Mahatma Gandhi University
B.Sc Botany Programme

SEMESTER I **Course 1** **BO1B01U**

Methodology and Perspectives of Science
&
An Introduction to the World of Plant Diversity

(Theory 36 hours, Practical 36 hours) **(Theory Credit 2, Practical credit 1)**

Methodology and Perspectives of Science *(Theory 18hours, Practical 18 hours)*

Module 1. **8 hours**

Introduction to science and scientific methods

-Introduction to science

-Steps in scientific methods

- observation and thoughts
- formulation of a hypothesis
- designing of experiments
- testing of hypothesis
- formulation of theories
- Revision of scientific theories with the advent of new technologies

Module 2. **10 hours**

Experimentation in science

- Selection of a problem
- Searching the literature
- Selection of variables, study area, and a suitable design
- Necessity of units and dimensions

  Units of length, volume, area, concentration, temperature, pressure
- Setting of hypothesis, Null- hypothesis and alternative hypothesis
- Need of control, treatments and replication
- Analysis, presentation and interpretation of data
- Testing of hypothesis, need of statistical tools (study of specific tools is not required)
- Examples of great experiments in life sciences

- An example of moving from a question to hypothesis and then to an experimental design
- Contributions and the great experiments of Louis Pasteur, and Robert Koch

-Ethics in science

Practical **18 hours**

1. Design and perform a simple experiment to familiarize with the methodology of science
2. Select an important classical experiment and find out the different elements of scientific method
3. Prepare a biographical sketch of great scientists with special emphasis on the scientific methodology involved in their experiments
4. Prepare $CuSO_4$. H_2O solution of different molarity using a stock solution
5. Determination of the area of different types of leaves using graph paper

An Introduction to the World of Plant Diversity **(Theory 18 hours, Practical 18 hours)**

Module 1 **3 hours**

- Plants, their uniqueness and importance as
  - Primary producers
  - Source of oxygen
  - Source of materials for food and shelter
  - Medicines and other compounds derived from plants
  - Source of fuel (fossil fuel, biofuel)
  - Recreational value

  (a brief account with examples alone is required)

Module 2. **3 hours**

Unity of living organisms

Unity in,

- Cellular organization
- Cell structure
- Metabolism
- Genetics
- Cell division
- Sexual reproduction (Only a preliminary study about the unity of different live forms in the above mentioned aspects alone is required)

Module 3. **12 hours**

1. Diversity of living organisms [No type study is expected)

- **Prokaryotes**
  - Bacteria – general characteristics, variation in form (bacillus, coccus, vibrio, spirillum)
  - Cyanobacteria / BGA (No type study is intented) – general characteristics, pigments in Cyanobacteria, variation in form
- **Eukaryotes**
  - Eichler's Classification
  - **Cryptogams**

-Algae:-

- General characteristics
- Diversity in thallus morphology (Unicellular, colonial, unbranched filamentous, branched filamentous)
- Diversity in pigments (Pigments characteristic of Chlorophyceae, Rhodophyceae and Phaeophyceae)

- Fungi

General characteristics

- Diversity in thallus morphology (unicellular forms, aseptate and septate hyphal forms)

- Lichens

General characteristics

- Diversity in thallus morphology (crustose, foliose and fruticose forms)

- Bryophytes
  - General characteristics
  - Diversity in thallus morphology
  - Alternation of generation, prominence of gametophyte
  - Concept of embryo

-Pteridophytes

- General characteristics
- Diversity in morphology
- Concept of vasculature (study of different types of steles is not required)
- Alternation of generation, prominence of sporophyte

-Phanerogams

-Gymnosperms

- General characteristics
- Diversity in morphology
- As the first plant group exhibiting seed habit, advantages of seed
- Special structures which contributed to the development of seed (ovule, integuments of ovule, endosperm)

-Angiosperms

- General characteristics
- Diversity in morphology (dicots, monocots, herbs, shrubs, trees, climbers, twiners, branched, unbranched)
- Concept of fruit, advantages of fruit
- Special structures which contributed to the development of fruit (ovary, placenta)

-**Animals**

- Major differences between plants and animals
  (Detailed study of different classes not required)

- **Habitat Diversity** (Brief study only)
  - Aquatic:- Fresh water, marine, mangrove
  - Terrestrial:- Evergreen forest, deciduous forest, grass land
  - Epiphytic
- **Evolutionary trends in the plant world** (shift in habitat from aquatic to terrestrial, shift in prominence of gametophyte to sporophyte, shift from thalloid forms to differentiated forms, evolution of conducting tissue; tracheids to vessels, origin of seed and fruit)
- Interactions in the plant world. Examples of,
  - Plant – plant interactions (Brief account of Parasitic plants and epiphytes)
  - Plant – microbe interactions (Brief account of root nodules and Micorrhiza)
  - Plant – animal interactions (Brief account of Leaf and stem galls and mermicophylly)

Practical **18 hours**

1. Collect, identify, record and submit 3 genera each from algae, fungi, bryophytes, pteridophytes, gymnosperms and angiosperms. Use appropriate preservation techniques.
2. Study and submit a report on any one of the interactions observed in the plant world
3. Conduct a field visit to any one of the ecosystems/ botanic gardens to experience the plant diversity. Submit a report with photographs.

4. From a lot of given materials identify a particular plant group
5. From a lot of given materials identify plants with vascular elements, plants which can produce seeds, fruits, embryos

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Mahatma Gandhi University
B. Sc Botany Programme

SEMESTER II **Course 2** **BO2B02U**

General Informatics and Methodologies in Plant Sciences

A. General Informatics

(Theory 36 hours, Practical 36 hours) **(Theory Credit 2, Practical credit 1)**

General Informatics (Theory 18 hours, Practical 18 hours)

Module 1.

Overview of the information technology **3 hours**

-Features of the modern personal computers and peripherals.

-Internet as a knowledge repository, e-mail, search engines (Google,), study of educational sites related to life sciences (DNAi, Scitable) , academic search techniques,(Science direct and INFLIBNET)

-Introduction to the use of information technology in teaching and learning

Module 2.

Use of computers **15 hours**

-DOS – The basic concept of operating systems (Study of commands not required)

-MS-WINDOWS:- logging to windows, organizing files and folders, copying, moving, deleting and saving documents, installing software, installing hardware

-MS-WORD:- word processing using WORD, editing tools (cut , copy, paste,) formatting tools (font, paragraph) use of spell check, inserting tables (draw), inserting graphs and pictures

-MS-EXCEI:- Creating a worksheet, data entry, sorting (ascending and descending), use of statistical tools in EXCEL (SUM, MEAN, MODE, MEDIAN), preparation of graphs (bar diagram, pie chart and line graph)

-MS-POWERPOINT:- Creating a presentation, Inserting tables, charts and pictures into slides, Use of animation tools

Practicals **18 hours**

1. Gather information and pictures on a given topic using the internet. Make a list of the sites visited for the purpose
2. Prepare a project report using MS-WORD based on the information and pictures gathered from the internet.
3. Prepare a worksheet using a set of data collected and find out the SUM, MEAN, MEDIAN and MODE using EXCEL
4. Prepare suitable tables/ charts/graphs based on the data using EXCEL
5. Prepare a powerpoint presentation based on the 1& 2 exercises

B. Methodologies of Plant Science (Theory 18 hours, Practical 18 hours)

Module 1.

Microtechnique **6 hours**

- Introduction
- Microscopy:- simple, compound, phase contrast, fluorescent, confocal and electron microscopes (working principle and application only)
- Microtome:- rotary, sledge (application only)
- Killing and fixing :- Purpose,

  Agents used:-

  Killing agents – Formalin, Ethyl alcohol

  Fixing agents - Carnoy's fluid, Farmers' fluid, FAA
- Dehydration:- Purpose, Agent used – Ethyl alcohol
- Sectioning:- Hand sections, microtomy
- Staining technique:- Principle of staining

  Stains:- Safranin, Hematoxylin, Acetocarmine

  Vital stains: Purpose , Examples: Neutral red and Evan's blue

  Mordents : Purpose and examples

  Single staining and Double staining
- Mounting and Mounting Media, Purpose of mounting media , Glycerin, DPX, Canada balsam
- Use of permanent whole mounts, permanent sections
- Maceration
- Smear and squash preparation

Practicals **2 hours**

1. Maceration and identification of tracheary elements

Module 2

Biophysics **3 hours**

- Principles and applications of colorimeter, spectrophotometer and centrifuge, Beer-Lambert's Law,
- Separation methods :- chromatography ; thin layer , paper, column (principle and applications only) , electrophoresis ; PAGE, Agarose gel electrophoresis(Principle and applications only)
- pH:- concept of pH, methods to measure pH ; pH paper and pH meter,
- Buffers:- definition, functions of buffers in biological systems, use of buffers in biological research, examples of commonly used buffers

Practicals **6 hours**

1. Preparation of 0.1M sodium phosphate buffer (pH 6 and 7)
2. Measurement of pH using pH meter
3. Paper chromatography of plant pigments (demonstration)
4. Electrophoresis of nucleic acids (demonstration)
5. Column chromatography of plant pigments (demonstration)
6. Determination of the concentration of a given solution of $CuSO_4$ using colorimetry

Module 3

Biostatistics **8 hours**

- Introduction, statistical terms and symbols
- Sample:- concept of sample, sampling methods,
- Collection and representation of data, graphic representation of data(Line graph, bar diagram, Pie diagram & Histogram)
- Measures of central tendency:- mean, mode, median
- Measures of dispersion:- standard deviation, standard error
- Distribution patterns:- normal distribution, binomial distribution
- t-test :- introduction, uses, procedure
- chi-squire test:- introduction, uses, procedure

Practicals **10 hours**

1. Collect numerical data and find out the central tendencies and prepare different types of graph mentioned in the syllabus
2. Familiarize with situations requiring t-test, chi-squire test

Module 4

Research Methodology **1 Hour**

- Need for research
- Types of research
- Scientific literature, Books, Research Journals, Reputed National and International journals in life sciences, Research paper
- INSDOC services
- Laboratory Etiquette
- Laboratory Hygiene

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MAHATMA GANDHI UNIVERSITY

B.Sc. BOTANY PROGRAMME

Semester III Course-3 BO3B03U

ANATOMY AND REPRODUCTIVE BOTANY OF ANGIOSPERMS

(Theory: 54 hours; Practical: 36 hours) (Theory Credit 3, Practical Credit1)

Course Objectives

1. This course aims to impart an insight into the internal structure and reproduction of the most evolved group of plants, the Angiosperm.
2. Identifies role of anatomy in solving taxonomic and phylogenetic problems.
3. Understand the structural adaptations in plants growing in different environment.
4. Understand the life cycle pattern of Angiosperms.
5. Understand the morphology and development of reproductive parts.
6. Get an insight in to the fruit and seed development.

ANATOMY (Theory: 36 hours. Practical: 27 hours,)

Module-1

2 hours

Scope and importance of Plant Anatomy

Interdisciplinary applications: - Histotaxonomy, Histochemistry, Pharmacognosy, Physiological Anatomy, Ecological Anatomy, Evolutionary trends in plant anatomy

Module -2 6 hours

Study of Cell wall: Gross structure of primary and secondary cell walls, simple and bordered pits. Structure and function of plasmodesmata.

Submicroscopic structure of cell wall- Cellulose, micelle, micro fibril and macro fibril.

Different types of Cell wall thickening in tracheary elements

Extra cell wall thickening materials: - Lignin, cutin, suberin and callose.

Origin of cell wall; Growth of Cell wall- Apposition and intussusceptions – cavities & ducts, schizogenous & lysigenous developments

Non living inclusions in plant cell: - Reserve food materials -carbohydrate (starch), protein (Aleurone grain) and lipids (fats and oil);

Secretory products- pigments, enzymes and nectar.

Metabolic byproducts: - tannin, gums, resins, essential oils, mucilage, latex, mineral crystals and alkaloids

Module-3 7 hours

Tissues

Meristematic tissue- definition, structure, function and classification

Apical organization and theories; Shoot apex- Apical cell theory, Histogen theory and Tunica-Corpus theory.

Root apex - Histogen theory and Korper-Kappe theory.

Permanent Tissue: - Structure and function of simple and complex tissues.

Distribution and function of mechanical tissues in plants.

Plant fibres-economic importance.

Secretory tissues: - a). External secretory tissue- glands and nectaries, b). Internal secretory tissues- laticifers.

Module-4 7 hours

Tissue System- Structure and Function in root, stem and leaves.

a) Epidermal Tissue System- Epidermis, Cuticle, Trichome, Stomata, Bulliform cells, Cork and Silica cells.

b) Ground Tissue System- Cortex, Endodermis, Pericycle, Pith and Pith rays.

c) Vascular Tissue System- Different types of vascular bundles and their arrangement in root and stem

Nodal anatomy- Leaf Trace, Leaf gap, Branch trace and Branch gap.

Module-5. 3 hours

Vascular cambium: - Development, structure and function, Activity of cambium, role of cambium in budding, grafting and wound healing.

Module-6. 8 hours

Normal secondary growth in dicot stem and root.

Wood anatomy- basic structure, heart wood, sap wood, hard wood, soft wood, growth rings and dendrochronology, porous and non porous wood, ring porous and diffuse porous wood, tyloses, knots.

Wood rays: Structure and cell types, uniseriate and multiseriate rays; heterocellular and homocellular rays.

Reaction wood- Tension wood and compression wood.

Properties, defects and seasoning of wood.

Stem thickening in monocots.

Periderm: Structure and development- phellum, phellogen, phelloderm, bark, polyderm, rhytidome and lenticel.

Module-7. 3 hours.

Anomalous secondary structure: *Bougainvillea* stem, *Bignonia* stem and *Dracaena* stem.

Practicals 27 hours

1. Cell types and tissues.
2. Non living inclusions – starch grains, cystolith, raphides, aleurone grains.
3. Primary structure of stem root and leaf-Dicots and Monocots.
4. Stomatal types: - anomocytic, anisocytic, paracytic, diacytic and grass type.
5. Secondary structure of dicot stem and root.
6. Anomalous secondary structure of *Bougainvillea* stem, *Bignonia* stem and *Dracaena* stem.

Reproductive Botany (Theory-18 hrs. Practical -9 hrs,)

Module-1 2 hours

Introduction: - General account and interdisciplinary relevance of embryology , embryology in relation to taxonomy; experimental embryology.

Module-2 2 hours

Life cycle of Angiosperms.

Floral morphology- parts of flower; androecium-morphology and types of anthers; gynoecium- morphology and types of carpel and types of placentation.

Module-3 4 hours

Structure and development of anther, microsporogenesis, development of male gametophyte, dehiscence of anther, structure of pollen, pollen germination, pollen tube growth and pollen viability.

Module-4 3 hours

Structure and development of ovule, megasporogenesis, embryosacs-monosporic (polygonum type), bisporic (Allium type) and tetrasporic (Peperomia type). Structure of mature embryo sac.

Module-5 3 hours

Pollination mechanisms and agencies of pollination; pollen stigma interaction; compatibility and incompatibility; syngamy and fusion; apomixis.

Module-6 4 hours

Development of endosperm and embryo in Dicots and Monocots; Polyembryony; Development and general structure of fruits(dry and fleshy) and seed.

Practicals 9 hours

1. Identification of C.S. of anther, embryo sac and embryo.
2. Identification of various anther types-monothecous, dithecous
3. Identification of placentation types.
4. Observation of pollen and locating pollen pore
5. Pollen germination study

Suggested Additional Topics

Applied Anatomy: Wood anatomy and identification of wood;
Wood fibres and Economic uses, Food fibers
Internal Structure of fruits, seeds and vegetables.
Cellulose fibre source and use in paper industry- Pulp and paper manufacture.
Fruit and leaf abscission
Electron microscopic structure of plant parts and their application in different branches of plant science

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MAHATMA GANDHI UNIVERSITY

B.Sc. BOTANY PROGRAMME

Semester IV Course-4 BO4B04U

MICROBIOLOGY AND PHYCOLOGY

(Theory: 54 hours; Practical: 36) (Theory Credit 3, Practical Credit1)

Course objectives

Enable the student to

1. Understand the world of microbes
2. Understand the identifying characters of the lower groups of plants
3. Have an idea on diverse groups of plants
4. Understand the application of microbiology in different fields.

MICROBIOLOGY (Theory: 20hours; Practical: 12 hours)

Module 1 **1 hour**

Introduction, Scope of Microbiology

Module 2 8 **hours**

- Bacteria - Morphology and classification based on staining, morphology and flagellation
- Fine structure - cell wall - Peptido glycan- cytoplasm - Nucleoid, Flagella
- Reproduction- Binary fission
- Genetic recombination - Conjugation, transformation & transduction
- Archaebacteria, Mycoplasma - general characters

Module 3 6 **hours**

Virus- General composition and properties - Architecture of TMV, HIV and Bacteriophages ,Multiplication and transmission.

Module 4 5 **hours**

Applied Microbiology

1. Role in Nitrogen cycle.
2. Biofertilizers & Bio pesticides.
3. Biogas production.
4. Reconvertion of waste products.
5. Bioremediation.
6. Spoilage and preservation of food.
7. Antibiotics.
8. Production of Vinegar, curd, Yoghurt, single cell protein and Probiotics.
9. Bio reactors.

PRACTICAL 12 **hours**

Students are expected to do the following practical

1. Preparation of bacterial smear.
2. Grams staining.
3. Isolation of microbes from soil (Dilution plate method).

PHYCOLOGY (Theory: 34 hours ; Practical: 24 hours)

Module 1 **3 hours**

Introduction - General characters of algae. Classification (Fritsch F. E, 1935; 1945.

Module 2 **20 hours**

General characters of the following major groups with special reference to the structure , reproduction and life cycles of the following types.

a. Cyanophyceae: *Nostoc*

b. Chlorophyceae: *Chlamydomonas, Volvox, Spirogyra, Oedogonium*, *Cladophora, Chara*

c. Xanthophyceae: *Vaucheria*

d. Bacillariophyceae: *Pinnularia*

e. Phaeophyceae : *Sargassum*

f. Rhodophyceae :*Polysiphonia*

Module 3 **9 hours**

Economic importance

a. Algae as pollution indicator and in waste water treatment
b. Commercial products: Agar, Alginates, Carrageenin, Diatomaceous earth
c. Algae in soil fertility, Fertilizer, Nitrogen fixation, minerals, soil algae and symbiosis
d. Sources of food & medicine
e. Diatoms and nanotechnology
f. As a source of Hydrogen as fuel
g. Toxic algae – Algal blooms, red tides & fish poisoning
h. Algae as primary producers – Oxygen liberators
i. Cyanobacteria as a source of restriction endonuclease
j. Role of algae in aquaculture.

Module 4 2 hours

Algal culture: scope and methods

Praticals **24 hours**

1. Make micro preparation of vegetative and reproductive structures of the types mentioned in the syllabus.
2. Identify the algal specimens up to the generic level by noting their key characters.
3. Make labeled sketches of the specimens observed.

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websites

http://www.phycology.net/
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http://www.brphycsoc.org/ (the british phycological society)
http://www.intphycsoc.org/ (international phycological society)
http://www.isaseaweed.org/ (the international seeweed association)
http://botany.si.edu/projects/algae/
http://botany.si.edu/projects/algae/ (Smithsonian national museum of natural history

MAHATMA GANDHI UNIVERSITY

B.Sc. BOTANY PROGRAMME

Semester V Course-5 BO5B05U

MYCOLOGY, LICHENOLOGY AND PLANT PATHOLOGY

(Theory: 36 hours; Practical: 45 hours) (Theory Credit 2, Practical Credit 2)

Course Objectives

Enable the student to

1. Understand the diversity of fungal and lichen world and its significance.
2. Understand the various plant diseases and their impact on agriculture.
3. Familiarize with the various measures adopted to control plant diseases.

I MYCOLOGY **(Theory 24 hours; Practical : 36 hours)**

Module 1 15 **hours**

1. Introduction , structure, reproduction, life cycle, evolutionary trends. Classification based on Ainsworth (1973)
2. Distinguishing characters of different classes of fungi with special reference to reproductive structures and life history of the genera mentioned in each group

a) Myxomycotina – General Characters
b) Mastigomycotina – *Albugo*
c) Zygomycotina - *Rhizopus*
d) Ascomycotina
* Hemiascomycetes -- *Saccharomyces*
*Plectomycetes -- *Pencillium*
* Pyrenomycetes – *Xylaria*
* Discomycetes -- *Peziza*
e) Basidiomycotina
* Teliomycetes ---*Puccinia*
* Hymenomycetes—*Agaricus*
f) Deuteromycotina – *Fusarium*

Module 2 **7 hours**

1. Economic importance of Fungi –useful and harmful aspects.
2. Fungi of Agricultural importance –mycoherbicides, myconematicides , mycoparasites , Mycorrhiza –diversity , function and significance.
3. Fungal biotechnology- Fundamental principles.
   Mushrooms- edible and poisonous types.
   cultivation technique-Spawn production .
   Cultivation of Oyster mushroom.

II LICHENOLOGY **2 hours**

Module 1

General account , economic and ecological importance of lichen
Structure, reproduction and life cycle of *Parmelia.*

PRACTICALS 36 **hours**

1. Students are expected to identify the following types by making suitable microprepartions and make labeled sketches *Rhizopus , Albugo , Saccharomyces, Pencillium , Xylaria, Peziza, Puccinia, Fusarium and Parmelia.*
2. Isolation and culture of Oyster mushroom mycelium.
3. Preparation of bed for mushroom cultivation.
4. Staining of endomycorrhiza / fungus.
5. Isolation of fungus from dung, air ,fruits ,vegetables.
6. Slide culture technique of fungus.

III PLANT PATHOLOGY **(Theory 12 hours; Practical : 9 hours)**

Module 1 4 hours

History of plant pathology, Classification of plant diseases on the basis of causative organism and symptoms , Host parasite interaction , Defense mechanism in host ,Mechanism of infection, transmission and dissemination of diseases.

Module 2 2 hours

Control of plant diseases –

Prophylaxis-quarantine measures, seed certification

Therapeutic – physical therapy , chemotherapy.

Biological control.

Module 3 5 hours

Study of following diseases with emphasis on symptoms, disease cycle and control

Bunchy top of Banana.

Bacterial blight of Paddy.

Root wilt of Coconut.

Abnormal leaf fall of Rubber .

Fungicides - Bordeaux mixture, Tobacco Neem decotion, preparation. (Brief account only)

Module 4 1 hours

Medical mycology- Mention about fungal infections of man – Fungal allergens Athelet's foot, aspergillosis, candidiosis, aflatoxin

Practicals 9 hours

Students are expected to :

1. Identify the diseases mentioned in the syllabus with respect to causal organisms and symptoms
2. Submit herbarium preparations of various stages (3stages) of any one of the diseases mentioned.
3. Students should be trained to prepare the fungicide – Bordeaux mixture, Tobacco decotion .

Suggested Additional Topics

Fungal ecology- details of fungal decomposition of organic matter , coprophilous fungi, cellulolytic fungi, lignin degrading fungi ,details of wood decay. soil fungi Plant diseases, Role of enzymes in pathogenesis.

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MAHATMA GANDHI UNIVERSITY
B.Sc. BOTANY PROGRAMME
Semester V Course 6 BO5B06U
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, Lunularia, 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 V Course 7 BO5B07U

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)**

Floral morphology .

Unit 1

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 V Course 8 BO5B08U

CELL MOLECULAR BIOLOGY AND EVOLUTION

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

Objectives

1. Understand the Ultra structure and functioning of cell in the submicroscopic and molecular level.
2. Get an idea of origin, concept of continuity and complexity of life activities.
3. Familiarization of life process.
4. Understand the basic and scientific aspect of diversity.
5. Understand the cytological aspects of growth and development.
6. Understand DNA as the basis of heredity and variation.
7. Understand the concept of evolution as the basis of biodiversity.

Module – I

CELL BIOLOGY **28 hours**

Unit 1.Historical account of cell Biology 1 hours

Cell theory

Protoplasm theory

Unit 2.Cell 8 hours

The physio-chemical nature of plasma membrane and cytoplasm Eukaryotic, Prokaryotic cell.

The ultra structure of plant cell with brief description and function of the following organelles-Endoplasmic reticulum, Plastids, Mitochondria, Ribosomes, Dictyosome, Microbodies, lysosomes. Vacuole and cell sap, Nucleus - ultra structure, nucleolus structure and function.

Unit 3 Chromosomes 15 hours

Morphology - fine structure Dupraw model - Nucleosome model – chemical organization of nucleosome – nucleoproteins, karyotype and idiogram; Special type of chromosomes - salivary gland ,Lampbrush and B chromosome.Cell cycle, mitosis, meiosis: significanceof mitosis and meiosis.Change in number of chromosomes -Aneuploidy and Euploidy

Change in the structure of chromosomes - Chromosomal abberations deletion, duplication, inversions and translocations. Meiotic Behaviour of chromosomes.

Unit 4 Mutations 2 hours

Spontaneous and induced. Mutagens- Physical and Chemical mutagens. Chromosomal and point mutations. Molecular mechanism of mutation - Transition, Transvesion and Substitution.

Unit 5 Stem cells; definition, sources and applications. 2 hours

Module – II **17 hours**

MOLECULAR BIOLOGY

Unit1. Nucleic acids - structure of DNA and RNA - basic features, alternate forms of DNA - types and structure of RNA 3hrs.

unit2. Replication of DNA - Meselson-Stahl experiment - details of semiconservative replication of DNA 3 hrs.

unit3. Gene expression - concept of gene, definitions - the central dogma - details of transcription in procaryotes and eucaryotes - RNA prosessing.details of translation - genetic cod features 6hrs.

unit4. Control of gene expression - positive and negative control - operon model - lac operon, trp operon -attenuation 3hrs

unit5. Genetic basis of cancer - oncogenes - tumor suppressor genes - metastasis -2hrs

Module – III

EVOLUTION **9 hours**

Unit 1 Introduction, Progressive, Retrogressive, Parallel and Convergent evolution. Theories of evolution - Lamark's, Darwin's, Weisman's and De Vries. 4 hours

Unit 2 Neo Darwinism 5 hours

Reproductive isolation, Mutation, Genetic drift, Speciation. Variation and evolution, hybridization and evolution, Polyploidy and evolution. Mutation and evolution.

Practicals **45 hours**

1. Make acetocarmine squash preparation of onion root tip to identify mitotic stages.
2. Study the Mitotic Index of onion root tip cells
3. Study of meioses in any flower bud by smear preparation of PMC's
4. Identification of Barr body
5. PTC Testing
6. Identification of salivary gland chromosome.
7. Identify and study photographs and diagrams of cell division anomalies like lagging chromosomes, chr. bridge, aneuploidy, polyploidy. study the chromosomal patterns/ Karyotype in auto-, allo-, and aneuploids
8. Work out elementary problems based on DNA structure and replication

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MAHATMA GANDHI UNIVERSITY

B.Sc. BOTANY PROGRAMME

Semester VI Course 9 BO6B09

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 – Iodine 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

ENVIRONMENTAL SCIENCE AND ECOTOURISM

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

Course Objectives:

1. Acquaint the student with the significance of Environmental Science.
2. Help the students to understand the extent, limitations and depletion of natural resources
3. Help the student to design novel mechanism for the sustainable utilization of natural resources.
4. Enable the students to understand the structure and function of the Ecosystems
5. Make the students to identify the nature and interactions of populations in the ecosystem
6. Enable the students to understand various kinds of pollution in the environment, their impacts on the ecosystem and their control measures
7. Make the students aware about the nature and structure of various environmental laws in India
8. Make the students aware about the role of various movements in the protection of nature and natural resources.
9. Make the students aware about the extent of the total biodiversity and their conservation.
10. Make the students to assess the positive and negative impacts of Ecotourism and its role in the sustainable utilization of resources for tourism.

ENVIRONMENTAL SCIENCE **48 hours**

Module 1 **1 hour**

Environmental science and its multidisciplinary nature

Introduction, relevance and scope, public awareness

Module 2 **6 hours**

Natural Resources

- Types of resources-renewable and non renewable
- Forest resources: Timber extraction, mining, dams, over exploitation, deforestation, MFP (minor Forest products) , Joint Forest Management (JFM)
- Water resources: surface and ground water, drinking water, dams-benefits and problems, conflict over water, Rain water harvesting, Water shed conversation
- Food resources: major food crops in India. Causes of food shortage. Food security, world food problems.
- Energy resources: Energy plantation, - *Jatropha*
- Land resources: Land use, land degradation, desertification, EFL(Ecologically Fragile Land)

- Conservation of natural resources, ecological footprints

Module 3 — 10 hours

Ecosystems:

- Structure and function of ecosystem: Ecosystem components- abiotic and biotic, Productivity – primary and secondary-gross and net productivity. Decomposition in nature, homeostasis in ecosystem
- Ecological energetics: energy flow, trophic levels, food chain and food web, ecological pyramids
- Nutrient cycles: Biogeochemical cycles of C, N and S.

Module 4 — 4 hours

Community ecology

- Population: size, density, natality, mortality.
- Community characteristics: Species diversity and species richness, dominance, growth forms and structure, trophic structure.
- Association of communities: plant association, ecotypes, ecotone, edge effect, ecological indicators.
- Ecological succession: types of succession, process – migration, ecesis, colonization, stabilization and climax community; hydrosere, xerosere, lithosere.

Module 5 — 4 hours

Plants and environment

Ecological complexes and factors affecting plants growth and response:

- Climatic factors: temperature and pressure; water - precipitation, humidity, soil water holding capacity; light - global radiation.
- Topographic factors: altitude and aspects
- Edaphic factors - profile and physical and chemical properties of soil
- Biotic factors: interactions – positive and negative.

Species – ecosystem interaction: Habitat, ecological niche, microclimate

Adaptation of plants to environment: To Water- Xerophytes, Hydrophytes; Temperature – thermo periodicity, vernalization; light – photoperiodism, heliophytes, sciophytes; salinity – halophytes, mangroves.

Module 6

Environmental pollution and Management — **12 hours**

- Definition and general introduction
- Air pollution: Causes and sources, types of pollutants-particulates-aerosol, mist, dust, smoke, fume, plume, fog, smog. Effect of air pollution on plants and animals, Bhopal Gas Tragedy.
- Water pollution: Sources and types of pollutants. Water quality standards, water quality assessment. Ground water pollution-blue baby syndrome. Cycling of heavy metals, hydrocarbons. Eutrophication, BOD, Minamata disease.

- Soil pollution: Causes and sources-waste dumps, municipal wastes, agrochemicals, mining, solid waste management-vermi composting.
- Noise pollution: Sources, standards and measurements, effect on health, control techniques.
- Thermal pollution: Sources and effects
- Nuclear hazards: Sources and impacts.
- EIA: Environmental Impact Assessment in polluted areas

Module 7

Social issues and the environment: **2 hours**

Climate change, global warming and green house gases, IPCC, Acid rain, Ozone layer depletion, nuclear accidents and nuclear holocaust.

Module 8

Environmental legislation and laws: **1 hour**

(1) Environment (protection) Act, 1986, (2) Air (Prevention and control of pollution) Act, 1981, (3) Water (Prevention and control of pollution) Act, 1974, (4) Wildlife (protection) Act, 1972, (5) Forest (Conservation) Act, 1980 (briefly)**.**

Module 9 **6 hours**

Biodiversity and Conservation biology:

- Endemism: Definition-types-factors. Hotspot of endemism-hotspots in India. IUCN-threat categories. Red data book., Western Ghats as the hottest spot and its conservations.
- Biodiversity loss: Causes and rate of biodiversity loss, extinction-causes. Alien species, negative and positive impacts
- Conservation efforts: Rio Earth Summit, Agenda 21, Kyoto protocol, COP 15(15th Conference of the Parties under the U N Framework Convention on Climate Change), IPCC (Inter Governmental Panel for Climate Change) and its contribution. Conservation strategies and efforts in India and Kerala, In situ and ex situ conservation methods. Role of NGOs in biological conservation

Module 10 **2 hours**

Organizations, movements and contributors of Ecological studies

- *Organizations*: BNHS, WWF, CSE, NEERI, , MoEF, Green Peace, Chipko
- *Famous contributors of Ecology in India:* Salim Ali, M.S. Swaminathan, Madhav Gadgil, M.C. Mehta, Anil Agarwal, Medha patkar, John C. Jacob, Sunderlal Bahuguna

ECOTOURISM: **6 hours**

Definition, concept, introduction, history, relevance and scope. Components of ecotourism: Forms and types of ecotourism in India and Kerala, ecotourism resources-biological, historical, cultural, and geographical. Ecotourism centers in Kerala. Positive and negative impacts of ecotourism.

Practicals – **45 hours**

1. Estimation of CO_2, Cl, and salinity of water samples (Titremetry)
2. Determination of pH of soil and water
3. Assessment of diversity, abundance, and frequency of plant species by quadrate method (Grasslands, forests)
4. Study of the most probable number (MPN) of coliform bacteria in water samples
5. EIA studies in degraded areas (Sampling – line transect, Quadrate)
6. Visit to any forests types including grasslands and preparation of the list of Rare and threatened (R&T) plants (no collection of specimens)
7. Collection, identification and preparation of the list of exotic species in the locality.
8. Identification of pollutant to respective pollution types.
9. Study of anatomical, morphological, physiological adaptation of plants to the environment (Xerophytic, Hydrophytic, Epiphytic, Halophytic).
10. Collection and recording of rain data by using simple rain gauge.

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MAHATMA GANDHI UNIVERSITY

B.Sc. BOTANY PROGRAMME

Semester VI Course 11 BO6B011

GENETICS, PLANT BREEDING AND HORTICULTURE

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

Course Objectives

1. Understand the basic principles of heredity
2. Understand the inheritance pattern of nuclear and extra nuclear genes
3. Understand the methods of crop improvement
4. Understand the importance of horticulture in human welfare

GENETICS (Theory 25 hrs)

Module 1. 2 hours

Origin of a new branch of Biology- Genetics- Mendelian era; basic laws of inheritance, Mendelian ratios

Module 2. 8 hours

Growth of Genetics- post Mendelian period- modified Mendelian ratios; incomplete dominance-flower color in *Mirabilis*: Interaction of genes- comb pattern in poultry (9:3:3:1): Epistasis- recessive- coat color in mice (9:3:4); dominant epistasis- fruit color in summer squash (12:3:1): complementary genes- flower color in *Lathyrus* (9:7).

Module 3. 2 hours

Multiple alleles- general account: ABO blood group in man; co dominance; self sterility in *Nicotiana*.

Module 4 2 hours

Quantitative characters- polygenic inheritance, continuous variation- kernel color in wheat; ear size in maize.

Module 5 4 hours

Linkage and crossing over- importance of linkage, linkage and independent assortment. Complete and incomplete linkage. Crossing over- general account, cytological basis of crossing over- two point test cross; determination of gene sequences; interference and coincidence; mapping of chromosomes.

Module 6 4 hours

Sex determination- sex chromosomes and autosomes- chromosomal basis of sex determination; XX-XY, XX-XO mechanism; sex determination in higher plants (*Melandrium album*); genic balance theory of sex determination in *Drosophila*; sex chromosomal abnormalities in man- Down's syndrome, Klinefelter's syndrome, Turner's syndrome- Sex

linked inheritance- eye color in Drosophila, Haemophilia in man; Y-linked inheritance.

Module 7 2 hours

Extra nuclear inheritance- general account- maternal influence- plastid inheritance in *Mirabilis*, cytoplasmic male sterility in plants, kappa particle in *Paramecium*.

Module 8 1 hour

Population genetics-Hardy Weinberg law

PLANT BREEDING **(Theory: 15hours)**

Module 1 2 hours

Introduction and objectives of plant breeding; methods of plant breeding

Module 2 3 hours

Plant introduction- procedure of plant introduction, quarantine regulations, acclimatization- agencies of plant introduction in India, major achievements..

Module3 2 hour

Selection- mass, pureline, clonal- genetic basis of selection-achievements.

Module 4 6 hours

Hybridization- procedure- intergeneric, interspecific and intervarietal hybridization.with examples- composite and synthetic varieties- heterosis in plant breeding, inbreeding depression; genetics of heterosis and inbreeding depression; single cross, pedigree method, bulk population method, multiple cross, back cross, polyploidy breeding, male sterility in plant breeding. Use of apomixis in plant breeding.

Module 5 2 hours

Mutation breeding- methods- achievements in India; breeding for pest, disease and stress resistance

HORTICULTURE **(Theory: 14 hours)**

Module 1 2 hours

Introduction to horticulture- definition, history, classification of horticultural plants, disciplines of horticulture; Garden tools and implements. Irrigation methods- surface, sub, drip and spray irrigations, mist chambers- advantages and disadvantages

Module 2 6 hours

Propagation of horticultural plants- by seeds- Seed viability, seed dormancy, seed testing and certification, seed bed preparation, seedling transplanting, hardening of seedling; advantages and disadvantages of seed propagation. Vegetative propagation- organs used in propagation- natural and artificial vegetative propagation; methods- cutting, layering, grafting and budding; advantages and disadvantages of vegetative propagation.

Module 3 6 hours

Gardening- ornamental gardens, indoor gardens, kitchen gardens- terrestrial and aquatic gardens- garden adornments; garden designing- garden components- lawns, shrubs and trees, borders, hedges, edges, walks, drives- famous gardens of India; Landscape architecture- home landscape design, parks. Physical control of plant growth- training and pruning; selection of plant for bonsai, bonsai containers and method of bonsai formation

Practical **45 hours**

A. Genetics 27 hours

a. Students are expected to work out the problems in:

1. Monohybrid , dihybrid cross and back crosses.

2. All types of modified Mendelian ratios mentioned in the syllabus.

b. Study of human karyotype and study of characteristic karyotypes and symptoms of the syndromes mentioned in the syllabus

B. Plant breeding 9 hours

1. Emasculation and bagging

2. Comparison of percentage of seed germination and the effect of any one chemical on the rate of elongation of radicle in any three crop seeds

C. Horticulture 18 hours

1. Tongue grafting, budding ('T' and patch), air layering

2. Identification of different garden tools and their uses

3. List out the garden components in the photograph of the garden given

4. Preparation of potting mixture in the given proportion

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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:

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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