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
3. Plasma membrane : Structure, Models and functions, Atpases, Ion Carriers, Channels, Pumps, transporters.
4. Plasmodesmata – Structure, functions, gap junctions.
5. Plant vacuole : Structure and function, tonoplast membrane, Atpases, transporters and storage organelle
6. Cell organella 1: Mitochondria and Chloroplasts structure and function, genome organization bio genesis.
7. Cell organell II : Structure and function of microbodies, golgi apparatus lysosomes, endoplasmic reticulum.
8. Cytoskeleton: Organisation and role of microtubules and micro filaments during cell division, cellular movements intermediate filaments.

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:

1. Lodish, H, Berk A, Z, Pursky, SL Matsudiara P.Baltimore, D a d Darnel, J 2000: Molecular cell Biology (4th edition) W.H. Freeman & Co., Newyork, USA.
2. Buchman, B B, Gruissem, W and Jones R.L (2000): Eiochemistry and Molecular Biology of plants, American Society of plant, Physiologists Maryland, USA.
3. Kelinsuith, L.J. and Kish V M 1995 Principles of Cell and Molecular Biology 2nd edition, Harper Collins college publishers, Newyork, USA.
4. Rost T et al 1998 Plant Biology Wadsworth Publishing Co., California, USA.

5. Molecular Biology of the Cell (2002) IV Edition, Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter, Garland Science Taylor and Francis group.

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 allelism, 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 :

1. Sinnott, L.C. Dunn & Bodzhasky : Principles of Genetics.
2. SRB Edger & Ower : General Genetics
3. E.W. Burns : Genetics
4. Griffiths, A..F. Miller, H.. Suzuki, Lewontin Gelbart: Introduction to Genetic Analysis.

5. G.S. Khush: Cytogenetics of Aneuploids.
6. Sharma, A.K. & Sharma A: Chromosome Techniques.
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.
4. Breeding of crops pollinated plants – Hybridization and pest hybridization selection methods – synthetic varieties.
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 :

1. Sinnott, L.C. Dunn & Bodzhasky : Principles of Genetics.
2. SRB Edger & Ower : General Genetics.
3. E.W. Burns : Genetics
4. Griffiths, A.J.F. Miller, H.J. Suzuki J, Lewontin Gelbart : Introduction to Genetic Analysis.
5. G.S. Khush: Cytogenetics of Aneuiploids
6. Sharma, A.K. & Sharma A: Chromosome Techniques.
7. C.R. Burnham: Discussions in Cytogenetics.
8. Poehmau & Borthakur 1981: Breeding Asian Field Crops.

9. Singh, BD.: Plant Breeding.
10. Allard, R.W. 1961: Principles of Plant Breeding.
11. James L. Brewbaker : Agricultural Genetics.
12. Briggs & Knowles : Introduction to Plant Breeding.

M.Sc. Agricultural Biotechnology – Semester I

Core Paper 104: Molecular Biology

1. DNA structure: A, B, Z forms of DNA. Organisation of the eukaryotic gene. Promoter and terminator sequences. Split gene.

2. Modern concept of the gene: Overlapping genes. Nested genes. Repeated genes. Polyprotein gene. Assorted gene. Transposons: Types and mechanism of transportation. Molecular basis of mutations.

3. DNA replication – Semi conservative replication, uni and bi directional replication, Enzymes of replication, RNA priming and primosome complex. Mechanism of DNA replication in prokaryotes and eukaryotes. Telomerases and replication at the ends. DNA damage and repair – photoreactivation, excision repair, recombinational repair, SOS and adoptive response and regulation.

4. Expression of DNA: Transcription in pro and eukaryotes. Transcription factors: types. mRNA processing in eukaryotes, splicesome, tRNA structure and function. Structure of ribosome in relation to its function as a protein manufacturing factory. Translation in pro- and eukaryotes. Genetic code. Post translational modifications and protein trafficking.

5. Regulation of gene expression: In Bacteria: Lac and Try operons. Positive and negative control. In Eukaryotes: Cis and Trans factors. Temporal and spatial regulation of gene expression.
   Signal transduction: G proteins, transmembrane proteins.
   Role of DNA methylation in gene expression. Role of chromatin structure in gene expression.

6. Assignments on the topics mentioned in the syllabus.

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

Suggested Books

1. Buchaman B. B., Gruissem, W and Jones R.I. 2000. Biochemistry and Molecular Biology of Plants: American Societies of Plant Physiologists, Maryland, U.S.A.
2. Lewin B, 2000. Genes VIII Oxford University Press, New York.
3. R.F. Weavor, 1999. Molecular Biology, WCB Mc Graw Hill.

4. Glick, B.R. and Thompson J.E. 1992. Methods in Plant Molecular Biology and Biotechnology, CRC Press, Boc Raton Florida.

5. Shaw, C.H. 1998. Plant Molecular Biology. A practical approach, IRL Press, Oxford.

6. Lodish, Berk A, Zipursky, S.L., Matsdaira, P. Baltimore, D. and Damell, . 2000. Molecular Cell Biology (4th edition). W.H. Freeman & Co. New York, U.S.A.

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.
3. Pathways of regeneration – biochemical and molecular aspects of tissue culture cycle.
4. Methods of androgenic and genomic haploid production-dihaploids and application in agriculture embryo rescue.
5. Cell culture: Establishment, plating efficiency, induction and selection of mutants.
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.
9. Secondary metabolite production in tissue cultures: biotransformation.

Suggested Laboratory Exercises :

1. General outlay of PTC laboratory.
2. Preparation of media.
3. Callus induction – Cajanus, bajra/ Sorghum, tomato.
4. Anther Culture - Rice, Tobacco.
5. Establishment of cell cultures and determination of growth pattern and plating efficiency.
6. Protoplast isolation.
7. Observing stages of Somatic Embryogenesis.

Suggested Books :

1. Vasil, I.K. & Thorpe T.A. 1994. Plant cell and tissue culture.
2. Bhojwani, S.S. & Rajdau, M.K. 1996. Plant tissue culture theory and practice.
3. Reinert, J & Baja, YPS 1997, Applied and Fundamental aspects of plant cell, tissue and organ culture.
4. Mantel, S.H. & Smith, H. Plant Biotechnology.
5. Reinert J.C. and Yeoman MM, Plant Cell and tissue culture a laboratory Manual.
6. Evans, D.A., W.R. Sharp, P.V. Ammirato, Y. Yamada Hand Book of Plant Tissue Culture.
7. Kasha, K.J. (Ed.) Haploids in higher plants – Advances and potential.
8. Bary We. Reinhard, M.S. & Zenk (Edi) Plant Tissue Culture and its Biotechnology Application.

M.Sc. Agricultural Biotechnology – Semester II

Core Paper 202: Tools and Techniques of Genetic Engineering

1. Recombinant DNA technology: Principle of genetic engineering cloning vectors – essential features of a plasmid vector, common plasmid vectors, phage vectors, cosmids, animal viruses as vectors, artificial mini chromosomes, scoreable and selectable markers.
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.
5. Techniques in genetic engineering – 3: PCR – based *in vitro* mutagenesis, DNA sequencing, chromosome walking, chromosome jumping, DNA-micro arrays, DNA - foot printing.

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 :

1. Primrose SB 1995: Principles of Genome avalepia.
2. Old R W and Primrose SB 1989: Principles of Gene Manipulation, Black Well Scientific Publications, Oxford, U.K.
3. Jolls. O and Jornvali H (eds) 2000: Proteomics in functional genomics, Birkhauser veriog, Basel, Switzerland.
4. Henry R J, 1997: Practical Applications of Plant Molecular Biology, Chapman & Hall London, UK.
5. Principles of Gene Manipulation S.B. Primorose, RM Twyman and R.W. old sixth edition (2001) Blackwell science.
6. Gene Cloning and DNA analysis, An introduction, Fourth edition TA Brown (2001) Black well science.
7. From Genes to clones, Introduction to gene Technology, (Erist L Winnacker (2003) Panima Publishing corporation.

M.Sc. Agricultural Biotechnology – Semester II

Core Paper 203: Agriculture Microbiology

1. Microbes of agricultural importance : Prokaryotes: Bacteria, Cyanobacteria and viruses-general form, growth and reproduction. Culture of bacteria and viruses; identification of auxotrophic mutants for genetic analysis. Eukaryotes: Protozoa, Nematodes, Algae and Fungi. Outline classification of algae and fungi to serve as a key for identifying taxonomic status of agriculturally important genera. General form and different model reproductive cycles in the three groups.

2. Genomes and genes of Microbes: Genome and extra genomic elements of bacteria. Genes in extragenomic elements. Genome of viruses-cos sites and their role in packaging. Genes involved in Lytic and Lysogenic cycles. Genomes of algae, fungi and protozoa. Genome sizes of economically important organisms and status of sequence information.

3. Recombination in microbes with cryptic sex: Transformation, conjugation, transduction and sexduction in bacteria. Parasexual cycle in mitosporic fungi – vegetative compatibility groups – compatibility tests; Direct confrontation, genetic complementation of mutants. Population Genetic analysis aided by DNA markers to demonstrate parasexuality.

4. Microbe based biofertilizers: Cyanobacterial biofertilizers. Azolla and Anabena symbiotic association. Bacteria (Rhizobium) biofertilizers, Fungal (Mycorhiza) bio-fertilizers. Nitrogen fixation-asymbiotic and symbiotic, nodule formation. Genetics and biochemistry of nitrogen fixation. Nif genes. Transfer of nif genes. Soil microbes releasing plant growth substances.

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.
2. Biotechnology in Agriculture, Mac Millon India Ltd., 1992, Edn. M.S.Swaminath.
3. Trends in Agricultural insect pest management, G.S. Dhaliwel & Ramesh Arora Bio-router of plant diseases, K.G. Mukherji & K.L. Gang, C.B.S. Purnachand distribution (1980).
4. S.S. Purohit: Agricultural Biotechnology (2003) Agribion India.
5. R.S. Mehrote: Plant Pathology Tata Mc Graw Hill (1980).
6. Winnacker : From Genes to clones Panima Publishing Corporation (2003).

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, T_4, M_{13} Phage, λ phage, ϕ x 174 TMV, Cu MV, Neurospora yeast and Chalmy domoney.

2. Genetics of viruses – Phage phenotypes, Genetic recombination in phages – Lytic and lysogenic cycles and their genetic basis – Phage heterozygosity, Genetic recombination – Mapping of viral genomes – Genetic fine structure analysis of rII locus.

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

4. Genetics of bacteria – Transformation and Transduction. Process of transformation and gene mapping. Generalized and specialized transduction and genetic mapping.

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.

7. Concept of molecular markers – their advantages, construction of RFLP, RAPD markers and their common variants – use in construction of genetic maps and their application.

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.

9. Genetics of Nitrogen fixation.

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.
2. Instant notes in Genetics – P.C. Winter, G.I. Hickey & H.L. Fletcher. Viva Books Pvt. Ltd., New Delhi, 1999.
3. General Genetics SRB OWEN & Edgar.
4. Principles of Genetics, Snustad D.P., Simmons, M.J. and Jenkin, J.B. John Wiley and Sons, Inc. New York, 1997.
5. An introduction to Genetic Analysis. A.J.F. Griffith, J.H. Miller, D.J. Suyuki, R.C. Lewontus & W.M. Gelbard. W.H. Freeman and Company, New York.
6. Modern Genetics, Ayala and Kiger.

M.Sc. Agricultural Biotechnology – Semester III

Core Paper 301: Plant Metabolic Engineering

1. Carbohydrate metabolism : Classification, triose and hexose phosphate pools. Pathways utilizing and adding to the pools. Synthesis and degradation of sucrose and starch. Diurral fluctuations in plants and their regulation. Genetic engineering of sugars.

2. Photosynthesis: Light absorption and energy conservation, pigment systems I and II and their structural organization, electron transport and ATP synthesis. Calvins cycle. Plastid genome origin and organization. Transcription, translation and regulation of plastid genes in chloroplast development. Genetic engineering of photosynthesis.

3. Lipid metabolism: Synthesis and degradation of fats and fatty acids. α- and β-oxidation. Outlines of terpenoid and flavonoid pathways. Oil crops, signal transduction – Receptors and G-proteins Calcium – Calmoudulin cascade.

4. Concept of secondary metabolites. Historical and current status. Importance of secondary metabolites in medicine and agriculture. Introduction to pathways and their networking. Transfer of entire pathways and completion of partial pathways through genetic engineering.

5. Metabolic engineering: Pathway engineering for new products and new pathways. Redirecting metabolic flow – desensitization of feed back inhibition, elevating rate limiting enzymes. Metabolic control theory and network rigidity. Identification of principal nodes and assessing metabolic rigidity.

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.
4. Estimation of Chlorophyll Pigments by Arnon method.
5. Separation of Chlorophyll Pigments by chemical method.
6. Separation of Chlorophyll Pigments by paper Chromatography.
7. Estimation of soluble sugars by Colorimetric method.
8. Estimation of free fatty acids.
9. Light effect on Photosynthesis.
10. Effect of CO_2 on Photosynthesis.

Suggested Books :

1. Lincoln, Tiaz and Eduardo Zeiga (2003). Plant Physiology, Paxima Publishing Co.
2. Buchanan, B.B. Gruiesson, W. and Jones R.S. (2000). Biochemistry and Molecular Biology of Plants.
3. Derris D.T., Turpa, D.H. Leferbure, D.D. and Layzell D.B. 1987. Plant Metabolism.
4. Lodish, H. Berk A, Zipursty S.C., Matudaira, P. Baltimore, D and Darell J. 2000. Molecular Biology, W.H. Freeman and Company.

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.
4. Mass multiplication of biocontrol agents.
5. Study of genetically engineered organisms.
6. Visiting the Agricultural fields for assessing the pest problem.

Suggested Books:

1. Brock T.D. and Modigaa M.T. (Latest edition)
2. Biology of Microorganisms, Prentice Hall, New Jersey
3. Pelczar M.J; Chan E.C.S. and Kreig N.R. 1993.
4. Microbiology, Tata Mc-Graw HTK Publishing Co., New Delhi.
5. Stainer, R.Y; Ingram J; Wheelis, M.G. and Paintor, P.R. 1986
6. The Microbial World-Prentice Hall-New Jersey
7. Alexander M. 1985; Introduction to soil Microbiology John Wileys & Sons, New York.
8. Rangaswamy. G and Bagyaraj, D.I. (1992)
9. Agricultural Microbiology, Asia Publishing House, New Yoerk.

10. Subba Rao N.S. 1987Advance in Agricultural Microbiology, Oxford & IBH, New Delhi
11. Waksman S.A. 1952, Principles of Soil Microbiology. John Wileys & Sons
12. Subba Rao. N.S. 1987 Bio-fertilizers in Agriculture and Agroforestry, 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 syste4m (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 persentiles. Varience, 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 Randam 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 randamised and completely randamised, latin square, missing plot techniques.

Suggested Laboratory exercises:

Problems on topics included in theory syllabus

Suggested Books:

1. Bilgrami, S.A.R. (2000). An introduction to Agricultural Economics (2nd Edition), Himalyan Publishing House, Mumbai.

2. Sadhu, A.N. and J. Singh (2000) Agricultural problems in India (3rd edition), Himalayan Publishing House, Mumbai.

3. Sundaram, I.S (2002) Rural Development (4th edition) Himalayan Publishing House, Mumbai.

4. Government of India Economic Survey (Annual), New Delhi.

5. Government of India, Ninth Five year plan (1997-2000), Vol. I & II, planning commission, New Delhi.

6. Reserve Bank of India, Hand Book of Statistics on Indian Economy (Annual).

7. Soni. R.N. (2000), Leading issues in Agricultural Economics, Arihant press, Jalandar.

8. Rundar Datta and K.P.M Sundaram S. Chand & Co, New Delhi, Latest edition.

9. Lyman OH: An introduction to statistical methods and data analysis.

10. Bio-statistics, P.N. Arora &) P.K. Malhan Himalayan Publishing House, Mumbai.

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.

2. Concepts of relative measures of dispersion. Correlation Analysis and Regression Analysis. Concepts of Karl Pearson's coefficient of correlation (ungrouped data only) Spearman's Rank correlation coefficient, problems and simple regression.

3. Elements of probability theory: Definition of probability, classical definitions relative frequency approach and axiomatric. Addition rule, multiplication rule, simple problems and probability. Distributions – meaning of desecrate and continuous random variable. Concept of expectation binomial, poisson and normal distributions.

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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:

1. R. Rangaswamy , A textbook of Agricultural Statistics.
2. P.N. Arora & P.K. Malhan, Biostatics, Himalayan Publishing House, Mumbai.
3. S.C. Gupta, Fundamentals of Statistics, Himalayan Publishing House, Mumbai.
4. Lyman O.H., An introduction to Statistical Methods and data analysis.

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:

1. Anonymous 1997 “National Gene bank: Indian Heritage on Plant Genetic Resources (Booklet)”, National Bureau of Plant Genetic Resources, New Delhi.
2. Arora, R.K., and Nayar, E.R. 1984: “Wild Relatives of Crop Plants in India”, NBPGR, Science Monograph No. 7.
3. Baker H.G., 1978: “Plants and Civilization (3rd Edition)”
4. A. Wordsworth, Belmount Bola, P.V., and Veghabi, Y, 1986: “Field guide to Common Indian Trees”. Oxford University Press, Mumbai.

5. Falk.D.A; Olwell, M and Millan, C 1996: Restoring Diversity, Island Press, Columbia, USA. F.A.O/IBPGR, 1989,: “Technical Guidelines for Safe Movement of Germplasm”.

6. Frankel, O.H; Brown, A.H.D., and Burdon J.J., 1985: “The Conservation of Plant Diversity”, Cambridge University Press, Cambridge, U.K.

7. Heywood, U., (ed) 1995: “Global Diversity Assessment. United Nations Environment Programme”, Cambridge University Press, Cambridge, U.K.

8. Kothari, A., 1997: “Understanding Biodiversity Life sustainability and Equity Orient”.

9. Walter, K.S. and Gilet. H.T., 1997: “IUCN Red List of Threatened Plants”.

IUCN. The World Conservation Union.

M.Sc. Agricultural Biotechnology – Semester IV

Core Paper 402: Bioinformatics

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 strctures, 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
6. Predictive methods of protein structure using protein sequences.

7. Constructing phylogeny trees

Books Suggested:

1. Induction of Bioinformatics – T.K. Attwood & D.J. Parry-Smith 2002, Pealson Education Singapore Pvt. Ltd Indian, Indian Branch, Delhi. ISBN 817808

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.
4. Dormancy – factors effecting and regulations.
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.
4. Observing seeds of somatic embryogenesis.

Suggested Books:

1. Hudsom T Hartmann, D.I. Kester, F.T. Davies & R.L. Geneve, 2002. Plant Propagation principles and Practicles. Prentice – Hall of India, New Delhi.
2. Agarwal, Seed Technology.

3. Baskin, Seeds.

4. Frankel, O.H. Brown, A.H.D. and Burdon J.J. 1995. The Conservation of Plant Diversity, Cambridge University Press, U.K.

5. Hudson, T. Hartmann, D.I., Kester, F.T. Davies and R.L. Geneve 2002. Plant propagation principles and practices. Prentice Hall of India, New Delhi.

M.Sc. Agricultural Biotechnology – Semester IV

Core Paper 404 : Agricultural Applications of Genetic Engineering

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

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

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

4. Developing stress tolerant varieties, vaccine and antibody producing plants. Terminator technology, Introduction of male sterility through genetic engineering. Genetic engineering in improving nitrogen fixation in plants.

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. Agrobactrium mediated gene transfer
3. GFP cloning
4. GUS his to chemical 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

2. Old R W and Primorose SB 1989: Principles of Genome Manipulation, Black well Scientific publications, Oxford, UK

3. Jolles. O and Jornvali H (eds) 2000: Proteomics in functional genomics, Birkhauser veriorg, Basel, Switzerland.

4. Henry RJ, 1997: Practical applications of Plant Molecular Biology, Chapman & Hall London, UK.

5. Principles of Gene Manipulation S. B. Primorose, RM Twyman and R.W. old sixth edition (2001) Blackwell science.

6. Gene Cloning and DNA analysis, an introduction, Fourth edition TA Brown (2001) Blackwell science.

7. From Genes to clones, Introduction to gene Technology. (Erist L Winnacker (2003) Panima Publishing Corporation.