

Department of Botany

Learning outcomes for B.Sc. Botany

Develop a conceptual understanding of principles and importance of Botany. They will be able to demonstrate knowledge on selected topics of microbiology and Lower plants, Plant Taxonomy, Anatomy, Embryology, Cytology, Plant Physiology, Biodiversity, Plant tissue culture and be able to apply this knowledge to analyze a broad range of different phenomena.

Program Specific Outcomes:

1. After the completion of B.Sc. Botany students go for M.Sc.
2. Students after this course have the option to join Indian Civil Services as IAS, IFS etc.

Semester-I:

After completion of this semester students will gain knowledge of - General characteristics of Viruses and their economic importance, Bacteria, Mycoplasma, Archaeobacteria, Cyanobacteria. Life history of Algae such as- Volvox, Oedogonium, Chara, Ectocarpus and Polysiphonia.

Life history of Fungi such as- Albugo, Mucor, Penicillium, Puccinia, Cercospora and types of Lichens.

Classification, General characteristic and economic importance of Bryophyta such as - Marchantia, Anthoceros, Polytrichum. Sporophytic evolution in Bryophyta.

Classification, General characteristic and economic importance of Pteridophyta such as - Rhynia, Lycopodium, Equisetum, Marsilea. Stellar evolution in Pteridophyta, Heterospory and Seed habit.

Practical Work:

Students can identify different types of cyanobacteria.

Students can classify and identify the Algal and fungal genus and specimen included.

Students can make micro preparation of the material of Pteridophyta and Bryophytes and identify them anatomically.

B.Sc Botany: Semester-II

After completion of this semester students will gain knowledge of -

Morphology of vegetative and reproductive parts, systematic position and life cycle of Pinus and Gnetum, Geological time scale Introduction to Palaeobotany and types of fossils

Systematic, Types of classification: Bentham & Hooker and Engler & Prantl classification systems. An introduction to Angiosperm Phylogeny Group (APG). Current concepts in Angiosperm Taxonomy: Embryology in relation to taxonomy Cytotaxonomy, Chemotaxonomy and Numerical Taxonomy. ICN, Shenzhen code and Herbarium.

Systematic study and economic importance of plants belonging to the following families: Polypetalae, Gamopetalae and Monocotyledons.

Components of ecosystem, energy flow, food chain and food webs. Plants and environment, ecological adaptations of plants, Hydrophytes, Xerophytes and Mesophytes, Plant Succession serial stages, modification of environment, climax formation with reference to Hydrosere and Xerosere.

Practical Work:

Students can make micro preparation of the material of Gymnosperm and identify them anatomically. Technical description of the flowering plants families.

B.Sc Botany: Semester-III

Student will gain idea about-

Meristems, Tissues and Tissue Systems, Leaf, Stem and root anatomy: Vascular cambium - Formation and function.

Anomalous secondary growth of Stem, Root, Wood structure.

History and importance of Embryology, Microsporogenesis ovule structure and types. Pollen morphology, pollination and fertilization, Pollination Types, Pollen - pistil interaction, Double fertilization.

Seed - structure appendages and dispersal mechanisms, Endosperm, Embryo development and types, Polyembryony and Apomixis.

Practical Work:

Students will develop the skill and be able to prepare double stained micro preparation of the given material and identify on the basis of observation.

B.Sc Botany: Semester-IV

After completion of this course students will gain knowledge of-

Plant cell envelope, Models of membrane structure, Functions, fluidity and Selective permeability of the membranes, Cell Organelles, such as endoplasmic reticulum, ribosomes, golgi complex, lysosomes, peroxisomes and glyoxysomes. Mitochondria and Chloroplast.

Nucleus, DNA & RNA, Chromosomes, Special types of chromosomes such as Lampbrush and Polytene chromosomes. Extranuclear genome: Mitochondrial DNA and Plastid DNA.. Plasmids, Cell division

Plant -Water Relations, Mineral Nutrition, Transpiration and Enzymes.

Photosynthesis, Respiration, Nitrogen metabolism and Physiological effects of Phytohormones.

Practical Work:

Students will develop the skill and be able to learn Cytochemical methods, ultra structure of cell organelles using photographs. Chloroplast, Mitochondria, Nucleus, Ribosomes, Endoplasmic reticulum and Golgi complex, Special types of Chromosomes (Polytene chromosome and Lampbrush. Osmotic potential of vacuolar sap by Plasmolytic method, rate of transpiration using Cobalt chloride method, stomatal frequency, catalase activity, Chloroplast pigments using paper chromatography technique, Estimation of protein by Biurette method, Mineral deficiency- Detail study of Micronutrients and Macronutrients, Identification of C3, C4 and CAM plants.

B.Sc Botany: Semester-V

After completion of this semester students will realize that people are dependent on intact habitats that sustain the various organisms we need to produce food, medicines, clothing and other materials. Biodiversity is the key indicator for the health of an ecosystem. The purpose of Biodiversity assessment was that areas of high Biodiversity plays a vital role in determining key areas for conservation and establishing conservation priorities. They will discover that life can be found almost everywhere on earth. Biodiversity given an overview of species and habitat in a particular area, identifies threats and sets out steps to be taken to protect and improve the area to preserve and enhance its biodiversity for the future.

The three interlocking, overlapping arrows symbolize the three objectives of conservation: - maintenance of essential ecological processes and life-support systems; - preservation of genetic diversity; - sustainable utilization of species and ecosystems

At the end of this paper students will know that the biodiversity loss can have significant direct human health impacts if ecosystem services are no longer adequate to meet social needs. Indirectly, changes in ecosystem services affect livelihoods, income, local migration and, on occasion, may even cause or exacerbate political conflict.

Plants play a vital role in human life. Plants provide many products for human benefits, such as timber, fibres, medicines, dyes, firewood, pesticides, oils, and rubber.

Practical Work:

Students will develop the skill and be able to -

Study on local biodiversity, plant communities, Assessment of biodiversity, Avenue trees, Ornamental Plants: Any five locally available ornamental plants, Timber Value, Fruits, Nuts, Medicinal value, Field trip and preparation of Herbarium.

B.Sc Botany: Semester-VI

After completion of this semester students will understand that the plant tissue culture is the techniques which are widely used to grow better quality plants, tissues or organs under sterile conditions on a nutrient culture medium of known composition. Several techniques are used for plant tissue culture. Clones are made using this technique.

Through the process of apical meristem culture, virus free germplasm is produced. By obtaining the technique of somatic embryogenesis, several types of artificial synthetic seeds are produced.
- Plant tissue culture is used for the production of secondary metabolites in large quantities.

Tissue culture is seen as an important technology for developing countries for the production of disease-free, high quality planting material and the rapid production of many uniform plants.

Micropropagation is used for the development of foliage and ornamental plants. By using tissue culture methods, ornamental plants are produced in large numbers. Embryo culture technique is applied to overcome embryo abortion, seed dormancy and self-sterility in seeds. Plant tissue culture methods are employed in plants for the introduction of a foreign gene into plant cells.

Practical Work:

Students will develop the skill and be able to learn -

Isolation of plant DNA. (Tomato), Production of synthetic seeds /Encapsulation of embryo, MS medium, protoplasts, Minor Experiments, Callus induction, Micropropagation/multiple shoots, Anther culture, PCR –Demonstration, Gene transfer methods, Instruments used in Biotechnology lab, Study of anther, embryo and endosperm culture, micropropagation, somatic embryogenesis, artificial seeds through photographs, Study of methods of gene transfer through photographs, Agrobacterium-mediated, direct gene, electroporation, microinjection, microprojectile bombardment, genetic engineering for production of Bt cotton, Golden rice, FlavrSavr, Restriction digestion and gel electrophoresis of plasmid DNA.

B.Sc., BOTANY

First Year, I -Semester

Paper-I Microbial Diversity and Lower Plants

UNIT – I

(15 hours)

- 1) Bacteria:** Structure, nutrition, reproduction and economic importance. Brief account of Archaeobacteria, Actinomycetes and Mycoplasma with reference to little leaf of Brinjal and Papaya leaf curl
- 2) Viruses:** Structure, replication and transmission; plant diseases caused by viruses and their control with reference to Tobacco Mosaic and Rice Tungro.
- 3) An outline of plant diseases of important crop plants caused by bacteria and their control with reference to Angular leaf spot of cotton and Bacterial blight of Rice.

UNIT-II

(15 hours)

- 1) General characters, structure, reproduction and classification of algae (Fritsch)
- 2) Cyanobacteria:** General characters, cell structure and their significance as biofertilizers with special reference to Oscillatoria, Nostoc and Anabaena.
- 3) Structure and reproduction of the following:

Chlorophyceae- Volvox, Oedogonium and Chara.

Phaeophyceae- Ectocarpus

Rhodophyceae- Polysiphonia.

UNIT-III

(15 hours)

- 1) General characters and classification of fungi (Ainsworth).
- 2) Structure and reproduction of the following: (a) Mastigimycotina- Albugo (b) Zygomycotina- Mucor (c) Ascomycotina- Saccharomyces and Penicillium. (d) Basidiomycotina- Puccinia (e) Deuteromycotina- Cercospora.
- 3) Economic importance of lichens

UNIT-IV

(15 hours)

- 1) Bryophytes:** Structure, reproduction, life cycle and systematic position of Marchantia, Anthoceros and Polytrichum, Evolution of Sporophyte in Bryophytes.

2) Pteridophytes: Structure, reproduction, life cycle and systematic position of Rhynia, Lycopodium, Equisetum and Marsilea.

3) Stellar evolution, heterospory and seed habit in Pteridophytes.

Practical Syllabus (45 hours)

1. Study of viruses and bacteria using electron micrographs (photographs).

2. Gram staining of Bacteria.

3. Study of symptoms of plant diseases caused by viruses, bacteria, Mycoplasma and fungi:

Viruses: Tobacco mosaic

Bacteria: Angular leaf spot of cotton and Rice tungro.

Mycoplasma: Little leaf of Brinjal and Leaf curl of papaya

Fungi: White rust on Crucifers, Rust on wheat & Tikka disease of Groundnut.

4. Vegetative and reproductive structures of the following taxa:

Algae: Oscillatoria, Nostoc, Volvox, Oedogonium, Chara, Ectocarpus and Polysiphonia.

Fungi: Albugo, Mucor, Saccharomyces, Penicillium, Puccinia and Cercospora

5. Section cutting of diseased material infected by Fungi and identification of pathogens as per theory syllabus. White rust of Crucifers, Rust on wheat & Tikka disease of Groundnut.

6. Lichens: Different types of thalli and their external morphology

7. Examination of important microbial, fungal and algal products: Biofertilizers, protein capsules, antibiotics, mushrooms, Agar-agar etc.

8. Field visits to places of algal / microbial / fungal interest (e.g. Mushroom cultivation, water bodies).

9. Study of Morphology (vegetative and reproductive structures) and anatomy of the following Bryophytes: Marchantia, Anthoceros and Polytrichum.

10. Study of Morphology (vegetative and reproductive structures) and anatomy of the following Pteridophytes: Lycopodium, Equisetum and Marsilea.

11. Study of Anatomical features of Lycopodium stem, Equisetum stem and Marsilea petiole & rhizome by preparing double stained permanent mounts.

B.Sc., BOTANY

First Year, II -Semester

Paper-II Gymnosperms, Taxonomy of Angiosperms and Ecology

UNIT-I

(15 hours)

- 1) Gymnosperms: General characters, structure, reproduction and classification (Sporne's). Distribution and economic importance of Gymnosperms.
- 2) Morphology of vegetative and reproductive parts, systematic position and life cycle of Pinus and Gnetum,
- 3) Geological time scale Introduction to Palaeobotany, Types of fossils and fossilization, Importance of fossils.

UNIT-II

(15 hours)

- 1) Introduction: Principles of plant 4 systematic, Types of classification: Artificial, Natural and Phylogenetic; Systems of classification: Salient features and comparative account of Bentham & Hooker and Engler & Prantl classification systems. An introduction to Angiosperm Phylogeny Group (APG).
- 2) Current concepts in Angiosperm Taxonomy: Embryology in relation to taxonomy Cytotaxonomy, Chemotaxonomy and Numerical Taxonomy.
- 3) Nomenclature and Taxonomic resources: An introduction to ICN, Shenzhen code – a brief account. Herbarium: Concept, techniques and applications.

UNIT-III

(15 hours)

- 1) Systematic study and economic importance of plants belonging to the following families: Polypetalae Annonaceae, Capparidaceae, Rutaceae, Fabaceae (Faboideae/Papilionoideae, Caesalpinioideae, Mimosoideae), Cucurbitaceae
- 2) Gamopetalae: Apiaceae, Asteraceae, Asclepiadaceae, Lamiaceae, Monochalmydeae: Amaranthaceae, Euphorbiaceae
- 3) Monocotyledons: Orchidaceae, Poaceae and Zingiberaceae.

UNIT-IV

(15 hours)

1. Components of ecosystem, energy flow, food chain and food webs.
2. Plants and environment, ecological adaptations of plants, Hydrophytes, Xerophytes and Mesophytes

3. Plant Succession serial stages, modification of environment, climax formation with reference to Hydrosere and Xerosere.

Practical Syllabus (45 hours)

1. Study of Morphology (vegetative and reproductive structures) of the following taxa: Gymnosperms - Pinus and Gnetum.

2. Study of Anatomical features of Pinus needle and Gnetum stem by preparing double stained permanent mounts.

3. Fossil forms using permanent slides / photographs: Cycadeoidea. Systematic study of locally available plants belonging to the families prescribed in theory Syllabus (Minimum of one plant representative for each family)

4. Study of morphological and anatomical characteristics of locally available plant species (Eichhornia, Hydrilla, Pistia, Nymphaea, Asparagus, Opuntia, Euphorbia melii)

5. Demonstration of herbarium techniques.

6. Candidate has to submit at least 30 herbarium sheets.

B.Sc. BOTANY II Year - SEMESTER – III

PLANT ANATOMY AND EMBRYOLOGY

UNIT – I

Meristems: Types, histological organization of shoot and root apices and theories.

1. Tissues and Tissue Systems: Simple, complex and special tissues.
2. Leaf: Ontogeny, diversity of internal structure; stomata and epidermal outgrowths.

UNIT –II

4. Stem and root anatomy: Vascular cambium - Formation and function.
5. Anomalous secondary growth of Stem -Achyranthes, Boerhaavia, Bignonia, Dracaena; Root— Beta vulgaris.
6. Wood structure: General account. Study of local timbers — Teak (*Tectona grandis*), Rosewood, (*Dalbergia latefolia*), Red sanders, (*Pterocarpus santalinus*) Nallamaddi (*Terminalia tomentosa*) and Neem (*Azadirachta indica*).

UNIT-III

7. History and importance of Embryology.
8. Another structure, Microsporogenesis and development of male gametophyte.
9. Ovule structure and types; Megasporogenesis; types and development of female gametophyte.

UNIT- IV

10. Pollen morphology, pollination and fertilization, Pollination Types, Pollen - pistil interaction, Double fertilization.
11. Seed - structure appendages and dispersal mechanisms.
12. Endosperm - Development and types. Embryo - development and types; Polyembryony and Apomixis -- an outline.

B.Sc. BOTANY II Year - SEMESTER – III

PLANT ANATOMY AND EMBRYOLOGY

PRACTICAL

1. Demonstration of double stain technique.
2. Preparation of double stained Permanent slides Primary structure: Root - Cicer, Canna; Stem — Tridax, Sorghum Secondary structure: Root — Tridax sp.; Stem —Pongarnia Anomalous secondary structure: Stem: Achyranthes, Boerhavia, Bignonia, Dracaena Root: Beta vulgaris
3. Stomatal types using epidermal peels (Dicots).
4. Structure of anther and microsporogenesis using permanent slides.
5. Structure of pollen grains using whole mounts - Hibiscus, Acacia and Grass).
6. Pollen viability test using Evans Blue — Hibiscus
7. Study of ovule types and developmental stages of embryo sac.
8. Structure of endosperm (nuclear and cellular); Developmental stages of dicot and monocot embryos using permanent slides.
9. Isolation and mounting of embryo (using Cymopsis / Senna / Crotalaria)

B.Sc. BOTANY II Year - SEMESTER – IV

CELL BIOLOGY AND PLANT PHYSIOLOGY

UNIT I

1. Plant cell envelope: Ultrastructure of cell wall, molecular organization of cell membranes.
2. Models of membrane structure, Functions, fluidity and Selective permeability of the membranes.
3. Cell Organelles: Structure and semi autonomous nature of Mitochondria and Chloroplast.
4. Structure and role of endoplasmic reticulum, ribosomes, golgi complex, lysosomes, peroxisomes and glyoxysomes.

UNIT-II

1. Nucleus: Ultra structure, types and functions of DNA & RNA.
2. Chromosomes: Morphology, organization of DNA in a chromosome, Euchromatin and Heterochromatin, Karyotype. Special types of chromosomes: Lampbrush and Polytene chromosomes.
3. Extranuclear genome: Mitochondrial DNA and Plastid DNA.. Plasmids.
4. Cell division: Cell and its regulation; mitosis, meiosis and their significance

UNIT- III

1. Plant -Water Relations: Physical properties of water, diffusion, imbibitions, osmosis; osmotic and pressure Potential, absorption and transport of water.
2. Mineral Nutrition: Essential macro and micro mineral nutrients, and symptoms of mineral deficiency.
3. Transpiration; Stomatal structure and movement. Mechanism of phloem transport. Mechanism of phloem transport.
4. Enzymes: Nomenclature, Characteristics, Classification and factors regulating enzyme activity.

UNIT- IV

1. Photosynthesis: Photosynthetic pigments, Mechanism of photosynthetic electron transport and evolution of oxygen, Photophosphorylation. Carbon assimilation pathways: C₃, C₄ and CAM.
2. Respiration: Aerobic and Anaerobic; Glycolysis, Krebs cycle and electron transport system.
3. Nitrogen Metabolism: Biological nitrogen fixation
4. Physiological effects of Phytohormones: Auxins, gibberellins, cytokinins, ABA, ethylene and Brassinosteroids.

B.Sc. BOTANY II Year SEMESTER – IV

CELL BIOLOGY AND PLANT PHYSIOLOGY

PRACTICAL

1. Demonstration of cytochemical methods: Fixation of plant material and nuclear staining for mitotic and meiotic studies.
2. Study of various stages of mitosis using cytological preparation of Onion root tips.
3. Study of various stages of meiosis using cytological preparation of onion flower buds.
4. Study of ultra structure of cell organelles using photographs. Chloroplast, Mitochondria, Nucleus, Ribosomes, Endoplasmic reticulum and Golgi complex.
5. Study of Special types of Chromosomes (Polytene chromosome and Lampbrush chromosomes-Permanent slide)
6. Determination of osmotic potential of vacuolar sap by Plasmolytic method using leaves of Rheodiscolor / Tradescantia.
7. Determination of rate of transpiration using Cobalt chloride method
8. Determination of stomatal frequency using leaf epidermal peelings / impressions
9. Determination of catalase activity using potato tubers by titration method
10. Separation of chloroplast pigments using paper chromatography technique
11. Estimation of protein by Biurette method
12. Mineral deficiency- Detail study of Micronutrients and Macronutrients
13. Identification of C₃, C₄ and CAM plants.

B.SC. BOTANY III YEAR:

SEMESTER-V PAPER-V: (A) BIODIVERSITY & CONSERVATION

UNIT - I

1. Plant diversity and its scope: Genetic diversity, Species diversity, Plant diversity at the ecosystem level, Agro biodiversity and cultivated plant taxa, wild taxa.
2. Values and uses of Biodiversity: Ethical and aesthetic values, Precautionary principle, Methodologies For valuation, Uses of plants, Uses of microbes.

UNIT-II

3. Loss of Biodiversity: Loss of genetic diversity, Loss of species diversity, Loss of ecosystem diversity, Loss of agro biodiversity, projected scenario for biodiversity loss.
4. Management of Plant Biodiversity: Organizations associated with biodiversity, management Methodology for execution-IUCN, UNEP, UNESCO, WWF, NBPGR.
5. Biodiversity legislation and conservation, Biodiversity information management and communication.

UNIT-III

6. Conservation of Biodiversity: Conservation of genetic diversity, species diversity and ecosystem Diversity
7. Principles of conservation –In-situ and Ex-situ conservation. Sacred groove, Botanical garden, Biosphere reserves, Sanctuaries, National parks (In-situ) and Tissue culture, Gene / seed / pollen banks and Cryopreservation (Ex-situ).

UNIT-IV:

8. Role of plants in relation to Human Welfare; Importance of forestry their utilization and commercial aspects, Avenue trees, Ornamental plants of India.
9. Alcoholic beverages through ages. Fruits and nuts, important fruit crops and their commercial importance. Wood and its uses.

B.SC. BOTANY III YEAR - SEMESTER-V

PAPER- V: (A) BIODIVERSITY& CONSERVATION

DSE-1: ELECTIVE

PRACTICAL SYLLABUS

1. Study on local biodiversity: Herbs, shrubs and trees; Seasonal, Annual, biennial and perennial plants.

2. Study of morphological characteristics of plant communities: Hydrophytes (Eichhornia, Hydrilla, Pistia, Nymphaea, Vallisneria), Xerophytes: (Asparagus, Opuntia, Euphorbia milii, Casuarina, Calotropis).

3. Assessment of biodiversity

i) Avenue trees: Pongamia pinnata, Butea monosperma, Spathodea sp., Delonix regia, Jacaranda mimosifolia, Cassia fistula, Mimosa pudica, Acacia leucophloea, and Albizia lebeck.

ii) Ornamental Plants: Any five locally available ornamental plants.

iii) Timber Value: Acacia nilotica, Tectona grandis and Azadirachta indica

iv) Fruits: Mangifera indica (Mango), Ziziphus mauritiana, Psidium guajava (Guava), Annona squamosa

v) Nuts: Anacardium occidentale (Cashew), Terminalia catappa (Badam)

vi) Beverages: Madhuca indica, Camellia sinensis (Tea), Coffea arabica (Coffee), Borassus flabellifer (Toddy palm) and Caryota urens

vii) Medicinal value: Catharanthus roseus, Tinospora cordifolia and Phyllanthus emblica, Ocimum sp., and Azadirachta indica

4. Field trip: Collection of plants from the field, identification and preparation of Herbarium.

B.SC. BOTANY III YEAR: SEMESTER-VI

PAPER-2B: TISSUE CULTURE AND BIOTECHNOLOGY

DSE-2 ELECTIVE

UNIT – I

1. Tissue culture: Introduction, sterilization procedures, explants, culture media - composition and preparation; Nutrient and hormone requirements, Micropropagation.
2. Organ culture: Totipotency, Vegetative Organs-Root, Shoot, Leaf culture Reproductive Organs-Anther, Ovule, Embryo culture
3. Callus culture and isolation and fusion of protoplast culture 4. Organogenesis, Embryogenesis (somatic and zygotic).

UNIT- II

5. Applications of tissue culture: Production of pathogen free plants and stress resistant plants, somaclonal variants and synthetic seeds.
6. Induction of hairy roots and its applications in production of secondary metabolites.
7. Haploidy and triploids, Cryopreservation and Germplasm Conservation.
8. Somatic hybrids and Cybrids.

UNIT- III

9. Biotechnology: Introduction, history, scope and applications.
10. rDNA technology: Basic aspect of gene cloning, Enzymes used in gene cloning-Restriction enzymes, Ligases, Polymerases.
11. Gene cloning: Recombinant DNA, Bacterial Transformation and selection of recombinant clones, vectors- cloning vehicles (Plasmid, Cosmids, Bacteriophages, & Phasmids; Eukaryotic Vectors (YAC) Gene Construct; Applications of rDNA technology.

UNIT - IV

12. Gene Libraries: construction of genomic and cDNA libraries, colony hybridization; Probes-oligonucleotide, Polymerase Chain Reaction (PCR) and its applications.

13. Methods of gene transfer- Agrobacterium-mediated, Direct gene transfer by Electroporation, Microinjection, Microprojectile bombardment; Selection of transgenics-selectable marker and reporter genes.

14. Application of transgenics in improvement of crop productivity and quality traits. Pest resistant transgenic crops (Bt-cotton & Bt-brinjal); herbicide resistant plants (Roundup Ready soybean); crops with quality traits (FlavrSavr tomato, Golden rice).

B.Sc. BOTANY III Year - SEMESTER-VI

Paper-2B: Tissue Culture and Biotechnology Practical

(DSE-2 ELECTIVE)

Major Experiments

1. Isolation of plant DNA. (Tomato)
2. Production of synthetic seeds /Encapsulation of embryo
3. Preparation of plant tissue culture medium - MS medium
4. Isolation of protoplasts.

Minor Experiments

1. Callus induction
2. Demonstration of Micropropagation/multiple shoots
3. Anther culture
4. PCR –Demonstration
5. Study of biotechnology products: Samples of antibiotics and vaccines
6. Photographs of Gene transfer methods.
7. Instruments used in Biotechnology lab- Autoclave, Laminar air flow, Hot air oven and Incubator.
8. Demonstration of In-vitro sterilization and inoculation methods using leaf and nodal explants of tobacco, Datura, Brassica etc.

Spotting

1. Study of anther, embryo and endosperm culture, micropropagation, somatic embryogenesis & artificial seeds through photographs.
2. Study of methods of gene transfer through photographs: Agrobacterium-mediated, direct gene transfer by electroporation, microinjection, microprojectile bombardment.
3. Study of steps of genetic engineering for production of Bt cotton, Golden rice, FlavrSavr tomato through photographs.
4. Restriction digestion and gel electrophoresis of plasmid DNA.
