SEMESTER- I

Paper Name: BIO-ENTREPRENEURSHIP	
Paper Code: BITIDC1013	**Semester: I**
Type: IDC	**Credit: 3 (2L+1P)**
Total classes: 45= 30+15 (L+P)	**Total Marks: 100 (T60+P20+IA20)**

Objective:
To enable the students to promote the concept of inter-disciplinary leaning and earn while you learn concept.

Course Outcomes (CO):
CO1: To promote and explore the potential of bio-entrepreneurship, start Ups
CO2: To promote and explore the concept of circular economy and trash to gold concept
CO2: To explore and harvest the possibility of entrepreneurship from locally available resources

Theory: 30 classes

Unit 1: Basic of Entrepreneurship **6 Classes**

Basic of Entrepreneurship, Innovation, Concept of Enterprise, Start-Ups. Identify Scopes and opportunities. SWOT/SWOC analysis.

Unit 2: Bio-entrepreneurship with mushroom and value addition **6 Classes**

Mushroom production: An agribusiness activity, mushroom culture preparation and preservation techniques, spawn production, oyster mushroom cultivation, economics of oyster mushroom cultivation, cultivation of paddy-straw mushroom

Unit 3: Bio-entrepreneurship with solid waste management **6 Classes**

Concept of Compost. Solid Waste Management: Vermicompost. Gobar Gas/methane gas production. Concept of Bee Keeping, Lac Culture

Unit 4: Bio-entrepreneurship with sericulture and allied science **12 Classes**

Concept of seri culture, food plants of silk worm, Life cycle of *Samiacynthia ricini* (Eri) and *Antheraea assama* (Muga), Horticulture, Hydroponics, Orchid culture, Concept of fishery, Integrated fishery, Composite fishery, Prawn Culture, Cage Culture; Bio floc

Practical:15 Classes

1. Mushroom Cultivation
2. Hands on demonstration on Fish Farming
3. Culture and Subculture of mycelium
4. Demonstration on Spawn Preparation

5. Vermicompost Preparation/ Gobor Gas
6. Bee Keeping
7. Pearl Cultivation
8. Exposure Visit
9. Business DPR preparation for Start-Ups

Suggested Readings:

- *NitaBhal,2002.Handbookonmushroom.4th Edition.VijayPrimlaniforOxfordandIBHPublishing Co Pvt. Ltd,NewDelhi*
- *Mushrooms(Cultivation,Marketingandconsumption, 2011.ManjitSingh,BhuvneshVijay,ShwetKamal,G.C Wakchaure. DirectorateofMushroomResearch (ICAR),ChambaghatSolan..*
- *Introduction to economic Zoology: 2014.By Supriti Sarkar :* **Publisher :** New Central Book Agency
- *Economic Zoology by Shukla & Upadhyay:* **Publisher :** Rastogi Publications: 2008
- *Mushroom (The Health Food): A multilingual Approach byRaju Ali, Mamoni Rabha, Hankhray Boro, Vashkar Biswa & Dr.Sandeep Das: Publisher: N.L Publication, 2017.*

Paper Name: CELL STRUCTURE AND DYNAMICS	
Paper Code: BITMAJ1014	**Semester: I**
Type: CORE	**Credit: 4 (3L+1P)**
Total Classes: 60= 45+15 (L+P)	**Total Marks: 100 (T60+P20+IA20)**

Objective:
To gain the knowledge related to the basics of different types cell structure and morphology

Course Outcomes (CO):
CO1: Upon completion of the course, the student will be able to understand the structural organization of a prokaryotic and eukaryotic cell.
CO2: The learner shall know the origin/biogenesis of the cell components

Theory: 45 classes

Unit 1: Origin of life on Earth **15 classes**

The theory of Extra-terrestrial contact - import of life throughmeteorites. Theory of Chemical Evolution, Abiotic formation of sugars, amino acids, organic acids,purines, pyrimidines, glycerol and formation of nucleotides and their polymerization toRNA on reactive Surfaces, polymerization of amino acids to Polypeptides andProteins. Ribozymes and RNA World. Formation of DNA, Formation of nucleoproteins,Prions, Natural Selection of Self-replicating Polymers.

Unit 2: Basic cell structure **5 classes**

Discovery of cell and Cell Theory; Prokaryotic and Eukaryotic cell;

Unit 3: Prokaryotic cell and its components **10classes**

The Slime and the cell wall of bacteriacontaining peptidoglycan and related molecules; the outer membrane of Gram-negative bacteria, thecytoplasmic membrane. Water and ion transport, mesosomes, flagella, Pilus, fimbriae, ribosomes,carboxysomes, sulphur granules, glycogen, polyphosphate bodies, fat bodies, gas vesicles; endospores,exospores, cysts. Mycelia of fungi and Actinomycetes, Cytoskeleton filament, heterocysts and akinetes ofCyanobacteria, Gliding and motility.

Unit 4: Eukaryotic cell and its components **15classes**

Comparison between plant and animal cells; Cell wall; Plasma membrane;Models of membrane structure;Cytoskeleton;Protoplasm; Mitochondria; Chloroplast; ER; Golgi complex; Lysosome, endosome andmicrobodies; Ribosome; Centriole; Nucleus.Biogenesis of Cellular organelles viz mitochondria, chloroplast, ER, Golgi complex;

Practical: 15 classes

1. To study the structure of any prokaryotic cellunder the microscope
2. To study the structure of anyplant cell under the microscope
3. To study the structure of any plant cell under the microscope
4. Observation of vacuoles (using onion epidermis/rose leaf etc)

5. Observation of mitochondria (using onion epidermis/root tips etc)
6. Study the effect of temperature and organic solvents on semi permeable membrane.

Suggested readings:

- *Microbiology- Prescott LM, Harley JP, Klein DA, Wm. C. Brown Publishers*
- *Microbiology: Tortora, G.J., Funke, B.R. and Case, C.L An Introduction Pearson Education.*
- *Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc.*
- *De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.*
- *Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASMPress & Sunderland, Washington, D.C.; Sinauer Associates, MA.*
- *Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.*

Paper Name: INSTRUMENTATION IN BIOTECHNOLOGY	
Paper Code: BITSEC1013	**Semester: I**
Type: SEC	**Credit: 3 (2L+1P)**
Total Classes: 45= 30+15 (L+P)	**Total Marks: 100 (T60+P20+IA20)**

Objective:
This paper will provide an in-depth understanding of various scientific instruments used for analysis of biological samples.

Course Outcomes (CO):
CO1: Apply the analytical methods in Biotechnology Industries
CO2: Understand the principle and trouble shootings in the analytical instruments.

Theory: 30 Classes

Unit 1: Microscopy **10 Classes**

Basic Principles and application of Simple Microscope, Compound Microscope, Sterio-zoom Microscope and Inverted Microscope, Transmission and Scanning Electron Microscopes; Principles of Fixation and Staining.

Unit 2: Optical Methods of Analysis **2 Classes**

Beer-Lambart Law, Basic Principles and application of Colorimeter and UV-Visible Spectrophotometer.

Unit 3: Chromatographic Methods of Analysis **5 Classes**

Working Principle, instrumentation and Application of Paper, Thin Layer, Column and High-Pressure Liquid Chromatography

Unit 4: Electrophoretic Techniques **10 Classes**

Principle and factors affecting Electrophoresis-pH, voltage, supporting medium in Agarose Gel Electrophoresis, PAGE, SDS-PAGE

Unit 5:Centrifugation **3 Classes**

Principle of Centrifugation, differential and density gradient centrifugation, ultracentrifugation, sedimentation analysis and RCF

Practical: 15 Classes

1. Sample preparation, Plant and Animal Tissue fixation and staining technique and microscopic study
2. Quantitative analysis of biological samples (Protein, Carbobydrate) by colorimetric/ spectrophotometric methods
3. Separation of amino acids by Paper and Thin Layer Chromatography
4. Electrophoretic separation of nucleic acids/ proteins.

***Suggested Readings**:*

- *Wilson and Walker: Principles and Techniques in Practical Biochemistry, Cambridge University Press*
- *Jayaram: Laboratory Manual in Biochemistry, New Age International Publications.*

Paper Name: INTRODUCTION TO BIOTECHNOLOGY	
Paper Code: BITMIN1014	**Semester: I**
Type: MINOR	**Credit: 4 (3L+1P)**
Total Classes: 60= 45+15 (L+P)	**Total Marks: 100 (T60+P20+IA20)**

Objective:
To provide foundation in biotechnology by offering students with theoretical and workingknowledge of the various principles and techniques employed in biotechnology.

Course Outcomes (CO):
CO1: Shall learn to apply various tools of biotechnology in agriculture, environment and food sciences.
CO2: Understand and solve biological and ecological problems and harness potential of living systems for the benefit of human mankind.

Theory: 45 Classes

Unit 1: Scope and Introduction to Biotechnology 1**0 Classes**

Historical perspective& Definitions of Biotechnology,Traditional and Modern Biotechnology, Overview of Branches of Biotechnology: Plant, AnimalBiotechnology, Marine Biotechnology, Agriculture, Healthcare, Industrial Biotechnology, PharmaceuticalBiotechnology, Environmental Biotechnology, Medical Biotechnology.

Unit 2: Applications of Biotechnology in Agriculture **15Classes**

Overview of Applications of Biotechnology in Agriculture: GM Food, GM Papaya, GM Tomato, Fungaland Insect Resistant Plants, BT Crops, BT Cotton and BT Brinjal, Pros and Cons.Biotechnological applications in enhancement of Food Quality, Quality Factors inPre-processed Food, Microbial role in food products (Yeast and Bacterial based process and products).

Unit 3: Applications of Biotechnology in Environment **10Classes**

Overview of Applications of Biotechnology in Environment: Solid Waste Management, Biopesticides, Biofertilizers and Biofuels, Bioremediation.

Unit 4: Research in Biotechnology **10 Classes**

Overview of Biotechnology Research in India. Ethical Issues in Biotechnology. Biosensors and Tissue engineering. Overviewof Biotechnology Institutions in India (Public and Private Sector)

Practical: 15 Classes

1. Safety, Check-in, Laboratory record keeping
2. Introduction to various laboratory instruments
3. Pipetting techniques
4. Preparation of Solutions, buffers etc
5. Sterilization techniques

Suggested Readings:

- *McGregor, C.W.; Membrane separation in Biotechnology; Marcel Dekker, Inc, New York.*
- *Frieferder, S.; Physical Biochemistry; Freeman and Co., New York.*
- *Biotol Series (I - IV); Techniques used in Bioproduct Analysis; ButerworthHeineman,U.K.*
- *Work, T.S.; Lab. Techniques in Biochemistry and Molecular Biology, Elsevier, New York.*
- *Microbiology: Michael J. Pelczar Jr., E. C. S Chan, Noel R. Krieg*
- *Smith J. E., Biotechnology, 3rd Edition, Cambridge University Press (2006)*

Paper Name: WASTE AND ENERGY MANAGEMENT	
Paper Code: BITVAC1014	**Semester: I**
Type: CORE	**Credit: 4** **NCC/NSS-2 + 2 (1L+1P)**
Total Contact hours: 60= 45+15 (L+P)	**Total Marks: 100 (T60+P20+IA20)**

Objective:

The objective of the paper is to encourage trash to gold and the concept shall explore the genesis of circular economy.

Course Outcomes (CO):

CO1: The paper shall enable the students to learn utilize the waste material for initiating entrepreneurship

CO2: The paper shall enable the student to understand how important is waste and how waste can be cheaper raw materials to initiate a process

Theory: 15 Classes

Unit1:Introduction and future perspectives of waste and energy management

Identification of waste streams in your area, mushroom cultivation on different agricultural wastes, GobarGas,Vermicompost, Bioleaching and biohydrometallurgy, pyrolysis, biofertilizers from organic wastes.

Practical: 15 Classes

1. Cultivation of Banana and the stem of the Banana in utilization of Vermicomposting
2. Culture of Earthworm *(Eisenia fetida)*
3. Gobar and utilization in methane gas genesis
4. Areacanut leaf plate making
5. Formation of ethanol from waste of sugarcane

SEMESTER- II

Paper Name: **BASIC BIOCHEMISTRY**	
Paper Code: BITMIN1024	**Semester: II**
Type: MINOR	**Credit: 4 (3L+1P)**
Total Classes: 60= 45+15 (L+P)	**Total Marks: 100 (T60+P20+IA20)**

Objective: To ensure students gain knowledge about the structure, properties and functions of bio-molecules.

Course outcomes (CO):
CO1: The course will provide an insight into various aspects of basic aspects of bio-molecules.

Theory: 45 Classes

Unit 1: Water, vitamins and minerals **6Classes**

Water: Physical properties and hydrogen bonding of water; structure of liquid water and its solvent properties; hydrophobic interactions; ionization of H2O and ion product of water; the pH scale; relationship between pH and pKa (HendersonHasselbalch equation); buffers.
Vitamins: Introduction, chemistry, properties and functions of fat- and water-soluble vitamins;
Minerals:Introduction: major, minor and trace elements.

Unit 2: Proteins and enzymes **15Classes**

Proteins: Definition, biological functions of proteins; structure of twenty alpha-amino acids commonly found in proteins; abbreviations and classification of 20 amino acids; zwitterion nature of amino acid in aqueous solutions; essential amino acids; peptide bond formation; backbone structure of proteins/polypeptides; Nterminal and C-terminal amino acids; properties of amino acids/proteins arising from their dipolar nature; basic understanding of primary, secondary, tertiary, quaternary and domain structure of proteins/peptides; fibrous and globular proteins; elementary ideas on protein denaturation and renaturation.
Enzymes: Chemistry and Classification of Enzymes; General properties;

Unit 3: Carbohydrates **10Classes**

Definition, biological functions; classification into monosaccharides (aldoses and ketoses), oligosaccharides and polysaccharides; optical isomerism, open chain and ring structures of carbohydrates; mutarotation; structure of biologically important carbohydrates (D-glucose, D-galactose, D-mannose, D-fructose, D-ribose, D-2-deoxyribose, D-maltose, D-lactose, D-sucrose); polysaccharides-starch, cellulose, glycogen and mucopolysaccharides; suitability of polysaccharides as storage material.

Unit 4: Lipids **10Classes**

Definition; biological functions; general formulae, nomenclature and properties of fatty acids; essential and non-essential fatty acids; classification of lipids; general structure and function of major lipid subclasses: acylglycerols, phosphoglycerides, sphingolipids, waxes, terpenes,

steroids and prostaglandins; saponifiable and non-saponifiable lipids; suitability of triglycerides as storage lipids; saponification number and iodine number; biomembranes.

Unit 5: Nucleic acids **10 Classes**

Nucleosides and nucleotides; generalized structural plan of nucleic acids; Watson-Crick model of DNA; size of DNA in prokaryotic and eukaryotic cells; central dogma of molecular biology

Practical:15Classes

1. Calculation of molarity, normality and molecular weight of compounds.
2. Preparation of standard buffer and pH determination
3. Qualitative analysis of carbohydrates (sugars)
4. Qualitative analysis of Proteins
5. Qualitative analysis of Lipids
6. Hydrolyze of Starch by salivary amylase

Suggested readings:

- *Principles of Biochemistry by Lehninger, Nelson and Cox*
- *BIOS Instant Notes in Biochemistry- David Hames and Nigel Hooper*

Paper Name: BIOETHICS AND BIOSAFETY	
Paper Code: BITIDC1023	**Semester: II**
Type: IDC	**Credit: 3 (2L+1P)**
Total Classes: 45= 30+15 (L+P)	**Total Marks: 100 (T60+P20+IA20)**

Objectives:
To introduce basic concepts of ethics and safety that is essential for Life Science Labs.

Course Outcomes (CO):
CO1: Know about the biosafety regulations and ethical concepts in biotechnology.
CO2: Understand the importance of bioethics and biosafety procedures to be followed, with knowledge of the basic concepts, its principles, and use.
CO3: Recognize the importance of biosafety practices and guidelines in research.

Theory: 30 Classes

Unit 1: Bioethics **10 Classes**

Bioethics – Necessity of Bioethics, different paradigms of Bioethics – National & International. Ethical issues against the molecular technologies. Legal andsocioeconomic impacts of biotechnology, health and safety issues.

Unit 2: Biosafety **10 Classes**

Biosafety– Introduction to biosafety and health hazards concerning biotechnology.Objectives, Risk assessment in biotechnological research and their regulation,physical and biological contaminants, field trial and planned introduction of GMOs.

Unit 3: Biosafety Guidelines **10 Classes**

Biosafety guidelines in India, Biosafety levels for plant, animal and microbial researches. Introduction to the concept of containment level and Good Laboratory Practices (GLP) and Good Manufacturing Practices (GMP).

Practical: 15 Classes

1. General safety measures and study of safety notices
2. Study of symbols and warnings on reagent bottles
3. Study of preventive measures and first aid during laboratory hazards
4. Demonstration of handling of fire extinguisher
5. Case study on handling and disposal of radioactive waste
6. Case study on handling and disposal of medical/microbial waste
7. Study of components and design of a Biosafety laboratory

Suggested Readings / Books

- *Bioethics and Biosafety in Biotechnology by Sree Krishna V., New Age International (P) Ltd., Publ., Mumbai. 2007*
- *The Indian Environmental Protection Act (EPA), 1986*

- *Rules for manufacture, use/import/export and storage of hazardous microorganisms or cells Act, 1989*
- *Food Safety and Standards act (Government of India), 2006*

Paper Name: BIOMOLECULES	
Paper Code: BITMAJ1024	**Semester: II**
Type: CORE	**Credit: 4 (3L+1P)**
Total Classes: 60= 45+15 (L+P)	**Total Marks: 100 (T60+P20+IA20)**

Objective:
To ensure students gain knowledge about the structure and functions of bio-molecules and their biomedical importance.

Course outcomes (CO):
CO1: The course will provide an insight into various aspects of basic aspects of bio-molecules and their activities in and outside cell.

Theory: 45 Classes

Unit 1: Vitamins, Minerals **11Classes**

Vitamins: Chemistry, properties and functions of fat- and water-soluble vitamins;
Minerals:Major, minor and trace elements.
Enzymes: Chemistryof Enzymes; Enzyme Kinetics- basics of Michalis Menten Equation; Regulation of Enzyme Activities; Enzyme Inhibitors.

Unit 2: Proteins **14Classes**

Biological functions of proteins; structure & classification of amino acids and properties; essential amino acids; peptide bond formation;specialized proteins: myoglobin, hemoglobin, collagen, elastin, and keratin; Structure of protein: primary, secondary, tertiary and quaternary structures, Ramachandran plot; protein structure and domain structure of proteins/peptides; fibrous and globular proteins; elementary ideas on protein denaturation and renaturation.

Unit 3: Carbohydrates **8Classes**

Chemistry and Classification; Monosaccharide: glucose, fructose, mannose, galactose; Stereoisomer, Epimers, Benedict's reaction, osazone, glycosides, amino sugars, deoxy sugar; Disaccharides: sucrose, lactose, maltose; Polysaccharides: starch, glycogen; Mucopolysaccharides and glycoprotein.

Unit 4: Lipids **7Classes**

Chemistry and Classification of Fatty acids; Saturated, unsaturated and essential fatty acid; Physical and chemical properties: acid number; Triacylglycerol, Phospholipids and Cholesterol.

Unit 5: Nucleic acids **5Classes**

Chemistry of purine & pyrimidine, nucleosides, nucleotides; Structure and properties of DNA; Different types of DNA; RNA - structure and functions of mRNA, tRNA, rRNA.Watson-Crick model of DNA; size of DNA in prokaryotic and eukaryotic cells; central dogma of molecular biology

Practical:15Classes

1. Preparation of standard solutions (%, Molar, Molal and Normal) of acids and alkali, Stock and working solution.
2. Preparations of buffer solutions of known pH and molarity using pH meter (Bicarbonate/phosphate/acetate)
3. Hydrolyze of Starch by salivary amylase
4. Qualitative tests for Carbohydrate; Proteins; lipids.
5. Paper and Thin Layer chromatography for Amino Acids
6. Estimation of Carbohydrates and Proteins by Colorimetric method.

Suggested readings:

- *Principles of Biochemistry by Lehninger, Nelson and Cox*
- *BIOS Instant Notes in Biochemistry- David Hames and Nigel Hooper*
- *Biochemistry- Editors: Berg, J. M., Tymoczko, J. L.andStryer, L., Freeman.*

Paper Name: PLANT AND ANIMAL TISSUE CULTURE TECHNIQUES	
Paper Code: BITSEC1023	**Semester: II**
Type: SEC	**Credit: 3 (2L+1P)**
Total Classes: 45= 30+15 (L+P)	**Total Marks: 100 (T60+P20+IA20)**

Objective:
This paper shall enable the students to understand the plant and animal tissue-based application and utility which opens the scope for various scale ups and start-ups.

Course Outcomes (CO):
CO1: Learners will be acquainted with the laboratory knowledge and skill for plant tissue culture-based research
CO2: This course shall help the students to know about the functional utility of various animal tissue application including insights in medical biotechnology and diagnostics

Theory: 30 Classes

Unit 1: **Introduction to tissue culture** **8 Classes**

Introductory history, Laboratory organization, Cell culture, Cellular Totipotency, Somatic Embryogenesis.
Composition of culture media, Growthhormones, Vitamins, Unidentified supplements, selection of media

Unit 2:Plant tissue culture techniques **7 Classes**

Preparation steps for tissue culture, surfacesterilization of plant tissue material, sterilization of medium components, basic procedure for aseptic tissue transfer, incubation ofculture. Callus Culture, Cell Suspension Culture, OrganMicro-culture, plant micro-propagation, Somatic Embryogenesis, Artificial seed.

Unit 3:Introduction to laboratory set up for animal tissue culture **7 Classes**

Understanding Laboratory set up for animal tissue culture. Various media of animal tissue culture. Understanding various instruments like Laminar Air Flow Cabinet, Bio safety Cabinet, Autoclave, Centrifuge, CO2 Incubator etc.

Unit 4:Animal tissue culture **8 Classes**

Karyotype, soma clonal studies. Primary and Secondary culture, monolayer and suspension culture. Various hormones and bioactive components and their utility. Application of animal tissue culture. Tissue grafting

Practical: 15 Classes

1. Handling of autoclave, LAF, centrifuge etc
2. Preparation of different types of plant tissue culture media
3. Preparation of various media for animal tissue culture.
4. Sterilization of medium components and other tools used in plant and animal tissue culture.
5. Initiate a callus culture
6. Preparation of artificial seed
7. Culture of lymphocyte for karyotype

Suggested readings:

- *Bhojwani, S.S. and Razdan 2004 Plant Tissue Culture and Practice.*

- *Reinert, J. and Bajaj, Y.P.S. 1997 Applied and Fundamental Aspects of Plant Cell, Tissue and Organ Culture. Narosa Publishing House.*
- *Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications: R. Ian Freshney:: John Wiley & Sons, Inc.*
- *Animal Cell Culture: A Practical Approach:John Masters::Publisher : OUP Oxford*
- *Animal Cell Culture: Concept and Application:Sheelendra M. Bhatt :Publisher : Alpha Science International Ltd*
- *Animal Tissue Culture:P Ramadass and A Wilson Aruni:Publisher : Mjp Publishers*

Paper Name: SERICULTURE	
Paper Code: BITVAC1024	**Semester: II**
Type: CORE	**Credit: 4** **NCC/NSS-2 + 2 (1L+1P)**
Total Contact hours: 60= 45+15 (L+P)	**Total Marks: 100 (T60+P20+IA20)**

Objective:

The objective of the paper is to encourage students to know about host plant of silk and also various species of silk worm including weaving

Course Outcomes (CO):

CO1: The paper shall enable the students to learn utilize the bioresource for production of silk.

CO2: The paper shall enable the student to understand the utility of host plant of silk work

Theory: 15 Classes

Unit 1: SERICULTURE **15 Classes**

Origin and history of sericulture, Characteristic features of the order Lepidoptera, Life cycle of *Samiacynthiaricini* (Eri) and *Antheraeaassama*(Muga), anatomical structure of silk gland, Food habits of silkworms, different varieties of mulberry with special reference to Assam,silkworm as food, thread spinning, Diseases of silkworm and its control, Perspectives of sericulture and textile industry, Role of women in sericulture.

Practical:15 Classes

1.Selection and plantation of host plant of Silk worm

2.Rearinig of silk worm.

3.Spining of thread of cocoon

4. Weaving cloths with the threads spined from the silk

SEMESTER- III

Paper Name: TAXONOMY AND BIODIVERSITY	
Paper Code: BITMIN2014	**Semester: III**
Type: MINOR	**Credit: 4 (3L+1P)**
Total Classes: 60= 45+15 (L+P)	**Total Marks: 100 (T60+P20+IA20)**

Objective:

To gain the knowledge related to the basic concept of biodiversity and conservation and also different types taxonomy

Course Outcomes (CO):

CO1: Upon completion of this course, Students will gain knowledge about biodiversity exploration, estimation and conservation.

CO2: Upon completion of this course, Students will know the concept of methodology in taxonomy.

CO3: Upon completion of this course, Students will learn about the different tools in the taxonomy so that they can relocate the phylogenetic position of plant or taxa.

Theory: 45 Classes

Unit 1: Basic concept of Taxonomy 8 classes

Classification, Construction of Phylogenetictree, Systematics, Cladistics, Cladograms, Phenetics, Nomenclature.

Unit 2: Basic concept and global pattern of Biodiversity 13 classes

What is Biodiversity, why should we conserve it, Elements of Biodiversity - Ecosystem Diversity, Genetic Diversity, Species Abundance & Diversity, Patterns of Species Diversity. Measuring biodiversity, Cataloguing and Discovering Species, Geographical Patterns of Species Richness, Biogeography, Importance of Distribution Patterns (Local Endemics, Sparsely Distributed Species, and Migratory Species), GAP Analysis.

Unit 3: Biodiversity & Conservation 14 classes

Overexploitation threatening living species, International Trade,Animalsthreatenedbyinternationaltrade,ProblemsinControllingInternationalTrade(Enforcement,Reservations,IllegalTrade),FreeTrade&theEnvironment,FreeTrade&Conservation,CommonpatternsofOverexploitation.TheUSEndangeredSpeciesAct,StateEndangeredSpecies Acts Successes and Failures of the Endangered Species Act Role of ESA in HabitatProtection, Critical Habitat, Problems with the Endangered Species Act, Habitat ConservationPlans.

Unit 4: Molecular Taxonomy in relation to DNA characteristics & Protein sequences 10 Classes

Modes of molecular evolution, Neutral theory of Molecular evolution, genetic markersfortaxonomicpurposes,comparingtotalgenomebyDNA-DNAhybridization, comparing DNA sequences, Cladistics, biological identification through DNA barcodes, chromosome painting, establishing molecular homologyusingprotein sequences.

Practical: 15 classes

1. Acquaintance with open-source databases of biodiversity.

2. Sampling of plant and animal biodiversity of the College/University campus
3. Determine species location in a given study area.
4. Microtome technique to study the biological characters of the samples.
5. Taxonomic identification of wild and cultivated plants represented in local flora.
6. Pollen preparations by Acetolysis method (Semi-permanent) and study of different pollen morphophytes.

Suggested readings:

- *Plant Taxonomy (2nd Edition McGraw Hill Education) by O.P. Sharma*
- *Plant taxonomy (1st Edition Eastern Book House, Guwahati) by Akhil Baruah*
- *Plant Taxonomy & Biodiversity (Santra Publications Pvt. Ltd.) by N.D. Paria*
- *Textbook of Biodiversity (Notion Press) by Anupam Rajak*

Paper Name: CELL BIOLOGY	
Paper Code: BITMAJ2014	**Semester: III**
Type: CORE	**Credit: 4 (3L+1P)**
Total Classes: 60= 45+15 (L+P)	**Total Marks: 100 (T60+P20+IA20)**

Objective:

The objective of the cell biology course is to provide students with a comprehensive understanding of the fundamental principles and mechanisms of cellular organization, function, and communication.

Course Outcomes (CO):

CO1: Understand the basic structure and functions of cells, including the plasma membrane, organelles, and cytoskeleton.

CO2: Explain the process of cell division and cell differentiation.

CO3: Describe the mechanism of cellular communication and signaling, including the role of receptors, hormones, and second messengers.

CO4: Discuss the cellular basis of disease, including the mechanism of cell death and the role of cellular process in disease pathogenesis.

CO5: Understand the fundamental practical experiments that are conducted in the field of cell biology, particularly those that pertain to significant topics.

Theory: 45 Classes

Unit 1: Introduction to cell structure **10 Classes**

History of the discovery of the cell, cell as the structural and functional unit of life, cell theory, the structure of prokaryotic, and eukaryotic cells, microscopic techniques for the study of cells, plasma membrane structure and functions, membrane composition and dynamics, transport of ions and macromolecules, membrane vacuolar system.

Unit 2: **Cell Organelles** **10 Classes**

Cell organelles and their structure and functions: structure and functions of Mitochondria, Chloroplast, Nucleus, Gogi body, Endoplasmic reticulum, Lysosome, Peroxisome, and Ribosome. Origin of Mitochondria and Chloroplast.

Unit 3:Cell Division and Cell Death: **9 Classes**

Mitosis, Meiosis, Cell Cycle, and its regulation, Diseases caused due to the dysregulation of cell division and cell cycle, Cell division in prokaryotes; Cell death mechanisms: Necrosis, Apoptosis, Autophagy; Clearance of dead cells: Efferocytosis.

Unit 4: **Extracellular Matrix and Cell Signalling** **16 Classes**

Composition, molecules that mediate cell adhesion, membrane receptors for extracellular matrix, macromolecules, regulation of receptor expression and function.Cell-to-cell communications; overview- types of cell-signaling- mechanism of varioustypes of signal transduction pathways of cells.

Practical: 15 Classes

1. Study of the structure of any Prokaryotic and Eukaryotic cell.

2. Study the effect of temperature and organic solvents on the plasma membrane.
3. Preparation of Nuclear, Mitochondrial & Cytoplasmic fractions.
4. Study of mitosis.
5. Study of meiosis.
6. Total cell count by suitable method

Suggested readings:

- *Watson et al., Molecular Biology of the gene, 5th Edition, Pearson Prentice Hall. USA, 2003.*
- *Lodish et al., Molecular cell Biology, 4th Edition, W.H. Freeman & Company, 2000.*
- *Benjamin Lewin, Gene IX, 9th Edition, Jones and Barlett Publishers, 2007*
- *Karp, G, Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc, 2010.*
- *Becker, W.M et al., The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco, 2009.*
- *Albert Bruces et al., Molecular Biology of the Cell. 5th edition. Garland Science, 2008.*

Paper Name: INTELLECTUAL PROPERTY RIGHTS	
Paper Code: BITIDC2013	**Semester: III**
Type: IDC	**Credit: 3 (2L+1P)**
Total Classes: 45= 30+15 (L+P)	**Total Marks: 100 (T60+P20+IA20)**

Objectives:

The course is designed to provide comprehensive knowledge to the students regarding the general concepts and importance of IPR.

Course Outcomes (CO):

CO1: Acquaint the learners with the basic concepts of Intellectual Property Rights and the types of IPRs.

CO2: Acquire the knowledge on world trade organization, trade agreements and investments.

CO3: Understand the process of patenting and patent laws in India.

CO4: Learn the role of IPR in biodiversity protection.

Theory: 30 Classes

Unit 1: Introduction to Intellectual Property Right: 7 Classes

Introduction, intellectual property and on, types of Intellectual Property Rights: Patent, copyright, Trademark, Design, trade secret, Traditional Knowledge and Geographical indication. Commercial Exploitation, and Protection of IPR.

Unit 2: National and International agencies: 6 Classes

WIPO, World Trade Organization (WTO), Trade- Related Aspects of Intellectual Property Rights (TRIPS), General Agreement on Tariffs and Trade (GATT).

Unit 3: Patents 10 Classes

Basics of patents - Types of patents; Patentable and Non-Patentable inventions, Process Product patent, Utility Patent (Short term patent). Indian Patent Act 1970; Recent amendments; Patent Cooperation Treaty (PCT) and implications. Process of patenting. Types of patent applications: Provisional and complete specifications; Concept of "prior art", patent databases (USPTO, EPO, India). Financial assistance, schemes, and grants for patenting.

Unit 4: Protection of Biodiversity 7 Classes

Indian Biodiversity Act, Plant variety protection, plant breeder's rights, Protection ofPlant Varieties and Farmer's Right Act (2001) , Choice and management of IPRs,advantage and limitations of IPRs.

Practical and Field Visits: 15 Classes

1. Patent infringement-Case Studies (Basmati rice, Turmeric, Neem)
2. Proxy filing of Indian Product patent
3. Proxy filing of Indian Process patent
4. Exploring patent database

Suggested readings/books:

- *Intellectual Property Rights by Deborah E. Bouchoux., Delmar Cenage Learning. 2005*

- *Intellectual Property Rights on Biotechnology by Singh, KC, BCIL, New Delhi*
- *Fundamentals of lP for Engineers: K.Bansl& P.Bansal*
- *Intellectual property right, Deborah, E. Bochoux, Cengage learning.*
- *Intellectual property right - Unleashing the knowledge economy, Prabuddha Ganguli, Tata McGraw Hill Publishing Company Ltd.*

Paper Name: MICROBIAL TECHNIQUES	
Paper Code: BITSEC2013	**Semester: III**
Type: SEC	**Credit: 3 (2L+1P)**
Total Classes: 45= 30+15 (L+P)	**Total Marks: 100 (T60+P20+IA20)**

Objective:

The objective of the course is to train the students on the various aspects of a microbiology laboratory.

Course Outcomes (CO):

CO1: Learners with get acquainted with the various tools, equipment's, instruments used in a microbiology laboratory.

CO2: They will be able to identify microorganisms based on various parameters such as size, shape, morphology, biochemical**.**

CO3: The students will be able to culture, sub-culture and also to preserve the microorganisms.

Theory: 30 Classes

Unit 1: Microscopy-Principles, part and function 10 Classes

Light microscope (Bright-field microscope, Phase-Contrast Microscope, Dark-field Microscope, Fluorescence Microscope and Differential Interference Contrast (DIC) microscope).

Electron Microscope (Transmission electron microscope and Scanning electron microscope)

Unit 2: Dyes and staining techniques 5 Classes

Types of dyes (acidic and basic), simple staining (positive staining & negative staining), differential staining (Gram's stain, acid fast stain), special staining (endospore stain)

Unit 3: Media for culture of microorganisms and sterilizing techniques 5 Classes

Basic components of a microbial growth media, Dry heat (red heat, incineration, hot air) and moist heat sterilization (autoclave)

Unit 4: Techniques for enumeration of microorganisms, Pure culture & Maintenance and preservation 5 Classes

Shape of the microorganism and arrangement of the cells (microscopic), colonial morphology (macroscopic)

Serial dilution, pour plate method, spread plate method, sub-culturing (streak plate method), Culture plate, culture tube, freeze drying (lyophilisation)

Characterization using different biochemical analysis

Practical: 15 Classes

1. Preparation of slides
2. Observe the different classes of Microbes for morphology and arrangement under a microscope after appropriate staining procedures
   i. Bacteria
   ii. Fungi
   iii. Yeast
3. Preparation of microbial media for bacteria, fungi, yeast and algae

4. Enumerate the microorganisms from soil, water and air sample
5. Obtain a pure culture of bacteria, fungi and yeast
6. Characterization of microbes based on various biochemical test.

Suggested readings:

- *Microbiology: A laboratory manual. James Cappuccino and Natalie Sherman.*
- *Microbiology- Prescott LM, Harley JP, Klein DA, Wm. C. Brown Publishers*
- *Microbiology: Tortora, G.J., Funke, B.R. and Case, C.L An Introduction Pearson Education.*
- *Brock Biology of Microorganisms- Madigan MT, Martinko JM and Parker J. Pearson/Benjamin Cummings.*

Paper Name: MICROBIOLOGY	
Paper Code: BITMAJ2024	Semester: III
Type: CORE	Credit: 4 (3L+1P)
Total Classes: 60= 45+15 (L+P)	Total Marks: 100 (T60+P20+IA20)

Objective:

To acquaint the students with history, classification and role of microbiology in agriculture, food and environment.

Course Outcomes (CO):

CO1: Classify microbes through basic techniques and know their evolutionary relationship.

CO2: Analyze the diversity, distribution and demonstrate the morphology and structure of microbial cells.

CO3: Culture microbes and demonstrate microbial growth kinetics and metabolic pathways.

CO4: Discuss on bacterial recombination techniques of bacterial reproduction.

CO5: Gain knowledge on microflora associated to the human body and the environment.

CO6: Gain hands on experience to prepare culture media, isolate, identify microbes and perform microbial cell count.

Theory: 45 Classes

Unit 1: Microbial classification **15 Classes**

History of microbiology.

Classification of Bacteria and Archaea, Fungi, Algae, Protozoa, Helminthes and Viruses.

Basic principles and techniques used in bacterial classification

Evolutionary relationship among prokaryotes. Phylogenetic and numerical taxonomy.

Use of DNA and r-RNA sequencing in classifications.

Unit 2: Microbial growth and Metabolism **10 Classes**

Cultivation and Maintenance of microorganisms: Nutritional categories of micro-organisms, methods of isolation, Purification and preservation.

Growth curve, Generation time, synchronous batch and continuous culture, measurement of growth and factors affecting growth of bacteria.

Metabolic pathways, amphi-catabolic and biosynthetic pathways

Unit 3: Bacterial Reproduction **10 Classes**

Bacteriophages: Morphology and Life cycles, Conjugation, Transformation and Transduction. Endospores and sporulation in bacteria.

Unit 4: Normal microflora **10 Classes**

Bacterial pollutants of water, coliforms and non coliforms

Microorganism in food: Moulds, Yeasts, bacteria. Major food born infections and intoxications. Symptoms, pathogenesis and transmission of bacterial, viral, protozoan and fungal diseases in plants and animals

Control of Microorganisms: By physical, chemical and chemotherapeutic Agents

Practical: 15 Classes

1. Preparation of culture media (solid and liquid) and sterilization
2. Pure culture techniques (Spread, pure, streak)
3. Determination of air microflora
4. Determination of soil microflora
5. Determination of water microflora
6. Gram staining technique.

Suggested Readings:

- *Microbiology – Pelczar, Chan, Krieg, Tata McGraw Hill Publications.*
- *Microbiology- Prescott LM, Harley JP, Klein DA, Wm. C. Brown Publishers*
- *Microbiology: Tortora, G.J., Funke, B.R. and Case, C.L An Introduction Pearson Education.*
- *Brock Biology of Microorganisms- Madigan MT, Martinko JM and Parker J. Pearson/Benjamin Cummings.*
- *General Microbiology- Stainier RY, Ingraham JL, Wheelis ML & Painter PR. MacMillan*

SEMESTER- IV

Paper Name: GENETICS	
Paper Code: BITMAJ2054	**Semester: IV**
Type: CORE	**Credit: 4 (3L+1P)**
Total Classes: 60= 45+15 (L+P)	**Total Marks: 100 (T60+P20+IA20)**

Objective:
To understand how genes, chromosomes and different genetic information function and also to understand the pathways related to functionality of traits

Course Outcomes (CO):
CO1: Enable students to understand the basic of genetic and flow of genetic information
CO2: Enable students to understand macromolecules, its mutation, its repair and genetic markers
CO3: Enable students to understand population and population genetics
CO4: Enables students to understand molecular genetics, gene expression and gene regulation

Theory: 45 Classes

Unit 1: Introduction to Genetics: 10 Classes

Mendelian Genetics (Mendelian Laws, concept of alleles and multiple alleles,dominance, incomplete dominance, co-dominance), Genomes Organization (Prokaryotes and Eukaryotes), Organelle genome, genome mapping and genome evolution, Non-Mendelian Genetics (Gene interaction)

Unit 2: Nucleic Acid, mutation, repair and markers: 15 Classes

Structural aspects – Components of DNA and RNA, Nucleosides & Nucleotides, Double helical structure of DNA (Watson-Crick model), Various forms of DNA. Kinds of Mutation, Mutagens, influence of Mutation, Molecular basis of Mutation, Significance of Mutation. Concept of DNA Repair. Concept of markers, molecular markers, gene mapping, use of molecular Marker

Unit3: Population Genetics 10 Classes

Phenotype & Genotype. Genetic Drift, Gene flow, Migration, Island Effect, Bottle Neck Effect,HumanGeneticDiversity. HardyWenbergLaw,&PopulationGenetics.

Unit 4: Molecular Genetics 10 Classes

DNA Replication, Protein Expression, Genetic Code,Comparative genomics, molecularphylogenetics, Molecular Taxonomy

Practical: 15 Classes

1. Study of chromosome in suitable metaphase plate

2. DNA Isolation and quantification
3. Staining of nucleus and cytoplasm of animal and plant cells
4. Estimation of DNA by suitable method.
5. Study of different Karyotypes
6. Blood group determination
7. Study of mitosis and meiosis

Suggested readings:

- *Genetics:AConceptualAppraoch,B.A.Pierce,W.H.FreemanandCompany.*
- *CellBiology;G.Karp;JohnWileyandSons,Inc.*
- *NewClinicalGenetics,AndrewReadandDianDonnai,ScionPublishingLtd.*
- *HumanMolecularGenetics,T.StrachalandA.Read,GarlandScience.*
- *HumanGenetics:ConceptsandApplications,R.Lewis,McGrawHillHigherEducation.*
- *Genetics:MonroeW.Strickberger.Prentice-Hall India,Publication.*
- *PrinciplesofGenetics:Gardner,Simmons,Snustad.WileyPublications*

Paper Name: IMMUNOLOGY	
Paper Code: BITMAJ2044	**Semester: IV**
Type: CORE	**Credit: 4 (3L+1P)**
Total Classes: 60= 45+15 (L+P)	**Total Marks: 100 (T60+P20+IA20)**

Objective:
This paper shall enable the student to understand various processes of immune system

Course Outcomes (CO):
CO1. Enables the students for understanding of basic immunological process in the mammalian body.
CO2. Enable the students for understanding of humoral immunity.
CO3. Enables better understanding of Antigens and immunogenicity
CO4. Enables the student to understand disorders and cancer immunology

Theory: 45 Classes

Unit1: Introduction to Immune System **15 Classes**

Immune system of vertebrate and invertebrate. Componentsofinnateandacquiredimmunity. Organsandcellsoftheimmunesystem-primaryandsecondarylymphoidorgans. Humoral and cellular immune response.

Unit 2: Antibody **15 Classes**

Immunoglobulins-basicstructure,classes&subclassesofimmunoglobulins. Class switching and allelic exclusion of antibodies. B cell receptor and T cell receptor

Unit 3: Antigen and Immunogenicity **10 Classes**

Antigen, types, MHC molecules. Antigen processing and presentation. Hapten-carriersystem. Self and non-self-recognition. Precipitation and agglutination

Unit 4:Disorders Related to Immunity5 Classes

Autoimmune disorders, immune deficiency, Tuberculosis, Vaccines and edible vaccines. Cancer immunology

Practical: 15 Classes

1. Total blood Count
2. Separation of serum and plasma from blood
3. Practical leading to agglutination and precipitation
4. Demonstration of Double diffusion and immunoprecipitation
5. Determination of blood group
6. Demonstration of ELISA, Western Blotting
7. Determination of microbial load

Suggested readings:

- *Immunology,JanisKuby,Freeman.*
- *EssentialsofImmunology,I.M.Roitt,Wiley-Blackwell.*
- *Immunology,NandiniSethi.*
- *EssentialClinicalImmunology:JohnBZabriskie:CambridgeMedicinePublishing*
- *ImmunologyandEvolutionofInfectiousDiseases: StevanAFrank*

Paper Name: MOLECULAR BIOLOGY	
Paper Code: BITMAJ2034	**Semester: IV**
Type: CORE	**Credit: 4 (3L+1P)**
Total Classes: 60= 45+15 (L+P)	**Total Marks: 100 (T60+P20+IA20)**

Objective:

The objective of the molecular biology course is to equip students with a deep understanding of the molecular processes that underlie the organization, replication, and expression of genetic information in living organisms.

Course outcomes (CO):

CO1: Understand the basic structure and significance of DNA.

CO2: Understand the basic principles of molecular biology, including the central dogma of biology, DNA replication, transcription, and translation.

CO3: Describe the mechanisms of gene expression, including transcriptional and post-transcriptional regulation.

CO4: Explain the techniques used to study DNA, RNA, and proteins, such as PCR, gel electrophoresis, DNA sequencing, and protein purification.

CO5: Discuss the role of molecular biology in biotechnology, medicine, and other fields of science.

CO6: Understand the fundamental practical experiments that are conducted in the field of molecular biology.

Theory: 45 Classes

Unit 1: Nucleic Acids and their organization **7 Classes**

Watson and Crick model of DNA structure, A, B & Z forms of DNA, Nucleic acid as the genetic material, Genome and its organization in prokaryotes, eukaryotes, and viruses.

Unit 2: DNA Replication **10 Classes**

DNA replication in prokaryotes, eukaryotes, and viruses.Proteins and enzymesinvolved in DNA replication.

Unit 3: Expression Studies **14 Classes**

Transcription in prokaryotes and eukaryotes. Proteins and enzymes involved in transcription**.**Post-transcriptional modification of RNAs, translation in prokaryotes and eukaryotes.Proteins and enzymes involved in translation.Post-translational modification, analysis of transcription, translation,

Unit 4: Gene Regulation, **Recombination, and its application** **14Classes**

Gene regulation in prokaryotes, eukaryotes, and viruses.Gene regulation by non-coding RNAs, DNA-protein interactions, Recombination and its molecularmechanism, gene targeting (Cre-Lox*p*, Flp-Frt, CRISPER-Cas9) and antisense RNAs, Site-directed mutagenesis, model organisms in molecular biology.

Practical: 15 Classes

1. Preparation of solutions/buffers for Molecular Biology experiments.
2. Isolation of DNA from bacterial cells/plant cells/animal cells.
3. Estimation of DNA.
4. Agarose gel electrophoresis of DNA
5. Preparation of restriction enzyme digestion of DNA.
6. Preparation and transformation of competent cells.
7. Protein estimation and preparation of SDS-PAGE.

Suggested readings:

- *Watson JD, Baker TA, Bell SP, Gann A, Levine M and Losick R (2008) Molecular Biology of the Gene, 6th edition, Cold Spring Harbour Laboratory Press, Pearson Publication.*
- *Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition. John*
- *Wiley & Sons. Inc.*
- *De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII*
- *Edition. Lippincott Williams and Wilkins, Philadelphia.*
- *Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). The World of the Cell.*
- *VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.*
- *Jocelyn E Krebs (2009). Genes X, Jones & Bartlett Learning.*
- *Review articles.*

Paper Name: PLANT BIOTECHNOLOGY	
Paper Code: BITMIN2024	**Semester: IV**
Type: MINOR	**Credit: 4 (3L+1P)**
Total Classes: 60= 45+15 (L+P)	**Total Marks: 100 (T60+P20+IA20)**

Objective:
The objective of the course is to familiarize and train the students on various techniques involved in plant tissue culture.

Course Outcomes (CO):
CO1: Have a clear theoretical concept on micropropagation, tissue culture media, sterilization techniques and different techniques for culturing shoot tip, embryo, pollen, anther and ovary etc. and developing haploids, hybrids and homozygous lines.
CO2: Have an understanding about the different plant transformation terms and technology viz. Ti-plasmid & Ri-plasmid, binary vectors, vector-less DNA transfer, promoters for plant transformation and chloroplast transformation.
CO3: Have a concept on the application of plant transformation technologies on developing herbicide resistance, insecticide resistance, disease resistance, nematode resistance and for increased productivity and performance.
CO4: Understand and apply the knowledge of transformation technologies for the production and purification of industrially significant products from genetically engineered plants.
CO5: Explain and apply the knowledge of recombinant DNA technology for plant breeding. Also have a clear concept on techniques involved in germplasm conservation.

Theory: 45 Classes

Unit1: Introduction to plant tissue culture **15 Classes**

Scope of plant tissue culture, Composition of plant tissue culture media, Callus and suspension culture. Plant tissue culture techniques: Seed, Embryo, Callus, Organs, Cell and Protoplast culture, anther, Meristem and shoot tip culture. Organogenesis, Embryogenesis, Micropropagation, advantages and disadvantages of micropropagation.

Unit2: Hybridization and significance **10Classes**

Methods of protoplast isolation and fusion, Somatic hybridization, identification and selection of hybrid cells, Cybrids, Potential of somatic hybridization limitations. Soma-clonal variation and their significance. Artificial seeds and their application.

Unit3: Plant transformation technology **10Classes**

Ti and Ri plasmid, *Agrobacterium* mediated gene transformation, Direct DNA transfer methods to plants. Application of Plant transformation technology in herbicide resistance & insect resistance. Plant secondary metabolites and their production using transgenic plants.

Unit4: Molecular Markers **10Classes**

Plant molecular markers - RFLP, RAPD, AFLP, microsatellites, SNP, SSCP, SCAR.

Practical: 15Classes

1. Preparation of plant tissue culture media (Murashige & Skoog's medium)
2. Methods of sterilization of glassware, media
3. To select, prune, sterilize and prepare an explant for culture.
4. Micropropagation of selected plants using nodal explants
5. Preparation of artificial seeds
6. To demonstrate various steps of Micropropagation.

Suggested reading

- *Bhojwani, S.S. and Razdan 2004 Plant Tissue Culture and Practice.*
- *Reinert, J. and Bajaj, Y.P.S. 1997 Applied and Fundamental Aspects of Plant Cell, Tissue and Organ Culture. Narosa Publishing House.*
- *Russell, P.J. 2009 Genetics – A Molecular Approach. 3rdedition. Benjamin Co.*
- *Sambrook & Russel. Molecular Cloning: A laboratory manual. (3rd edition)*
- *Slater, A., Scott, N.W. & Fowler, M.R. 2008 Plant Biotechnology: The Genetic Manipulation of Plants, Oxford University Press.*