MAHATMA GANDHI UNIVERSITY

B.Sc. BOTANY PROGRAMME

Semester VI Course 9 BO6B09U

PLANT PHYSIOLOGY AND BIOCHEMISTRY

(Theory 54: hours; Practical : 45 hours) (Theory Credit 2, Practical Credit 2)

Course objectives

1. Understand the basic principles related to various physiological functions in plant life.
2. Familiarize with the basic skills and techniques related to plant physiology.
3. Understand the role, structure and importance of the bio molecules associated with plant life.
4. Familiarize with the recent trends in the field of plant physiology.
5. Familiarize with applied aspects of plant physiology in other fields like agriculture.

PLANT PHYSIOLOGY (Theory 36: hours; Practical : 33 hours)

MODULE -I 6 hours

Water relations

A. Physical aspects of absorption-Diffusion, imbibition, osmosis, OP, DPD, TP, WP, Concept of Water potential, matrix potential, pressure potential.

B. Absorption of water-active & passive, Ascent of sap-cohesion adhesion theory, Transpiration-types-mechanism-theories-(starch-sugar, proton-K+ion exchange)-significance – antitranspirants, Guttation.

MODULE II 3hours

Mineral Nutrition and mechanism of absorbtion.

Essential and non essential elements- macro& micro- role- deficiency symptoms.

Absorption of minerals– active & passive-ion exchange, carrier concept.

MODULE III 10 hours

Photosynthesis

History - Photosynthetic pigments, photo exitation- Fluorescence, Phosphorescence - Absorbtion and action spectra, Red drop and Emerson enhancement effect, Concept of photo systems, Cyclic & Non Cyclic photophosphorylation, Carbon assimilation pathways- C_3, C4, CAM- Photorespiration –factors affecting photosynthesis.

MODULE - IV 2 hours

Translocation of solutes

Pathway-phloem transport-mechanism-pressure flow-phloem loading and unloading.

MODULE – V 8 hours

Respiration

Aerobic and Anaerobic, Glycolysis, Krebs cycle, Electron transport system & Oxidative phosphorylations, ATPases - chemi osmotic hypothesis-RQ –significance-factors affecting respiration.

MODULE – VI 1hour

Plant responses to environment

Allelochemicals- herbivory

MODULE – VII 4hours

Physiology of growth and development

A. Physiological effects and practical application of hormones-Auxins, Giberillins, Cytokinins, ABA, ethylene.
B. Physiology of flowering–phytochrome-photoperiodism-vernalisation

MODULE – IX 2 hours

Stress physiology

Abiotic-concept of plant responses to water, salt and temperature stresses-Biotic- pathogens

BIO-CHEMISTRY (Theory 18: hours; Practical : 12 hours)

MODULE - I 2 hours

Water, Solutions & pH

Physical and chemical properties of water, Acid and bases, pH definition, significance, measurement, pH indicators, buffer action, pH and lif .

MODULE – II 10 hours

Chemistry of biological molecules

Carbohydrates- structure and role of mono-di & poly-saccharides-common sugars seen in plants

Proteins-peptide bond-essential and non essential amino acids-primary structure-physiologically important proteins.

lipids - general features and their roles - fatty acid types and structure - fatty acid derivatives- fats and oils, structure and functions - compound lipids

MODULE – III

Enzymes 6 hours

Nomenclature, characteristics mechanism and regulation of enzyme action, enzyme kinetics, factors affecting enzyme action.

Plant physiology Practical (33 hours)

Core Experiments

1. Determination of osmotic pressure of plant cell sap by plasmolytic method.
2. Compare the stomatal indices of hydrophytes, xerophytes and mesophytes.
3. Separation of plant pigments by thin layer chromatography (TLC) and paper chromatography.
4. Measurement of photosynthesis by Willmott's bubbler/any suitable method.
5. Estimation of plant pigments by colorimeter.

Demonstration only- experiments.

1. Papaya petiole osmoscope.
2. Demonstration of tissue tension.
3. Relation between transpiration and absorption.

4. Necessity of chlorophyll, light and CO_2 in phytosynthesis.
5. Simple respiroscope
6. Respirometer and measurement of R.Q.
7. Fermentation.
8. Measurement of transpiration rate using Ganong's photometer/ Farmer's Potometer.

Biochemistry – Practical. 12 hours

1. General test for carbohydrates- Molischs test, Benedicts's tests, Fehling's test.
2. Colour test for starch – lodine test.
3. Colour tests for proteins in solution. Biuret test, Million's test, Ninhydrin test.
4. Detect the presence of any three major organic compounds in the given food stuff/material viz. reducing /non-reducing sugar/fat proteins/starch.sucrose.
5. Action of various enzymes in plant tissues: peroxides, dehydrogenase.
6. Estimation of protein using colorimeter.

Suggested additional topics

1. Mycorrihzae
2. Chelating agents
3. Photosynthetic rates, efficiencies and crop production.
4. Pentose phosphate pathway.
5. Nitrogen fixation.
6. Plant protective coats –cutins ,waxes and suberin.
7. Senescence and abscission.
8. Circadian rhythms.

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MAHATMA GANDHI UNIVERSITY

B.Sc. BOTANY PROGRAMME

Semester VI Course 10 BO6B010U

BRYOLOGY, PTERIDOLOGY, GYMNOSPERMS & PALEOBOTANY

(Theory: 54 hours ;Practical :45 hours) (Theory Credit 3, Practical Credit1)

Course objectives

1. Understand the diversity in habits, habitats and organization of various groups of plants.
2. Understand the evolutionary trends in plants.
3. Identify the anatomical variations in lower groups of plants.
4. Understand the significance of Paleobotany.

BRYOLOGY (Theory: 16 hours ;Practical :15 hours)

Module 1 2 hours

Introduction, general characters, classification, Evolution of Bryophytes.

Module 2 12 hours

Morphology, anatomy and reproduction in *Riccia, Marchantia, Anthoceros* and *Funaria.*

Evolution of sporophyte and gametophyte (Development of sex organs not necessary).

Module 3 2 hours

Importance of Bryophytes, Prevention of soil erosion, pollution monitoring and control, Antibiotics, Horticultural importance.

Practical 15 hours

Make micro preparations of the types mentioned. Study vegetative and reproductive structures.

PTERIDOLOGY (Theory:16 hours ; Practical :18 hours)

Module 1 2 hours

Introduction, general characters, classification, evolution of Pteridophytes.

Module 2 14 hours

Structural organization of sporophyte and gametophyte (devt. of sex organs not necessary) of the following types with special reference to stelar structure, heterospory and seed habit.

1. *Psilotum*
2. *Lycopodium*
3. *Selaginella*
4. *Equisetum*
5. *Pteris*
6. *Marsilea*

Practicals 18 hours

Make micropreparations to study stelar structure and sporangia of the mentioned types.

Identify at sight, noting the morphology.

GYMNOSPERMS (Theory: 14 hours ; Practical :12 hours)

Module 1 2 hours

Introduction, general characters, classification, origin and evolutionary significance

Module 2 12 hours

Study of morphology, anatomy and reproductive features of *Cycas, Pinus* and *Gnetum.*

Practical 12 hours

Study of the morphology, anatomy and reproductive structures of the types mentioned.

PALAEOBOTANY (Theory: 8 hours)

Module 1 3 hours

Introduction, Study of geological time scale, formation of fossil, fossil types & technique of study, fossil as a fuel.

Module 2 4 hours

Detailed study of
Fossil Pteridophyte : *Rhynia*
Fossil Gymnosperm: *Williamsonia*
Fossil Angiosperm : *Palmoxylon*

Indian contribution to Palaeobotany 1 hour

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MAHATMA GANDHI UNIVERSITY

B.Sc. BOTANY PROGRAMME

Semester VI **Course 11** **BO6B011U**

ANGIOSPERM MORPHOLOGY,

SYSTEMATIC BOTANY AND ECONOMIC BOTANY

(Theory 54 hours; Practical : 45 hours) **(Theory Credit 3, Practical Credit1)**

Course objectives:-

1. Acquaint with the aims, objectives and significance of taxonomy.
2. Identify the common species of plants growing in Kerala and their systematic position.
3. Develop inductive and deductive reasoning ability.
4. Acquaint with the basic technique in the preparation of herbarium.
5. Familiarizing with the plants having immense economic importance.

Module-1. **(Theory 6 hours; Practical : 6 hours)**

Morphology .

Unit 1 Leaf Morphology (types, venation, phyllotaxy),

Unit 2 Morphology of flower

1. Parts of a flower- description of flower and it's parts in technical terms.
2. Flower as modified shoot.
3. Types of flower – Hypogyny, Perigyny and Epigyny, Symmetry of flowers.
4. Aestivation types.
5. Placentation types.
6. Floral Diagram and Floral Formula.

Unit 2

1. Inflorescence:-
   (a) Racemose types-Simple Raceme, Corymb, Umbel, Spike, Spadix and Head.
   (b) Cymose types-Simple Cyme, Monochasial- Scorpoid and Helicoid, Dichasial
   (c) Special type- Cyathium, Hypanthodium

2. Fruits: – Simple-Fleshy, Dry- dehiscent, indehiscent, Aggregate, Multiple(Sorosis and Syconus)

Module- 2. **(Theory 40 hours)**

Systematic Botany

Unit 1 Aim, Scope and Significance 1 **hour**

Unit 2. Types of Classification- Artificial (Brief account), Natural – Bentham and Hooker(Detailed account) and Phylogenetic (Brief account) **3 hours**

Unit 3. Binomial Nomenclature, ICBN- Brief account 1 **hour**

Unit 4. Interdiciplinary approach in Taxonomy- Cytotaxonomy and Chemotaxonomy. 1**hour**

Unit 5. Herbarium technique- Preparation of herbarium, their preservation. Important herbaria, Botanical Gardens and BSI. 2 **hours**

Unit 6. Family studies: - 32 **hours**

Study the following families of Bentham and Hooker's System with special reference to their morphological and floral characters. Special attention should be given to common and economically important plants within the families

Annonaceae, Nymphaeaceae,Malvaceae, Sterculiaceae, Rutaceae, Meliaceae, Anacardiaceae, Leguminosae (Mimosaceae, Caesalpiniaceae and Fabaceae), Combretaceae, Myrtaceae, Cucurbitaceae, Apiaceae, Rubiaceae, Compositae (Asteraceae), Sapotaceae,Apocynaceae, Asclepiadaceae, Solanaceae, Convolvulaceae, Scrophulariaceae, Acanthaceae, Verbenaceae, Lamiaceae (Labiatae), Amaranthaceae, Euphorbiaceae, Orchidaceae, Liliaceae, Arecaceae, Graminae (Poaceae)

Module- 3 **(Theory 8 hours)**

Economic botany

6 hours

Unit 1. Study of the following groups of plants based on their uses with special reference to the botanical name, family and morphology of the useful part

Cereals- Rice, Wheat
Millets- Ragi
Pulses- Green gram, Bengal gram, Black gram
Sugar yielding plants – Sugarcane
Fruits:- Apple, Pineapple, Orange, Mango and Banana
Vegetables:- Bittergourd, Ladies finger, Carrot and Cabbage.
Timber yielding plants:- Teak wood and Jack wood
Beverages- Tea, Coffee
Fibre yielding plants- Coir, Jute, Cotton
Oil yielding plants- Ground nut, Gingelly
Rubber yielding plants- Para rubber
Gums and Resins- White damer, Gum Arabic, Asafoetida
Spices – Cardamom, Pepper, Cloves , Ginger
Insecticide yielding Plants- Tobacco and Neem

Unit 2. Ethnobotany and it's significance. 2 hours.

Study of the following plants used in daily life by tribals and village folks for Food, Shelter and Medicine

Food :- *Artocarpus, Corypha, Phoenix*
Shelter - *Bamboosa, Ochlandra and Calamus*
Medicine - *Curcuma, Trichopus zeylanicus and Alpinia galangal*

Practicals 45 hours.

1. Identify the following inflorescence and fruits:-
   (a) Inflorescence - Simple raceme, Spike, Corymb, Head, Dichasial cyme and Cyathium.
   (b) Fruits - Simple: - Nut, Legume, Berry and Drupe Multiple and Aggregate
2. Preparation of floral formula from floral description.
3. Identify the families mentioned in the syllabus by noting their key, vegetative and floral characters.
4. Students must describe the floral parts, draw the L.S., floral diagram and write the floral formula of at least one flower from each family.
5. Study the finished products of plants mentioned in the syllabus of economic botany with special reference to the morphology, botanical name and family.
6. Prepare herbarium of 25 plants with field notes.
7. Conduct field work for a minimum of 5 days under the guidance of a teacher
8. Identify and describe the ethnobotanical uses of the items mentioned in the syllabus.

Suggested additional topics

1. Interdisciplinary approach in Taxonomy, Molecular taxonomy, Numerical taxonomy, Barcoding for species identification and Taxonomy for biodiversity characterization.
2. Binomial nomenclature- Historical account, ICBN, Principles and major rules in – Type concept, priority, valid publication, author citation.

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MAHATMA GANDHI UNIVERSITY

B.Sc. BOTANY PROGRAMME

Semester VI Course 12 BO6B012

BIOTECHNOLOGY AND BIOINFORMATICS

(Theory 54 hours; Practical : 45hours) (Theory Credit 3, Practical Credit1)

COURSE OBJECTIVES

1. Familiarize with the fundamental principles of biotechnology, various developments in biotechnology and potential applications.
2. Make aware that the life forms and activities can be exploited for human advancement.
3. Impart an introductory knowledge about bio informatics to the students.
4. Use of computers to handle biological data base.

BIOTECHNOLOGY (Theory 36 hours ; Practical 26 hours)

Module-1 10 hours

1. Introduction – The concept of biotechnology, landmarks in biotechnology.

2. Plant tissue culture – Principles and techniques.
   Cellular totipotency, *in vitro* differentiation –de differentiation and re-differentiation , callus induction, organogenesis and somatic embryogenesis.
3. Tissue culture medium – Basic components in tissue culture medium – Solid and liquid medium – suspension culture. Murashige and Skoog medium – composition and preparation. Aseptic techniques in tissue culture – sterilization – different methods – sterilization of instruments and glass wares, medium, explants; working principle of laminar air flow and autoclave; preparation of explants – surface sterilization. Inoculation, incubation, subculturing.
4. Micropropagation - Different methods – axillary bud proliferation, direct and indirect organogenesis and somatic embryogenesis. Different phases of micropropagation – hardening, transplantation and field evaluation Advantages and disadvantages of micropropogation. Somaclonal variation.

Module – 2 *10* ***hours***

1. *Methods and Applications* of tissue culture - Shoot tip and meristem culure Synthetic seed production, embryo culture, I*n vitro* mutagenesis, Protoplast isolation culture and regeneration – transformation and transgenics, Somatic cell hybridization- cybrids. I*n vitro* secondary metabolite production — cell

immobilization, bioreactors *In vitro* production of haploids – anther and pollen culture, *In vitro* preservation of germplasm.

Module – 3 8 hours

Recombinant DNA Technology

Gene cloning strategies – recombinant DNA construction – cloning vectors – plasmids pBR322, bacteriophage based vectors, Ti plasmids. Restriction endonucleases and ligases – Ligation techniques, transformation and selection of transformants – using antibiotic resistances markers, southern blotting; PCR.

Different methods of gene transfer – chemically stimulated DNA uptake by protoplast, transduction, electroporation, microinjection, microprojectiles, *Agrobacterium* mediated gene transfer gene library ,gene banks.

Module – 4 **3 hours**

Application of Biotechnology in :

Medicine - Production of human insulin, human growth hormone and vaccines, gene therapy, monoclonal antibodies, biopharming.

Forensics - DNA finger printing.

Agriculture - Genetically modified crops – Bt crops, Golden rice, Flavr Savr Tomato, Virus herbicide resistant crops, Edible vaccines.

Environment - Bioremediation- use of genetically engineered bacteria- super bug.

Industry - Horticulture and Floriculture Industry, production of vitamins, amino acids and alcohol.

Module – 5 **3 hours**

Scope and relevance of the following technologies(Methodology not required) Microbial biotechnology, Tissue Engineering technology, Embryonic stem cell culture, animal cloning, Micro array technology, Bionanotechnology.

Module-6 **2 hours**

Social and ethical issues, biosafety , biowar, patenting and IPR issues.

PRACTICALS 32 hours

1. Preparation of nutrient medium – Murashige and Skoog medium, sterilization, preparation of explants, inoculation.
2. Extraction of DNA from plant tissue.
3. Immobilization of whole cells or tissues in sodium alginate.
4. Determination of appropriate flower bud containing uninucleate pollen for anther culture using cytological techniques
5. Study of genetic engineering tools and techniques using photographs/diagram (Southern blotting, DNA finger printing, PCR,)
6. Visit a well equipped biotechnology lab and submit a report along with the practical record.

BIOINFORMATICS (Theory : 18 hours ; Practical : 10 hours)

Module-1 **7 hours**

1. Introduction to Bioinformatics, scope and relevance, genome, transcriptome, proteome.
2. Biological data bases –
   Nucleotide sequence database – EMBL, Gen Bank, DDBJ.
   Protein sequence database – PDB, SWISS PROT
   Organismal database – *Saccharomyces* genome database
   Biodiversity database – Species 2000
3. Information retrieval from Biological database, sequence alignment types and tools: pair wise sequence alignment multiple sequence alignment, use of BLAST, FASTA.

Module-2 **6 hours**

1. Genomics : DNA sequencing Sangers procedure-automation of DNA sequencing, genome sequence assembly, Genome projects – Major findings of the following genome projects – Human, *Arabidopsis thaliana*, Rice, *Haemophilus influenza*, Application of genome projects.
2. Proteomics : Protein sequencing- Edman degradation method, automation of sequencing, protein structure prediction and modelling (Brief account only)

Module-3 **5 hours**

A brief account on

1. Molecular phylogeny and phylogenetic trees.
2. Molecular visualization – use of Rasmol.
3. Molecular docking and computer aided drug design.

PRACTICALS **13 hours**

1. Familiarizing with the different data bank mentioned in the syllabus.
2. Molecular visualization using Rasmol.
3. Blast search.

Suggested additional topics

Tissue culture and crop improvement, Genetic transformation and transgenics, Advances in crop biotechnology molecular markers-molecular biology tools in plant breeding, Gene and genome library, Terminator technology, Advances in microbial biotechnology, enzyme technology, Advances in animal biotechnology-stem cell research. Micro array Bioinformatics.

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