# Course structure of M.Sc. Botany

Total Credits: 2400

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<tr>
<th>S.N.</th>
<th>Course Code</th>
<th>Name of Course</th>
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**FOURTH SEMESTER: 24 CREDITS**

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*Two elective courses are to be studied in addition to dissertation in fourth semester.
** Lab course (17A&17B) based on the elective course opted by the student.
Semester-I

BOT/I/CC/01: Paper I: Microbiology: Bacteria Virus and Lichens

(48 h, 4 credits, Max Marks 100; 75 External Exam+ 25 internal assessment)

Unit 1

General account of Microorganisms: History of microbiology, Golden Era of Microbiology, characteristic features of bacteria, General account of actinomycetes, classification of microorganism-five kingdom classification, Microbial growth- measurement of microbial growth, Batch, Fed-batch and continuous culture.

Unit 2

Morphology and structure of Bacterial cells: Morphology of bacterial cells based on size, shape and arrangement, fine structure of bacterial cells (of both Gram negative and gram positive bacteria) capsule cell wall, cell appendages (flagella, fimbriae, pilli), structure of plasma membrane, cytoplasmic inclusions-mesosomes, chlorosome. Ribosome- Site of protein synthesis, Microbial genetics- transformation, conjugation and transduction.

Unit 3

Morphology and structure of viruses: History, morphology, fine structure, shape and classification of viruses. Mycophases and Prions, Tobacco mosaic virus(TMV), T4 Bacteriophage and HIV- their fine structure, genome organization and multiplication, bacteriophage therapy.

Unit 4

General account of lichens: Occurrence and distribution, trends in classification, morphological diversity, type forms and ecological groups anatomy (homeomerous and heteromerous), reproduction, Economic importance of lichens, Lichenic acid.

Suggested Readings


**BOT/I/CC/02: Paper II: Phycology**

*(48 h, 4 credits, Max Marks 100; 75 External Exam+ 25 internal assessment)*

**Unit 1**

**History and Classification of Algae:** Criteria of classification, important systems of classification, position of the Algae in the plant kingdom, Classes and Divisions of Algae, Characteristics of Divisions and classes of Algae

**Importance of Algae:** Useful and harmful aspects of algae

**Unit 2**

**The Pigments of Algae:** Pigments and chloroplasts, principal kinds of Algal pigments, properties of chlorophylls, carotenoids, phycobilins, pigments of Cyanophyceae, Chlorophyceae, Charophyceae, Xanthophyceae, Bacillariophyceae, Phaeophyceae and Rhodophyceae

**Ecology of Algae:** Diversified habitats of Algae, Eutrophication, water blooms and phytoplanktons

**Unit 3**

A detailed study of following orders with given genera

**Cyanophyta:** Chroococcales (*Chroococcus, Microcystis*), Oscillatoriales (*Oscillatoria* and *Lyngbya*), Nostocales (*Anabaena*, *Spirulina*), Rivulariales (*Rivularia*)

**Chlorophyta:** Chlamydomonadales (*Haematococcus*), Volvocales (*Pandorina, Eudorina*), Chlorococcales (*Chlorella, Hydrodictyon*), Cladophorales (*Cladophora*), Chaetophorales (Coleochaete, Fritschiella), Zygnematales (*Zygnema*)

Charophyta: Charales (*Chara*)
Unit 4
A detailed study of following orders with given genera

Xanthophyta: Heterosiphonales (*Botrydium, Vaucheria*)

Bacillariophyta: Pennales and Centrales (Pinnate diatoms and centric diatoms).

Phaeophyta: Ectocarpales (*Ectocarpus*), Laminariales (*Laminaria*), Fucales (*Sargassum, Fucus*).

Rhodophyta: Gigartinales (*Gracillaria*), Gelidiales (*Gelidium*), Ceramiales (*Polysiphonia*), Nemaloniales (*Betrachospermum*).

Suggested Readings:


BOT/I/CC/03: Paper III: Mycology

(48 h, 4 credits, Max Marks 100; 75 External Exam + 25 internal assessment)

Unit 1

General characteristics and Classification of Fungi

Reproduction in Fungi (vegetative, asexual and sexual)

Heterothallism and Heterokaryosis

Parasexual cycle.

Unit 2

Recent trends in classification of Fungi

Phylogeny of Fungi

Importance of Fungi
Unit 3

General account of the following classes of fungi with emphasis on the given genera:

**Myxomycotina:** *Stemonitis, Physarum*

**Mastigomycotina:** *Allomyces, Monoblepharis.*

**Oomycotina:** *Saprolegnia, Pythium, Phytophthora, Sclerospora.*

**Zygomycotina:** *Mucor, Pilobolus, Entomophthora.*

Unit 4

**Ascomycotina:** *Saccharomyces, Aspergillus, Talaromyces (Penicillium), Taphrina, Phyllactinia, Peziza, Cordiceps, Claviceps.*

**Basidiomycotina:** *Puccinia, Ustilago, Geastrum, Fomes, Uromyces.*

**Deuteromycotina:** *Fusarium, Cercospora, Pyricularia, Colletotrichum, Trichoderma, Helminthosporium.*

Suggested readings:


**BOT/I/CC/04: Paper IV: Bryophyta and Pteridophyta**

(48 h, 4 credits, Max Marks 100; 75 External Exam+ 25 internal assessment)

Unit 1

Evolutionary Trends in Bryophytes; Bryology in India.
General idea about morphology, cytology and reproduction in Bryophyta.
Ecological and Economic Importance of bryophytes, Role of bryophytes in monitoring mineral deposition and as indicator of air pollution.
Modern Systems of Classification of Bryophytes.
Unit 2

Salient features of the following groups with special reference to the genera given:

(A) Marchantiophyta

(i) Sphaerocarpales- Sphaerocarpos

(ii) Marchantiales- Marchantia, Lunularia, Plagiochasma, Reboulia, Asterella, Cryptomitrium, Targionia, Conocephalum, Cyathodium

(iii) Jungermanniales- Frullania, Porella, Radula

(iv) Metzgeriales- Pellia, Sewardiella, Metzgeria, Riccardia

(v) Calobryales- Haplomitrium

(B) Anthocerotophyta

Anthocerotales- Anthoceros, Foilioceros, Megaceros, Phaeoceros, Notothylas

(C) Bryophyta

Sphgnales- Sphagnum

Andreales- Andreaea

Takakiales- Takakia

Eubryales- Buxbaumia, Polytrichum

Unit 3

A brief account of origin of pteridophytes, classification of pteridophytes, Heterospory and seed habit, evolution of steler system, telome theory, Evolution of sorus, apogamy, apospory and apomixes.

A brief account of the class:

Psilophytopsida- Rhinia, Horneophyton

Psilotopsida- Psilotum

Unit 4

A brief account of the class

Lycopsida- Lycopodium, Lepidodendron, Lepidocarpon, Selaginella, Isoetes

Sphenopsida- Hyenia, Sphenophyllum, Calamites, Equisetum
Pteropsida:
Eusporangiate - Ophioglossales
Protoleptosporangiate - Osmunda,
Leposporangiate: (a) Filicales - Adiantum
    (b) Marsileales – Marsilea
    (c) Salvineales - Azolla

Suggested Readings
Ram Udar. Fifty years of Bryology in India. Golden Jubilee Series. IBS, New Delhi

BOT/I/CC/05: Based on the CC/01 to CC/04 papers
Semester II

BOT/II/CC/06: Paper V: Gymnosperms and Paleobotany

(48 h, 4 credits, Max Marks 100; 75 External Exam + 25 internal assessment)

Unit 1
Introduction: History, classification, distribution and evolution of gymnosperms
Brief account of the families of Pteridospermales (Lyginopteridaceae, Medullosaceae, Caytoniaceae and Glossopteridaceae)

Unit 2
General account of Cycadeoideales
General account of Cordaitales
General account of Pentoxylales
Morphology, anatomy and reproduction in Cycadales

Unit 3
Morphology, anatomy and reproduction in Ginkgoales
Morphology, anatomy and reproduction in Coniferales
General account of Ephedrales
General account of Welwitschiales
General account of Gnetales

Unit 4
Preservation of fossil plants
Types of fossils and modes of formation of different kinds of fossils
Gondwana flora

Suggested Reading
BOT/II/CC/07: Paper VI: Diversity and Taxonomy of Angiosperms

(48 h, 4 credits, Max Marks 100; 75 External Exam+ 25 internal assessment)

Unit 1

Important system of classification Bentham & Hooker, J. Hutchinson and A. Takhtajan and their merits and demerits.

Salient features of International Code of Botanical Nomenclature.

The species concept: Taxonomic Hierarchy, species, genus, family and other categories. Principles used in assessing relationships, delimitation of taxa and attribution of rank.

Unit 2


Plant exploration in India with special reference to Uttarakhand.

Origin and evolution of angiosperms, Fossils, Type of inflorescence and their origin.

Unit 3

Taxonomic tools, herbarium, flora, histological, cytological, phytochemical, serological, biochemical, and molecular techniques.

Concepts of phytogeography, endemism, plant migration, invasions and introduction.

Unit 4

Distinguishing features only of the following families and their economic importance. Ranunculaceae, Rutaceae, Fabaceae, Asteraceae, Rosaceae, Lamiaceae, Asclepiadaceae, Euphorbiaceae, Fagaceae, Violaceae, Convolvulaceae, Apiaceae, Acanthaceae, Rubiaceae, Solanaceae, Orchidaceae, Cyperaceae, Poaceae, Liliaceae.

Practical Marks 42.5 (External 32.5+Internal 10) Credit 01 Periods 12.5

Suggested readings


BOT/II/CC/08: Paper VII: Plant Development and Reproductive Biology

(48 h, 4 credits, Max Marks 100; 75 External Exam+ 25 internal assessment)

Unit 1

**Morphology:** Morphology of flower, Stamen and Carpel, Floral Characteristics, structure of the pistil, pollen stigma interactions, Plant adaptation – physiological and their morphological nature (xerophyte, hydrophyte and halophyte)

Unit 2

**Shoot development:** Organization of the shoot apical meristem (SAM): control of cell division and tissue differentiation, especially xylem and phloem: secretary ducts and laticifers

Leaf growth and differentiation, structural development and classification of stomata and trichomes.

**Root Development:** Organization of root apical meristem (RAM), vascular tissues differentiation, lateral root, root hairs.

Unit 3

**Male gametophyte:** Structure of anthers, microsporogenesis, role of tapetum, pollen development, pollen germination, pollen tube growth and guidance, pollen allergy,

**Female gametophyte:** Ovule development, megasporogenesis, development and organization of the embryo sac, structure of the embryo sac cells.

Unit 4

**Pollination, pollen-pistil interaction and fertilization:** pollination mechanism and vectors, sporophyte and gemetophytic self-incompatibility, double fertilization.

**Seed development and fruit growth:** Endosperm development during early maturation and desiccation stages: embryogenesis, cell lineages during late embryo development, polyembryony, apomixes

**Latent life- dormancy:** Importance and types of dormancy: seed dormancy, bud dormancy.

Suggested Readings:

Pollen biology by K. R. Shivanna and N.S. Rnagaswamy.
BOT/II/CC/09: Paper VIII: Cytogenetics and Plant Breeding

(48 h, 4 credits, Max Marks 100; 75 External Exam+ 25 internal assessment)

**Unit 1**

**Mendelian principles:** Dominance, Segregation, independent assortment; extension of mendelian principles (codominance, incomplete dominance, gene interactions, pleotropy); linkage and crossing over, sex linked, sex limited and sex influenced characters

**Genetic recombination and gene mapping:** Recombination, role of Rec A and Rec B,C,D enzymes, gene mapping methods (linkage maps, tetrad analysis, mapping with molecular markers); population genetics- population, gene pool, gene frequency, Hardy-Weinberg law

**Unit 2**

**Structural and numerical alteration in chromosome:** Origin, meiotic behaviour and consequences of duplication, deficiency, inversion and translocation; effect of aneuploidy on phenotypes in plants; transmission of monosomics and trisomics and their use in chromosome mapping of diploid and polyploid species, evolution of major crop plants (wheat and rice)

**Unit 3**

**Mutation:** spontaneous and induced mutation; physical chemical mutagens; molecular basis of mutation; DNA damage and reparir mechanisms; transposable elements, mutations induced by transposons; inherited human diseases; cell cycle and apoptosis, cancer at cellular level.

**Unit 4**

**Chromosome structure:** packing of DNA, molecular organization of centromere and telomere, nucleolus and ribosomal RNA genes; euchromatin and heterochromatin; Nuclear DNA content, C-value paradox; cot-curves and their significance

**Gene structure and expression:** genetic fine structure; cis-trans test; introns and exons; RNA splicing multiple alleles, pseudoallele, regulation of gene expression in prokaryotes and eukaryotes
Suggested Readings:


BOT/II/CC/10: Based on the CC/05 to CC/08 papers
BOT/II/SSC/01: Paper I: Plant Cell Structure and Functions

Principles of microscopy, structural organization of the plant cell and its chemical foundation, Cell wall structure and function, Plasma membrane, Cytoskeleton, organization and role of microtubules and microfilaments.

Structure and functions of endoplasmic reticulum, golgi apparatus, ribosomes and protein synthesis

Structure and genome organization of chloroplast and mitochondria

BOT/II/SSC/02: Paper II: Applied microbiology

III Semester

BOT/III/CC/11: Paper IX: Plant Ecology

(48 h, 4 credits, Max Marks 100; 75 External Exam + 25 internal assessment)

Unit 1

Climate, soil and vegetation patterns of the world: Major terrestrial biomes; Zonoecotones, Orobiomes and Pedobiomes, Fresh water aquatic ecosystems; Marine ecosystems; Vegetation Types and environmental factors.

Vegetation organization: Concepts of community and continuum; Community structure and attributes; Edges and ecotones; Keystone species and control of community structure. Species interactions: Types of interactions, interspecific competition; Amensalism; herbivory; parasitism; Commensalism, carnivory, pollination, symbiosis (obligate and facultative symbiosis).

Unit 2

Population Ecology: Characteristics of population; population growth curves; population regulation life history strategies (r and k selection); population genetics and natural selection.

Habitat and niche: Concept of habitat and niche; niche width and overlap, fundamental and realized niche.

Unit 3

Ecological succession: Causes, mechanism and types, changes involved in succession; Transient and cyclic changes; Examples of succession; Methods of standing succession; concept of climax.

Ecosystem: Structure and functions; primary production (methods of measurement, Global pattern, Controlling factors); energy dynamics (Tropical organization, energy flow pathways, ecological efficiencies); litter fall and decomposition (mechanism, substrate quality and climatic factors); Global biogeochemical cycles of C, N, P and S (pathways, processes in terrestrial and aquatic ecosystems); nutrient use efficiency; Global hydrological cycle.

Unit 4

Applied Ecology: Biodiversity concept; Levels of Biodiversity: genetic, species, community and ecosystem diversity; Uses of biodiversity; Biodiversity, Ecosystem services and functions; Distribution of biodiversity; Gradients of biodiversity; Hotspots; Threats to biodiversity; Extinction of species; Biodiversity assessment and inventory; Conservation of biodiversity; Indices; biodiversity and its conservation; International efforts for conserving biodiversity. Environmental pollution: kinds; sources; quality parameters; effects on plants and ecosystems and remedies.
Climate change and conservation: Biology; Greenhouse gases; sources, trends and role; ozone layer and ozone hole; Consequences of climate change; principles of conservation; Major approach to management with special reference to Indian Biosphere reserves.

Suggested readings

Odum, E.P. 1983Basic Ecology Saunders, Philadelphia

BOT/III/CC/12: Paper X: PLANT RESOURCE UTILIZATION AND CONSERVATION

(48 h, 4 credits, Max Marks 100; 75 External Exam+ 25 internal assessment)

Unit 1

Sustainable development: Basic concepts.

World centres of primary diversity of domesticated plants: The Indo-Burmese centre plant introduction and secondary centres.
An idea of (i) Food, forage and fodder crops. (ii) Fibre crops. (iii) Medicinal and Aromatic Plants and (iv) Vegetable oil- yielding crops and their uses.

Unit 2

Important fire-wood and timber-yielding and non-timber forest products (NTFPs) Such as bamboos, rattans, raw materials for paper-making, gums, tannins, dyes, resins and fruits.

Green revolution: Benefits and adverse consequences.

Plants used as avenue trees: for shade, pollution control and aesthetics.

Unit 3

Strategies for conservation- in-situ conservation: International efforts and Indian initiatives; protected areas in India-sanctuaries, National Parks, biosphere reserves, wetlands, mangroves and coral reefs for conservation on wild biodiversity.
Unit 4

**Strategies for conservation- ex-situ conservation:** Principles and practices; botanical gardens, field gene banks, seed banks, in vitro repositories, cryobanks, general account of the activities of botanical Survey of India (BSI), National Bureau of Plant Genetic resources (NBPGR), Indian Council of Agriculture Research (ICAR), Council of Scientific and Industrial Research (CSIR) and Department of Biotechnology (DBT) for conservation, non-formal conservation efforts.

**Suggested Readings:**

Technical guidelines for the site movement of Germplasm (1989) by FAO IBPGR.

**BOT/III/CC/13: Paper XI: Biotechnology**

(48 h, 4 credits, Max Marks 100; 75 External Exam + 25 internal assessment)

**Unit 1**

Plant cell and tissue culture: Concept of cellular totipotency, principle of root and shoot generation in vitro, clonal propagation, applications of cell and tissue culture.

**Unit 2**

Callus culture, organ culture, cell suspension culture, cryopreservation, protoplast culture, organogenesis, somatic embryogenesis, artificial seed, somatic hybridization, hybrids and cybrids, and somaclonal variation.

**Unit 3**

Recombinant DNA technology: Tools of genetic engineering, enzymes, cloning vectors, plasmids, cosmids, lamda phage, shuttle vectors, BACs, and YACs.
Cloning strategies, Screening and selection of transformants.

**Unit 4**

Gene libraries (a general account): Genomic DNA libraries, cDNA libraries
Hybridization- colony hybridization, Southern hybridization, Northern hybridization, Western hybridization,
DNA sequencing techniques: Concept of nucleic acid sequencing, Maxam and Gilbert sequencing, Sanger sequencing

Genetic Engineering of plants: Aims, tools, strategies for development of transgenic plant with suitable examples

**Suggested Readings:**

BOT/III/CC/14: Paper XII: Plant Physiology and Biochemistry

(48 h, 4 credits, Max Marks 100; 75 External Exam + 25 internal assessment)

Unit 1

Membrane transport and translocation of water and solutes: Plant – water relations, mechanism of water transport through xylem, phloem loading and unloading, passive and active solute transport, membrane transport of proteins.

Enzymology: General aspects, allosteric mechanism, regulatory and active sites, isozymes, kinetics of enzymatic analysis, Michaelis - Menten equation and its significance.

Signal transduction and sensory photobiology: Receptors, phospholipids signaling, phytochromes and cryptochromes.

Unit 2

Photosynthesis: General concepts and historical background, steps of photosynthesis, Emerson’s effect, two pigment systems, Calvin cycle, photorespiration and its significance. C4 cycle, CAM pathway

Respiration: Glycolysis, TCA cycle, electron transport chain and ATP synthesis, pentose-phosphate pathway, glyoxylate cycle.

Nitrogen fixation and metabolism: Biological nitrogen fixation, mechanism of nitrate uptake and reduction, ammonium assimilation.

Unit 3

Plant growth regulators: Physiological effects and mechanism of auxins, gibberellins, cytokinins, ethylene, abscisic acid, polyamines, jasmonic acid, hormone receptors and vitamins and hormones, phytochrome and cryptochrome.

Photoperiodism and vernalization: Photoperiodism and its significance, floral induction and development, significance of vernalization.

Stress physiology: Plant responses to biotic and abiotic stress, mechanism of biotic and abiotic stress tolerance, water deficit and drought resistance, salinity stress, freezing and heat stress, oxidative stress.

Unit 4

Carbohydrates: structure and function of Monosaccharides, oligosaccharides, polysaccharides.

Lipids: Fat metabolism (Simple lipids, compound lipids, derived lipids).

Proteins: Amino acids, Structure of primary, secondary and tertiary proteins, protein sequencing.
Suggested Readings:

Dennins, D. T; D.H. Turpin; D.D. Lefebvre and D.B. Layzell. Plant Metabolism.
Lehninzer. Principles of Biotechnology
Ribonsen, T. 1968. The biochemistry of Alkaloides Springer Verlog, Berlin

BOT/III/CC/15: Based on the CC/09 to CC/12 papers
Semester IV

BOT/IV/EC/16(i): Elective Course/Special Paper XIV(i): Forest Ecology
(48 h, 4 credits, Max Marks 100; 75 External Exam+ 25 internal assessment)

Unit 1

General Aspects of Forests: Forest ecology and forest ecosystem, Importance of forests in environmental conservation, Wildlife biodiversity and Climate change.

Primary Productivity and Detritus Pool: Solar radiation and energy units; Concept of primary productivity.

Formulations of Primary Productivity: Photosynthetic pathways and their significance; photosynthetic capacity; distribution of biomass; Allocation of Net primary production and accumulation of biomass; Measurement of biomass and primary productivity in forest ecosystems of the world; Plant biomass and turnover; efficiency of energy Capture; Human Use of Productivity; Environmental factors and productivity.

Unit 2

Litter Fall in Forest Ecosystems: determining litter fall, factors affecting it; Forest litter: type of litter; Coarse Woody debris; forest floor litter mass.

Detritus Pathway of Energy Flow and Decomposition Processes: Decomposer organisms and their trophic interactions; decomposition processes; Measurements of Litter Decomposition; Decomposition rate.

Unit 3

Nutrient Cycling in Forest Ecosystems: The nutrient cycle models in forest ecosystem; Ecosystem Inputs of Nutrients: Atmosphere, Weathering of rock minerals, Hydrologic inputs, Biological inputs, biotic accumulation and storage of nutrients in plants; Nutrient outputs (Ecosystem losses). Stream water losses, losses to the atmosphere; Nutrient losses due to fire, nutrient losses in forest harvest;

Intra-System Cycle: Availability of nutrients in soil solution; Nutrient supply and uptake, Role of mycorrhizae in nutrient cycling; Nutrient concentration and storage in vegetation; Nutrient reabsorption; Nutrient return from vegetation to soil; Decomposition and nutrient release, nutrient use efficiency, nutrient conserving adaptation in oligotrophic soil; Effects of N and P enrichment on biodiversity.

Forest Hydrology: Impact of forest on precipitation apportionment, Water discharge from watersheds, Role of water in nutrients cycling.
Unit 4

**Succession:** An idea of forest succession with focus on Himalayan forest ecosystem.

Attributes of species of different successional stages; recovery measures of disturbed sites and species selection for disturbed sites in Himalaya.

**Major forest types of forest India:** Forest classification of India; Forest of Himalaya with particular reference to Sal, Pine and Oak forests.

**Global climate changes and forests.**

**Man and forest:** Commercial exploitation of forest, shifting Agriculture; settled agriculture; structure and functioning of Central Himalayan Agroecosystem. Regeneration status of major forest trees acut vs Chronic human disturbance; Shifting cultivation.

**SUGGESTED READING:**


**BOT/IV/EC/16 (ii): Elective course/special paper (ii): Plant Pathology**

(48 h, 4 credits, Max Marks 100; 75 External Exam+ 25 internal assessment)

Unit 1

A brief history of plant pathology in India and losses caused by pathogens and pests; types of pathogens, symptoms of different diseases.

**Inoculum:** Inoculum types, theory of inoculums, survival and longevity of inoculums, inoculums production, potential and density.
**Plant microbes interaction:** molecular basis of host recognition, pathogenesis: prepenetration, penetration and post penetration events, factors affecting disease development (host factors, environmental factors, virulence susceptibility).

**Dissemination of pathogens:** Means of dissemination (active and passive dissemination).

**Unit 2**

**Genetics and host parasite interaction:** Concept of compatibility and specificity, gene for gene relationship, genetics of resistance, source of resistance, inheritance of resistance in the host.

**Enzymes and toxins:** Enzymes involved in disease development, toxins and their role in plant health.

**Physiology of diseased hosts:** Change in physiology processes, e.g., respiration, photosynthesis and disturbance in other metabolic pathways.

**Unit 3**

**Disease resistance:** (i) Protection (structural, chemical, absence of nutrients and common antigens) (ii) Defence (histology defence, chemical- polyphenols, prohibitins, inhibitins, phytoalexins, lectins), (iii) Genetic resistance: resistant genes, biotechnological approaches for transfer of R- genes into susceptible plant.

**Seed pathology:** Seed borne pathogens, mechanism of seed infections in field and during storage, transmission of pathogens through seeds, seed health testing methods, market disease of fruits and vegetables.

**Disease control:** Cultural practices, chemical methods (insecticides, systematic and non-systematic chemical), biological control: Introduction, biological control of insects and pests, use of resistance varieties quarantine.

**Unit 4**

**Brief account, structure, importance, disease cycle and control of the following:**

(i) Damping off, (ii) Wilt, (iii) Root rot, stem rot and fruit rot (iv) Mildews (powdery and downy), (v) Rusts, smuts, (vi) Leaf spots and leaf blights.

(ii) General characteristics, importance, disease cycle and control of the following: (i) Bacterial disease, (ii) Viral disease, (iii) Mycoplasma disease.

**Suggested readings:**


BOT/IV/EC/16 (iii): Elective Course/Special paper (iii): Taxonomy of Angiosperms
(48 h, 4 credits, Max Marks 100; 75 External Exam+ 25 internal assessment)

Unit 1

History of different systems of classification (introduction only). Important systems- Benthom and Hooker, Hutchinson, A. Takhtajan, A. Cronquist, Robert Thorne.

A brief account of major contributiun made by the following taxonomists: C. Linnaeus, J.D.Hooker, William Roxburgh and Duthie.

Unit 2

Taxonomic evidences- wood anatomy, embryology, palynology, cytotaonomy, biosystematics, chemotaxonomy and numerical taxonomy.

Cladistics in taxonomy, relevance of taxonomy to conservation.

Unit 3

Some important families: Magnoliaceaea, Myrtaceae, Scrophulariaceae, Verbinaceae, Cannabinaceae, Lauranthaceae, Primulaceae, Fagaceae, Orchidaceae, Poaceae.

Local plant diversity and general account of Kumaun flora

Unit 4

Scrophulariaceae, Verbinaceae, Cannabinaceae, Cucurbitaceae, Fagaceae, Orchidaceae, Poaceae. Wild and cultivated fruits of Kumaun.

Suggested readings

BOT/IV/EC/16 (iv): Elective Course/Special Paper (iv): BRYOLOGY

(48 h, 4 credits, Max Marks 100; 75 External Exam+ 25 internal assessment)

Unit 1

Distribution of bryophytes in India, the bryogeographical units: Vanishing bryophytes in Kumaun Himalaya, the red List monotypic, endemic liverwort taxa. Rare and endangered liverworts of Kumaun Himalaya.

Taxonomic methodology in the identification of some common West Himalaya mosses, distinguishing features of the following orders, families and genera.

1. Polytricales
   Polytrichaceae- *Pogonatum, Atricum*

2. Fissidentales
   Fissidermaeae- *Fissidens.*

3. Dicranales
   Dicranaceae- *Dieranum*

4. Pottiales
   Pottiaceae- *Hyophila, Hydrogonium.*

5. Grimmiales
   Grimmiaceae- *Grimmia, Rhacomitrium.*

6. Bryales- (a) Bryaceae- *Bryum, Rhodobryum*
   (b) Mniaceae- *Mnium*
   (c) Bartramiaefceae- *Philonotis*

7. Isobryales- (a) Orthotricaceae- *Macrinitrum*
   (b) Leucodontaeeae- *Leucodan*
   (c) Meteoriaceae- *Meteorium*
   (d) Neckeraeae- *Neeckera, Cryptoleptodon*

8. Hypnobryales- (a) Thuidiaceae- *Thuidium, Anomodon, Herpetin*
   (b) Brachytheciaceae- *Brachythecium*
   (c) Entodontaceae- *Entodona*
   (d) Hypnaceae- *Hypnum*
Unit 2

**Bryophyte ecology:** Habitats, growth forms, the role of bryophytes in succession, bryophytes as bio-indicators, and uptake of mineral elements, response to air pollution.

Unit 3

**Physiology of bryophytes:** General idea of conduction and water reactions in bryophytes, external and internal conduction cells involved in conduction, ecto, exo and mesohydric groups, desiccation and hydration, desiccation tolerance.

Unit 4

**Culture of bryophytes:** A general idea of culture techniques for bryophytes.

**Chemistry of bryophytes:** A brief account of distribution of various organic compounds in bryophytes and their uses in medicines.

**Suggested Readings:**


**BOT/IV/EC/16 (v): Elective Course/Special Paper V: Ethnobotany, Traditional Knowledge And Intellectual Property Rights**

(48 h, 4 credits, Max Marks 100; 75 External Exam+ 25 internal assessment)

Unit 1

Ethnobotany: Its Concept, Scope and Relevance.
Interdisciplinary approaches in Ethnobotany.
Ethnobotany in India: Retrospect and prospects.
Methods of research in Ethnobotany.

Unit 2

Indigenous systems of medicines in India.
Traditional Agriculture Practices in Ancient India.
Some aspects of Biodiversity and Indian Traditions.
Unit 3
Role of ethnobotany in primary health care programmes and development of new drugs. Ethnobotany on development and conservation on bioresources. Plant exploration Crop and Germplasm collection of land races: Methods and strategies.

Unit 4
Traditional knowledge of Uttarakhand: With species reference to food and medicine. Ethnobotany of major tribal communities (Raji, Bhotia, Tharu and Boxa) of Uttarakhand. Changing values in traditional societies and ecological implications.

Unit 5

*Practicals:
1. Field trips for exploring traditional knowledge.
2. Knowing what plants used by tribes.
3. Process of preparation of drinks, food etc. including storing process.
4. Identification of ethnobotanical plants or subjects used by locals.

Suggested Readings:
Elective Course/Special Paper (vi): Lichenology
(48 h, 4 credits, Max Marks 100; 75 External Exam+ 25 internal assessment)

History of Lichenology, Biogeographical distribution, habitat and growth form of lichens.
Classification
Symbiosis in lichens- types of symbiotic association
Identification, morphological, anatomical and chemical methods (spot test, thin layer chromatography, microcrystallography and UV fluorescence analysis).
Reproduction- asexual and sexual means, lichenized and non lichenized diasporas, isidia, soredia, conidia, pariethecia and apothecia.
Chemistry- chemical composition of lichens primary and secondary metabolites, major pathway of secondary metabolite formation.
Physiology- nutrients, elemental accumulation and mineral cycling, nitrogen metabolism and lichen sensitivity to air pollution.
Role of lichens in environmental monitoring- pollution succession, lichenometry, pedogenesis and biodeterioration.
Importance of lichens- as food, medicine, dyes, perfumery etc
An elementary idea of lichen tissue culture
Tools and techniques used in identification of some common Central Himalayan lichen

Families and their representative genera

Parmeliaceae, Lecanoraceae, Teloschistaceae, Ramalinaceae, Physciaceae, Collematacaceae, Candelariaceae, Pertusariaceae, Peltigeraceae

Lichen flora of Kumaun Himalaya general account

Suggested Readings:

Divakar P.K and Upreti D.K (2005) Parmelioid lichens in India (A revisionary study), Bishen Singh Mahendrapal Singh: Dehradun India
Smith A.L (1921) lichen Cambridge University press. London
Environment: Definition, major components of physical environment, Geosphere, lithosphere, hydrosphere, atmosphere and outer space. Impact of man and physical environment and vice-versa.

Resource and Energy Conservations: Concepts of resources, renewable and non-renewable resources, resource conservation, soil, water and forest resources, wild life resources, wild life management laws and principle, wild life sanctuaries, national parks and biosphere reserves. Introduction to various energy resources such as solar, wind, biomass, thermal, nuclear and biogas. energy conservation pattern and strategies.

Environmental monitoring: Meaning and scope, Environmental monitoring as a tool to environmental management concept of bio monitoring and biological indicator, biodiversity indices, environmental monitoring system.

Ecotoxicology: Branches and its significance, types of toxicants, toxic elements, organomettalic and organometalliods, toxic inorganic and organic compounds, toxic natural products national and international laws of toxicology, radiation, ecology and recycling.

Environmental Pollutions: Definition, types and cause of pollution, air pollution, carbon, sulphor and nitrogen pollution, acid rains, ozone fluorocarbon hydrocarbons, metal photochemical products, water pollution sources of pollution and the pollutants, solid waste pollution, degradation and cycling of water, noise pollution, radioactive pollution and the pollutants, global warming and climate change, legal aspects of environmental pollution. Indian laws and policies for control of environmental pollution.

Environmental Impact Assessment: Scope, importance and applications of EIA process. Its role in protection and conservation of environment and economic resources, environmental and socio-economic aspects environmental priorities in India.

Environmental Management: Definition and basic concept, sustainable development environmental issues challenges and strategies in management, eco-planning, national and international organization and policies on environmental management, environmental management with special reference to land, water and forest resources, environmental education and awareness. Environmental laws.

References:
2. Environmental Sciences- G.T. Miller
3. Environmental Science- R.T. Wright
4. Environmental Science- Piyush Malviya and Pratibha Singh
5. Environmental Science and Impact Assessment- S.C. Santra
General concept of Global climate change; Greenhouse effect; Greenhouse gases; Carbon footprint; Impact of global warming and climate change especially on elevated temperature, weather extremes, ecosystem disruption, human health, sea level rise and impact on forests; International initiative for mitigating global changes; Intergovernmental Panel on Climate Change (IPCC); United Nations Framework Convention on Climate Change; Kyoto Protocol; Montreal Protocol; Paris Pact; India’s initiatives for mitigating climate change.

**BOT/IV/SCC/04: Medicinal Plants of Central Himalaya**

(48 h, 4 credits, Max Marks 100; 75 External Exam + 25 internal assessment)

Retrospect and prospects of medicinal plants
Brief history, properties, action and uses of some important medicinal plants
Diversity, distribution and indigenous uses of threatened medicinal plants
Government policies for conservation and management of threatened medicinal plants
Economics and exploitation of resources and people conflict.