factors in gene regulation; gene splicing; chromosomal hormonal and environmental regulations of gene expression.


Practicals:

1) Isolation of soil bacteria : Observation of bacteria colony phenotypes.
2) Isolation and culture of bacteria from modules.
3) Generation of RAPD patterns using PLR.
4) Working out problems on topics included in the theory.
Books:
1. Microbial genetics by Freidfelder.

M.Sc. Agricultural Biotechnology – Semester III

Core Paper 301: Plant Metabolic Engineering


Suggested Lab Exercises:

Plant Metabolic Engineering
1. Isolation of DNA
2. SDS – PAGE Electrophoretic Separation of Proteins.
3. Estimation of Proteins by Lowry et.al.
5. Separation of Chlorophyll Pigments by chemical method.
7. Estimation of soluble sugars by Colorimetric method.
8. Estimation of free fatty acids.
9. Light effect on Photosynthesis.

Suggested Books :

M.Sc. Agricultural Biotechnology – Semester III

Core Paper 302: Crop Protection and Integrated Pest Management

(IPM)

1. Losses in crops due to pests, Importance of plant diseases, Classification of plant diseases, Causes and symptoms of plant diseases, Disease epidemics, Prevention of epidemics

2. Genetics of pathogenocity, Pathotypes, Mechanism of disease resistance, Breeding for disease and insect resistance, Sear’s work on rust resistance in wheat

3. Genetic engineering for improvement of disease resistance, Genetic manipulation of Crops for insect resistance, Molecular Mechanisms conferring herbicide resistance, Transgenic crops

4. Chemical Control strategy for crop protection, Biological control-concepts and techniques, Bio-organism for pest Management, Bt based pesticides, Baculovirus pesticides, Mycopesticides, production and formulation technologies

5. Principles of integrated Pest Management (IPM), IPM modules for cotton, IPM modules for sugarcane, IPM practices for Pulse crops, IPM practices for oil crops

Suggested Laboratory Exercises:

1. Study of symptoms, microscopic examination of diseased parts and identification of the pathogens involved in some of the crop diseases.

2. Examination of the organisms used for biological control.

3. Culture techniques for the entomopathogens.


5. Study of genetically engineered organisms.

6. Visiting the Agricultural fields for assessing the pest problem.

Suggested Books:

2. Biology of Microorganisms, Prentice Hall, New Jersey
5. Stainer, R.Y; Ingram J; Wheelis, M.G. and Paintor, P.R. 1986
6. The Microbial World-Prentice Hall-New Jersey
10. Subba Rao N.S. 1987 Advance in Agricultural Microbiology, Oxford & IBH, New Delhi
M.Sc. Agricultural Biotechnology – Semester III

Core Paper 303: Agro-Economics

1. Agricultural finance in India: importance; types or requirements; sources: non-institutional and institutional: existing rural credit delivery system (multi-agency approach);
Agricultural marketing in India: Markets and marketing functions, channels of distribution of various commodities; regulated markets and warehousing; Role of Cooperatives in Agriculture.

2. Agricultural planning in India: decentralized planning and indicative planning; incentives in agriculture: price and non-price incentive; input subsidies; Agricultural price policy (AP)
Nature of demand and supply of agricultural products: Need for state intervention; objectives of APP; instruments an evaluation; Food security in India and public distribution system.
An overview of agricultural development; Globalization of India Economy and its effects on Indian Agriculture.

3. Presentation and classification of data: Discrete and continuous variables, frequency distributions, graphical representation Ogives and other forms of representations.
Measures of location and dispersion: Mean, median, mode, quartiles, deciles and percentiles. Variance, Skewness and kurtosis.

4. Elements of probability theory: Definition of probability, classical definitions relative frequency approach and axiomatic approach, Addition rule, multiplication rule and Bayer’s rule formula.
Discrete Random variable, continuous random variable; Binomial Possion and normal distributions and their properties and importance.
Small sample theory; F-distribution, students t-distribution Tests for assumed mean, comparison of means two samples. Chi-square distributions, contingency tables, Applications Chi-square tables. Goodness of fit test.

5. Correlation and regression
Analysis of variance: One-way, two way; field plot designs randomised and completely randomised, latin square, missing plot techniques.

Suggested Laboratory exercises:
Problems on topics included in theory syllabus

Suggested Books:


M.Sc. Agricultural Biotechnology – Semester III

Core Paper 304: Biostatistics

1. Presentation and classification of data: Discrete and continuous variables, frequency distributions, graphical representation, Measures of dispersion, Mean, Median, Mode, Quartiles, Range, Quartile Deviation, Mean deviation, Standard Deviation.


4. Tests of significance; Basic concepts, large sample tests, sampling of attributes, (test of single proportion, list of significance for difference of proportions). Sampling of variables (Test of Significance, for a single mean & difference of mean). Small samples tests – definition of students distribution test for assumed mean, comparison of means two samples, paired t-test. Definition of chisquare distributions, chisquare test for Goodness of fit and chisquare test for independents of attributes.

5. Analysis of variance, definition of ‘f’ distribution, one way, two way. Classification problems, basic concepts of experimental design, CRD, RBD.

Suggested Laboratory exercises:

1. Methods of central tendency (arithmetic mean, median, mode)
2. Measures of dispersion (standard deviation)
3. Probability theory
4. Problems on Binomial and poisson distribution.
5. Problems on Binomial Normal Distribution.
6. Large sample tests.
7. Small sample tests.
8. Chisquare tests.
9. ANOVA – one way & two way classification.
10. Correlation
11. Regression

Suggested Books:
M.Sc. Agricultural Biotechnology – Semester IV

Core Paper 401: Agricultural Biodiversity and Intellectual Property Rights

1. Definition; Historical and geographical causes for diversity; Genetic diversity Molecular diversity; Species and Population biodiversity; Quantifying biodiversity Maintenance of ecological biodiversity;

2. Collection and conservation of biodiversity; Assessing, analyzing and documenting biodiversity; Morphological and molecular characterization of biodiversity vulnerability and extinction of biodiversity. Case studies of IPR in relation to Indian Flora- Basmati Rice, Turmeric and Neem.

3. Introduction to biodiversity database: endangered plants, endemism and Red Data Books Biodiversity and centers of origins of plants; Biodiversity hot spots in India; Global biodiversity information systems.

Suggested Laboratory exercises:

1. Biodiversity studies in and around Visakhapatnam.
2. Collection of biodiversity related material from different sources.
3. Submission of the above in the form of assignments.

Suggested Books:


IUCN. The World Conservation Union.
1. Introduction to Bioinformatics and internet:

Origin of Bioinformatics
Branches of Bioinformatics: Genomics, Proteomics, Transcriptomics.
Scope of Bioinformatics.
World Wide Web (WWW).
Web browsers: Internet explore, Mozilla, Godzilla.
HTML, HTTP.
Intra and Internet concept and packages.

2. Biological Data Bases and Data Base searching:

Introduction to Data Bases.
Types of Data Bases.
Sequence of Data Bases: Gene Bank, Swiss – Prot, TrEMBL, PIR (Protein information Resource), UniProt (Universal Protein Resource).
Protein Structure Data Bases: PDB (Protein Data Bank), CATH (Protein Structural Classification), SCOP (Structural Classification of Proteins), ModBase (Databases of Comparative Protein Structure Models).
An account on NCBI.
Data base searches: BLAST & FASTA
BLAST (Basic Local Alignment Search Tool)
   1. Understanding the NCBI – BLAST
   2. Understanding scoring matrices: BLOSUM & PAM
   3. BLAST against NCBI Database
   4. Creating Local BLAST Database
   5. BLAST against Local Database

3. Genome Analysis and Comparative Genomics:

Genome projects: Aims, Stages, E.coli, Yeast, Homosapiens, Arabidopsis thaliana genome characteristics.
Genome Annotation: Understanding the Genome Annotation pipeline, Gene finding,
Repeat sequences, CGP s, Tools used.
Genome Annotation: Tools used.
Physical map of Genomes and sequences assembly: Assembling sequences and Conitgs.
RNA analysis: Structure prediction, Ribosome binding site and termination region prediction.
Comparative genomics: orthologs Vs paralogs, Why and What to compare. Synteny maps, Cluster of orthologous genes, Unique genes, Phylogenetic relationships.

4. Sequence Analysis and Molecular Phylogeny:

Pair wise Comparison.
Multiple Sequence Alignment & Dynamic Programming, Clustal W, PILEUP
Global Alignment: Needleman – Wunsch.
Local Alignment: Smith – Waterman.
Dot plot.
Scoring matrices PAM, BLOSSUM.
Molecular phylogeny: Concept, methods of tree construction: UPGMA, Neighbor joining, Maximum parsimony, Minimum Evolution, Boot strapping.

5. Protein analysis & Proteomics:

Protein Secondary Structure Prediction.
Understanding Chou – Fasman method.
Pfam Domain Database.
Understanding Protein Domain Architectures.
PRODOM
Transmembrane Helix prediction.
Signal Peptide Prediction.
Protein 3D structure prediction, Homology Modeling, Threading.
Drug design: Predicting protein – biomolecule structures, protein – protein interactions, Constraint – based methods – PROTEIN DOCKING (Molegro)
Bioinformatics in Microarrays: Design of Microarrays, Analysis of data from microarrays.

Suggested Laboratory exercises:

1. Collection of sequence
2. Gene search
3. Annotating the gene
4. BLAST
5. Submitting DNA sequence to a data base
7. Constructing phylogeny trees

Books Suggested:


M.Sc. Agricultural Biotechnology – Semester IV

**Core Paper 403: Seed Technology**

1. Cryo-preservation and conservation of genetic resources.
2. Biology of seed: Seed reserves and nutritional quality, Phytohormones and seed development, synthetic seeds.
3. Germination of seeds, Water Potential regulation during seed germination; other factors regulating germination.
5. Harvesting and processing of seeds.
6. Seed testing and certification process.
7. Seed treatment and storage.

**Suggested Laboratory Exercises**

1. Synthetic seed preparation.
2. Cryo preservation methods.
3. Tetrazolium test for seed viability and determination.

**Suggested Books:**

2. Agarwal, Seed Technology.


Core Paper 404: Agricultural Applications of Genetic Engineering

1. Introducing genes into pro-and eukaryotes using gene transfer methods. DNA-mediated and Agrobacterium mediated transfers, microinjection, electroporation, somatic cell hybridization.

2. Genetic engineering for resistance to insect pests, herbicides and diseases in cereal and commercial crops.

3. Transgenesis and transgenic plants with an emphasis on tobacco, cotton, tomato and rice as model systems.


5. Improvement of qualitative characters – Nutritional value of storage products - elite strains rich in iron, protein and amino acids, golden rice colours – anthocyanines, betalaines, crocin and crocetins. Flavours – capsaicin, vanillin, stevioside thaumatin

Suggested Laboratory Exercises

1. Transformation in Bacteria
2. Agrobacterium mediated gene transfer
3. GFP cloning
4. GUS histochemical reaction
5. Restriction mapping
6. DNA micro assays
7. DNS sequencing
8. Electrophoresis of proteins, enzymes and DNA

Suggested Books

1. Primrose SB 1995: Principles of Genome avalepia