

**M.Sc. Agriculture Biotechnology Choice Based Credit System (CBCS) 2016-17**

**Semester I**

**Marks**

Sr. No.	Course Code	Subject/Title	Credits	Theory	Int Ass
1	16ABT21C1	Cell Biology	04	80	20
2	16ABT21C2	Bio molecules & Metabolism	04	80	20
3	16ABT21C3	Microbiology	04	80	20
4	16ABT21C4	Molecular Biology	04	80	20
5	16ABT21C5	Genetic Engineering	04	80	20
6	16ABT21C6	Lab course-I (Cell Biology, Bio molecules)	04	100	
7	16ABT21C7	Lab course-II {Microbiology (16ABT21C3), Molecular Biology (16ABT21C4), Genetic Engineering(16ABT21C5)}	04	100	
	<b>Total</b>		<b>28</b>		

**Semester II**

Sr. No.	Course Code	Subject/Title	Credits	Theory	Int Ass
1	17ABT22C1	Plant Tissue Culture	04	80	20
2	17ABT22C2	Molecular Breeding	04	80	20
3	17ABT22C3	Plant molecular biology	04	80	20
4	17ABT22D1	Bioinformatics/ Green House Management and Plant Protection/ Biomass and Bio energy	04	80	20
5	Open Elective	To be chosen from the basket of open Electives provided by the university	03		
6	Foundation Course	To be chosen from the basket of Foundation Course provided by the university	02		
7	17ABT22C4	Lab course-I {Plant Tissue Culture (17ABT22C1)}, {Bioinformatics/ Green House Management and Plant Protection/ Biomass & Bio energy ( 17ABT22D1)}	04	100	
8	17ABT22C5	Lab course-II {Mol. Breeding (17ABT22C2), Plant Molecular Biology (17ABT22C3)}	04	100	
	<b>Total</b>		<b>29</b>		

**Semester III**

Sr. No.	Course Code	Subject/Title	Credits	Theory	Int Ass
1	17ABT23C1	Plant Genetic Engineering	04	80	20
2	17ABT23C2	Genomics and Proteomics	04	80	20
3	17ABT23D1	Plant Metabolic Engineering & Molecular Farming/ Biotic and Abiotic Stress Biology	04	80	20
4	17ABT23D2	Industrial & Food Biotech/ Crop Protection & Integrated Pest Management/ Biostatistics & Agro-economics	04	80	20
5	Open Elective	To be chosen from the basket of Open Electives course provided by the university	03		
6	17ABT23C3	Lab course-I (Plant Genetic Engg, Genomics and Proteomics) (17ABT23C1, 17ABT23C2)	04	100	
7	17ABT23C4	Lab course-II 17ABT23D1, 17ABT23D2	04	100	
	<b>Total</b>		<b>27</b>		

**Semester IV**

<b>Sr. No.</b>	<b>Course Code</b>	<b>Subject/Title</b>	<b>Credits</b>	<b>Theory</b>	<b>Int Assss</b>
<b>1</b>	<b>18ABT24C1</b>	<b>IPR Bio safety, Ethical, Legal , Social issues In Agriculture Biotechnology</b>	<b>04</b>	<b>80</b>	<b>20</b>
<b>2</b>	<b>18ABT24C2</b>	<b>Animal Biotechnology &amp; Immunology</b>	<b>04</b>	<b>80</b>	<b>20</b>
<b>3</b>	<b>18ABT24C3</b>	<b>Dissertation</b>	<b>20</b>	<b>300</b>	
	<b>Total</b>		<b>28</b>		

**Total credits=112**

**Choice Based Credit System (Syllabus 2016-18)**

**M.Sc. Agriculture Biotechnology**

**Semester--I**

***Course Title: Cell Biology***

***MM. Th 80 + IA 20***

**Course Code No. 16 ABT21C1**

**Time: 3h**

**NOTE: In all nine questions will be set, two from each unit and one compulsory question of short answer type covering all the units. Students are required to attempt one compulsory question and four others selecting at least one from each unit. All questions are of equal marks.**

**Theory**

**UNIT I**

Diversity of cell size and shape, Cell Theory.

Structure of Prokaryotic and Eukaryotic cells - Isolation and growth of cells. Microscopic techniques for study of cells.

Sub-cellular fractionation and criteria of functional integrity Cellular organelles- Plasma membrane, cell wall and their structural organization,

**UNIT II**

Cellular organelles- Mitochondria, Chloroplast; Nucleus and other organelles and their organization, Transport of nutrients, ions and macromolecules across membrane. Cellular energy transactions - role of mitochondria and chloroplast, Metabolite pathways and their regulation.

**UNIT III**

Cell cycle - molecular events and model systems

Cellular responses to environmental signals in plants and animals- mechanisms of signal transduction. Cell motility - cilia, flagella of eukaryotes and prokaryotes, Biology of cancer,

**UNIT IV**

Cellular basis of differentiation and development - Development in Drosophila and Arabidopsis, Spatial and temporal regulation of Gene expression, Brief introduction to the Life Cycle and Molecular Biology of some important pathogen of AIDS, Malaria, Hepatitis, Tuberculosis, Filariasis, Kala-azar.

**Practical**

1. Microscopy: Bright field, phase contrast & Fluorescence Microscopy.
2. Microtomy
3. Instrumental methods for Cell Biology
4. Sub cellular fractionation and marker enzymes.
5. Histochemical techniques
6. Mitosis & Meiosis

**Suggested Readings**

1. Lodish et al., Molecular Cell Biology Freeman and Company 2000.
2. Smith and Wood. Cell Biology, Chapman and Halls 1996
3. Watson et al. Molecular Biology of the gene. Pearson Prentice Hall, USA 2003
4. Benjamin Lewin. Gene X, Jones and Barlett Publishers, 2010.

**M.Sc. Agriculture Biotechnology**

**Semester—I**

Course Title: **Bio-molecules and metabolism**

*MM. Th 80 + IA 20*

Course Code No. **16 ABT21C2**

**Time: 3h**

**NOTE: In all nine questions will be set, two from each unit and one compulsory question of short answer type covering all the units. Students are required to attempt one compulsory question and four others selecting at least one from each unit. All questions are of equal marks.**

### **Theory**

#### **UNIT I**

Chemical foundations of Biology—pH, pK, acids, bases, buffers, stabilizing interactions (van der Waals, electrostatic, hydrogen bonding, hydrophobic interactions, weak bonds, covalent bonds). Principles of thermodynamics, Macro molecular and supra molecular assemblies. Amino acids and peptides-classification and properties, Sugar- classification and reactions.

#### **UNIT II**

Polysaccharides- Composition, structure and functions,

Proteins: Classification, hierarchy in structure, Ramachandran Plot, Nucleic acids-Classification, structure, functions

Type and classification of enzymes, coenzyme, enzyme kinetics (Michaelis-Menten equation, Km, Vmax, turnover number), LB plots, Enzyme inhibition, allosteric enzymes, Immobilised enzymes.

#### **UNIT III**

Bio-physical techniques in proteins, nucleic acids and polysaccharides structure analysis (UV/Visible, IR, NMR, LASER, MASS-spectrometry, Fluorescence spectroscopy, X - ray Crystallography, Cryoelectrom microscopy, Isothermal Calorimetry (ITC), Surface Plasmon Resonance, Techniques in separation and characterization of protein and nucleic acid: Chromatography techniques (affinity, ion-exchange, gel filtration, HPLC, Hydrophobic electrophoresis, Isoelectric focussing, 2DE, MudPIT).

#### **UNIT IV**

Protein folding: biophysical and cellular aspects

Metabolism of carbohydrate (Glycolysis, Pentose phosphate pathway, Glycogen metabolism, Gluconeogenesis, Citric acid cycle). Lipids (Alpha and beta oxidation of fatty acids, Ketobodies, fatty acid biosynthesis) Metabolism of amino acids and nucleotides, in born errors of metabolism; Electron transport and oxidative phosphorylation..

#### **Practicals**

1. Titration of amino acids
2. Colorimetric determination of pK.
3. Reactions of amino acids, sugars and lipids
4. Isolation, purity determination and quantitation of cholesterol, DNA and mRNA
5. Quantitation of Proteins and Sugars,
6. Analysis of oils-iodine number, saponification value, acid number
7. UV/Visible, IR and Fluorescence spectroscopy, Absorption spectra.
8. Separation techniques and characterization of protein and nucleic acid: Chromatography techniques: Centrifugation, Chromatography (Ion-exchange, gel permeation, TLC etc.) and Electrophoresis,

#### **Suggested Readings:**

1. Lehninger Principles of Biochemistry 4th Ed **By** David L. Nelson and Michael M. Cox, WH Freeman and Company.
2. Chemistry of Biomolecules: an Introduction (Paperback) **By** Richard J. Simmonds. Publisher: Royal Society of Chemistry
3. Principles of Biochemistry (Hardcover) **By** Geoffrey Zubay. Publisher: McGraw Hill College.
4. Biochemistry **By** Lubert Stryer. WH Freeman and Co.

5. Biochemistry: The Molecular Basis of Life (Paperback) **By** Trudy McKee and James R McKee. Publisher: McGraw-Hill Higher education.
6. Biochemistry and Molecular biology **By** William H. Elliott and Daphne C. Elliott. Oxford University Press.
7. Biochemistry (Hardcover) 3rd Ed. **By** Donald J. Voet and Judith G. Voet. John Wiley and Sons.
8. Biochemistry: Biomolecules, Mechanisms of Enzyme Action and Metabolism Vol 1 (Hardcover) **By** D Voet. John Wiley and Sons.
9. Fundamentals of Biochemistry: Life at the Molecular Level [Import] (Hardcover)  
**By** Donald Voet, Judith G. Voet and Charlotte W. Pratt. Publisher: Wiley.
10. Principles of Biochemistry (Paperback) **By** Robert Horton, Laurence A Moran, Gray Scrimgeour, Marc Perry and David Rawn. Pearson Education.
11. Biochemistry **By** U. S. Satyanarayana
12. Outlines of Biochemistry **By** Eric C Conn, PK Stumpf, G Bruening and Ray H. Doi. John Wiley & Sons.

## **M. Sc. Agriculture Biotechnology**

**Semester—I**

**Course Title: Microbiology**

MM. Th 80 + IA 20

**Course Code No. 16 ABT21C3**

Time: 3h

**NOTE: In all nine questions will be set, two from each unit and one compulsory question of short answer type covering all the units. Students are required to attempt one compulsory question and four others selecting at least one from each unit. All questions are of equal marks.**

### **Theory**

#### **UNIT I**

The Beginning of Microbiology Discovery of the microbial world by Antony von Leeuwenhoek: spontaneous generation versus biogenesis, Developments of microbiology in the twentieth century. Development of microbiology as a discipline, establishment of fields of medical microbiology, immunology and environmental microbiology with special reference to the work of following Scientists : Joseph Lister, Paul Ehrlich, Edward Jenner, Louis Pasteur, Robert Koch, Martinus W. Beijerinck, Sergei N. Winogradsky, Alexander Fleming, Selman A. Waksman, Elie Metchnikoff, Norman Pace, Carl Woese and Ananda M. Chakraborty. Overview of scope of Microbiology; Basic sterilization techniques in microbiology laboratory.

Systematic and Taxonomy, Microbial evolution, Systemics and taxonomy, Evolutionary chronometers, Ribosomal RNA oligonucleotide sequencing, signature sequencing and protein sequencing, Basic concept of Bergey's Manual of systemic bacteriology

#### **UNIT II**

Microbial Growth The definition of growth, mathematical expression of growth and generation time, specific growth rate, Synchronous growth; Batch and Continuous culture; Diauxic growth, Growth affected by environmental factors like temperature, pH, water availability, radiation, pressure and oxygen concentration, anaerobic culture. Determination of microbial growth by different methods. Culture collection, and preserving and stocking of pure cultures, pure culture concept, nutritional classification of microorganisms on basis of carbon, nitrogen and electron sources, Different types of bacterial culture media, Calvin cycle and Reductive TCA cycle; Hydrogen, iron and nitrite oxidizing bacteria; Nitrate and sulfate reduction

#### **UNIT III**

Prokaryotic Diversity Bacteria: Purple and green bacteria; Cyanobacteria; Homoacetogenic bacteria; Acetic acid bacteria; Budding and appendaged bacteria; Spirilla; Spirochaetes;

Gliding and sheathed bacteria; Pseudomonads; Lactic and propionic acid bacteria; Mycobacteria: Rickettsias, Chlamydiae and Mycoplasma. Archaea:

Archaea as earliest Life forms: Halophiles; Methanogens; Hyperthermophilic archaea; Thermoplasma

Eukaryotic: Algae, Fungi, Slime molds and Protozoa.

#### **UNIT IV**

Viruses: Structure of Viruses: Capsid symmetry; enveloped and non-enveloped viruses. Isolation purification and cultivation of viruses, Concepts of Viroids, Virusoids, satellite viruses and Prions; life cycle of RNA phages; Lytic and lysogenic phages (lambda and P1 phage), one step multiplication curve, Salient features of TMV, T4 phages, ΦX174, Hepatitis B virus, Retro viruses.

Prokaryotic Cells: Capsule, Glycocalyx, S-Layer, Detailed structure of Cell walls of Gram positive and Gram negative bacteria, LPS, protoplasts, spheroplasts, L-forms, Flagella and motility, Cell membranes of eubacteria and archaeobacteria, Endospores: structure, functions and stages, mesosomes, bacterial chromosomes, pili, plasmids and transposons. Different types of Mutation and Ames test for mutagenesis. Bacterial Transformation, Conjugation, Transduction, Interrupted mating experiments.

Genetic systems of Yeast and Neurospora; Extra-Chromosomal Inheritance

### **Practicals**

1. Light microscope demonstration
2. Isolation of pure culture by streaking method.
3. CFU enumeration by spread plate method.
4. Measurement of microbial growth by turbidometry methods.
5. Effect of temperature, pH and carbon and nitrogen sources on growth.
6. Microscopic examination of bacteria by Gram stain,
7. Acid fast stain and bacterial staining for spores and capsule.
8. Bacterial transformation and transduction
9. Biochemical characterization of selected microbes e.g. *E. coli*
10. Isolation of Plasmids/genomic DNA and DNA agarose gel electrophoresis

### **REFERENCE BOOKS**

1. Atlas RM. (1997). Principles of Microbiology. 2nd edition. WM.T.Brown Publishers.
2. Black JG. (2008). Microbiology: Principles and Explorations. 7th edition. Prentice Hall
3. Pelczar Jr MJ, Chan ECS, and Krieg NR (2004) Microbiology. 5th edition Tata McGraw Hill.
4. Stanier RY, Ingraham JL, Wheelis ML and Painter PR. (2005). General Microbiology. 5 th edition McMillan.
5. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7 th edition. McGraw Hill Higher Education.

**Theory**

**NOTE: In all nine questions will be set, two from each unit and one compulsory question of short answer type covering all the units. Students are required to attempt one compulsory question and four others selecting at least one from each unit. All questions are of equal marks.**

**UNIT I**

**DNA Replication:** Prokaryotic and eukaryotic DNA replication, Mechanics of DNA replication, enzymes and accessory proteins involved in DNA replication and DNA repair. **Transcription:** Prokaryotic transcription, Eukaryotic transcription, RNA polymerase, General and specific transcription factors, Regulatory elements in mechanisms of transcription regulation, Transcriptional and post-transcriptional gene silencing

**Modifications in RNA:** 5'-Cap formation, Transcription termination, 3'-end processing and polyadenylation, Splicing, Editing, Nuclear export of mRNA, mRNA stability

**UNIT II**

**Translation:** Prokaryotic and eukaryotic translation, the translation machinery, Mechanisms of initiation, elongation and termination, Regulation of translation, co- and post translational modifications of proteins.

**Protein Localization:** Synthesis of secretory and membrane protein, Import into nucleus, mitochondria, chloroplast and peroxisomes, Receptor mediated endocytosis

**Oncogenes and Tumor Suppressor Genes:** Viral and cellular oncogenes, tumor suppressor genes from humans, Structure, Function and mechanism of action of pRB and p53 tumor suppressor proteins

**UNIT III**

**Antisense and Ribozyme Technology:** Molecular mechanism of antisense molecules, inhibition of splicing, polyadenylation and translation, disruption of RNA structure and capping, Biochemistry of ribozyme; hammer head, hairpin and other ribozymes, strategies for designing ribozymes, Applications of Antisense and ribozyme technologies

**Homologous Recombination:** Holliday junction, gene targeting, gene disruption, FLP/FRT and Cre/Lox recombination, RecA and other recombinases

**Molecular Mapping of Genome:** Genetic and physical maps, physical mapping and map- based cloning, choice of mapping population, Simple sequence repeat loci, Southern and fluorescence in situ hybridization for genome analysis, Chromosome micro dissection and micro cloning.

**UNIT IV**

**Molecular markers in genome analysis:** RFLP, RAPD and AFLP analysis, Molecular markers linked to disease resistance genes, Application of RFLP in forensic, disease. prognosis, genetic counseling, Pedigree, varietal etc. Animal trafficking and poaching; Germplasm maintenance, taxonomy and Bio-diversity

**Genome Sequencing:** Genome sizes., organelle genomes, Genomic libraries, YAC, BAC libraries, Strategies for sequencing genome, Packaging, transfection and recovery of clones, Application of Sequencing sequence information for identification of defective genes.

**PRACTICALS**

1. Isolation & quantification of genomic DNA
2. Plasmid isolation & quantification
3. Southern blotting
4. RFLP analysis
5. Isolation and quantification of RNA
6. Isolation of polyA + RNA
7. Northern blotting
8. Preparation of probes
9. *In vitro* Transcription
10. *In vitro* translation
11. Metabolic labeling of proteins and immune-precipitation

**Suggested readings**

1. Benjamin Lewin. Gene X, 10<sup>th</sup> Edition, Jones and Barlett Publishers 2010.

2. J D Watson et al., Biology of Gene, 6<sup>th</sup> Edition, Benjamin Cummings publishers Inc. 2007
3. Alberts et al., Molecular Biology of the Cell, Garland, 2002
4. Primose SB, Molecular Biotechnology, Panima, 2001.

**M.Sc. Agriculture Biotechnology**

**Semester--I**

**Course Title: Genetic Engineering**

**MM. Th 80 + IA20**

**Course Code No. 16 ABT21C5**

**Time: 3h**

**NOTE: In all nine questions will be set, two from each unit and one compulsory question of short answer type covering all the units. Students are required to attempt one compulsory question and four other questions selecting at least one from each unit. All questions are of equal marks.**

### **Theory**

#### **UNIT I**

##### **Scope and Milestones in Genetic Engineering**

Genetic engineering guidelines, Molecular Tools and Their Applications, Restriction enzymes, modification enzymes, DNA and RNA markers, Nucleic Acid Purification, Yield Analysis, Nucleic Acid Amplification and its Applications, Gene Cloning Vectors, Restriction Mapping of DNA Fragments and Map Construction, Nucleic Acid Sequencing, cDNA Synthesis and Cloning , mRNA enrichment, reverse transcription, DNA primers, linkers, adaptors and their chemical synthesis, Library construction and screening, Alternative Strategies of Gene Cloning

#### **UNIT II**

Cloning interacting genes-Two-and three hybrid systems, cloning differentially 'expressed genes. Nucleic acid microarray arrays, Site-directed Mutagenesis and Protein Engineering, How to Study Gene Regulation? DNA transfection, Northern blot, Primer extension, S1 mapping, RNase protection assay, Reporter assays

Expression strategies for heterologous genes, Vector engineering and codon optimization, host engineering, *in vitro* transcription and translation, expression in bacteria, expression in yeast, expression in insect cells, expression in mammalian cells, expression in plants.

#### **UNIT III**

Processing of recombinant proteins: Purification and refolding, characterization of recombinant proteins, stabilization of proteins. Phage Display, T-DNA and Transposon Tagging, Role of gene tagging in gene analysis, Identification and isolation of genes through T-DNA or Transposon.

#### **UNIT V**

Transgenic and gene knockout technologies. Targeted gene replacement, chromosome engineering.

Gene therapy: Vector engineering strategies of gene delivery, gene replacement/augmentation, gene correction, gene editing, gene regulation and silencing.

### **PRACTICALS**

1. Bacterial culture and antibiotic selection media. Preparation of competent cells.



2. Isolation of plasmid DNA.
3. Isolation of lambda phage DNA.
4. Agarose gel electrophoresis and restriction mapping of DNA
5. Construction of restriction map of plasmid DNA.
6. Cloning in plasmid/phagemid vectors.
7. Preparation, of helper phage and its titration
8. Preparation of single stranded DNA template
9. DNA sequencing
10. Gene expression in E. coli and analysis of gene product
11. PCR and Reporter Gene assay (Gus/CAT/b-GAL)

**Suggested Readings**

1. S B Primrose, R M Twyman, and R W Old. Principles of Gene manipulation. S B University Press, 2001
2. Brown T A. Genomes, 3rd Edition, Garland Science 2006.
3. J Sambrook and DW Russel, Molecular Cloning: A laboratory Manual Vols1-3. CSHL, 2001.
4. DM Glover and B D Hames, DNA cloning, Oxford 1995.
5. Recent reviews in scientific journals.

**M.Sc. Agriculture Biotechnology**  
**Course Title: Plant Tissue Culture**  
**Course Code No. 17ABT 22C1**

**Semester—II**  
**MM. Th 80 + IA 20**

**Time: 3hrs**

**NOTE: In all nine questions will be set, two from each unit and one compulsory question of short answer type covering all the units. Students are required to attempt one compulsory question and four other questions selecting at least one from each unit. All questions are of equal marks.**

### **Theory**

#### **Unit I**

History of plant cell and tissue culture, Culture media; various types of cultures: callus, cell suspension, nurse, root, meristem, In Vitro differentiation: Organogenesis and somatic embryogenesis; Molecular basis of plant organ differentiation Micro-propagation– plant multiplication, hardening, transplantation, genetic fidelity, scale up and cost reduction, bioreactor, artificial seeds; Applications of tissue culture: Virus elimination by shoot tip culture.

#### **Unit II**

*In vitro* pollination and fertilization, Wide hybridization and Embryo rescue, Androgenesis: Anther and pollen culture, Gynogenesis-ovule and ovary culture, dihaploids, their applications in genetics and plant breeding; Somaclonal and gametoclonal variations, In vitro selection. Protoplast isolation and purification; Protoplast viability test; Protoplast culture and regeneration; Somatic hybridization - methods and applications; Cybrids,

#### **Unit III**

Large-scale production of alkaloids and other secondary metabolites through cell culture techniques; high yielding cell lines, factors effecting production, Biotransformation, elicitors induced production, Hairy root culture and production of secondary metabolites.

Immobilization of plant cells.

#### **Unit IV**

Plant Genetic resources, **Germplasm conservation and cryopreservation**, cryoprotectants, Gene bank, Some case studies on **success stories on commercial application** of plant tissue culture.

### **Practicals**

1. Preparation of Murashige and Skoog medium, stocks of macronutrients, micronutrients, vitamins and hormones, autoclaving, filter sterilization of hormones and antibiotics.
2. Surface-sterilization of seeds, establishment of axenic plants, acclimatization of tissue culture plants and establishment in greenhouse.
3. Callus induction in tobacco leaf discs and regeneration of shoots,
4. *In vitro* root induction and transplantation of in vitro-raised plants
5. Anther culture
6. Protoplast isolation viability test and culture

### **Texts/References:**

1. R.H.Smith, Plant Tissue Culture: Techniques and Experiments, Academic Press, San Diego. 1992.
2. S S Bhojwani and M K Razdan, Plant Tissue Culture, Elsevier Publ.

**Time: 3hrs**

**NOTE:**

**In all nine questions will be set, two from each unit and one compulsory question of short answer type covering all the units. Students are required to attempt one compulsory question and four other questions selecting at least one from each unit. All questions are of equal marks.**

**Theory**

**Unit I**

Conventional methods for crop improvement: Principles of plant breeding, Breeding methods for self and cross pollinated crops, Heterosis breeding, Mutation breeding, Limitations of conventional breeding. Plant Genome – Nuclear and cytoplasmic; Significance of organelle genomes; Genome size and sequence components; Modern gene concept - Gene structure, structural and functional genes.

**Unit II**

Molecular markers: Definition, properties, kinds of molecular markers: Restriction based and PCR based; RFLP: methodology and applications, RAPD & AFLP: Principles, methodology and applications, Development of SCAR and SSR markers. Other markers: CAPS, SNP, Comparison of different marker systems, Gene flow in plants – Development of mapping population – Marker Assisted Selection (MAS), screening and validation;

**Unit III**

Trait related markers and characterization of genes involved; Mapping genes on specific chromosomes; QTL mapping; Gene pyramiding; Transcript mapping techniques. Development of ESTs, Molecular markers for plant genotyping and germplasm analysis; Fidelity analysis; settling IPR issues; Marker Assisted Breeding in transgenics – herbicide resistance; Pest and disease resistance; Quality enhancement etc. Allel mining,

**Unit IV**

TILLING, EcoTILLING, Recent advances – Non gel based techniques for plant genotyping – Homogenous assays– Qualitative/Real Time assays; DNA Chip and its technology.

**Practicals**

1. Isolation of DNA, DNA purity and quantification tests
2. Agarose gel electrophoresis and restriction mapping of DNA
3. PCR amplification and PCR-based DNA markers.
4. Southern blotting
5. Preparation of probes
6. Phylogenetic relationship, construction of genetic linkage maps using computer softwares.
7. DNA finger printing methods.

**Texts/References:**

1. Anolles, G. C. and Gresshoff, P.M., DNA markers – protocols, application overviews. Wiley – Liss, New York, 1997
2. Clark, D. P., Molecular Biology, Elsevier, USA, 2005.
3. Henry R. J., Plant Genotyping: The DNA fingerprinting of plants. CABI, New Delhi, 2005.

## M.Sc. Agricultural Biotechnology Semester—II

Course Title: Plant Molecular Biology

MM. Th 80 + IA 20

Course Code No. 17ABT 22C3

Time: 3h

**NOTE: In all nine questions will be set, two from each unit and one compulsory question of short answer type covering all the units. Students are required to attempt one compulsory question and four other questions selecting at least one from each unit. All questions are of equal marks.**

### Theory

#### Unit I

Solute movement; Water relations; Concept of plasticity in plant development; Analysing plant growth; Mobilization of food reserves during seed germination; Hormonal control of seed germination and seedling growth; Tropisms. Floral Induction and Development; Photoperiodism and its significance; Inflorescence and floral determination; Molecular genetics of floral development and floral organ differentiation; Sex determination; Source-sink relationship

#### Unit II

**Carbon Assimilation;** Carbon dioxide uptake and assimilation; Calvin Cycle; Hatch-Slack pathway; Reductive pentose phosphate pathway; Photorespiration; Glycolate metabolism; Molecular biology of photosynthetic processes

**Nitrogen, sulphur and phosphorus metabolism;** Nitrate reduction, Pathways of ammonia assimilation, transamination; Symbiotic and non-symbiotic nitrogen fixation; Role of lectins; nod genes; nif genes; Structure, function and regulation of nitrogenase; Leghaemoglobin; Nodulins; Molecular aspects of regulation and enhancement of nitrogen fixation; Mycorrhizal-plant symbiosis; Regulation of nitrogen assimilation, uptake, transport and assimilation of sulphate and phosphate.

#### Unit III

**Signal Transduction** – Basic concepts; Receptors and G-proteins; Cyclic AMP cascade; Phospholipid and Ca<sup>2+</sup>-calmodulin cascade; MAP kinase cascade; Sucrose sensing mechanism.

**Senescence and Programmed Cell Death (PCD)** – Senescence and its regulation; Hormonal and environmental control of senescence; PCD in the life cycle of plants.

#### Unit IV

**Biosynthesis of Plant Hormones and Elicitors;** Structure and metabolism of auxins, gibberellins, cytokinins, abscisic acid, ethylene, brassinosteroids, salicylic acid, jasmonates and related compounds.

**Molecular Mechanism of Hormone Action** – Hormone signal perception, transduction and gene regulation; Role of mutants in understanding hormone action.

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### Practicals

1. Plant DNA extraction, digestion of DNA with restriction enzymes,
2. DNA agarose gel electrophoresis.
3. Polymerase chain reaction to amplify a plant gene.

4. Homogenization of leaves, sub-cellular fractionation by differential centrifugation, chloroplast purification, SDS-PAGE analysis of chloroplast proteins.
5. RNA extraction, Agarose gel electrophoresis of RNA,
6. RT-PCR analysis of a plant gene.

### **Suggested Readings**

1. [Lincoln Taiz, Eduardo Zeiger](#), Plant Physiology, Sinauer Associates, 2010.

John Buchanan, Wilhelm Gruissem, Russell Jones, Biochemistry and Mol Biol Of Plants. John Wiley and Sons, 2002.

17.

## **M. Sc. Agriculture Biotechnology Semester—II**

**Course Title: Bioinformatics**

**MM. Th 80 + IA 20**

**Course Code No. 17ABT 22D1**

**Time: 3h**

**NOTE: In all nine questions will be set, two from each unit and one compulsory question of short answer type covering all the units. Students are required to attempt one compulsory question and four other questions selecting at least one from each unit. All questions are of equal marks.**

### **Theory**

#### **UNIT I**

Computers: An overview of computers, architecture; generations. What is programming? Algorithms. Introduction to MS Office. MS Access, Front Page and introduction to C, Java and SQL (structured query language). Introduction to computer networking, topology, networking protocol (FTP; TCP/IP), Colour, Sound & Graphics.

#### **UNIT II**

Introduction to PERL: Scalar variables, strings and numbers, Assignment statements, Arrays, Hashes, Operators, Input from file, Standard Input, Conditional and logical operators, loops, I/O, Input from file named in command line, Regular expression, Pattern matching, Subroutines. Applications of PERL in Bioinformatics.

#### **UNIT III**

Biological Sequence Databases: Overview of various primary and secondary databases that deal with protein and nucleic acid sequences. Databases to be covered in detail are GenBank, EMBL, DDBJ, Swiss Prot, PIR, and MIPS for primary sequences. Various specialized databases like TIGR, Hovergen, TAIR, PlasmDB, ECDC.

#### **UNIT IV**

Sequence Comparison Methods: Method for the comparison of two sequences viz., Dot matrix plots, NeedlemanWusch & SmithWaterman algorithms. Analysis of computational complexities and the relative merits and demerits of each method. Theory of scoring matrices and their use for sequence comparison; Statistical analysis and evaluation of BLAST; CLUSTAL-X/W; Molecular Phylogeny.

### **Practicals:**

- Computational analysis of genomic and proteomic data.
- Network search on genomic and proteomic databases. □
- Use of PERL programming for : i) Storing DNA sequence ii) DNA to RNA

transcription iii) Counting nucleotides

- Phylogenetic tree construction.

### **Suggested Readings**

1. David W. Mount Bioinformatics: Sequence and Genome Analysis CSHL Press, 2004
2. A. Baxevanis and FBF Ouellette, Bioinformatics: A practical guide to the analysis of genes and proteins 2nd eds. John Wiley 2001
3. Jonathan Pevsner Bioinformatics and functional genomics 1st Ed. Wiley Liss 2003
4. P E Bourne and H. Weissig Structural Bioinformatics Wiley 2003.

### **M.Sc. Agriculture Biotechnology**

**Course Title: Green House Management and Plant Protection**

**Course Code No. 17ABT 22D1**

### **Semester-II**

**MM. Th 80 + IA 20**

**Time: 3h**

### **Theory**

**NOTE: In all nine questions will be set, two from each unit and one compulsory question of short answer type covering all the units. Students are required to attempt one compulsory question and four others selecting at least one from each unit. All questions are of equal marks.**

### **UNIT I**

Plant propagation structures; Green House, hot beds, cold frames and lath houses. Miscellaneous propagation structures- fluorescent light boxes and propagating frames Carbon dioxide enrichment in green house. Containers for propagating and growing young plants.

### **UNIT II**

Media for propagating and growing nursery plants; Media components: Sand, peat sphagnum moss, vermiculite, pumice, perlite, synthetic plastic aggregates and compost. Mixtures for container growing. Preplanting treatments of soil and soil mixes, heat treatments, fumigation with chemicals.

### **UNIT III**

Sanitation, soil enrichment and other requirements of propagation: Physical propagation facilities, propagation media and plant material. Supplementary fertilizers controlled release fertilizers. Salinity in soil mixtures, water quality and soil pH. Handling of container grown plants.

### **UNIT IV**

Plant protection from weeds: Types of weeds, crop-weed competition and weed control methods. Classification of herbicides. Working of selective weed killers. Biological and integrated weed control. Plant protection from diseases and interest: Diseases of crops-definition, nature, and causes. Control of diseases by fungicides and antibiotics. Control of insect pests: Principles, physical and mechanical control, cultural control, host plant resistance, biological control, legislature or regulatory method, chemical control and other methods of insect control

### **Practicals**

1. To study specialized greenhouse operations.
2. Formulations of the plant growth media.
3. To study pest management in green house.
4. To study water and plant nutrition management.
5. Harvesting and postharvest handling in green house.
6. Management of farm records in green house

### **Books:**

1. Hann J.J., Holley W.D. and K.L.Goldsberry : Greenhouse management
2. Furuta, T. : Nursery management handbook
3. Langhans R.W. :Green house management

**M.Sc. Agriculture Biotechnology**  
**Course Title: Biomass and Bioenergy**  
**Course Code No. 17ABT 22D1**

**Semester II**  
**MM. Th 80 + IA 20**  
**Time: 3h**

**Theory**

**NOTE: In all nine questions will be set, two from each unit and one compulsory question of short answer type covering all the units. Students are required to attempt one compulsory question and four others selecting at least one from each unit. All questions are of equal marks.**

**UNIT I**

Energy sources - General account-Nuclear energy and Fossil fuel energy, Non – Nuclear and Non – Fossil fuel energy. Bioenergy-energy plantations, social forestry and Silvi culture energy farms.

**UNIT II**

Biomass and source of energy: Composition of biomass, aquatic and terrestrial biomass production of algal and fungal biomass, Organic wastes as a renewable source of energy, sources of wastes and composition of wastes.

**UNIT III**

Bioenergy sources: Petroleum plants (petro plants) - hydrocarbons for higher plants like *Hevea* and *Euphorbia*. Algal hydrocarbons. Alcohols: Alcohols as a liquid fuel-Hydrolysis of lignocellulosic materials, Ethanol production, fermentation and recovery of ethanol.

**UNIT IV**

Biomass conversion: Non biological process- Direct combustion (hog fuel), pyrolysis, Gasification and Liquefaction. Biological process: Enzymatic digestion, aerobic and anaerobic digestion Gaseous fuels: Biogas and hydrogen: Biogas technology benefits from biogas plants. Biogas production: aerobic digestion solubilization, acidogenesis, methanogenesis. Biogas production from different feed stocks like *Salvinia* and *Eichornia*. Hydrogen as a fuel: Photobiological process of hydrogen production. Hydrogenase and hydrogen production

**Practicals:**

1. Formulation of different types of plant growth media.
2. Formulation of different types of microbial growth media.
3. Isolation of cellulose degrading bacteria from the soil.
4. Isolation of biogas producing bacteria from the cattle dung.
5. To study the various methods of biomass measurement
6. Production of ethanol from sucrose by yeast.

**References:**

1. Vepal S Malik & Padma Sridahar: Industrial biotechnology
2. Michael L Mckinney & Robert M Schoch: Environmental science-systems and solutions Kerry Turner R: Sustainable Environment Management
3. Indian Institute of Ecology & Environment Publ.: International Encyclopedia of Ecology and environment Vol.1-30

M.Sc. Agricultural Biotechnology

Semester—III

Course Title: Plant Genetic Engineering

MM. Th 80 + IA 20

Course Code No. 17ABT 23C1

Time: 3hrs

**NOTE: In all nine questions will be set, two from each unit and one compulsory question of short answer type covering all the units. Students are required to attempt one compulsory question and four other questions selecting at least one from each unit. All questions are of equal marks.**

### Theory

#### Unit I

**Agrobacterium-plant interaction:** Virulence; Ti and Ri plasmids; Opines and their significance; T-DNA transfer; Disarming the Ti plasmid, Agrobacterium-mediated gene delivery, Cointegrate and binary vectors and their utility; Flower dip transformation, **Direct gene transfer** -PEG-mediated, electroporation, particle bombardment and alternative methods; **Screenable and selectable markers;** Monocot transformation, Promoters and poly A signals, Characterization of transgenics; **Chloroplast transformation:** advantages, vectors and successes; Gene stability and gene silencing, gene stacking,

#### Unit II

**Viral resistance:** coat protein mediated, nucleocapsid gene, antisense and RNAi, **Fungal diseases:** chitinase, 1-3 beta glucanase, RIP, antifungal proteins, thionins, PR proteins, **Insect pests resistance:** Bt genes, Non-Bt like protease inhibitors, alpha amylase inhibitor, **nematodes resistance and herbicide resistance:** phosphinothricin, glyphosate, sulfonyl urea, atrazine.

#### Unit III

**Drought, salinity, thermal stress, flooding and submergence tolerance:** perception and signaling of stress, osmoprotectants, stress proteins, oxidative stress, **post-harvest losses, long shelf life of fruits and flowers:** use of ACC synthase, Polygalacturanase, ACC oxidase, **male sterile lines:** bar and barnase systems.

#### Unit IV

**Genetic engineering for increasing crop productivity:** enhancing photosynthetic, nutrient use and nitrogen fixing efficiencies of plants, **Genetic Engineering for quality improvement:** Seed storage proteins; essential amino acids, Vitamins and minerals, heterologous protein production in transgenic plants, biodegradable plastics, Plants as biofactories, Biosafety and risk assessment of GM crops.

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### Practicals

1. Isolation of plasmids with reporter (*gus*) gene,
2. Preparation of microprojectiles, transformation using a particle gun, GUS staining.
3. Leaf disc transformation using Agrobacterium, establishment of transgenic plants, and GUS staining or GFP viewing.
4. DNA extraction from transgenic plants, DNA estimation, PCR analysis,
5. Southern blot analysis to prove T-DNA integration,
6. RT-PCR to study transgene expression,
7. Western blotting to study the accumulation of transgene-encoded protein.

### Texts/References:

1. Adrian Slater, Nigel Scott and Mark Fowler, Plant Biotechnology: The genetic manipulation of plants, 1st Edition, Oxford University Press, 2003.



2. Edited by BR Jordan, 2nd Edition, The Molecular Biology and Biotechnology of Flowering, CABI, 2006.
3. Jaiwal P K & Singh R P (eds) Plant Genetic Engineering Vol-1 to Vol. 9. Studium Press, USA, 2006.
4. Denis Murphy, Plant Breeding and Biotechnology: Societal Context and the Future of Agriculture, Cambridge University Press, 2007.
5. P K Gupta Plant Biotechnology, Rastogi Publication, Meerut, India.

**M.Sc. Agri. Biotechnology**

**Semester—III**

**Course Title: Genomics and Proteomics.**

**MM. Th 80 + IA 20**

**Course Code No. 17ABT 23C2**

**Time: 3h**

**NOTE: In all nine questions will be set, two from each unit and one compulsory question of short answer type covering all the units. Students are required to attempt one compulsory question and four other questions selecting at least one from each unit. All questions are of equal marks.**

### Theory

#### Unit I

**Introduction:** Structural organization of genome in Prokaryotes and Eukaryotes; Organelle DNA mitochondrial, chloroplast; DNA sequencing principles and translation to large scale projects; Recognition of coding and non-coding sequences and gene annotation; Tools for genome analysis-RFLP, DNA fingerprinting, RAPD, PCR, Linkage and Pedigree analysis;**Physical mapping of genome:** Conventional cytogenetics, Physical mapping by restriction hybridization analysis, FISH and related techniques, Chromosome painting and microdissection, Long range physical mapping Contig assembly, Chromosome walking and map-based cloning..

#### Unit II

**Genome sequencing projects:** Microbes, plants and animals; Accessing and retrieving genome project information from web; Identification and classification using molecular markers-16SrRNA typing/sequencing, EST's and SNP's. **Comparative-genomics:** Introduction, comparative genomics of plants; **Evolutionary Genomics:** Introduction to genome evolution, Acquisition of new genes, Evolution of non-coding regions, Molecular phylogenetics and applications, Evolution of multigene families in the genome

#### Unit III

**Proteomics:** Protein analysis (includes measurement of concentration, aminoacid composition,N-terminal sequencing); 2-D electrophoresis of proteins; isoelectric-focusing; Peptide fingerprinting; LC/MS-MS for identification of proteins and modified proteins; MALDI-TOF;SAGE and Differential display proteomics, Protein-protein interactions, Yeast two hybrid system.

#### Unit IV

**Functional genomics and proteomics:** Introduction, Strategies to find functional genes in the genome, Gene tagging strategies and application. ESTs and its utility in genomics, Differential gene profiling methods, DNA chips/Microarrays, SAGE and SNPs analysis, Protein and peptidemicroarray-based technology; PCR-directed protein *in situ* arrays; Structural proteomics

### Practicals

1. Preparation of DNA from prokaryotes and eukaryotes.
2. Isolation of plasmids from E.coli cells.
3. Agarose gel electrophoresis of plasmid and chromosomal DNA.
4. Protein isolation from different plant tissues.
5. Separation of proteins using SDS-PAGE.
6. Restriction endonuclease digestion of plasmid and chromosomal DNA of E. coli cells.
7. Identification of SSR molecular markers from EST using computational approach.

### Texts/References:

1. Voet D, Voet JG & Pratt CW, Fundamentals of Biochemistry, 2nd ed. Wiley 2006
2. Brown TA, Genomes, 3rd ed. Garland Science 2006
3. Campbell AM & Heyer LJ, Discovering Genomics, Proteomics and Bioinformatics, 2nd ed. Benjamin Cummings 2007
4. Primrose S & Twyman R, Principles of Gene Manipulation and Genomics, 7th ed, Blackwell, 2006
5. Glick BR & Pasternak JJ, Molecular Biotechnology, 3rd ed, ASM Press, 1998

**M. Sc. Agri. Biotechnology**

**SEMESTER-III**

**Course Title: Plant Metabolic Engineering & Mol. Farming MM. Th 80 + IA 20**  
**Course Code No. 17ABT 23D1**

**Time: 3hrs**

**NOTE: In all nine questions will be set, two from each unit and one compulsory question of short answer type covering all the units. Students are required to attempt one compulsory question and four other questions selecting at least one from each unit. All questions are of equal marks.**

### **Theory**

#### **UNIT I**

Basic concepts of Metabolic Engineering – Overview of cellular metabolism; Different models for cellular reaction.

**Primary Metabolites** giving special attention to sugars, amino acids and lipids: The basic structure, The biochemical pathway, Carbon flow Different regulatory points (regulation at enzyme level and whole cell level, Alteration of feed back regulation, Limiting accumulation of end products). **Genetic manipulation** of composition and content of starch, amino acids (lysine and sulfur containing) and oil.

#### **UNIT II**

**Secondary Metabolites** giving special emphasis to following components of Flavanoid pathway, Terpenoid pathway, Polyketoid pathway: The basic structure, The biochemical pathway, Carbon flow, Different regulatory points (regulation at enzyme level and whole cell level, Alteration of feed back regulation, Limiting accumulation of end products). **Genetic manipulation** of flavonoid pathway, Terpenoid and Polyketoid pathways in plants and their value addition with significance in horticulture, agriculture and medicine

#### **UNIT III**

Metabolic Profiling & Transcription Factors for Metabolic Engineering

Metabolic flux - Integration of anabolism and catabolism, metabolic flux distribution analysis bioprocess, material balance, kinetic types, equilibrium reaction. Experimental determination method of flux distribution, metabolic flux analysis and its applications, Metabolic engineering with Bioinformatics, Analysis of metabolic control and the structure, metabolic networks, metabolic pathway synthesis algorithms

#### **UNIT IV**

Metabolic Engineering to improve tolerance of plants to abiotic factors/climate change, biodegradable plastics. Applications of Metabolic Engineering - in pharmaceuticals (edible vaccines, plantibodies etc), food technology, nutraceuticals, agriculture, biofuels, and biomass conversion, Bioenergy generation: Bioethanol and biohydrogen;

### **Practical**

1. Development of high yielding microbes by mutagenesis.
2. SDS – PAGE for the separation of Proteins.
3. Estimation of proteins by colorimetric methods.
4. Separation and estimation of Chlorophyll Pigments
5. Estimation of soluble sugars by Colorimetric method.
6. Estimation of free fatty acids.
7. Metabolic engineering and bioinformatics tools

### **Suggested Readings**

1. [Gregory N. Stephanopoulos](#), [Aristos A. Aristidou](#), [Jens Nielsen](#). Metabolic Engineering: Principles and Methodologies
2. J. Nielsen, Metabolic Engineering, Springer, 2001
3. Reviews from Metabolic Engineering journal, Elsevier
4. P K Jaiwal (ed), Plant Genetic Engineering Vols. 7 & 8: Metabolic Engineering and Molecular Farming- I and II, Studium Press LLC, USA. 2006.

**M.Sc. Agricultural Biotechnology**  
**Course Title: Biotic and Abiotic stress biology**  
**Course Code No. 17ABT 23D1**

**Semester--III**  
**MM. Th 80 + IA 20**

**Time: 3hrs**

**NOTE: In all nine questions will be set, two from each unit and one compulsory question of short answer type covering all the units. Students are required to attempt one compulsory question and four other questions selecting at least one from each unit. All questions are of equal marks.**

## Theory

### Unit I

**Climate change:** Impact of global climate change on agricultural production, reduced green house gas emission from agri-practices, UV-B radiation, Ozone depletion; Green house effect; effect of increased CO<sub>2</sub> and high O<sub>3</sub> on crop productivity and target for crop biotechnology, Exploitation of plant–microbes partnership for improving biomass and remediation: Biocomposting; Biofertilizers; Slow release fertilizers, , Vermiculture.

### Unit II Pollution

**Enviromental pollution;** Source of pollution; Air, water as a source of natural resource; Hydrocarbons, substituted hydro carbons; Oil pollution; Surfactants; Pesticides; Measurement of pollution; Water pollution; Biofilm; Soil pollution; Radioactive pollution; Impact of pollutants; Measurement techniques; Pollution of milk and aquatic animals

Waste water collection; control and management; Waste water treatment; Sewage treatment through chemical, microbial and biotech techniques; Use of bacteria, fungi, plants, enzymes, and GE organisms; Plasmid borne metabolic treatment; Bioaugmentation; Treatment for waste water from dairy, distillery, tannery, sugar and antibiotic industries, solid waste treatment

### Unit III

**Abiotic stress** –Physiological and molecular responses of plants to drought, salinity, heat and cold stress, Ionic and osmotic homeostasis; Stress perception and stress signaling pathways, Oxidative stress and reactive oxygen species scavenging, functional genomics, metabolomics and system biology of stress, miRNA in abiotic stress; Overcoming stress: breeding efforts, marker assisted breeding, transgenic approaches.

Responses of plants to nutrient deficiency - Phosphorous and Iron deficiencies; Physiological and molecular biology of heavy metal tolerance; Bioremediation of contaminated soils and waste land; Bioremediation of contaminated ground water; Phytoremediation of soil metals

### Unit IV

**Biotic stress** - Plant interaction with bacterial, viral and fungal pathogens and herbivores, plant responses to pathogen and herbivores– biochemical and molecular basis of host plant resistance

– toxins of fungi and bacteria – systemic and induced resistance –pathogen derived resistance – signaling - gene for gene hypothesis – genetic engineering for biotic stress resistance – gene pyramiding, biotic stress associated miRNA.

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## Practicals

1. Methods to measure various physiological processes (photosynthesis, transpiration, gas exchange, stomatal conductance, epicuticular wax, Chlorophyll stability index, cell membrane stability) in plants – methods to quantify endogenous hormones (auxin, ABA etc.,) and Proline in plants.
2. Rapid screening tests for abiotic stress tolerance (drought, salinity - PEG, Mannitol & NaCl).
3. Estimation of antioxidants and antioxidant enzymes - Ascorbate, Superoxide dismutase, Catalase, and Peroxidase.
4. Major insect, nematode pests and diseases of crop plants – study of phytotoxaemia and other categories of insect damage in crop plants.

5. Toxin – production - extraction - purification - selection of toxin resistant calli- assay of toxins to pathogens - bioassay for PR protein - culturing and isolation of *Bt* – bioassay techniques.

### **Suggested readings**

1. Pareek, A.; Sopory, S.K.; Bohnert, H.J.; Govindjee (Eds.) Abiotic Stress Adaptation in Plants, Springer, 2010,
2. Heribert Hirt, Plant Stress Biology: From Genomics to Systems Biology, Copyright Wiley-VCH Verlag GmbH & Co. 2010
3. Tuteja N, Sarvajeet Singh Gill, Tuteja R (Editors) Omics and Plant Abiotic Stress Tolerance (2011), Bentham Science Publishers, UAE & USA. (eISBN: No.: 978-1-60805-058-1)
4. Narendra Tuteja, Sarvajeet Singh Gill, Antonio F Tubercio and Renu Tuteja (Editors) Improving Crop Resistance to Abiotic Stress (2011) Volume 1 & 2, Wiley Wiley-VCH Verlag GmbH & Co. Weinheim, Germany, ISBN 978-3-527-32840-6
5. [David M. Orcutt, Erik T. Nilsen](#), The Physiology of Plants Under Stress: Soil and Biotic Factors, Volume 2 , Jon Wiley Publ .

**M. Sc. Agri. Biotechnology**

**Semester-III**

**Course Title: INDUSTRIAL AND FOOD BIOTECHNOLOGY**

**Course Code No. 17ABT 23D2**

**MM. Th 80 + IA20**

**Time: 3hrs.**

**NOTE: In all nine questions will be set, two from each unit and one compulsory question of short answer type covering all the units. Students are required to attempt one compulsory question and four others selecting at least one from each unit. All questions are of equal marks.**

### **Theory:**

#### **UNIT I**

Industrial and food Biotechnology: Introduction, history, importance, applications of biotechnology in industry and food processing, significant advances, recent developments, risk factors, safety regulations.

#### **UNIT II**

Bioprocessing- Basic principles in bioprocess technology, media formulation, sterilization, thermal death kinetics, batch and continous sterilization, systems, Bioprocess control and monitoring variables such as temperature, agitation, pressure, pH. Microbial processes – production, optimization, screening, strain improvement, factors affecting down stream processing and recovery, Representative examples of ethanol, organic acids, antibiotics etc. Industrial microorganisms, microbes exploited commercially- Saacharomyces, Lactobacillus, Pencillium, Acetobactor, Bifidobacterium, Lactococcus, Streptococcus, etc. Dairy fermentation and fermented products.

#### **UNIT III**

Microbial enzymes in food processing, Industrial production of enzymes, Food and Beverages fermentation- alcoholic and non-alcoholic beverages, Food additives and supplements- probiotics, health care products, vitamins and antibiotics, Fuel and industrial chemicals –alkanes, industrial ethanol etc.

#### **UNIT IV**

Modification of microbes, /enzymes -strain improvement, enzymes/cofactor engineering, Technologies for microbial inactivation, Applications in product development and improvement. Cell immobilization for product enhancement - Classical examples, Biosensor and Bioprocess monitoring, model systems and process control.

### **Practicals:**

1. Isolation of industrially important microorganisms for microbial process.
2. Determination of thermal death point and thermal death time of a microorganism for design of a sterilizer.

3. Determination of growth curve of a supplied microorganism and also determine substrate degradation profile.
4. Compute specific growth rate ( $\mu$ ), growth yield ( $Y_{x/s}$ ) from the above.
5. Comparative studies of ethanol production using different substrates.
6. Microbial production of citric acid using *Aspergillus niger*
7. Microbial production of antibiotic (Penicillin)
8. Production and estimation of Alkaline Protease
9. SauerKraut fermentation.

#### **Suggested Reading**

1. Gautam NC, Food Biotechnology in Comprehensive Biotechnology, Vol 7. Shree Publishers New Delhi 2007
2. Gutierrez-Lopez GF et al., Food Science and Food Biotechnology, CRC Press, Washington, 2003.
3. Maheshwari DK et al., Biotechnological application of microorganisms, IK International New Delhi 2006.
4. Stanbury PF et al., Principles of Fermentation Technology, Elsevier UK, 1995.
5. Waites M J et al Industrial Biotechnology: An introduction. Blackwell Pub. UK, 2007.

#### **M. Sc. Agricultural Biotechnology**

**Semester—III**

#### **Choice Based Paper**

**Course Title: Crop Protection and Integrated Pest Management MM. Th80 + IA 20**

**Course Code No. 17ABT 23D2**

**Time: 3h**

**NOTE: In all nine questions will be set, two from each unit and one compulsory question of short answer type covering all the units. Students are required to attempt one compulsory question and four others selecting at least one from each unit. All questions are of equal marks.**

#### **Theory**

##### **Unit I**

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, Principles of integrated Pest Management (IPM), IPM modules for cotton, IPM modules for sugarcane, IPM practices for Pulse crops, IPM practices for oil crops, Economic and ecological affects of pesticide use in India.

##### **Unit II**

Genetics of pathogenecity, Pathotypes, Mechanism of disease resistance, Breeding for disease and insect resistance, Sear's work on rust resistance in wheat. Genetic engineering for improvement of disease resistance, Genetic manipulation of Crops for insect resistance, Molecular Mechanisms conferring herbicide resistance, Transgenic crops,

##### **Unit III**

Genetic engineering and new technologies- their progress and limitations in IPM programmes, deployment of benevolent alien genes for pest management; scope and limitations of bio- intensive and ecological based IPM programmes. Application of IPM to farmers' real-timesituations.

##### **Unit IV**

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

#### **Practicals**

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.

## BOOKS

1. Dhaliwal GS & Arora R. 2003. Integrated Pest Management – Concepts and Approaches. Kalyani Publ., New Delhi.
2. Horowitz AR & Ishaaya I. 2004. Insect Pest Management: Field and Protected Crops. Springer, New Delhi.
3. Ignacimuthu SS & Jayaraj S. 2007. Biotechnology and Insect Pest Management. Elite Publ., New Delhi.
4. Peshin, R, Dhawan, AK. (Eds.). 2009. Integrated Pest Management, Volume 1: Innovation- Development Process. Springer publishers.

**M. Sc. Agricultural Biotechnology**

**Semester—III**

**Choice Based Paper**

**Course Title: Biostatistics and Agro-economics**

**MM. Th80 + IA 20**

**Course Code No. 17ABT 23D2**

**Time: 3h**

**NOTE: In all nine questions will be set, two from each unit and one compulsory question of short answer type covering all the units. Students are required to attempt one compulsory question and four others selecting at least one from each unit. All questions are of equal marks.**

### Theory

#### UNIT I

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

#### UNIT II

Elements of probability theory: Definition of probability, classical definitions relative frequency approach and axiomatic approach. Discrete Random variable, continuous random variable; Binomial Poisson 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. Goodness of fit test. Correlation and regression, Analysis of variance: One-way, two way; field plot designs randomised and completely randomised, latin square, missing plot techniques.

#### UNIT III

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.

#### UNIT IV

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; Food security in India and public distribution system. An overview of agricultural development; Globalization of India Economy and its effects on Indian Agriculture.

### Practicals

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.

## ANOVA – one way & two way classification **BOOKS**

1. [Nilabja Ghosh](#), 2013. India's Agricultural Marketing. Springer.
2. Bhalla, G. S. and Singh, G. 2012. Economic Liberalisation and Indian Agriculture: A District- Level Study. SAGE publications.
3. Fukuda-Parr, S. (Ed.). (2012). The gene revolution: GM crops and unequal development. Taylor & Francis.
4. 31
5. Bhalla, G. S., & Singh, G. (2001). *Indian agriculture: four decades of development*. Sage Publications.
6. Frankel, F. R. (2015). *India's Green Revolution: Economic Gains and Political Costs*. Princeton University Press.
7. Roy, B. C., & Pal, S. (2006). Investment, agricultural productivity and rural poverty in India. *Indian Agriculture in the New Millennium: Changing Perceptions and Development Policy*, 2, 367.
8. Bilgrami, S.A.R. (2000). An introduction to Agricultural Economics (2nd Edition), Himalyan Publishing House, Mumbai.
9. Sadhu, A.N. and J. Singh (2000) Agricultural problems in India (3rd edition), Himalayan Publishing House, Mumbai.
10. Sundaram, I.S (2002) Rural Development (4th edition) Himalayan Publishing House, Mumbai.
11. Reserve Bank of India, Hand Book of Statistics on Indian Economy (Annual).
12. Soni. R.N. (2000), Leading issues in Agricultural Economics, Arihant press, Jalandar.
13. Statistical Procedure for Agricultural Research By: Kwanchai A Gomes Arturo A.Gomez, John Wiley and Sons.
14. A text book of Agricultural Statistics. By: R. Rangaswamy, New Age International Pvt. Ltd. Statistics for Agricultural Sciences. By: G. Nageswar Rao, Oxford and IBH Publishing Co.

### **M. Sc. Agri. Biotechnology**

### **IPR BIOSAFETY, ETHICAL, LEGAL, SOCIAL ISSUES IN AGRICULTURE BIOTECHNOLOGY**

**Course Code No. 18ABT24C1**

**Semester-IV**

**MM. Th 80 + IA 20**

**Time: 3hrs.**

**NOTE: In all nine questions will be set, two from each unit and one compulsory question of short answer type covering all the units. Students are required to attempt one compulsory question and four others selecting at least one from each unit. All questions are of equal marks.**

#### **Theory:**

#### **UNIT I**

**IPR** - patents and copyrights. Patentability of life forms with special reference to Microorganisms, Pharmaceutical industries, Biodiversity, Naturally occurring substances. GMO, Human genome and IPR. Issue on IPR in Public-Private partnership. Availabilities of Patent facilitating funds, Substantive Patent Law Treaty (SPLT), World patent, European Patent

#### **UNIT II**

**Social and Ethical issues** - genetic discrimination: insurance and employment, human cloning, foeticide, sex determination. Somatic and germ line gene therapy, clinical trials, ethical committee function.

#### **UNIT III**

**Bio-safety** - Definition, Requirement, Bio-safety containment facilities, biohazards, genetically modified organisms (GMOs), living modified organisms (LMOs), Biosafety for human health and environment designing and management of laboratory and culture room as per the norm of GLP, GMP and FDA.



## UNIT IV

**Management**-Planning, Organizing, Leading & Controlling; Concepts and characteristics of information; Importance of MIS; Communication - type, channels & barriers; Financial management, planning and *control*, Characteristics of agricultural products; Problems of processed food marketing; Procurement & distribution systems; Location factors and other problems in processing of agricultural products.

### Suggested Reading

1. [Peter Dabrock](#), [Jochen Taupitz](#), [Jens Ried](#) (Editor) Trust in Biobanking: Dealing with Ethical, Legal and Social Issues in an Emerging Field of Biotechnology. Springer, 2012.
2. [Robert A. Bohrer](#), A Guide to Biotechnology Law and Business, Carolina Academic Press, 2007.
3. [Richard Sherlock](#) & JD Morrey, Ethical Issues in Biotechnology, 2002. 4. Selected papers from scientific journals and websites

**M. Sc. Agri. Biotechnology**

**Semester-IV**

**Course Title: Animal Biotechnology and Immunology**

**Course Code No. 18ABT24C2**

**MM. Th 80 + IA 20**

**Time: 3hrs.**

**NOTE: In all nine questions will be set, two from each unit and one compulsory question of short answer type covering all the units. Students are required to attempt one compulsory question and four others selecting at least one from each unit. All questions are of equal marks.**

### Theory

#### Unit I

History of animal cell culture, Cell culture media and equipments, Culture of animal cells, tissues and organs, primary culture, secondary culture, continuous cell lines, suspension cultures, somatic cell cloning and hybridization, transfection and transformation of cells, commercial scale production of animal cells. Applications of animal cell cultures.

#### Unit II

Structure of sperm and ova, cryopreservation of sperm and ova of livestock, artificial insemination, super ovulation, *in vitro* fertilization, cryopreservation and culture of embryo, embryo transfer, embryo splitting, embryo sexing, transgenic manipulation of animal embryos. Different applications of transgenic animal technology. Animal cloning: basic concept, cloning of embryonic and adult cells.

#### Unit III

History and scope of immunology, components of immune system: organ tissues and cells. Nature and Biology of antigens and super antigens, Antibody structure and function, Antibody diversity, Antigen - antibody interactions, Major histocompatibility complex, Regulation of immune response: Antigen processing and presentation, generation of humoral and cell mediated immune responses: Activation of B and T Lymphocytes; Cytokines and their role in immune regulation,

## UNIT IV

Cell-mediated cytotoxicity; Mechanism of T cell and NK cell mediated lysis, antibody dependent cell mediated cytotoxicity, macrophage mediated cytotoxicity, Hypersensitivity, Immunological tolerance; Autoimmunity, immunodeficiencies, vaccines. Antigen-antibodybased diagnostic assays.

### Suggested Readings

1. Kuby Immunology (2006) by Thomas J. Kindt, Richard A. Goldsby, Barbara A. Osborne, Janis Kuby (W.H. Freeman).
2. Immunology- A short course (2009) by Richard Coico, Geoffrey Sunshine (Wiley Blackwell).
3. Understanding immunology (2007) by Peter John Wood, Dorling KInderseley (Pearson Education, India).
4. Immunology (2007) by Kannan, I (MJP Pulishers,
5. Freshney I. Culture of Animal Cells: A Manual of Basic Technique, 5th Edition Publisher: Wiley-Liss, 2005 ISBN: 0471453293 |
6. Nigel Jen, Animal Cell Biotechnology:Methods and protocols, Humana Press
7. Gordon I 2005, Reproductive Techniques in farm animals CABI.

**M. Sc. Agriculture Biotechnology**  
**Course Title: Dissertation**  
**Course Code No. 18ABT24C3**

**Semester-IV**  
**Marks : 300**  
**(Dissertation: 200 + Viva voce 100)**

