

Proposed Syllabus for M.Sc. in Botany

[Two Years M.Sc course based on Choice Based Credit System (CBCS)]

Four semesters will cover all 25 units of the whole syllabus. One project work or one review paper will be prepared by the students in final semester. Each semester with five units of 50 marks each.

Two years PG course of Botany will be conducted for 1000 marks with 100 credit points. Semester I & II (BOT /ThGL/101-105 & BOT/ThGL/201-205) is totally based on Core subject.

Semester I : Full marks = 250 with 5 units (25 credit points).

Unit	Topic	Periods per week	Internal Assessment *	Theory	Practical	Full Marks	Credit points (Int.Assmt.+ Th + Pr)
BOT/ThGL/101	Microbiology	5	10	25	15	50	5 (1+2.5+1.5)
BOT/ThGL/102	Phycology	5	10	25	15	50	5 (1+2.5+1.5)
BOT/ThGL/103	Mycology	5	10	25	15	50	5 (1+2.5+1.5)
BOT/ThGL/104	Bryophytes and Pteridophytes	5	10	25	15	50	5 (1+2.5+1.5)
BOT/ThGL/105	Gymnosperm, Paleobotany, & Palynology	5	10	25	15	50	5 (1+2.5+1.5)
	Five units	25 periods	Marks 50	Marks 125	Marks 75	Total Marks 250	Total credit 25

Internal assessment (10 marks* for each unit) will be evaluated on the basis of attendance, performance in theory and practical classes, submission of practical note book, unit tests, performance in remedial classes etc.

Semester II : Full marks = 250 with 5 units (25 credit points).

Unit	Topic	Periods per week	Internal Assessment *	Theory	Practical	Full Marks	Credit points (Int.Assmt.+ Th+Pr)
BOT /ThGL/201	Cell Biology	5	10	25	15	50	5 (1+2.5+1.5)
BOT /ThGL/202	Genetics	5	10	25	15	50	5 (1+2.5+1.5)
BOT /ThGL/203	Molecular biology	5	10	25	15	50	5 (1+2.5+1.5)
BOT /ThGL/204	Plant Physiology	5	10	25	15	50	5 (1+2.5+1.5)
BOT /ThGL/205	Biochemistry	5	10	25	15	50	5 (1+2.5+1.5)
	Five units	Total 25	Marks 50	Marks 125	Marks 75	Total Marks 250	Total credit 25

ThGL: Theory (general) + Laboratory

FIRST SEMESTER
UNIT: BOT/ThGL/101:
Microbiology
(Theory 25 marks + Internal Asst.)

1. **History of Microbiology:** Leeuwenhoek's Animalcules, Cell theory, Spontaneous Generation, Germ theory of Disease, Koch's Postulates.
2. **Microbial taxonomy:** Basis of bacterial classification: polyphasic approaches to bacterial taxonomy. Salient features of major bacterial groups according to Bergey's Manual of Systematic Bacteriology.
3. **Microbial growth, nutrition and control:** Microscopy, Staining, Culturing Microorganisms: Obtaining a pure Culture, Preservation of microorganisms. Doubling time and growth rate, Phases of growth, Measurement of microbial growth, Continuous cultures of microorganisms, Different types of culture media, Factors affecting microbial growth, Nutritional types of microorganisms. Physical and chemical methods of controlling growth of microorganisms. Antibiotic resistance
4. **Concept on prokaryotic cells:** Structure and chemical composition of Gram + and Gram – bacterial cell wall, Passage of Molecules across microbial cell membrane; Archae: Characteristics, types and differences with eubacteria. Structure and functional characteristics of Actinomycetes and Mycoplasma.
5. **Nutrition and metabolisms of microorganisms:** Heterotrophy, chemoorganotrophy, chemolithotrophy, mixotrophy, and photoautotrophy.
6. **Virology:** Classification of viruses, Replication of viral nucleic acids; one step growth curve; lytic and lysogenic cycle.
7. **Environmental Microbiology:** a) Soil Microbiology: Rhizosphere & Microbial flora, nitrogen cycle, biological nitrogen fixation-symbiotic and nonsymbiotic; Role of Phosphorus and Sulfur stabilizing bacteria, b) Air Microbiology: Microbial flora of air; c) Water Microbiology: Microbial flora of water, treatment of waste water
8. **Applied and Industrial Microbiology and Clinical Microbiology:**
 - a) Microbial fermentation and production of small and macro molecules.
 - b) Microbial diseases: Animal diseases; cholera, AIDS, hepatitis, giardiasis. Plant diseases; tungro virus of rice, potato scab by Streptomyces, Black leg of Potato by bacteria, [Downy mildew of Grape](#).

Practical: (15 marks)

1. Basic microbiological techniques: Light-Microscopy; use of oil-immersion objective, Preparation of media, sterilization, slant and stab preparation.
 2. Cultivation of Microorganisms : on agar-slant/agar-plate;
 - a) Streak culture: Bacteria (Bacillus subtilis, Staphylococcus aureus, Escherichia coli);
 - b) Pure-culture: by streak-plate/pour plate methods.
 3. Characterization of selected pure culture isolates by Gram staining, simple and negative staining, endospore staining and physio-biochemical features (extracellular enzymes, antibiotic sensitivity).
 4. Determination of bacterial growth and growth kinetics by turbidometric and cell count method.
 5. A) Microbiological examination of water: i) a) Presumptive test b) Confirmatory test c) Completed test: for coliform; ii) IMViC reactions.
B) Microbiological examination of milk by methylene-blue dye reduction test.
 6. Isolation of antibiotic producing organism from soil and their sensitivity assay against standard laboratory strains of bacteria.
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FIRST SEMESTER
UNIT: BOT/ThGL/102 :
Phycology
(Theory 25 marks + Internal Asst.)

1. Introduction, Classification, Phylogeny and Evolution:

a. Range in thallus organization; Ultra-structure of algal cells; Reproduction and Phylogeny.

b. Parameters for classifying algae: Salient features of Cyanophyta (Cyanobacteria: classification, Heterocyst-ultra structure and biochemistry, nif gene);

Chlorophyta (Cell division pattern, ultra structure of flagella; classification and phylogeny);
Heterokontophyta [Xanthophyceae, Bacillariophyceae : Ultra structure and developmental patterns of diatom frustules, Role of Frustule protein; Phaeophyceae] and Rhodophyta.

c. Glaucophyta : Characteristics features and phylogenetic significance

d. Dinoflagellates: Cell structure.

e. Concept of Streptophyta and algal origin of land plants.

g. Phylogeny & Evolution: Endosymbiotic origin of Chloroplasts; evolution of chloroplast in different algal groups; molecular markers for phylogenetic study.

2. Algal ecology and Economic importance :

a. Algae in diversified habitats-examples with different geographical locations; Eutrophication, Algal Blooms, Red-tides; Algal toxins.

b. Pheromone in algae and ecological implication

c. Mass production for industrial use: nutraceuticals, pharmaceuticals, biofuel, biofertilizer, Phycocolloids - agar-agar, alginic acid, carageenan; Diatomaceous earth; Single cell protein.

d. *Chlamydomonas reinhardtii* as a model system for molecular biology and genetics.

Practical: (15 marks)

- (i) Study on algal diversity: Staining, micrometry, microphotography, Identification of the representative specimen from Cyanophyta (Cyanobacteria), Chlorophyta, Phaeophyta and Rhodophyta.
 - (ii) Field survey of Phytoplankton in different habitat and seaweed. Each candidate will submit 5 algal specimen with identification.
 - (iii) Identification with anatomical features of seaweeds.
 - (iv) Qualitative and Quantitative estimation of phytoplankton of different habitats.
 - (vi) Algal culture using defined media.
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FIRST SEMESTER

UNIT: BOT/ThGL/103:

Mycology

(Theory 25 marks + Internal Asst.)

1. Fungi in living world:

- a. Introduction : Diversity of fungi and fungus-like organisms; evolution and phylogeny including systematics.
- b. Physiology of Fungi : Growth - Factors affecting growth (Physical and Nutritional); Growth kinetics.
- c. Reproduction of Fungi : Spore forms, molecular and biochemical changes accompanying sporulation, spore liberation, spore dispersal, spore dormancy and germination. Sex hormones in fungi; Patterns of life cycle.
- d. Genetics of Fungi : Structure and organization of fungal genome, Mitosis and meiosis in fungi. Genetic control of asexual and sexual reproduction; extra-chromosomal inheritance in fungi.
- e. Ecology of Fungi : Fungi in different ecosystems : saprophytes, parasites, predators and symbionts – Lichens and Mycorrhizae (A brief over-view)

2. Fungi of Medical Interest :

- a. Mycoses ; Allergies of man and animal caused by fungi.
- b. Mycotoxins and Mycotoxicoses, with special reference to Aflatoxins and Ergot alkaloids.

3. Applied Mycology :

- a. Industrial application : Single cell protein, alcohol production, antibiotic production (penicillin), organic acids, enzymes and alkaloids (general account).
- b. Application of Mycorrhizae : Mycorrhizal networking in plant community benefitting agriculture and forestry.
- c. Mushrooms and Mushroom Cultivation : Edible and medicinal mushrooms; biological value of mushrooms, bioconversion of lingo-cellulosic wastes; Cultivation practices – pure culture, spawn production, compost and their preparation, techniques of cultivation of oyster and button mushrooms.

MYCOLOGY

Practical: (15 Marks)

1. Sterilization techniques and sterilizers.
 2. Preparation of fungal culture medium , slant, stab and pouring of plates
 3. Monosporous, Polysporous and fungal tissue culture; subculturing
 4. Isolation of fungi from air, water and soil by culture plate technique.
 5. Study of different type of spores.
 6. Study on the effect of temperature and pH on spore germination and mycelia growth.
 7. Studies on the morphological and reproductive structures of macro- and micro fungi :
Plasmodiophora, Albugo, Saccharomyces, Xylaria, Daldenia, Agaricus, Pleurotus, Volvariella, Clavaria, Puccinia, Auricularia, Fusarium, Alternaria, Colletotrichum, Cercospora, Curvularia, Cladosporium
 8. Study of fungal flora during field trip / Visit to Mushroom Cultivation Centre.
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FIRST SEMESTER
UNIT: BOT/ThGL/104 :
Bryophytes & Pteridophytes
(Theory 25 marks + Internal Asst.)

BRYOPHYTES (Marks 10)

1. General habit, habitat, global distribution, biogeography, growth forms, life forms and colonization.
2. **Outline of recent classification** (Goffinet & Shaw 2009) of bryophytes into three coordinate Phyla: Marchantiophyta (liverworts), Anthoceroophyta (hornworts) and Bryophyta (mosses). Origin, evolution and fossil history of bryophytes.
3. Characteristics, affinities and systematic position of Calobryales, Takakiales and Sphagnales. Comparative study of the gametophyte and sporophyte of major groups with special reference to Indian bryodiversity.
4. **Role of bryophytes in ecology & ecosystem dynamics :**
Poikilohydry, desiccation tolerant, succession dynamicity, as pollution indicator and for biomonitoring; as phytoremediator.
5. Metabolic chemistry of bryophytes.

PTERIDOPHYTES (Marks 15)

1. **Origin of land plants, Classification & Evolution :** Adaptive features of pteridophytes for early colonization on land habit; Outline of systematic treatment of pteridophytes; molecular systematic and chemosystematic approach; Distribution of extant groups in time and space; evolutionary significance of the members: a) Rhyniopsida, b) Zosterophylloids, c) Trimerophytoids and d) Early Lycopsids and Sphenopsids.
2. **Major Fern groups:** Distribution; Structure (study of shoot apex, leaf initiation and early leaf ontogeny in ferns, stomatal types and development; evolution of stele); Reproduction (origin and evolution of sporangium); Diversity of ferns in an ecological domain.

Characteristics and affinity of the members from the following orders:
a) Ophioglossales b) Marattiales c) Osmundales d) Filicales (generalised form of Simplicales, b) Gradatae and Mixtae types) e) Polypodiales; f) Gleicheniales.
3. **Ecological Perspective :** Diversity of ferns in an ecological domain; Heterospory and seed habit; Soral evolution in ferns, Salviniaceae; insect, microorganism interaction with pteridophyte; Endangered and Endemic pteridophytes and their conservation.
4. **Phytochemistry, Cytogenetic of Pteridophytes :** Biochemical aspects of gametophyte differentiation; antheridogens-chemical nature and mode of action; Determination of femaleness in free sporing; Heterosporous plants; Polyploidy, Apospory, Apogamy, Apomixis and genetic variability in fern population-genetic load.

Practical: (15 Marks)

BRYOPHYTE (Marks 5)

1. Workout on comparative morphology and anatomy of the gametophytes and sporophytes of different groups of Bryophytes: Marchantiales, Jungermanniales, Anthocerotales, Isobryales, Hypnobryales, Funariales, Pottiacles, Bryales & Dicranales (depending on availability of the specimen).
2. Workout on different types of peristome structure (Nematodontae and Arthrodontae) for classification of mosses.

PTERIDOPHYTE (Marks 10)

1. Study of external and internal morphology of vegetative and reproductive structures (spore types, soral anatomy etc.) of the following species (depending on availability of species):

Lycopodium, Selaginella, Equisetum, Drynaria, Lygodium, Diplopterygium, Dicranopteris, Phymatosorus, Oleandra, Nephrolepis, Asplenium, Blechnum, Adiantum, Pteris, Glychaenia, Cyathea/Alsophila/Hemitelia, Christella, Microsorium, Phymatosorus, Ophioglossum and Salvinia.

2. External morphological features of the following taxa:

Psilotum/Tmesipteris, Isoetes coromandelina, Ophioglossum, Schizaea, Marattia, Cibotium, Ceratopteris, Acrostichum, Dryopteris, Cheilanthes, Woodwardia and Onychium.

Field trip to different ecological terrain for submission of 4 specimen only (keeping in mind the importance of Biodiversity & Conservation of different species) from Bryophytes and Pteridophytes.

FIRST SEMESTER

UNIT: BOT/ThGL/105: Gymnosperm, Palaeobotany and Palynology (Theory 25 marks + Internal Asst.)

A. GYMNOSPERMS: (Marks 10)

Classification and economic importance. General account on the morphology, anatomy and reproduction of the following groups:

- i) **Glossopteridales**- with special reference to Indian members; concept of angiosperm ancestor,
- ii) **Cycadales**- with special reference to distribution of extant members; origin and evolution of leaves and megasporangiate fructification, Molecular phylogeny.
- iii) **Coniferales** with special reference to Indian distribution; origin and evolution of seed-cone complex.
- v) **Gnetales**. with special reference to distinction among the groups and molecular phylogeny.

B. PALEOBOTANY (Marks 8)

a. Geologic time scale, Fossils and fossilization process: Types, nomenclature, Techniques for studying fossil plants (ground thin section, peel technique, transfer technique and microfossil analysis), Importance and significance.

b. Radiometric dating: Principle and application of Relative and Absolute dating (C^{14} , Argon and Uranium dating).

c. Continental drift hypothesis and Plate Tectonics- concept, evidences, mechanism.

d. Indian Gondwana system- 3-fold division, megafloristic assemblages.

C. PALYNOLOGY: (Marks 7)

a. Concept : Symmetry; Polarity; Shape, classes; Sporoderm stratification, sporoderm ornamentation, Extraexinous wall material; NPC classification, LO analysis; Sporopollenin: physical and chemical nature, function; Pollen wall proteins, chemical markers of exine and intine.

b. Application : Palynology in oil exploration, Honey analysis and in detection and diagnosis of pollen/spore allergy.

Practical : (15 Marks)

1. Study of Vegetative and reproductive structure of representative member of Cycadales, Coniferales and Gnetales and others depending on availability:
(For eg. *Cycas*, *Zamia*, *Pinus*, *Cedrus*, *Cupressus*, *Cryptomeria*, *Thuja*, *Araucaria*, *Cephalotaxus*, *Encephalartos*, *Tsuga*, *Taxodium*, *Ginkgo*, *Cunninghamia*, *Callitris*, *Cedrus*, *Podocarpus*, *Juniperus*, *Cryptomeria*, *Gnetum*, *Ephedra* and *Welwitschia*).
 2. Study of gymnosperm fossils (slide and megafossils).
 3. Pollen morphological study of different plant taxa.
 4. Pollen slide preparation (temporary and permanent).
 5. Study of Pollen in honey sample.
 6. Analysis of peat samples.
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