COMPLEMENTARY ELECTIVE COURSE IN BOTANY– 1
MICROBIOLOGY, PHYCOLOGY, MYCOLOGY AND LICHENOLOGY

Semester	Course Code	Hours per week	Credit	Exam Hours
I	IC01BOT	2+ 2	2	3

Course Outcomes

1. Understanding of the fundamental concepts in classification of plants.
2. Concept development in structure and reproduction of lower plants.
3. Enable the student to appreciate bio diversity, sustainable development with the help of their core subject and subsidiary subject botany.
4. Induce to experiment on the subject in an intensive way to facilitate an interdisciplinary profession/enterprise/enterpreneurship

Module 1: Introduction to living organisms **8 hrs**

General characters of major categories of living organisms- prokaryotes, eukaryotes, Microbes, Animals and Plants; kingdoms of living organisms. Six Kindom (Carl Woese). Akaryota- Viruses- RNA and DNA Viruses. General characters of bacteria and their classification based on flagella, Gram staining and shape.Economic importance of microbes.

Module 2. Phycology **16 Hrs**

General characters of algae and their classification up to classes (F E Fritsch); Range of thallus variation in Algae. Reproduction and life history of the following groups with reference to the types mentioned (Excluding the developmental stages).

a) Cyanophyceae – *Nostoc*
b) Chlorophyceae – *Volvox*, *Spirogyra*, *Oedogonium* and *Chara*
c) Phaeophyceae – *Sargassum*
d) Rhodophyceae – *Polysiphonia*

Economic importance of Algae: food, industry, medicine, biofertilizers; algal bloom.

Module-3- Mycology **9 Hrs**

General characters and classification by Ainsworth (brief account). General characters, thallus structure, reproduction and life history of the following groups with reference to the types mentioned:

a) Zygomycotina – *Rhizopus*
b) Ascomycotina – *Penicillium*
c) Basidiomycotina – *Puccinia*

Economic importance of Fungi

Module -4 – Lichenology **3 hrs**

Lichen - General account, Classification based on thallus morphology and partners. Economic importance of lichens. Structure, reproduction and life cycle of *Usnea*.

Practicals 2HRS/WEEK

1. Identification giving reasons of the vegetative & reproductive structures of the taxon mentioned in syllabus- *Spirogyra, Oedogonium, Chara, Sargassum, Polysiphonia, Rhizopus* and *Puccinia*
2. Identification of Tobacco Mosaic Virus, Bacteriophage, HIV and Nostoc by photographs

COMPLEMENTARY ELECTIVE COURSE IN BOTANY– 2
BRYOLOGY, PTERIDOLOGY, GYMNOSPERM BIOLOGY, PALAEOBOTANY, PHYTOPATHOLOGY AND ANGIOSPERM EMBRYOLOGY

Semester	Course Code	Hours per week	Credit	Exam Hours
II	2C02BOT	2+ 2	2	3

Course Outcomes

1. Understanding of the fundamental concepts in classification of Bryophytes, Pteridophytes, Gymnosperms.
2. Concept development in structure and reproduction of lower plants.
3. Enable the student to appreciate bio diversity, evolution and sustainable development with the help of their core subject and subsidiary subject botany.
4. Induce to experiment on the subject in an intensive way to facilitate an interdisciplinary profession/enterprise/enterpreneurship

Module-1 Bryology **5hrs**

General characters and classification - Structure, reproduction and Life cycle of *Riccia* (excluding developmental stages)

Relationship between algae and pteridophytes. Economic Importance of Bryophytes

Module-2 – Pteridology **5 hrs**

General characters – Structure, reproduction and Life cycle of *Selaginella* (excluding developmental stages) . Heterospory and Seed habit. Relationship between Bryophytes and Gymnosperms. Economic Importance of Pteridophytes

Module-3– Gymnosperms **5 hrs**

General characters - Structure, reproduction and Life cycle of *Cycas* (excluding developmental stages).

Relationship between Pteridophytes and Angiosperms. Economic Importance of Gymnosperms.

Module-4 Paleoboatny **5 hrs**

Objectives of Paleobotany – Geological time scale with special emphasis to plants and animal life in each era. Fossil formation and types- a brief account only. General account on Fossil algae, bryophytes, Pteridophytes and Gymnosperms. Fossil plants to study in detail-*Rhynia* and *Lepidodendron.*

Module-5- Phytopathology **6 hours**

Classification of plant diseases based on causative organisms and symptoms- Study of the following diseases with reference to their symptom, etiology, and control measures- Leaf mosaic of Tapioca, Blast disease of Paddy, Grey leaf spot of Coconut, Quick wilt of Pepper, Citrus canker. Root knot of Banana.

Module-6- Angiosperm Embryology **10 hrs**

Flower as a modified shoot; .Flower-Parts- arrangement -relative position –structure of anther and pistil- Microsporogenesis and microgametogenesis.-Mega sporogenesis and mega gametogenesis.- Mega gametophyte. Monosporic – Polygonum type-Pollination and fertilization. Dicot and monocot embryo-Endosperm- Nuclear, Cellular and Helobial.

COMPLEMENTARY ELECTIVE COURSE IN BOTANY– 3
ANGIOSPERM MORPHOLOGY, ANATOMY AND SYSTEMATICS

Semester	Course Code	Hours per week	Credit	Exam Hours
III	3C03BOT	3+ 2	2	3

Course Outcomes

1. Understanding of the fundamental concepts in classification of Angiosperms.
2. Concept development in diversity that exist in angiosperms through studies in morphology, anatomy and systematic. .
3. Enable the student to appreciate economic importance of plants belongin to the specified families.
4. Induce to experiment on the subject in an intensive way to facilitate an interdisciplinary profession/enterprise/enterpreneurship

Module-1 Morphology **8 hrs**

Leaf - simple, compound; venation and phyllotaxy.
Inflorescence: racemose, cymose and special types
Flower as a modified shoot, structure of flower - floral parts, their arrangement, relative position; cohesion and adhesion of floral parts, symmetry of flowers; types of aestivation and placentation; floral diagram and floral formula.
Fruits-classification- simple, aggregate and multiple

Module- 2 Anatomy **25 hrs**

Gross structure of primary and secondary cell walls pits, primary pit fields and plasmodesmata. General structure of plant cells with ergastic substances- Reserve, Secretory and by products.
Tissues – meristematic and permanent; classification of meristems based on position, origin; Organization of shoot apex and root apex- Histogen theory & Tunica corpus theory. Simple and complex tissues, secretory tissues (nectarines and hydathodes). Vascular bundles – types: conjoint collateral, bicollateral, concentric and radial.
Primary structure of monocots and dicots –root, stem and leaf. Secondary thickening in dicot stem and dicot root. Anomalous secondary thickening in *Boerhaavia.* Heart wood and sap wood; tyloses; hard wood and soft wood; growth rings, dendrochronology.

Module -3 Plant classification & Herbarium techniques 6 hrs

Systems of classification Artificial, Natural of Phylogenetic (Brief account only).
Nomenclature-Binomial system of nomenclature, ICBN (Brief account only)
Bentham & Hooker's system of classification (Up to series) and its merits and demerits.
Herbarium technique.. Significance of herbaria and botanical gardens; important herbaria and botanical gardens in India.

Module -4 Angiosperm families **15 hrs**

Study the following families of Bentham and Hooker's system of classification with special reference to major identifying characters and economic importance.

Annonaceae, Malvaceae, Fabaceae (with special emphasis to Subfamily Papilionoidiae, two others mention only), Rubiaceae, Asteraceae, Apocynaceae, Solanaceae, Euphorbiaceae, Orchidaceae and Poaceae.
Economic and Evolutionary significance of the families studied
Evolutionary significance of Angiosperms-relationship with gymnosperms

Practicals 2 hrs/week

1. Identify non-living inclusions- Cystolith , raphide
2. Identify different tissues and vascular bundles
3. Make suitable micropreparations and study the anatomy of primary structure of stem, root and leaves, secondary structure of dicot stem-*Vernonia* and Tinospora & root and anomalous structure of *Boerhaavia*
4. Identify different types of inflorescences and fruits included in the syllabus without drawing in the record
5. Learning family characteristics (not compulsoryt for the monocots) by demonstrations in the laboratory using one or two plants from each family included in the syllabus
6. Learning to describe plants in technical terms identifying the family to which the plant belongs.
7. Each student shall submit 10 herbarium specimens belonging to the families included in the syllabus & field book for evaluation
8. Economic importance of Anona, Cotton, Ladies Finger, Redgram, Green Gram, Bengal Gram, Black Gram, Coffee, Vernonia cineria, Helianthus, Catharanthus, Rauvolfia, Brinjal, Chilly, Tomato, Potato, Rubber, Tapioca, Indian Gooseberry, Keezharnelli, Rice, Wheat, Ragi, Sugarcane- With botanical name, Family and Morphology of the useful part and uses

Reference

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3. Heywood - Plant taxonomy - Edward Arnold London.
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5. Pandey, S.N, and S.P. Misra (2008)-Taxonomy of Angiosperms- Ane Books India, New Delhi.
6. Prithipalsingh (2007), An introduction to Biodiversity, Ane books India, Delhi.
7. Singh V. & Jain - Taxonomy of Angiosperms - Rastrogi Pubs, Meerut.
8. Singh G.1999. Plant systematics: Theory and Practice. Oxford and IBH, Pvt.Ltd.New Delhi.
9. Sivarajan V. V - Introduction to Principles of taxonomy - Oxford &I B H New Delhi.
10. Vashishta P. C - Taxonomy of Angiosperms - Chand & Co, Meerut.
11. Vasudevan Nair, R - Taxonomy of Angiosperms - APH Pub: New Delhi
12. Venkateswaralu, V. - Morphology of Angiosperms - Chand & Co.
13. Bilgrami K. S. & Dube -A Text book on modern Plant Pathology - Vikas Publishing House, New Delhi
14. Sambamurthy, A. V. S. S. 2006. A Textbook of Plant Pathology. I. K. International Pvt. Ltd., New Delhi
15. Smith K. M. - A Text Book of Plant Diseases, S. Chand & Company
16. Chaudhari K. (1984) Elementary principles of plant breeding. Oxford and IBH publishing Company
17. Sharma (1990) Principles and practice of plant breeding, Tata McGraw Hill, New Delhi

COMPLEMENTARY ELECTIVE COURSE IN BOTANY – 4
PLANT PHYSIOLOGY, ECOLOGY AND APPLIED BOTANY

Semester	Course Code	Hours per week	Credit	Exam Hours
IV	4C04BOT	3+ 2	2	3

Course Outcomes

1. Understanding of the fundamental concepts in Physiology
2. Concept development in plant ecology.
3. Enable the student to appreciate bio diversity, sustainable development with the help of their core subject and subsidiary subject botany in hts biotechnology era.
4. Induce to experiment on the subject in an intensive way to facilitate an interdisciplinary profession/enterprise/entrepreneurship.

Plant Physiology

Module -1- Plant Water Relations and Mineral Nutrition **12 hrs**

Cell as a physiological unit-

Water relations - Permeability, Imbibition, Diffusion, Osmosis, Plasmolysis and water potential. Absorption of water- Active and passive mechanisms. Ascent of sap - Root pressure theory, Transpiration pull or cohesion- tension theory.

Transpiration Types, mechanism of stomatal movement: K+ ion theory, Significance of transpiration, Guttation & anti-transpirants. Factors affecting transpiration

Mineral nutrition- General account on Micro and macro nutrients. The essential elements - criteria of essentiality. Function and deficiency symptoms of the following mineral nutrients: N, P, K, Mg, Fe, Zn, Mn

Absorption of mineral elements- Passive absorption- Simple and facilitated diffusion, Ion exchange, Donnan equilibrium. Active absorption –carrier concept

Module -2- Plant Physiology- Photosynthesis & Translocation **12 hrs**

Introduction, significance and general equation, Photosynthetic apparatus, photosynthetic pigments, Requirement of light-PAR. Flourescence and phosphorescence, Two pigment systems, red drop, Emerson enhancement effect, action and absorption spectra. Mechanism of photosynthesis- Hill reaction (Light reaction) -cyclic & noncyclic photophosphorylatin. Electron transport chain. Dark reactions–Calvin cycle.C4 and CAM pathways, photorespiration (Brief account only). Factors affecting photosynthesis- Law of limiting factors. Chemosynthesis- a brief account. Comparison and differentiation between Photosyntheris and Respiration.

Translocation of photosynthates and organic solutes: Pathway of movement, Phloem loading & unloading, Source-sink relationship, Mechanism of translocation (Pressure Flow Hypothesis).

Nitrogen Metabolism- Sources of N_2 – N_2 fixation, symbiotic and non-symbiotic –ammonium assimilation (Brief account only)

Module -3- Plant - Plant growth & development **8 hrs**

Plant growth- Definition, phases of growth, Natural plant hormones-physiological roles-brief (Auxins, Gibberillins, Cytokinins, Ethylene, Abscissic acid), synthetic hormones and practical applications (Brief account only)

Senescence and abscission, Photoperiodism and vernalization. Phytochromes. Dormancy of seeds-Factors causing dormancy, techniques to break dormancy, physiology of fruit ripening.

Module -4- Plant Ecology **12 hrs**

Introduction to ecology and environmental science- Definition- Scope and relevance -Need for public awareness. Brief account on Ecosystem- Concept, Structure & function and Factors affecting ecosystem.

Ecological adaptations: Morphological, anatomical and physiological adaptations of the following types: Hydrophytes, Xerophytes, Halophytes, Epiphytes and parasites.
Ecological succession- Definition and types. Details of Hydrosere.

Plant- Animal Interactions -Introduction, General categories with examples. Commensal interactions, Antagonistic interactions-Herbivory, Mutualisms- Pollination and seed dispersal. Co-evolution of plants and insects, Role of Plant-Animal interactions in sustainability of ecosystem. Brief account of myrmecophily, chiropterophily.

Module -4- Applied botany **10 hrs**

Methods of plant propagation- Media for propagation- Soil mixture, nursery beds, peat, vermiculite. Propagation by seed (brief) and Vegetative methods- Cutting, Layering, Grafting and Budding. Micropropagation through tissue culture

Plant breeding – Introduction & Objectives. Methods in plant breeding- Plant introduction and acclimatization.Quarantine (brief account). Selection- brief account on mass, pure line and clonal selection. Hybridization – General steps in Hybridisation. Successful examples in hybridisation Sugarcane, Rice, Wheat and Potato with emphasis to India.

Modern plant biotechnology: Methods and applications with successful examples of Bt Cotton and Golden Rice

Practicals 2hrs/Week

(i) Learn the principle and explain working with diagrams the following apparatus /experiments

1. Thistle funnel osmoscope
2. Measure the rate of transpiration by Ganong's potometer.
3. Relationship between transpiration and absorption (Absorbo-transpirometer)
4. Separation of leaf pigments by paper chromatography.
5. Rate of photosynthesis by Wilmot's bubbler
6. Mohl's half leaf experiment.
7. Ganong's light screen

(ii) Study the morphological & anatomical characteristics of plant groups –hydrophytes, xerophytes, halophytes, epiphytes and parasites with specified plants- Hydrophyte (Vallisnaria, Hydrilla), Xerophyte (Opuntia, Nerium), Halophyte (Avicennia), Epiphytes (Vanda) and parasites (Cuscuta).
(iii) Demonstration of the technique of emasculation, budding, grafting and layering
(iv) Insect visit diary of any two plants.