Semester I

BOT 401: MICROBIOLOGY - MYCOLOGY

Unit – 1. Bacteria
- General account, Archae and Eubacteria.
- Classification of micro-organisms, microbial morphology (shapes).
- Basic methods in microbiology, economic importance

Unit – 2. Virus
- Virus, characteristics, virions.
- Bacteriophages, lytic and lysogenic, economic importance.
- Phytoplasma, characteristics, plant diseases

Unit – 3. Mycology
- General characteristics, ultrastructure, hyphal Growth, aggregations in Fungi, Nutrition and Reproduction, economic importance
- Recent trends in Classification - Ainsworth; Alexopoulos and Mims.
- General Account of various groups, Heterothallism, Heterokaryosis and Parasexuality, Mycorrhizae.

Unit – 4. Plant Pathology
- Disease, Classification, Symptoms and Disease triangle. Disease Cycle, Host Parasite relationship
- Disease Control, Role of Weather and Soil fertility on disease development.
- Important diseases - Powdery mildew, Downy mildew, Rusts and Wilts.

SUGGESTED READINGS

BOT 401: MICROBIOLOGY - MYCOLOGY


BOT- 402: PHYCOLOGY AND BRYOPHYTES

Unit – 1. Algae - Classification
   - Criteria for Classification of algae: pigments, reserve food, flagella.
   - Classification - Smith, and Recent Classification of 11 Division by Van Hock et al.
   - Characteristics of Cyanophyta, Chlorophyta, Phaeophyta and Rhodophyta.

Unit – 2. Algae – Organization
   - Cell ultra-structure of Cyanophyta, Chlorophyta, Phaeophyta and Rhodophyta.
   - Thallus organization, Reproduction (Vegetative, Asexual & Sexual), algae in diversified habitats (terrestrial, freshwater and marine).
   - Applied Phycology: Biofertilizers, food, feed and uses in Industries. Algal blooms, Water Pollution, Toxicity, Biofouling and Control

Unit – 3. Bryophyta – Basics
   - General Account, Alternation of generation
   - General Classification including of Rothmaler and Proskauer, characteristics of different groups
   - Origin, Reproduction, Vegetative, Sexual, Distribution in India

Unit – 4. Bryophyta – Applications
   - Economic and Ecological Importance
   - Fossil Bryophytes, general account of fossil Bryophytes – Takakia
   - Research in Bryophytes
BOT- 402: PHYCOLOGY AND BRYOPHYTES


BOT 403: PTERIDOPHYTA-GYMNOSPERMS

Unit - 1. Pteridophyta - Basics
- General characters. Origin and evolution
- Alternation of generation, Evolution of Stele, Telome theory.
- Classification – Smith and General Account of various groups

Unit - 2. Pteridophyta – Evolution
- General account of Fossil Pteridophyta - *Asteroxylon, Miadesmia, Sigillaria* and *Calamophyton*.
- Spore producing parts and Soral Evolution. Origin and development of Heterospory. Origin of Seed habit
- Distribution of Pteridophytes in India, Economic importance

Unit – 3. Gymnosperms
- General characters, Classification by Coulter and Chamberlain, Sporne.
- Origin and evolutionary trend – primary vasculature, secondary wood, leaf, gametophyte, male – female and embryo
- Distribution of Gymnosperms in time and space (India). Economic Importance of Gymnosperms

Unit – 4. Paleobotany
- Techniques for Paleobotanical study, Paleoclimates, process of fossilization.
- General account of Pteridospermales, Bennettitales, Pentoxylales and Cordaitales.
- Gondwana flora, fossilized Pteridophytes – Gymnosperms
BOT 403: PTERIDOPHYTA-GYMNOSPERMS


---

BOT 404: PLANT TAXONOMY

Unit – 1. Botanical Nomenclature
- Taxonomy and systematic botany, aim, concepts of plant classification.
- Botanical nomenclature, International Code of Botanical Nomenclature, salient features, species concept
- Tools of taxonomy, plant explorations, collection, herbarium, methodology, flora, Botanical garden, BSI, e – herbarium

Unit – 2. Classification Systems
- Systems of classification (Natural, artificial, phytogenetic) and their merits/merits
- Taxonomic evidences (anatomy, embryology, phytochemistry, numerical, molecular)
- Phytogeography, regions of the world, flora of India, Gujarat flora

Unit – 3. Morphology
- Vegetative plant parts (root/ stem/ leaves) and their modifications
- Reproductive plant parts (Inflorescence/ flower/ fruit/ seed) and their modifications
- Plant forms, origin and general evolutionary trends in flowering plants.

Unit – 4. Plant Families
- Plant identification and use of keys, taxonomic literature
- Plant families – dicot (15) characteristics with representative examples and economic importance
- Plant families – monocot (05) features with examples and economic importance.
BOT 404: PLANT TAXONOMY


------------------------------------------------------------------------------------------------------------

BOT 405PR: Practical – I: Based on topics covered in BOT 401 and 402

------------------------------------------------------------------------------------------------------------

BOT 406PR: Practical – II: Based on topics covered in BOT 403 and 404

------------------------------------------------------------------------------------------------------------
Semester II

BOT 407: CYTOLOGY AND EVOLUTION

Unit – 1. Membrane Systems
- Plant Vacuole: Tonoplast Membrane; functions
- Nucleus : Structure; Nuclear Pores; Nuclesomse Organization;

Unit – 2. Cytoskeleton and Organelles
- Structure and function of Microbodies, Golgi apparatus, Lysosomes and Endoplasmic Reticulum.
- The Cytoskeleton; Organization and Role of Microtubules and Microfilaments; Control Mechanisms; Role of Cyclins and Cyclin - dependent Kinases.
- Other Cellular Organelles: Structure and function of Microbodies, Golgi apparatus, Lysosomes and Endoplasmic Reticulum.

Unit – 3. Cell Techniques
- Cell Cycle and Apoptosis: Programmed cell Death; Mechanisms and types, PCD in plant life cycle
- Techniques in Cell Biology, Microscopy (light, phase, contrast), SEM – TEM and Confocal Microscopy and cyphotometry
- Cytochemical techniques, cell fractionation, FISH and flow cytometry

Unit – 4. Evolution
- Fundamentals, forces, sources of variation, evidences
- Evidences and theories of organic evolution, Natural selection, Darwin – Lamarck theory
- Evolutionary divergence, isolating mechanisms, adaptation

BOT 407: CYTOLOGY AND EVOLUTION

BOT 408: PLANT PHYSIOLOGY

Unit – 1. Water and Mineral Nutrition
- Water, characteristics importance for plant, water absorption and transport, transpiration
- Mineral nutrition, essential elements, importance and deficiency symptoms
- Nitrogen metabolism, N in environment, assimilation, BNF

Unit – 2. Major Pathways
- Photosynthesis, photosynthetic apparatus, PS I & PS II, mechanism of electron – proton transport, carbon fixation (C₃/ C₄/ CAM), factors affecting photosynthesis, photorespiration – C oxidation cycle,
- Translocation of photosynthetic phloem, source – sink, partitioning and allocation.
- Respiration, Mitochondria, structure, glycolysis, TCA cycle, electron transport, ATP synthesis, different substrates

Unit – 3. Growth and Development
- Growth, development, concept, qualitative – quantative changes
- Growth regulators, biosynthesis, bioassay, mechanism of action, physiological effects, applications (auxin, cytokinin, gibberellins, ABA, ethylene)
- Physiological effects and role of jasmonic acid, polyamines, brassinosteroids, salicylic acid

Unit – 4. Plant Responses
- Phytochrome, Pr and Pfr structure, localization, plant responses, plant movement, cellular actions
- Flowering, shoot apex modification, floral meristem, photomorphogenesis, photoperiodism, biochemical signaling, vernalization
- Stress physiology, water status, deficit, drought, structural and biochemical features to overcome stress, chilling, salinity etc.

BOT 408: PLANT PHYSIOLOGY


---

**BOT 409: PLANT ECOLOGY**

**Unit – 1. Basics of Ecology**

- **Ecological Factors:** Soil, light, water etc, Principles of limiting factors; biotic factors, Productivity: Population ecology – concept, types, fluctuation, factors regulating size, mortality – natality
- Population ecology, concept, type, fluctuations, factors regulating size, autecology, mortality, natality.
- **Ecosystem Organization:** Structure and Function, Types, Energy Flow in Ecosystem, Biogeochemical cycles (C, N, P and S).

**Unit – 2. Community and Biodiversity**

- **Vegetation Organization:** Composition and Structure of Plant Community, Qualitative and Quantitative Characteristics, Phytosociological Methods, Ecological Niche.
- **Vegetation Development:** Process of Ecological Succession, Models and Climax Stage, Hydrosere, Xerosere and causes of succession, productivity concept.
- **Biological Diversity:** Concepts and levels; role of biodiversity in ecosystem functions and stability; speciation and extinction; IUCN categories of threat; biodiversity hot spots; ecology of plant invasion;

**Unit – 3. Environmental Issues**

- **Climate Change:** Greenhouse gases (CO₂, CH₄, N₂O, CFCs; sources, trends and role); ozone layer and ozone hole, consequences of climate change (CO₂ fertilization, global warming, sea level rise, UV radiation).
- **Environmental Pollution:** Air, Land and Water. Pollution, kinds; sources; quality parameters;
- Ecological Adaptations, various adaptations, types, sustainable development, EIA
Unit – 4. Remote Sensing

- Principles, components and types of Remote sensing
- Applications of remote sensing
- IRS, RADAR, GIS, GPS

**BOT 409: PLANT ECOLOGY**

1. Basic Ecology – Eugene P. Odum
2. Fundamentals of Ecology- P. Odum
3. Concept in Indian Ecology and Environmental Science – S. V. S. Rana
4. Ecology Theories and Application – Peter Stiling
5. Ecology & Environment – P. D. Sharma

**BOT - 410: PLANT BREEDING AND HORTICULTURE**

**Unit - 1. Breeding**

- Plant breeding – objectives, origin, domestication, hybrid vigour
- Principles and methods of Plant Breeding, Self pollinated crops, Cross pollinated crops, Clonal crops
- Plant Introductions - NBPGR

**Unit - 2. Biosafety and Bioethics**

- IPR, Patents, concept, benefits, GATT TRIPS
- Biosafety and bioethics,: objectives, risk assessment, containment, genetically modified plants
- Seed certification, Release of varieties, Plant Breeder’s Right, Labeling, Legislation

**Unit – 3. Horticulture**

- Propagation by seeds and vegetative structures, harvesting, storage and viability, germination, dormancy (seed and bud), Pretreatments
- Techniques, anatomical and Physiological aspects of rooting of cuttings, Grafting, Budding, Layering
- Important horticultural crops of India with emphasis on Gujarat fruit/ flowers, cultivation, harvest and post – harvest handling.
Unit – 4. Gardening and Landscape

- Cultivation under cover, greenhouse: advantages, construction, types, maintenance. Organic farming, mulching, composting, IPM, advantages
- Landscaping – principles, types, planning, Xeriscaping
- Garden – features / elements, styles, Indoor gardening, Gardens of India

BOT - 410: PLANT BREEDING AND HORTICULTURE


-------------------------------------------------------------------------------------------------------------------------------------

BOT 411PR: Practical – III: Based on topics covered in BOT 407 and 408
-------------------------------------------------------------------------------------------------------------------------------------

BOT 412PR: Practical – IV: Based on topics covered in BOT 409 and 410
-------------------------------------------------------------------------------------------------------------------------------------
Semester III

BOT – 501: PLANT ANATOMY AND EMBRYOLOGY

Unit - 1. General Anatomy
- Shoot and Root Apical Meristem, Cellular manifestation and factors affecting development, Shoot apex of Pteridophyta, Gymnosperm and Angiosperm, lateral roots, root hairs
- Epidermis, stomata, trichomes, types, role
- Secretory Ducts and Laticifers, types, development, function.

Unit - 2. Plant Wood
- Vascular elements, functional differentiation, p proteins
- Nodal Anatomy, Nodal types, leaf gaps, branch
- Wood development and environmental factors, heartwood, softwood and Role of cambium.

Unit – 3. Gametophyte Development
- Structure and development of microsporangium. Microsporogenesis, development of male gametophyte.
- Structure and development of megasporangium. Megasporogenesis, development of female gametophyte.
- Different types of embryo sacs, ultra structure of embryo sac, Nutrition.

Unit – 4. Fertilization
- Pollination, Pollen pistil interaction, Pollen viability, storage, germination, Fertilization, sexual incompatibility
- Embryo development, Types of embryogeny, Polyembryony, Nutrition, endosperm, seed development
- Palynology — morphographic, aeropalynology, Mellitopalynology, Paleopalynology, forensic palynology.

BOT – 501: PLANT ANATOMY AND EMBRYOLOGY


---

**BOT - 502: CLASSICAL AND MOLECULAR GENETICS**

**Unit - 1. Mendelian Genetics**
- Genetics – principles of inheritance, pea as a model hybrids
- Gene interactions, linkage and crossing over, genetic mapping
- Extra chromosomal inheritance, chloroplast, Mitochondria, genome and genes.

**Unit - 2. Mutation**
1. Chromosome aberrations, ploidy, variation in structure and arrangement.
2. Mutation, physical – chemical, molecular basis, recombination, Transposons.
3. Damage and repair, site directed mutagenesis, sex linked inheritance

**Unit – 3. Molecular Genetics**
- Molecular basis of genetics, experiments, DNA, characteristics, structure, forms of DNA, gene – genome, replication
- Genetic expression, transcription, code, translation, modification
- Gene regulation, prokaryotic, operon, eukaryotic

**Unit – 4. Genetic Engineering**
- Recombinant DNA technology, restriction enzymes, gene cloning, choice of vectors.
- Construction of genomic/ cDNA library, PCR
- DNA analysis, Southern – Northern blotting, sequencing, Molecular markers, microarrays, RNA interference, small RNAs, microRNAs, RNAi based modifications
BOT - 502: CLASSICAL AND MOLECULAR GENETICS


-------------------------------------------------------------------------------------------

BOT - 503: BIOINFORMATICS AND BIOSTATISTICS

Unit – 1. Basics of Computers
   • Introduction to Bioinformatics and basics of computers
   • Operating systems
   • Databases

Unit - 2. Bioinformatic Tools
   • Bioinformatic workstation
   • Sequence alignment
   • Genomics and proteomics, Applications

Unit – 3. Biostatistics – Scope
   • Principle and scope of statistical methods in biological research
   • Sampling, Data- types, Data Collection, Presentation of data
   • Measures of central tendency- Mean, median, mode
Unit – 4. Biostatistics – Methods
- Standard deviation/ error, Coefficient of variation, confidence limits, Tests of statistical significance (chi square, student t test)
- Probability - definitions of various events in probability, laws.
- Linear correlation, Linear regression, ANOVA, Use of computer in statistical analysis

BOT - 503: BIOINFORMATICS AND BIOSTATISTICS
2. Developing Bioinformatics Computer Skills-Gibas C & Jambeck P
3. The single Genetic Algorithm-Vose M D
4. Bioinformatics-Sequence,structure and Databases –Higgins D & Taylor W.
5. A Text Book of Biotechnology, R.C. Dubey, S. Chand Publication.

BOT - 504: PHYTORESOURCES AND CHEMISTRY

Unit - 1. Phytoresources
- Origins of agriculture, World centers of primary diversity of domesticated Plants;
- Origin, evolution, botany, cultivation and uses of Food, forage-fodder fuel, Fiber, furnishings, flavours, Medicinal plants, and oil-yielding plants of Gujarat and India.
- Non-wood forest products (NWFPs): Raw materials for paper – making, Gums and Resins, Dyes.

Unit – 2. Ethnobotany and Conservation
- Basic methods and approaches to study traditional knowledge, various sub disciplines
- Scope, voucher specimen, verification, screening and potential applications
- Conservation, principles, strategies, in situ – ex situ, protected areas, gene – seed banks, initiatives (international/ national), IUCN.

Unit – 3. Phytochemistry and Pharmacognosy
- Secondary metabolites, types – characteristics, extraction strategies, analysis, biosynthetic pathways and inter relationships
- Pharmacognosy, morphology (macro – micro), methods, adulterants, quality control.
- Role of Phytochemicals, commercial exploitations (cultivation, in vitro approaches), important medicinal plants with uses and yielding active principles from underground parts/ whole plant/ flowers/ fruits/ seeds.
Unit - 4. Metabolism
- Enzymes, types, distribution, Km value and enzyme kinetics, factors affecting activity
- Carbohydrates, structural types, biosynthesis, functions
- Proteins, amino – acids, types, structural characters, functions; Lipids, types, biosynthesis, storage lipids, function

BOT - 504: PHYTORESOURCES AND CHEMISTRY

8. Economic Botany – by S. L. Kochhar
10. Economic Botany – by Bendre & Kumar
12. Contribution to Indian Ethnobotany – I
14. Ethnobotany, Interdisciplinary Science Reviews
Semester IV

BOT- 507: PLANT BIOTECHNOLOGY

Unit – 1. Plant Tissue Culture
- General technique, Laboratory and equipments, aseptic techniques, nutrient medium, plant growth regulators
- Morphogenesis, Plant regeneration, somatic embryogenesis, advantages, synthetic seeds
- Callus, induction, transfer – subcultures, growth kinetics, cell suspension, application

Unit – 2. In vitro Production
- Micropropagation, cloning, various stages, applications, pathogen indexing, meristem culture, virus free plants, therapy (chemo/ Thermo), advantages
- Haploids, androgenesis, various pathways, factors affecting, advantages – applications, gynogenesis
- Phytochemicals, large scale cultures, bioreactors, improvement – elicitors, two phase systems, hairy root cultures, biotransformation, applications

Unit – 3. Plant Improvement
- Somatic hybridization, protoplast isolation, culture, fusion, selection of hybrids, advantages.
- Somaclonal variation, origin, factors inducing variations, cell selection, advantages
- Transgenic plant, gene construct, Ti plasmid, transformation, direct gene transfer methods, advantages

Unit – 4. Complementary Techniques
- Germplasm conservation, slow growth, cryopreservation (freezing – thawing), cryoprotectants, applications
- Distant hybridization, in vitro pollination/ fertilization, embryo culture, embryo – rescue, applications
- Commercial outlook, technology, important plants, International and Indian status, issues
BOT- 507: PLANT BIOTECHNOLOGY


BOT- 508: BIOPHYSICS AND MODERN APPROACHES

Unit – 1. Biophysics
- Free radicals, Bonds: types and their role
- Laws of Thermodynamics, role in plant processes and functions.
- Tracer techniques Autoradiography: Principle and Working, effect of radiation on biological system

Unit – 2. Separation methods
- Electrophoresis: Principle, types, IEF, technique and application.
- Chromatography: Principle, types, TLC, GLC, HPLC, technique and application.
- Centrifugation, principle, differential density, ultracentrifugation, application
Unit – 3. Analytic techniques
- Spectroscopy: Gel filtration (ion/affinity/exclusion), Principle, types, UV – visible technique and application
- X-ray diffraction, atomic absorption, application
- Advanced spectroscopy, IR, NMR, biosensors

Unit – 4. Modern Approaches
- Sustainable Agriculture, Organic Cultivation, Carbon Trading
- Food Biotechnology, transgenic, strategies
- Nutraceuticals and medicinal Plants

Suggested Readings:-
1. Basic Biophysics by Deniel, Agrobotanical Publishers
5. Useful Techniques for Plant Scientists, Arvind M. Dhopte and Manuel Livera, Publication Forum for Plant Physiologist, Akola, India.

BOT 509E: Elective – I
Total Credits: 4

Unit 1. Knowledge enhancement
i. Seminars – in house 0.25/sem = 0.75 (in 3 semesters)
   - Attend/participate elsewhere with certificate = 0.25
ii. Assignment with write-up and documentation = 1.0
   under guidance

Unit 2. Skill development
i. Workshop - Training – on photography/ Drawing/
   model making/ techniques/ Industrial training/
   nursery exercises etc. certificate of completion
   For 3 days = 0.5
   For 6 days = 1.0
Unit 3. Capacity building

i. Excursion – ethnobotanical/ floristic study, with report
   For 3 days = 0.5
   For 6 days = 1.0

ii. Visit to Institute – for industrial/ institutional with certificate of completion
    For 2 institutions = 0.5
    For 4 institutions = 1.0

Unit 4. Proficiency

i. Scientific Writing 1 period/ 15 days = 0.5

ii. Soft Skill 1 period/ 15 days = 0.5

iii. Communicative English 1 period/ 15 days = 0.5

---------------------------------------------------------------

BOT 510PP: Project Proposal

Compilation under guidance with write – up including introduction, problem, aim, literature survey, methodology, probable outcome, bibliography and enclosures.

---------------------------------------------------------------

BOT 512PR: Practical – VII: Based on topics covered in BOT 506 and 507

---------------------------------------------------------------