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

Semester I

Sr. No.	Course Code	Subject/Title	Credits	Marks 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	16ABT21CL1	Lab course-I (Cell Biology,Bio molecules)	04	100	
7	16ABT21CL2	Lab course-II {Microbiology(16ABT21C3), Molecular Biology (16ABT21C4), Genetic Engineering(16ABT21C5)}	04	100	
	Total		28		

Semester II

Sr. No.	Course Code	Subject/Title	Credits	Theory	Int Ass
1	16ABT22C1	Plant Tissue Culture	04	80	20
2	16ABT22C2	Molemmmcular Breeding	04	80	20
3	16ABT22C3	Plant molecular biology	04	80	20
4	16ABT22D1 Or 16ABT22D2 Or 16ABT22D3	Bioinformatics/ Green House Management and Plant Protection/ Biomass and Bio energy	04	80	20
5	Open Elective	To be chosen fromthe basket of open Electives provided by the university	03		
6	Foundation Course	To be chosen fromthe basket of Foundation Course provided by the university	02		
7	16ABT22DL	Lab course-I {Plant Tissue Culture (16ABT22C1)}, {Bioinformatics/ Green House Management and Plant Protection/ Biomass & Bio energy(16ABT22D1/D2/D3}	04	100	
8	16ABT22CL	Lab course-II {Mol. Breeding (17ABT22C2), PlantMolecular Biology(17ABT22C3)}	04	100	
	Total		29		

Semester III 2017-18

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	17ABT23DA1 or 17ABT23DA2	PlantMetabolic Engineering & Molecular Farming (DA1)/Biotic and Abiotic Stress Biology(DA2)	04	80	20
4	17ABT22DB1/DB2/DB3	Industrial & Food Biotech/ Crop Protection & Integrated PestManagement/ Biostatistics & Agro-economics	04	80	20
5	Open Elective	To be chosen fromthe basket of Open Electives course provided by the university	03		
6	17ABT23CL	Lab course-I (Plant Genetic Engg, Genomics and Proteomics) (17ABT23C1, 17ABT23C2)	04		100
7	17ABT23DL	Lab course-II 17ABT23DA1/ 17ABT23DA2 and 17ABTDB1/DB2/DB3	04		100
		Total	27		

Semester IV

Sr. No.	Course Code	Subject/Title	Credits	Theory	Int Assss
1	17ABT24C1	IPR Bio safety, Ethical, Legal , Social issues In Agriculture Biotechnology	04	80	20
2	17ABT24C2	Animal Biotechnology & Immunology	04	80	20
3	17ABT24C3	Dissertation	20	300	
	Total		28		

Total credits=112

Choice Based CreditSystem

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 fromeach unit. All questions areof equal marks.

Theory

UNIT I

Diversityof cell size and shape,Cell Theory.

StructureofProkaryotic and Eukaryotic cells - Isolation and growth ofcells. Microscopic techniques for studyofcells.

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, Biologyof 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 Biologyof some important pathogen of AIDS, Malaria, Hepatitis, Tuberculosis, Filaria, Kalazar.

Practical

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

Suggested Readings

1.Lodish et al.,Molecular CellBiologyFreeman and Company2000.
2.Smith and Wood.Cell Biology, Chapman and Halls 1996
3.Watson et al.Molecular Biologyof the gene. PearsonPrentice Hall, USA 2003
4.Benjamin Lewin. Gene X, Jones andBarlett 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 fromeach unit. All questions areof 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 andfunctions,

Proteins: Classification, hierarchyin 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, Immobilisedenzymes.

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 andnucleic acid: Chromatography techniques (affinity, ion-exchange, gel filtration, HPLC, Hydrophobic electrophoresis, Iso- electric 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, inborn errorsof metabolism; Electron transport and oxidative phosphorylation..

Practicals

1.Titration of aminoacids
2.Colorimetric determination of pK.
3.Reactions of amino acids, sugars and lipids
4.Isolation,puritydetermination andquantitationof cholesterol, DNA and mRNA
5.Quantitationof Proteins andSugars,
6.Analysis of oils-iodine number, saponificationvalue, acid number
7.UV/Visible, IR and Fluorescence spectroscopy, Absorptionspectra.
8.Separation techniques and characterization of protein and nucleic acid: Chromatography techniques: Centrifugation,Chromatography(Ion-exchange, gel permeation, TLC etc.) andElectrophoresis,

Suggested Readings:

1.Lehninger Principles of Biochemistry4th 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.Principlesof Biochemistry(Hardcover) ***By*** GeoffreyZubay. 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.Biochemistryand Molecular biology***By*** William H. Elliott and Daphne C.Elliott. OxfordUniversityPress.
7.Biochemistry(Hardcover) 3rd Ed**.** ***By*** DonaldJ. Voet and Judith G. Voet. John Wileyand Sons.
8.Biochemistry: Biomolecules, Mechanisms of Enzyme Action and Metabolism Vol 1 (Hardcover) ***By*** D Voet. John Wileyand Sons.
9.Fundamentals of Biochemistry: Life at the Molecular Level [Import] (Hardcover)
By Donald Voet, JudithG. Voetand 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.Outlinesof Biochemistry***By*** Eric C Conn,PKStumpf, G Brueningand RayH. Doi. JohnWiley& Sons.

M. Sc. Agriculture Biotechnology **Semester—I**

Course Title: Microbiology MM. Th80+ 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 fromeach unit. All questions areof equal marks.

Theory

UNIT I

The Beginningof MicrobiologyDiscoveryof the microbial world by Antonyvon

Leeuwenhoek: spontaneous generation versus biogenesis, Developments of microbiology in the twentieth century. Development of microbiologyas 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 inmicrobiologylaboratory.

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; Buddingand appendaged bacteria; Spirilla; Spirochaetes;

Glidingand sheathed bacteria;Pseudomonads; Lactic andpropionic acid bacteria; Mycobacteria: Rickettsias, Chlamydies and Mycoplasma. Archaea:

Archaea as earliest Life forms: Halophiles; Methanogens; Hyperthermophilic archaea; Thermoplasma Eukaryotic: Algae, Fungi, Slime molds andProtozoa.

UNIT IV

Viruses: Structure of Viruses: Capsid symmetry; enveloped and non-enveloped viruses. Isolation purification and cultivation of viruses, Conceptsof Viroids, Virusoids,satellite viruses and Prions; life cycle of RNA phages; Lytic and lysogenic phages (lambda and P1 phage), onestep multiplication curve, Salient featuresof 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 matingexperiments.

Genetic systems of Yeast andNeurospora; Extra-Chromosomal Inheritance

Practicals

1.Light microscope demonstration
2.Isolation of pure culturebystreaking method.
3.CFU enumeration byspread plate method.
4.Measurement of microbial growth byturbidometrymethods.
5.Effect of temperature, pH and carbon andnitrogen sources on growth.
6.Microscopic examinationof bacteria byGram stain,
7.Acidfast stainandbacterial stainingfor spores and capsule.
8.Bacterial transformation andtransduction
9.Biochemical characterization of selected microbes e.g. *E. coli*
10.Isolationof Plasmids/genomic DNA and DNA agarose gel electrophoresis

REFERENCE BOOKS

1.Atlas RM. (1997). Principlesof Microbiology. 2nd edition.WM.T.Brown Publishers.
2.BlackJG. (2008). Microbiology: Principles and Explorations.7th edition. Prentice Hall

3.Pelczar Jr MJ, Chan ECS,and KriegNR (2004) Microbiology. 5th edition Tata McGraw Hill.
4.Stanier RY, Ingraham JL, Wheelis MLand Painter PR. (2005). General Microbiology. 5 th edition McMillan.
5.WilleyJM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harleyand
Klein's Microbiology. 7 th edition. McGraw Hill Higher Education.

M.Sc. Agriculture Biotechnology **SemesterI**

Course Title: Molecular Biology ***MM. Th 80 + IA 20***
Course Code No.16 ABT21C4 **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 fromeach unit. All questions areof equal marks.

UNIT I

DNA Replication: Prokaryotic and eukaryotic DNA replication, Mechanics of DNA replication, enzymes and accessory proteins involved in DNA replication andDNA repair.**Transcription:** Prokaryotic transcription, Eukaryotic transcription, RNA polymerase, General and specific transcriptionfactors, Regulatoryelements 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, Regulationof translation, co- andpost translationalmodifications 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 suppressorproteins

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 designingribozymes, Applications of Antisense andribozyme 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 dissectionand 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 traffickingand poaching; Germplasmmaintenance, taxonomyand Bio-diversity

Genome Sequencing: Genome sizes., organelle genomes, Genomic libraries, YAC, BAC libraries, Strategies for sequencinggenome, Packaging, transfection and recoveryofclones, ApplicationofSequencingsequence information for identificationofdefective genes.

PRACTICALS

1.Isolation & quantificationof genomic DNA
2.Plasmid isolation & quantification
3.Southernblotting
4.RFLP analysis
5.Isolation and quantificationof RNA
6.Isolation of polyA + RNA
7.Northernblotting
8.Preparationof probes
9.*In vitro* Transcription
10.*In vitro* translation
11.Metabolic labelingof proteins and immune-precipitation

Suggested readings

1. Benjamin Lewin. Gene X, 10th Edition,Jones and Barlett Publishers 2010.
2.J D Watson et al.,Biologyof Gene, 6th Edition, Benjamin Cummings publishers Inc. 2007
3.Alberts et al.,Molecular Biologyof 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 atleast onefromeach unit. All questions are of equalmarks.

Theory

UNIT I

Scope and Milestones inGenetic 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, Libraryconstructionand 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, S1mapping, RNase protectionassay, 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 inplants.

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 isolationof genes throughT-DNA or Transposon.

UNIT V

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

Gene therapy: Vector engineeringstrategies ofgene delivery, gene replacement/augmentation, genecorrection, gene editing, gene regulation and silencing.

PRACTICALS

1. Bacterial culture andantibiotic selection media. Preparationof competent cells.
2.Isolation of plasmid DNA.

3.Isolation of lambdaphage DNA.

4.Agarose gel electrophoresis and restriction mappingof DNA

5.Construction of restriction map of plasmid DNA.

6.Cloninginplasmid/phagemid vectors.

7.Preparation,of helper phage and its titration

8.Preparationof single stranded DNA template

9.DNA sequencing

10.Gene expression inE. coli and analysis of gene product

11.PCR andReporter Gene assay (Gus/CAT/b-GAL)

Suggested Readings

1.S BPrimrose, R M Twyman, and R WOld.Principles of Gene manipulation.S B UniversityPress, 2001
2.BrownTA. Genomes, 3rd Edition,Garland Science 2006.
3.J Sambrookand DWRussel, Molecular Cloning: A laboratoryManual Vols1-3. CSHL, 2001.
4.DM Glover and B D Hames,DNA cloning, Oxford1995.
5.Recent reviews in scientificjournals.

M.Sc. Agriculture Biotechnology **Semester—II**
Course Title: PlantTissue Culture **MM. Th80 +IA 20**
Course Code No.17ABT22C1

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 atleast onefromeach unit. All questions are of equalmarks.

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; Applicationsof tissue culture: Virus elimination byshoottip 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 secondarymetabolites.
Immobilization of plant cells.

Unit IV

Plant Genetic resources, **Germplasm conservation and cryopreservation**, cryoprotectants, Gene bank, Some case studieson **success stories oncommercial application** of planttissue culture.

Practicals

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

Texts/References:

1.R.H.Smith, Plant TissueCulture: Techniques and Experiments, Academic Press, San Diego. 1992.
2.S S Bhojwaniand M KRazdan, Plant Tissue Culture, Elsevier Publ.

M .Sc. Agricultural Biotechnology

Semester—II

Course Title: Molecular Breeding **MM. Th80 +IA 20**
Course Code No.17ABT22C2

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 fromeach unit. All questionsare 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 andfunctional 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 mappingpopulation –Marker Assisted Selection (MAS), screeningand 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 anddisease resistance; Qualityenhancement etc. Allel mining,

Unit IV

TILLING, EcoTILLING, Recent advances – Non gel basedtechniquesfor plantgenotyping – Homogenousassays– Qualitative/Real Time assays; DNA Chip andits technology.

Practicals

1.Isolationof DNA, DNApurityand quantificationtests
2.Agarose gel electrophoresis and restriction mappingofDNA
3.PCR amplificationand PCR-based DNA markers.
4.Southernblotting
5.Preparation of probes
6.Phylogenetic relationship, constructionofgenetic linkage maps usingcomputer softwares.
7.DNAfinger printing methods.

Texts/References:

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

M.Sc. Agricultural Biotechnology Semester—II

Course Title: PlantMolecular Biology **MM. Th80 +IA20**

Course Code No.17ABT22C3 **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; Sexdetermination; Source-sink relationship

Unit II

Carbon Assimilation; Carbon dioxide uptake and assimilation; Calvin Cycle; Hatch-Slackpathway; 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-plantsymbiosis; Regulation of nitrogen assimilation,uptake, transport and assimilation of sulphate andphosphate.

Unit III

Signal Transduction– Basic concepts; Receptors and G-proteins; Cyclic AMP cascade; Phospholipid and Ca - calmodulincascade; MAP kinasecascade; Sucrosesensingmechanism.

Senescence and Programmed Cell Death (PCD) – Senescence and its regulation; Hormonal and environmental control of senescence; PCD in thelife 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 mutantsinunderstandinghormone action.

Practicals

1.Plant DNA extraction, digestion of DNA with restrictionenzymes, 2.DNA agarose gel electrophoresis.
3.Polymerase chain reaction toamplifya plant gene.
4.Homogenization of leaves, sub-cellularfractionation by differential centrifugation, chloroplast purification, SDS-PAGE analysis of chloroplast proteins.
5.RNA extraction, Agarose gel electrophoresis of RNA, 6.RT-PCR analysis of aplant gene.

Suggested Readings

1.Lincoln Taiz, Eduardo Zeiger, Plant Physiology, Sinauer Associates, 2010.

ob Buchanan, Wilhelm Gruissem, Russell Jones, Biochemisrtry and Mol Biol Of Plants. John Wiley and Sons,2002.
17.

M. Sc. Agriculture Biotechnology Semester—II

Course Title: Bioinformatics **MM. Th80 +IA20**

Course Code No.17ABT22D1 **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 atleast onefromeach unit. All questions are of equalmarks.

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 querry language). Introduction to computer networking, topology, networkingprotocol (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 PERLin 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 specializeddatabases like TIGR, Hovergen, TAIR, PlasmoDB, 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.
- Networksearch on genomic and proteomic databases.
- Use of PERLprogrammingfor : i) StoringDNA sequence ii)DNA to RNA

transcription iii) Countingnucleotides

- Phylogenetic tree construction.

Suggested Readings

1.David W. Mount Bioinformatics: Sequence andGenome Analysis CSHLPress, 2004
2.A. Baxevanis and FBF Ouellette, Bioinformatics: A practical guid to the analysis of genes and proteins 2nd eds. John Wiley 2001
3.JonathanPevsner Bioinformatics and functional genomics Ist Ed. WileyLiss 2003
4.P E Bourne and H.WeissigStructural Bioinformatics Wiley2003.

M.Sc. Agriculture Biotechnology **Semester-II**
Course Title: Green House Management and Plant Protection ***MM. Th 80 + IA 20***
Course Code No.17ABT22D2 **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 fromeach unit. All questions areof 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 youngplants.

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. Handlingof 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 regulSSatorymethod,chemical control and other methodsof insect control

Practicals

1.To studyspecialized greenhouse operations.
2.Formulations of the plantgrowth media.
3.To studypest management in green house.
4.To studywater and plant nutrition management.
5.Harvestingand postharvest handlingin green house.
6.Management of farmrecords ingreen house

Books:

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

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

Course Title: Biomass and Bioenergy ***MM. Th 80 + IA 20***

Course Code No.17ABT22D3 **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 fromeach unit. All questions areof equal marks.

UNIT I

Energy sources - General account-Nuclear energy and Fossil fuel energy, Non – Nuclear and Non – Fossil fuel energy. Bioenergy-energyplantations, social forestryand Silvi culture energyfarms.

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 andcompositionof wastes.

UNIT III

Bioenergysources: Petrolieum plants (petroplants) - hydrocarbonsforhigher plants like
Hevea and *Euphorbia*. Algal hydrocarbons. Alcohols: Alcohols as a liquid fuel-Hydrolysis of lignocellulosic materials, Ethanol production,fermentation andrecoveryof ethanol.

UNIT IV

Biomass conversion: Non biological process- Direct combustion (hog fuel), pyrolysis, Gasification and Liquification. Biological process: Enzymatic digestion, aerobic and anaerobic digestion Gaseous fuels: Biogas and hydrogen: Biogas technologybenefits frombiogas 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.Hydrogenese 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 cellulosedegradingbacteria from the soil.

4.Isolation of biogass producingbacteria from the cattle dung.
5.To studythe various methodsof biomass measurement
6.Production of ethanolfromsucrose byyeast.

References:

1.Vepal S Malik&Padma Sridahar: Industrial biotechnology
2.Michael LMckinney& Robert M Schoch: Environmental science-systems and solutions KerryTurner R: Sustainable Environment Management
3.Indian Institute of Ecology& Environment Publ.: InternationalEncyclopedia of Ecologyand environment Vol.1- 30

M.Sc. Agricultural Biotechnology **Semester—III**

Course Title: PlantGenetic Engineering **MM. Th80 +IA 20**

Course Code No.17ABT23C1

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 atleast onefromeach unit. All questions are of equalmarks.

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 binaryvectors 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 polyA 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,1-3betaglucanase, RIP, antifungal proteins, thionins, PR proteins, **Insect pests resistance**: Bt genes, Non-Bt like protease inhibitors, alpha amylase inhibitor, **nematodes resistance and herbicide resistance**: phosphoinothricin, 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 andbarnase 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, Biosafetyand riskassessment of GM crops.

20

Practicals

1.Isolation of plasmids with reporter (*gus*) gene,
2.Preparationof microprojectiles, transformation usinga particle gun, GUS staining.
3.Leaf disc transformationusingAgrobacterium, establishment of transgenic plants, andGUS stainingor GFP viewing.
4.DNA extraction fromtransgenic plants, DNA estimation, PCR analysis,
5.Southernblot analysis to prove T-DNA integration,
6.RT-PCR to studytransgene expression,
7.Western blottingto studythe 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 UniversityPress, 2003.
2.EditedbyBR Jordan,2nd Edition, The Molecular Biologyand Biotechnologyof Flowering, CABI, 2006.
3.Jaiwal P K&Singh R P (eds) Plant Genetic Engineering Vol-1 to Vol. 9. StudiumPress, USA, 2006.
4.Denis Murphy, Plant Breeding and Biotechnology: Societal Context and the Future of Agriculture, Cambridge UniversityPress, 2007.
5.P KGupta 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.17ABT23C2

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 atleast onefromeach unit. All questions are of equalmarks.

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 mappingContigassembly, Chromosome walkingand 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 familiesin 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.PreparationofDNAfromprokaryotes and eukaryotes.
2.Isolationofplasmids fromE.coli cells.
3.Agarose gel electrophoresis of plasmid and chromosomal DNA.
4.Proteinisolationfromdifferent plant tissues.
5.Separationofproteins using SDS-PAGE.
6.Restrictionendonuclease digestionofplasmid and chromosomal DNAofE. coli cells.
7.IdentificationofSSR molecular markers fromEST usingcomputational approach.

Texts/References:

1.Voet D, Voet JG &Pratt CW, Fundamentals of Biochemistry, 2nd ed.Wiley2006
2.BrownTA, Genomes, 3rd ed.Garland Science 2006
3.Campbell AM & Heyer LJ, DiscoveringGenomics, Proteomics and Bioinformatics, 2nd ed. Benjamin Cummings 2007
4.Primrose S & Twyman R, Principles of Gene Manipulation and Genomics, 7th ed, Blackwell, 2006
5.GlickBR & PasternakJJ, Molecular Biotechnology, 3rd ed, ASM Press, 1998

M. Sc. Agri.Biotechnology **SEMESTER-III**

Course Title: PlantMetabolic Engineering & Mol. Farming MM. Th80 +IA 20

Course Code No.17ABT23DA1

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 atleast onefromeach unit. All questions are of equalmarks.

Theory

UNIT I

Basic conceptsof Metabolic Engineering – Overview of cellular metabolism; Different modelsfor cellular reaction.

Primary Metabolites giving special attention to sugars, amino acids and lipids: The basic structure, The biochemical pathway, Carbon flow Different regulatorypoints (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

Seecondary 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 inhorticulture, 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 pathwaysynthesis 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, nutriceuticals, agriculture, biofuels, andbiomass conversion, Bioenergygeneration: Bioethanoland biohydrogen;

Practical

1.Development of high yielding microbes bymutagenesis.
2.SDS – PAGE for the separationofProteins.
3.Estimation ofproteins bycolorimetric methods.
4.Separationand estimationof Chlorophyll Pigments
5.Estimationof soluble sugars byColorimetric method.
6.Estimationof free fatty acids.
7.Metabolic engineeringand bioinformatics tools

Suggested Readings

1.GregoryN. Stephanopoulos, Aristos A. Aristidou , JensNielsen. Metabolic Engineering:Principles and Methodologies
2.J. Nielsen , Metabolic Engineering, Springer, 2001
3.Reviews from Metabolic Engineeringjournal, Elsevier
4.P K Jaiwal (ed), Plant Genetic Engineering Vols. 7 & 8: Metabolic Engineering and Molecular Farming- I and II, StudiumPress LLC, USA. 2006.

M.Sc. Agricultural Biotechnology **Semester--III**
Course Title: Biotic and Abiotic stress biology **MM. Th80 +IA 20**
Course Code No.17ABT23DA2
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 atleast onefromeach unit. All questions are of equalmarks.

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 CO2 and high O3 oncropproductivity and target for crop biotechnology,
Exploition of plant–microbespartnership 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 milkand 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 systembiologyof stress, miRNA in abiotic stress; Overcomingstress: breedingefforts, 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 soilmetals

Unit IV

Biotic stress - Plant interaction with bacterial, viral and fungal pathogens and herbivores, plant responses to pathogen and herbivores– biochemical and molecular basisof hostplant resistance
– toxinsof fungi andbacteria –systemic and inducedresistance –pathogen derived resistance –
signaling - gene for gene hypothesis – genetic engineeringfor biotic stress resistance – gene pyramiding, biotic stress associated miRNA.

26

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 screeningtestsfor abiotic stress tolerance (drought, salinity - PEG, Mannitol & NaCl).

3.Estimation of antioxidants and antioxidantenzymes - 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 PRprotein - culturingand isolationof *Bt* – bioassaytechniques.

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, CopyrightWiley-VCH VerlagGmbH & Co. 2010

3.Tuteja N, Sarvajeet Singh Gill, Tuteja R (Editors) Omics andPlant Abiotic Stress Tolerance (2011), BenthamScience Publishers,UAE & USA. (eISBN: No.: 978-1-60805-058-1)

4.Narendra Tuteja, Sarvajeet Singh Gill, Antonio FTubercio and Renu Tuteja (Editors) ImprovingCrop Resistance toAbiotic Stress (2011) Volume 1 & 2, Wiley Wiley-VCHVerlagGmbH &Co. Weinheim, Germany, ISBN 978-3-527-32840-6

5.David M. Orcutt, Erik T. Nilsen, The Physiologyof 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.17ABT23DB1

MM. Th80 +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 fromeach unit. All questions areof equal marks.

Theory:

UNIT I

Industrial and food Biotechnology: Introduction, history, importance, applications of biotechnology in industry and food processing, significant advances, recent developments, riskfactors, safetyregulations.

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, Representive examples of ethanol, organic acids, antibiotics etc. Industrial microorganisms, microbes exploited commercially- Saacharomyces, Lactobacillus, Pencillium, Acetobactor, Bifidobacterium, Lactococcus, Streptococcus, etc. Dairyfermentation andfermented products.

UNIT III

Microbial enzymes in food processing, Industrial production of enzymes, Food and Beverages fermentation- alcoholic and non-alcholicbeverages, 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 industriallyimportant 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 asupplied microorganismand alsodetermine substrate degradationprofile.
4.Compute specific growth rate (m), growth yield (Y x/s) fromthe above.
5.Comparative studies of ethanolproductionusingdifferent substrates.
6.Microbial productionof citric acid usingAspergillus niger
7.Microbial productionof antibiotic (Pencillin)
8.Production andestimation of Alkine Protease
9.SauerKrant fermentation.

Suggested Reading

1.Gautam NC, Food Biotechnologyin Comprehensive Biotechnology, Vol 7. Shree Publishers NeWDelhi 2007
2.Gutierrez-Lopez GFet el., Food Science and Food Biotechnology, CRC Press, Washington, 2003.
3.Maheshwari DKet al., Biotechnological applicationof microorganisms, IK International New Delhi 2006.
4.StanburyPFet 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 + IA20**

Course Code No.17ABT23DB2

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 fromeach unit. All questions areof 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 affectsof pesticideuse inIndia.

Unit II

Genetics of pathogenocity, Pathotypes, Mechanism of disease resistance, Breedingfor disease and insect resistance, Sear's work on rust resistance in wheat. Genetic engineering for improvement of disease resistance, Genetic manipulation of Cropsfor insect resistance, Molecular Mechanisms conferringherbicide 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. Applicationof IPM to farmers' real-timesituations.

Unit IV

Chemical Control strategy for crop protection, Biological control-concepts and techniques, Bio-organism for pest Management, Bt basedpesticides, Baculovirus pesticides, Mycopesticides,production andformulation technologies

Practicals

1.Studyofsymptoms, microscopic examinationofdiseased parts and identificationofthe pathogens involved in some ofthe crop diseases.
2.Examinationofthe organisms used for biological control.
3.Culture techniques for the entomopathogens.
4.Mass multiplicationofbiocontrol agents.
5.Studyofgeneticallyengineered organisms.
6.Visitingthe Agricultural fields for assessingthe 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 ProtectedCrops.Springer, New Delhi.
3.Ignacimuthu SS & Jayaraj S. 2007. Biotechnologyand 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

MM. Th80 +

Course Title: Biostatistics and Agro-economics **IA20**

Course Code No. 17ABT23DB3

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 fromeach unit. All questions areof equal marks.

Theory

UNIT I

Presentation and classification of data: Discrete and continuous variables, frequencydistributions, graphical representation of data and other forms of representations. Measures of location and dispersion: Mean, median, mode, quartiles, deciles and persentiles. Varience, Skewness and kurtosis.

UNIT II

Elements of probability theory: Definition of probability, classical definitions relative frequency approach and axiomatic approach. 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. Goodness of fit test. Correlation and regression, Analysis of variance: One-way, two way; field plot designs randamised and completely randamised, 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-agencyapproach); Agricultural marketing in India: Markets and marketing functions, channelsof distributionof various commodities; regulated markets and warehousing; Roleof 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 Economyand its effectson Indian Agriculture.

Practicals

1.Methods ofcentral tendency(arithmetic mean, median, mode)
2.Measures ofdispersion(standard deviation)
3.Probabilitytheory
4.Problems onBinomial and poissondistribution.
5.Problems onBinomial Normal Distribution.
6.Large sample tests.
7.Small sample tests.
8.Chisquare tests.
ANOVA– one way&two wayclassification**BOOKS**

1.Nilabja Ghosh, 2013. India's Agricultural Marketing. Springer.
2.Bhalla, G. S. and Singh, G.2012. Economic Liberalisation andIndian 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 PublishingHouse, Mumbai.
11.Reserve Bankof India, Hand Bookof Statistics on Indian Economy(Annual).
12.Soni. R.N. (2000), Leadingissues in Agricultural Economics, Arihant press, Jalandar.
13.Statistical Procedure for Agricultural Research By: Kwanchai A Gomes Arturo A.Gomez, John Wileyand Sons.

14.A text bookof Agricultural Statistics. By: R. Rangaswamy, New Age International Pvt. Ltd. Statistics for Agricultural Sciences.By: G. Nageswar Rao,Oxford and IBH PublishingCo.

M. Sc. Agri.Biotechnology **Semester-IV**

IPR BIOSAFETY, ETHICAL, LEGAL, SOCIAL ISSUESIN AGRICULTURE BIOTECHNOLOGY

Course Code No.17ABT24C1 **MM. Th80 +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 fromeach unit. All questions areof 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-safetycontainment facilities, biohazards, genetically modified organisms (GMOs), living modified organisms (LMOs), Biosafety for human health and environment designing and management of laboratoryand 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 processedfood marketing; Procurement & distributionsystems; Location factors and other problems in processingof agricultural products.

Suggested Reading

1.Peter Dabrock, Jochen Taupitz ,Jens Ried (Editor) Trust in Biobanking: Dealingwith Ethical, Legal and Social Issues in an Emerging Field of Biotechnology. Springer, 2012.

2.Robert A. Bohrer, A Guide toBiotechnologyLaw 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 andImmunology

Course Code No.17ABT24C2

MM. Th80 +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 fromeach unit. All questions areof 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 productionof animal cells. Applicationsof 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, cloningof embryonic and adultcells.

Unit III

Historyand scope of immunology, components of immune system: organ tissues and cells. Nature and Biologyof 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: Activationof 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) byRichard Coico, GeoffreySunshine (WileyBlackwell).
3.Understandingimmunology(2007) byPeter John Wood,DorlingKInderseley(Pearson Education,India).
4.Immunology(2007) byKannan, 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 andprotocols, Humana Press
7.Gordon I2005, Reproductive Techniques infarmanimals CABI.

M. Sc. Agriculture Biotechnology	**Semester-IV**
Course Title: Dissertation	**Marks : 300**
Course Code No.17ABT24C3	**(Dissertation:200 +Viva voce100**