

JIWAJI UNIVERSITY  
GWALIOR (M.P.)

SYLLABUS

FOR

**M.Sc. (BOTANY)**

SEMESTER SYSTEM

SESSION

2013 – 2015

### M.Sc. I SEMESTER

BOT 101	Bacteriology, Virology & General Microbiology	(100 Marks)
BOT 102	Biology and Diversity of Fungi and Plant Pathology	(100 Marks)
BOT 103	Biology and Diversity of Algae, Bryophytes and Lichens	(100 Marks)
BOT 104	Biology and Diversity of Pteridophytes and Gymnosperms	(100 Marks)
BOT 105	Practical Course Based on Theory Course 101 & 102	(100 Marks)
BOT 106	Practical Course Based on Theory Course 103 & 104	(100 Marks)

### M.Sc. II SEMESTER

BOT 201	Ecology-I Climatology, Soil Science and Autecology	(100 Marks)
BOT 202	Angiosperm Anatomy, Embryology and Palynology	(100 Marks)
BOT 203	Water Relations, Growth and Development	(100 Marks)
BOT 204	Plant Biochemistry and Metabolism	(100 Marks)
BOT 205	Practical Course Based on Theory Course 201 & 202	(100 Marks)
BOT 206	Practical Course Based on Theory Course 203 & 204	(100 Marks)

### M.Sc. III SEMESTER

BOT 301	Angiosperm Morphology and Taxonomy	(100 Marks)
BOT 302	Cytology and Molecular Biology of Plants	(100 Marks)
BOT 303	Biometry, Bioinformatics and Instrumentation	(100 Marks)
BOT 304	Ecology-II Synecology, Ecosystematology & Phytogeography	(100 Marks)
BOT 305	Practical Course Based on Theory Course 301 & 302	(100 Marks)
BOT 306	Practical Course Based on Theory Course 303 & 304	(100 Marks)

### M.Sc. IV SEMESTER

BOT 401	Genetics, Plant Breeding and Evolution	(100 Marks)
BOT 402	Plant Biotechnology: In Vitro Culture, Genetic Engineering and IPR Issue	(100 Marks)
<b>BOT 403</b>	<b>ELECTIVE PAPERS (OPTIONAL)</b>	
BOT E01	Industrial Microbiology	(100 Marks)
BOT E02	Biochemistry and Metabolism in Plants	(100 Marks)
BOT E03	Ethnobotany and Isolation of Natural Products	(100 Marks)
BOT E04	Stress Physiology	(100 Marks)
BOT E05	Plant Pathology and Mycotoxicology	(100 Marks)
BOT E06	Agroecosystem	(100 Marks)
<b>BOT 404</b>	<b>PROJECT/ INTERNSHIP</b>	(100 Marks)
BOT 405	Practical Course Based on Theory Course 401 & 402	(100 Marks)
BOT 406	Practical Course Based on Theory Course 403 & 404	(100 Marks)

## **BOT 101: BACTERIOLOGY, VIROLOGY & GENERAL MICROBIOLOGY**

### **UNIT 1:**

Bacterial taxonomy;  
Identification of bacteria.  
General characters of *Rickettsia* and *Chlamydia*.  
Diseases caused by *Rickettsia* and *Chlamydia*.  
Mode of nutrition in bacteria; autotrophy, heterotrophy, symbiosis.

### **UNIT II**

General account of sterilization culture media, pure culture techniques;  
A general idea about bacterial toxins and enzymes;  
Bacteriophage;  
Bacterial diseases: caused by *Escherichia coli*, *Shigella*.

### **UNIT III**

General properties and evolution of viruses;  
Cultivation of virus and viral assay;  
Transmission of plant viruses and control measures.  
Oncogenic viruses and tumorigenesis;  
Viral diseases: Encephalitis, Hepatitis AIDS and Rabies.

### **UNIT IV**

Biological nitrogen fixation: symbiotic and non symbiotic nitrogen - fixation;  
Fermentation technology: principle and types of fermentation.  
Microbial degradation of pesticides and hydrocarbons.  
Mycoplasma: general account and important diseases caused by them.

### **UNIT V**

Microbial conversion of waste product with particular reference to alcohol and biogas  
General account of Immunity, properties of antigens and antibodies.  
Allergy and types of allergies.  
Mycotoxins and their harmful effects.

### **PRACTICALS 101:**

1. Preparation of culture media.
2. Isolation of *Bacillus* and *Rhizobium* spp from soil and nodules.
3. Various methods of bacterial staining to study cell wall, endospore, capsule and flagella.
4. Identification of important genera by using biochemical tests: *Escherichia*, *Azotobacter*, *Staphylococcus*, *Bacillus*, *Pseudomonas*, *Rhizobium*, *Streptomyces*, *Xanthomonas*.
5. Construction of bacterial growth curve.
6. Quantitative estimation of bacteria in milk.
7. Isolation of streptomycin – resistant mutants of bacteria.
8. Sensitivity test of bacteria using different antibiotics.
9. Purification of TMV and study of thermal inactivation point and dilution point.
10. Virus concentration determination by local lesion on host.
11. Study of common vectors of plant virus: Nematodes, fungi and insects.
12. Bacteriophage isolation
13. Isolation and enumeration of bacteria: Actinomycetes and fungi from soil, rhizosphere and seed using different techniques.
14. Use of selective media for isolating micro- organisms.
15. Fermentation of alcohol and biogas from waste materials (Demonstration)

## **BOT 102: BIOLOGY AND DIVERSITY OF FUNGI AND PLANT PATHOLOGY**

### **UNIT I**

Recent trends on the classification of fungi with reference to morphological and paramorphological criteria;  
Comparative study of following sub-division;  
Mastigomycotina: *Albugo*, *Peronospora*, *Plasmopora*

### **UNIT II**

Comparative study of following sub-division;  
Zygomycotina: *Mucor*, *Rhizopus*, *Syncephalastrum*  
Ascomycotina: *Tapharina*, *Emericella*, *Penicillium*, *Chaetomium*, *Morchella*

### **UNIT III**

Comparative study of following sub-division;  
Basidiomycotina: *Puccinia*, *Melampsora*, *Ustilago*, *Polyporus*, *Cyathus*  
Deuteromycotina: *Fusarium*, *Cercospora*, *Colletotrichum*.  
Mushroom cultivation: Mycorrhizal application in agriculture and forestry;  
Fungal cytology and genetics: Heterothallism, heterokaryosis, parasexual cycle, mutation.

### **UNIT IV**

Symptomatology in fungal, bacterial and viral infection of plants  
Etiology and control of the following crop diseases

1. Paddy: paddy blast, paddy blight
2. Wheat: Black stem rust, Bunt of wheat
3. Bajara: green ear and Ergot
4. Sugarcane: Red rot disease of sugarcane.
5. Ground nut: Tikka disease
6. Maize Smut

### **UNIT V**

Role of enzymes and toxins in pathogenesis;  
Disease control by physical, chemical and biological methods, resistant varieties;  
Crop rotation, plant quarantines, seed certification

### **PRACTICAL 102:**

Study of the morphological characters and reproductive structures of the genera mentioned in the theory. Study of symptomatology of diseased species. Carbon and nitrogen utilization by fungi (in culture) vitamin requirement, staining techniques, induction and isolation of mutants.

1. Study of diseased specimens of plants with reference to symptomatology.
2. Isolation, purification and single spore culture of pathogens.
3. Measurement of the activity of enzymes of fungal pathogens: Cellulose, Pectinases.
4. Laboratory testing of fungicides (systemic and non-systemic) against pathogenic fungi.
5. Demonstration of biological control of pathogenic fungi *in vitro*.

## **BOT 103: BIOLOGY AND DIVERSITY OF ALGAE, BRYOPHYTES AND LICHENS**

### **UNIT I**

Comparative survey of important systems of classification of algae;  
Criteria for algal classification and modern trends;  
Diagnostic features of algal phyla, range of thallus and reproductive diversity; life history patterns, parallelism and evolution.

### **UNIT II**

Comparative account of algal pigments ; light microscopic structure, ultra structure and function of cell wall, flagella, chloroplast, pyrenoids and eyespots and their importance in taxonomy.  
Study of Cyanophyta, Chlorophyta, Xanthophyta, Bacillariophyta, Phaeophyta and Rhodophyta up to the order level with reference to the following genera: *Anabaena*, *Gonium*, *Chlorella*, *Enteromorpha*, *Bulbochaete*, *Clostridium*, *Acetabularia*, *Nitella*, *Botrydium*, *Navicula*, *Cyclotella*, *Batrachospermum* and *Gracillaria*.

### **UNIT III**

General characteristics of the division: Diophyta, Chrysophyta and Cryptophyta.  
Distribution of algae in soil, fresh water and marine environment, role of algae in soil fertility, productivity in fresh water and marine environment algae role in fisheries, algae in symbiotic association, algae in polluted habitats, algae as indicator of pollution, fossil algae, algae in biotechnology.

### **UNIT IV**

Origin of Bryophytes: Primitive vs. advanced characters, derived features: evolutionary lines. Classification.  
Comparative morphological, anatomical and cytological studies of gametophyte and sporophytes of Calobryales, Jungermanniales, Sphaerocarpaceae, Marchantiales, Takakiales, Sphagnales, Andreales and Bryales.

### **UNIT V**

Experimental studies in Bryophytes  
Spore germination, Protonemal differentiation, bud formation  
Parthenogenesis, apogamy, apospory and regeneration.  
Bryogeographical regions of India with reference to central India.  
Lichens: General account, structure and reproduction.

### **PRACTICAL 103:**

1. Collection and study of algae mentioned in theory, identification up to generic level using algal monographs.
2. Preparation of synthetic medium and cultivation of algae, unialgal and axenic culture and their maintenance.
3. Collection, preservation of algal herbarium (10 specimens).
4. Preparation of pigments.
5. Staining techniques of cytology studies.
6. Study of electron microscopy of some algae.
7. Morphology and structural study of representative member of the following group using cleared whole amount preparation, dissection and section: Jungermanniales – *Pellia* and *Porella* (or any other leafy liverwort); Marchantiales-*Plagiochasma*, *Dumortiera*, *Fimbriaria*, (*Astralla*, *Reboulia*, *Targionia*, *Conocephalum*/ *Weisnerella*, *Sphagnales*/ *Sphagnum*/ *Bryales*
8. Experiments to study spore germination, formation of protonema and bud development.
9. Study of Bryophytes in their natural habitats

## **BOT 104: BIOLOGY AND DIVERSITY OF PTERIDOPHYTES AND GYMNOSPERMS**

### **UNIT I**

Evolution of Pteridophytes; Soral and stealer evolution .  
Classification of Pteridophytes

### **UNIT II**

Comparative organography, systematics; reproduction and phylogeny of the following:  
Psilophytales, Rhyniales, Zosterophyllophytales.  
Psilotales.  
Lycopdiales, Lepidodendrales  
Sphenophyllales  
Ophioglossales, Marattiales, Osmundales, Filicales, Marsileales, Salviniiales.

### **UNIT III**

Speciation and evolutionary trends in ferns;  
Cytology;  
Polyploidy and hybridization;  
Pteridophytic life – cycle, apospory, vegetative apomixes.  
Recent trends in the classification of Gymnosperms

### **UNIT IV**

Morphology and anatomy of vegetative and reproductive organs, fossil representatives and interrelationship of Cycadales, Ginkgoales, Coniferales, Taxales, Ephedrales, Welwitschiales and Gnetales.

### **UNIT V**

Structure and evolution of archegonium in Bryophytes, Pteridophytes and Gymnosperms  
Distribution of living and fossil Gymnosperm in India.  
Economic importance of Gymnosperms.

### **PRACTICALS 104**

1. Study of morphology and anatomy of vegetative and reproductive tissues and organs using cleared whole mounts, dissections, sections, macerations and permanent preparations of living and fossil forms covered under theory.
2. Experiments on spore germination of prothallus, induction of sporophytes.
3. Preparation of models (Plasticine/ thermocol) to demonstrate stealer evolution.
4. Study of Pteridophytes in their natural habitats
5. Comparative study of the anatomy of vegetative and reproductive parts of *Ginkgo*, *Cedrus*, *Abies*, *Picea*, *Cupressus*, *Cryptomeria*, *Taxodium*, *Podocarpus*, *Cephalotaxus*, *Araucaria*, *Agathis*, *Taxus*, *Ephedra* and *Gnetum*.
6. Study of the important reproductive stages through specimens and permanent slides.
7. Preparation of models (Plasticine/ thermocol) to demonstrate the position and structure of microsporangia of *Cycas*, *Pinus*, *Taxus*, *Ephedra*, *Gnetum*. Seed-scale complex in female cone of *Pinus*, embryo of *Pinus*.

## **BOT 201: ECOLOGY-I CLIMATOLOGY, SOIL SCIENCE AND AUTECOLOGY**

### **UNIT I**

Definition, scope and concept of plant ecology.  
History of ecology and relation of ecology with other disciplines. Principles of ecology.  
Concept of environment, habitat and ecological niche.  
The environment we live in.

### **UNIT II**

Light and temperature as ecological factors.  
Precipitation and Relative Humidity as ecological factors.  
Measurement and analysis of light, temperature, precipitation and relation humidity.  
Importance of water as an important factor on the life of plants.

### **UNIT III**

Origin, development and formation of soil. Soil profile.  
Classification of soil.  
Effects of soil environment of plants.  
Chief soil types of India.

### **UNIT IV**

Biotic components of an ecosystem.  
Interrelation of various organisms.  
Population ecology, Natality, Mortality, Age distribution.  
Concept of carrying capacity.

### **UNIT V**

Morphological, anatomical and physiological relation of plants with their environment.  
Plant indicators.  
Ecotypic and Ecadic differentiation  
Physical and physiological dryness.  
Genecology

### **PRACTICALS 201**

1. Study of physical and chemical characteristics of soil by rapid field test.
2. Determination of moisture constant of soil.
3. Determination of pH of water.
4. Determination of dissolved oxygen in water
5. Determination of following data.
  - a. Solar energy
  - b. Atmospheric temperature
  - c. Relative Humidity
6. Determination of soil profile.
7. Determination of soil texture, colour, consistence.
8. Determination of height of the tree.
9. Determination of light penetration under water by Sechii dish.

## **BOT 202: ANGIOSPERM ANATOMY, EMBRYOLOGY AND PALYNOLOGY**

### **UNIT I**

Origin, growth, differentiation and ultra structure of cell and tissue, fine structure of plasmodesmata, microtubules, microfibrils and secondary structure.

Apical, lateral and intercalary meristems- their ultra structure and histochemistry, organogenesis.

Ontogeny, phylogeny, ultra structure and function of primary and secondary xylem; wood anatomy.

Ontogeny, phylogeny, ultra structure and function of primary and secondary phloem.

Structure variability in leaves, leaf histogenesis, leaf meristem, origin, development ultra structure of trichomes and stomata.

### **UNIT II**

Nodal anatomy-nodal types and evolutionary consideration

Vascular cambium vs. cork cambium factors controlling their activity, periderm, lenticles, abscission, wound healing.

Anatomy of monocotyledons and dicotyledonous seed and fruits, seed appendages, their anatomy structure and function.

Anatomy in relation to taxonomy.

Contemporary plant anatomy: current trends and prospects

### **UNIT III**

Microsporangium- structure and function of wall layers, ultra structure change in tapetum and meiocytes during Microsporogenesis, role of tapetum, pollen development, anther culture and haploid plants.

Pollen wall morphogenesis-microspore pollen mitosis; division of generative cell; pollen fertility and sterility; pollen storage viability and germination.

Megasporogenesis, various types of embryosacs, their development and fertilization.

### **UNIT IV**

Embryology and taxonomy; diagnostic embryological characters, primitive and advanced characters, comparative embryology of hybrids dysfunction of endosperm, arrested development of embryo.

### **UNIT V**

Development and evolution of pollen types; stereo and ultrastructure of exine, apertures, furrow.

Palynology and taxonomy.

Aerobiology and its application. Aeropalynology, methods of aerospora survey and analysis, pollen allergy and pollen calendars system approach for allergy.

Mellitopalynology: general account

Paleopalynology: role in coal and oilgenesis.

### **PRACTICALS 202:**

1. Use of paraffin method of microtechnique .
2. Acquaintance with ultratomy: use of wood microtomy and common and anatomy and histochemical methods.
3. Learning techniques of making temporary and permanent microscopic preparation.
4. Knowledge and use of photomicrography in anatomical studies.
5. Knowledge and use of the principles and working of electron microscopes.
6. Learning to use simple experimental method in anatomical studies.
7. Laboratory work planned on the basis of topic listed under theory.
8. Preparation of dissected whole mount of endothecium, tapetum, ovule, endosperm and embryo, squash preparation of tapetum, microspore mother cell, dyads, tetrads, pollinia, massulae.
9. Study of seed appendages from dissection, structure of seed coat from section and macerations.



## **BOT 203: WATER RELATIONS, GROWTH AND DEVELOPMENT**

### **UNIT I**

Water relations of plants: Unique physio-chemical properties of water, chemical potential, water potential. Apparent free space, bulk movement of water, soil plant atmosphere, continuum (SPAC), stomatal regulation of transpiration, hormonal and energy dependent hypothesis. Inorganic nutrition, physicochemical aspects of solute transport, diffusion and facilitated diffusion, passive and active transport. Nernst equation and Donnan's potential. Role of ATPase as a carrier, co-transport (symport) and counter transport (antiport). Ion channels, role of calmodulin. Importance of foliar nutrition and use of chelates.

### **UNIT II**

Photosynthesis: Energy pathway in photosynthesis, chloroplast as an energy transducing organelle. Composition and characterization of photo systems, I and II, electron flow through cyclic, non cyclic and pseudo cyclic photophosphorylation. Pathways of CO<sub>2</sub> fixation. Differences between C<sub>3</sub> and C<sub>4</sub> fixation and different kinds of C<sub>4</sub> pathways.

### **UNIT III**

CAM pathway: Occurrence, biological events and adaptive advantage. Photorespiration: Mechanism and regulation of photorespiration. Introductory studies on water stress and its tolerance mechanisms.

### **UNIT IV**

Enzymes: Classification, mode of action, K<sub>m</sub> value. Industrial application, immobilized enzymes, their preparation and application. Enzyme regulation: Competitive and non-competitive, allosteric enzymes

### **UNIT V**

Chemical control of growth and morphogenesis. Hormonal effects on growth and development. Bioassay of plant growth regulators and mode of action with reference to auxins. Gibberellins, cytokinins, abscisic acid and ethylene. Phytochrome: Chemistry and photo morphogenetic effects and role in flowering. Genetic study of secondary metabolites such as alkaloids (only types of wide occurrence.) Dormancy: Seed and bud dormancy; hormonal regulation.

## **BOT 204: PLANT BIOCHEMISTRY AND METABOLISM**

### **UNIT I**

Carbohydrates: classification, occurrence and structure of monosaccharide, oligosaccharides, polysaccharides (starch, cellulose and pectin).

Proteins: Amino acid, structure and characteristics, peptides and protein structure, function of proteins  
Conjugate proteins, Account of Lactins their function.

### **UNIT II**

Lipids: classification, occurrence, structure and importance of acryl lipids and phosphates.

Concept of free energy and entropy, high energy compound, Gibb's free energy concept in biochemical reaction.

Synthesis of ATP through oxidative electron transfer chain, chemiosmotic regeneration of ATP.

### **UNIT III**

Gluconeogenesis vs glycolysis

Biosynthesis of fatty acids.

Degradation of fatty acids.

Lipid as high energy molecules.

Role of Kreb's Cycle.

### **UNIT IV**

Nitrogen fixation by free living and symbiotic organisms, mechanism of nitrogen fixation, soil nitrogen sources, nitrogen uptake by plants and assimilation.

### **UNIT V**

Nitrate reductase system, substrate controlled induction, interrelation between photosynthesis and nitrogen metabolism.

Brief account of amino acid synthesis by reductive amination, GS-GOGAT system, transmission.

Basic structure of important phenolics and alkaloids: a general view of their synthesis.

### **PRACTICALS : 203 & 204**

1. Determination of water potential in different tissues.
2. Estimation of the Hill reaction activity.
3. Estimation of total nitrogen by kjaldahl method.
4. Principles of colorimetry, spectrophotometry and fluorimetry.
5. Determination of chlorophyll-a chlorophyll-b, total chlorophyll (Arnon's method).
6. Determination of chlorophyll-a chlorophyll-b, ratio in C<sub>3</sub> and C<sub>4</sub> plants.
7. Estimation of titrable and total acidity.
8. Estimation of protein by Biuret and Lowry's method.
9. Estimation of seed germination as affected by red and Infrared radiation.
10. Determination of gibberellic acid by half seed (cereal) method. Demonstration of effects of auxin on abscission, cytokinin on senescence and abscissic acid on stomatal regulation.
11. Determination of carotenoids.
12. Radioisotope methodology, auto-radiography, rule pulse and double labeling, isotope dilution method. Instrumentation and principles of counters.
13. Extraction and estimation of starch.
14. Determination of reducing sugars in fruits.
15. Identification of different kinds of sugars (spot tests).
16. Estimation of amino acids by ninhydrin.
17. Identification of proline, sulphur-containing amino acids with aromatic ring (spot test).
18. Separation and identification of sugars by paper chromatography.
19. Determination of Isoelectric point of proteins.
20. Separation of soluble protein by gel electrophoresis.
21. Extraction of amylase and determination of its activity.
22. Determination of Km and Vmax of Amylase or phosphorylase

## **BOT 301: ANGIOSPERM MORPHOLOGY AND TAXONOMY**

### **UNIT I**

General concept of morphology, origin and evolution of flower. Co-evolution of flower, vis a vis pollinators.

Origin and evolution of polypetal, sympetal, apetal; monoc, dioc. Monocot flower.

### **UNIT II**

Stamens: origin and evolution from foliar to reduced condition, extension of connective beyond anthers; mono, di and polyadelph; nectaries and nectar.

Carpels evolution, conduplicate, involute and other types, validity of the concept of foliar origin of carpel: alternative concepts and approaches ; specialized carpels; poly and syncarpy; superior, semi-inferior and inferior ovary; appendicular and receptacular concepts; evolution of types of placentations.

### **UNIT III**

Role of floral anatomy in interpreting the origin and evolution of a flower and floral parts. Floral anatomy and taxonomy.

Experimental study on flower.

### **UNIT IV**

Botanical exploration-historical perspective, brief account of botanical exploration in south east Asia with special reference to India. Botanical survey of India, its organization and role.

Principles of plant classification with emphasis on modern tools of taxonomy; molecular systematics, utility of taxonomy; biosystematics.

Phylogenetic systems of classification ; Cronquist, Takhtajan, AGP III

### **UNIT V**

Botanical nomenclature, ICBN, principles, articles, recommendation and amendments of code.

Familiarity with botanical literature, monographs, icons and floras, important periodicals with emphasis on Indian floristics, methods of literature consultation.

Threat assessment, different categories of threat, IUCN, Red Data Book. Important threatened plants of India.

### **PRACTICALS 301:**

1. Preparation of cleared whole mounts of floral parts of polypetalae, sympetalae and monocots for vasculature.
2. With the help hand section and dissection prepare longitudinal and transverse sections of flower. Examination of:
  - a. Transmitting tissue/ canal in stigma and style.
  - b. Various types of ovaries and placentations.
  - c. Special types of flowers with emphasis on vasculature of androecium and gynoecium.
3. Preparation of models (plasticine/thermocoll) of vascular skeleton of flower and placentaion.
4. Any other laboratory work based on theory syllabus.
5. Description of specimen.
6. Description of species based on various specimens, collective exercise.
7. Description of various species of a genus.
8. Location of key characters, use of keys at generic levels, after the description a collective exercise.
9. Location of key characters, use of keys at family levels.
10. Identification of diagnostic characters and use of key (provided)at level of various families after the description have been made.
11. Preparation of key (using specimens from three or four species).

## **BOT 302: CYTOLOGY AND MOLECULAR BIOLOGY OF PLANTS**

### **UNIT I**

The plant cell: structure, organization, cell cycle mechanism and its molecular basis, cytokinesis.  
Nucleus: structure, nucleolus organization.  
Generalized structure of plant cell organelles.

### **UNIT II**

Chromosome: structure, molecular basis of Chromosome structure. Eukaryotic genome .  
organization, prokaryotic genome organization, variation in Chromosome and its significance.

### **UNIT III**

DNA: packaging of DNA, nucleosome, nuclear membranes, C-value paradox, cot curves, chemical structure. genetic code.  
DNA replication in prokaryotes and eukaryotes.  
Transcription, RNA splicing.  
Translation: Prokaryotic and eukaryotic gene regulation (Operon concept).

### **UNIT IV**

Meiosis: origin and molecular events during meiosis.  
Mitosis: origin and molecular events during mitosis.  
Chromosomal aberrations: Heteroploidy, structural changes in chromosomes.

### **UNIT V**

Transposable elements and its molecular basis.  
Membrane structure and function, ATPase sites.  
Membrane transport with reference to transport protein.  
Signal transduction: on overview.

### **PRACTICALS 302:**

1. Staining.
2. Study of the microscope.
3. Study of the size and shape of the cell.
4. Staining and study of flagellum.
5. Vital staining.
6. Staining of mitochondria.
7. Study of chloroplasts.
8. Cytoplasmic streaming.
9. Study of mitosis by squash and smear.
10. Study of meiosis.
11. Measurement of meiosis chromosomes and comparison of their sizes.
12. Study of salivary gland and Meiotic chromosome.
13. Study of chromosome aberration like ring, anaphase bridges etc.
14. Camera-Lucida diagrams of chromosome.
15. Preparation of diagram.
16. Study of ultra structure of various cell organelles from electron micrographs.
17. Collection, fixation and preparation of paraffin blocks of materials.
18. Microtomy and staining of the slides by various methods.

## **BOT 303: BIOMETRY, BIOINFORMATICS AND INSTRUMENTATION**

### **UNIT I**

Measurement of central tendency: mean, median, mode and standard deviation.  
Chi square test.  
Analysis of variance (ANOVA).  
Application of probability distribution; binomial and normal.

### **UNIT II**

Test of significance.  
Correlation and regression.  
Growth curve: exponential and logarithmic.  
Principle of experimental design: randomization. Replication and local control.

### **UNIT III**

A general idea of chromatographic techniques theories and applications.  
High performance liquid chromatography (HPLC) basic study.  
Electrophoresis techniques and applications: basic study.  
Centrifugation: general theory: instrumentation and application.

### **UNIT IV**

Microscopy: Light and electron microscopy.  
Spectrophotometry: a general study of instrumentation and application of colorimetry.  
UV-Visible spectrophotometry NMR and ESR spectrophotometry.  
Polarimetry.

### **UNIT V**

Brief overview of information technology and science. Computerised database and DBMS  
Introduction of bioinformatics and sequence analysis.  
BLAST and FASTA  
Data types and database in molecular biology.  
Sequence databases and sequence alignment.  
AL computer graphic and information retrieval.

## **BOT 304: ECOLOGY-II SYNECOLOGY, ECOSYSTEMATOLOGY & PHYTOGEOGRAPHY**

### **UNIT I**

Concept and characteristics of plant community.  
Methods of studying vegetation.  
Raunkiers Life Forms.  
Biological spectrum.  
Seasonal aspect of vegetation.

### **UNIT II**

Plant succession.  
Concept of climax and climax communities.  
Energy flow.  
Trophic dynamics aspect of ecology.  
Food chain, food web, pyramid of number, biomass and energy.

### **UNIT III**

System transfer function.  
Agroecosystem.  
Biogeochemical cycles.  
Forest ecosystem.  
Rangeland management.

### **UNIT IV**

Vegetation types of India.  
Floristic regions of India.  
Production and productivity of various ecosystems.

### **UNIT V**

Phytogeography as a border line science.  
Principles of interpretation phytogeography.  
Age and Area Hypothesis.  
Discontinuous distribution, endemics and endemism.  
Satpura hypothesis.  
Gates of angiospermy.

### **PRACTICALS : 304**

1. Determination of minimum size of quadrat by species area curve method.
2. Determination of minimum number of quadrat by species area curve method.
3. Determination of frequency of various species by quadrat method and preparation of frequency diagram.
4. Determination of density of quadrat method.
5. Determination of abundance of species by quadrat method.
6. Determination of relative frequency by quadrat method.
7. Determination of relative density by quadrat method.
8. Determination of basal area by quadrat method.
9. Determination of relative dominance by quadrat method.
10. Determination of IVI by quadrat method.
11. Determination of community coefficient of two sites by quadrat method.
12. Preparation of biological spectrum of a locality.

## **BOT 401: GENETICS, PLANT BREEDING AND EVOLUTION**

### **UNIT I**

A brief history, scope and significance of genetics.  
Mendel's law of inheritance.  
Lethality and Interaction of genes.  
Quantitative inheritance: polygenic inheritance.  
Nature and concept of chemical basis of heredity.

### **UNIT II**

Multiple alleles.  
Self sterility.  
Linkage and its measurement.  
Crossing over: theories of crossing over.  
Mapping of genes on chromosomes.

### **UNIT III**

Genetic recombination in bacteria: conjugation, transformation and transduction.  
Cytoplasmic inheritance.  
Mutations : types, methods of artificial induction, method of detection of mutants.  
Biochemical genetics of *Neurospora*.

### **UNIT IV**

Origin of life.  
Mutation and evolution.  
Genetics and evolution.  
Genetic drift.  
Speciation.

### **UNIT V**

Method of plant breeding, plant introduction, mass, pure line and clonal selection.  
Aims and objectives of hybridization types: inter specific and intergeneric; back crossing.  
Grafts hybrids, chimeras and bud spot.  
Heterosis: theories and applications with reference to maize.  
Plant breeding work done in India with reference to wheat and rice.

### **PRACTICAL 401:**

1. Determination of probability of tossing for one coin.
2. Determination of probability for the throw of dice.
3. Determination of probability for tossing of two coins.
4.  $\chi^2$  test as applied to the result of above three experiments.
5. Determination of size of the leaves on a specific size of two population of a species and calculation of standard deviation and standard error.
6. Permutation and combination.
7. Correlation analysis.
8. Determination of genotype from the data provided.
9. Determination of linkage values from the data provided and preparation of chromosome map.
10. Determination of various mendelian ratio by checker board as well as by binomial equation.
11. Study of gene frequency in the populations.
12. Use of Anderson's scatter diagrams in the differentiation of the genetic population.
13. Emasculation of flower.
14. The working of the instruments used in various experiments must also explained./ At least 60% of the above mentioned exercises be performed and must be handed over to the external examiner who will select out the exercise to be distributed among at the time examination.

## **BOT 402: PLANT BIOTECHNOLOGY:IN VITRO CULTURE, GENETIC ENGINEERING AND IPR ISSUE**

### **UNIT I**

Concept and scope of Biotechnology.

Techniques of tissue culture, cell culture and organ culture.

Sterilization ,culture media.

In-vitro auxotrophs, disease resistance, salt and drought resistance, nutritional quality and herbicide resistance.

### **UNIT II**

Micropropagation.

Production of haploids: anther culture and pollen culture

Somatic embryogenesis, somaclonal variation.

Protoplast culture: isolation, culture and fusion of protoplast.

IPR-general idea about patents. Copyright, trademark and geographical indication.

### **UNIT III**

Biotransformation: production of useful compounds through cell culture; factors affecting yield: bioreactors.

Strategies of microbial strain improvement.

The recombinant DNA concept and principle of cloning.

Isolation and purification of DNA.

### **UNIT IV**

Restriction endonuclease : properties and types.

Blotting southern, northern and western

Selection and screening of recombinant clone.

Cloning vehicles salient features: plasmid , cosmid & Tiplasmid.

### **UNIT V**

Single stranded DNA viruses CaMV Lambda phage vectors M13 vectors.

Expression vectors.

Cloning construction of genomic and DNA libraries

Application of r- DNA technology in plant improvement.

### **PRACTICAL 402:**

1. Selection of salt tolerance / amino acid analogue resistance through cell culture.
2. Isolation and culture of protoplast.
3. Isolation and screening of industrially important microorganism.
4. Isolation of plant DNA, plasmid DNA, bacteriophage DNA.
5. Genetics colonization and tumour induction Agrobacterium Tiplasmid.
6. Restriction analysis and molecular weight DNA.
7. Sequencing and polymerase Chain Reaction.



## **ELECTIVE PAPERS (OPTIONAL)**

### **BOT E01: INDUSTRIAL MICROBIOLOGY**

#### **UNIT I**

Development and scope of Industrial Microbiology. Use of Fermentation equipments: Design and construction of fermenters, Batch and Continuous fermenters. Computer control of fermentation process. Characteristics of fermentation media, Raw materials (substrates).

#### **UNIT II**

Use of microorganisms in industries through ages.  
Strategies for isolation and screening of industrially important microorganism.  
Strategies for improvement of industrially important microbial strains.

#### **UNIT III**

Industrial product of vinegar.  
Industrial product of citric acid.  
Industrial product of antibiotics; penicillin and streptomycin.  
Industrial product of amino acids; glutamic acid and lysine.

#### **UNIT IV**

Microbes as a source of Single Cell protein (SCP).  
Mushrooms and food value of mushrooms.  
Dairy product from microorganisms; butter, yogurt and cheese.  
Hygiene and safety in fermentation industries.

#### **UNIT V**

Biopesticides: bacterial, fungal and viral control of insect pests.  
Biofertilizer: production and method of application.  
Bioremediation.

#### **PRACTICALS E01:**

1. Isolation and identification of bacteria, yeast and fungi from bakeries and fermenters of distilleries.
2. Inoculation of fungi and bacteria on sterilized glucose and sucrose solutions and identification of the different types of amino acids and organic acids in filtrate during different incubation periods. (Chromatography)
3. Isolation and identification of different types of fungi and bacteria from curd, rotten fruits and vegetables.
4. Collection of different types of mushrooms from local area/ region: inventory and analysis of their amino acid contents. (Chromatography)
5. Preparation of spawn for cultivation of edible mushrooms.
6. Observation of the antagonism of three antibiotics against common plant pathogens in Petri plates (disc methods).

## **BOT E02: BIOCHEMISTRY AND METABOLISM IN PLANTS**

### **UNIT I**

Lipid: General structure, classification.

Synthesis of fatty acid.

$\beta$ -Oxidation.

Synthesis of carbohydrates from fatty acids.

Protein: Amino acid structure and Biosynthesis; protein conformation, protein synthesis.

### **UNIT II**

Secondary plant products: General structure of important phenolic compound groups in plants.

Shikimic acid pathway and phenolic compound synthesis.

General structure and synthesis of alkaloids from amino acids.

Growth regulators: structure and biosynthesis of Ethylene, Jasmonates and Brassinolides.

### **UNIT III**

Cell wall components.

Cellulose: structure and model for biosynthesis, structure and operation of the model for synthesis at plasma membrane level.

Lignin: structure and biosynthesis in plants.

Cyanogenesis: a general account of cyanogenic compounds as glycosides.

### **UNIT IV**

DNA and RNA: structure

DNA replication.

Transcription in prokaryotes and eukaryotes, transcript modification.

Regulation of translation.

### **UNIT V**

Nitrate metabolism in plants.

Nitrogen fixation, Nitrogenase system.

Ammonium assimilation.

GS-GOGAT system.

## **BOT E03: ETHNOBOTANY AND ISOLATION OF NATURAL PRODUCTS**

### **UNIT I**

Ethnobotany, its scope, interdisciplinary approaches.

Ethnic groups of India : major and minor tribes, life styles of ethnic tribes, conservation practices of biodiversity, taboos and totems.

World centers of Ethnobotany with special reference to India.

### **UNIT II**

Role of Ethnobotany in national priorities, health care and development of cottage industries in India.

History and principles of ayurveda, Homeopathy, Allopathy, Unani and Siddha system of medicines.

A general idea of active principles of plants and plant parts their extraction and preparation of medicines in different systems.

### **UNIT III**

Scope and uses of essential oil from plants as perfumes, cosmetics and as flavoring agents.

Preparation of perfumes from aromatic plants with special reference to the following Lemon grass, Palm-rosa, Mint, Lavender, Rose, Eucalyptus and Vetiver.

### **UNIT IV**

Plants used in medicine with special reference to following.

*Adhatoda vasica, Asparagus racemosus, Hollarhina antidysenterica, Tinospora cordifolia*

*Terminalia arjuna, Terminalia bellerica, Terminalia chebula, Pterocarpus marsupium, Commiphora wightii.*

Regional relevance and credibility of medicinal plants used by tribals of M. P.

### **UNIT V**

Plants used in medicine with special reference to following.

*Argemone mexicana, Boerhaavia diffusa, Eclipta prostrata, Psoralea coralifolia, Withania somnifera,*

*Tylophora indica, Rauwolfia serpentina, Dioscorea deltoids.*

Plants used in scarcity, emergency and as supplementary foods by tribals of India.

### **PRACTICAL E03:**

1. Visit to tribal area and study of plant material used tribals.
2. Identification and description of important plants of ethno botanical importance.
3. Identification of important aromatic plants of the locality.
4. Extraction of active ingredients of plant and plant parts.
5. Extraction of perfumes of aromatic plants.
6. Pharmacognostic method of identification of drugs.
7. Methods of preparation of Kwath, Churra, Ark, Saiva Asav.
8. Diseases of some common medicinal plant of the locality.
9. Identification and description of 10 plants used by tribal for household purpose.

## **BOT E04: STRESS PHYSIOLOGY**

### **UNIT I**

Plants and water: Chemical and water potential gradients.

Determination of water potential of plants and tissues by Chardakov's, pressure chamber and psychrometric methods.

Stomatal size, frequency and measurements of stomatal aperture, porometry, Mechanism of stomatal opening and closing.

Physiological principles of dry land farming.

Wilting coefficient, water use efficiency, stress - degree - day concept, plant water - stress index and their relationship to several plant physiological processes.

Availability of soil water and determination of soil water potential.

### **UNIT II**

Drought and drought tolerance mechanisms: drought escape, drought tolerance with high tissue water potential; drought tolerance with low tissue water potential.

Morphological, physiological and biochemical parameters of drought resistance.

Screening methods to study drought resistance.

### **UNIT III**

Antitranspirants : Different types, mode of action and their use in alleviation of water stress.

Nitrogen fixation and drought.

Ultra structural consequences of drought

### **UNIT IV**

C<sub>4</sub> photosynthesis as CO<sub>2</sub> concentrating mechanism and its comparison with C<sub>3</sub> fixation

Elementary idea about chilling stresses.

Ultra violet stresses: Different band of UV radiations. Sensitivity of various bio-organic molecules; resistance mechanisms and measurement of resistance.

### **UNIT V**

Salinity and plant growth.

Saline and alkali soils

Salt tolerance: Halophytes; physiological aspects of salt tolerance,

Screening methods for salt tolerant varieties.

Elementary idea about temperature stresses.

### **PRACTICALS E04**

1. Estimation of free proline in leaves subjected to water stress.
2. Estimation of protein using Lowry's Method.
3. NR assay.
4. Determination of relative water content (RWC).
5. Determination of potassium and sodium using flame photometer.
6. To determine soil water potential using Tensiometer.
7. Determination of leaf water potential by using Chardakov's method.
8. Determination of water potential using pressure chamber.
9. Discussion on the working of colorimeter, flame photometer tensiometer and pressure chamber.
10. Separation of amino acid by TLC method.
11. Estimation of free sugars using anthrone method.

## **BOT E05: PLANT PATHOLOGY AND MYCOTOXICOLOGY**

### **UNIT I**

History and principles of plant pathology.

Milestones in phytopathology with particular reference to India.

Historical development of chemicals, legislative, culture and biological protection measures including classification of plant diseases.

Parasitism and Disease developments. Growth, reproduction, survival and dispersal of plant pathogens. Factors influencing infection, colonization and development of symptoms.

### **UNIT II**

Physiological and molecular plant pathology.

Effect of pathogens on plant pathological functions. Molecular mechanisms of pathogenesis: recognition phenomenon, penetration, invasion, primary disease determinant. Enzymes and toxins in relation to plant disease. Mechanism of resistance. Phytoalexins . RP protein (pathogenesis related proteins). Antiviral proteins.

### **UNIT III**

Management of plant Diseases: General principles of plant quarantine.

Production of disease free seeds and planting materials. Seed certification. Fungicide and antibiotics: Important culture practices and their role in disease management, solarization, integrated disease management.

### **UNIT IV**

History of Mycotoxins, mycotoxic fungi and related mycotoxins in food and feed, aflatoxins, factors influencing the production of aflatoxins, mycotoxicosis and aflatoxicosis. Detoxification and Regulatory aspects of control of Mycotoxins.

### **UNIT V**

Phytopathogenic toxins : Helminthosporium toxin, Alternaria toxins, Fusarium toxins, Mushroom toxins, plant toxins and phycotoxins (Algal toxins).

### **PRACTICALS E05**

1. Preparation of different types of media: solid liquid synthetic, semi synthetic.
2. Isolation of fungi from infected plant material and stored material.
3. Identification of fungi, and micrometry
4. Pathogenesis: Koch's Postulates.
5. Preparation of TLC plate.
6. Extraction of aflatoxin from stored seed samples.
7. Quantitative estimation of aflatoxins.
8. Demonstration of slides/photograph showing important histopathological changes in liver, kidney and intestine of affected animals/ birds.
9. Symptomatology: collection of diseases plants and preparation of Herbarium.

## **BOT EO6: AGROECOSYSTEM**

### **UNIT I**

Introduction and concept of agroecosystem.  
Agroclimatic zones of India.  
Various types of Indian field and plantation crops.  
Various types of Indian commercial and horticultural crops.

### **UNIT II**

Various agronomic practices, adapted in cropland ecosystem.  
Weed control-normal, Mechanical and biological.  
Insects and pests of cropland ecosystem-any five forms.  
Green evolution.

### **UNIT III**

Structure of biotic and abiotic community of a cropland ecosystem-a case study.  
Herbicide degradation and accumulation in a cropland ecosystem.  
Sink source relationship.

### **UNIT IV**

Influence of irrigation cycling on cropland ecosystem.  
Crop geometry.  
Influence of mineral cycling on cropland ecosystem.  
Phytoallelopathy in croplands.

### **UNIT V**

Input-output ratio in agroecosystem.  
Energy flow in a cropland ecosystem.  
Biofertilizers.  
Farm management.

## **PRACTICALS E06:**

1. To compare the density of a cropland with that of a natural ecosystem.
2. To compare the frequency of a cropland with that of a natural ecosystem.
3. To compare the Abundance of a cropland with that of a natural ecosystem
4. To compare the soil texture, colour and consistency of a cropland ecosystem with that of a natural ecosystem.
5. To compare a natural and cropland ecosystem by calculating community-coefficient.
6. To calculate and comment upon the following at three different levels of a cropland i.e. top of the crop, middle level of the crop and base of the crop.
  - a. Solar intensity.
  - b. Relative humidity.
  - c. Atmosphere temperature.
7. To calculate the temperature of soil at two different depths i.e. 10cm. in cropland and compare it with a natural ecosystem.
8. To prepare a random design of an experiment to study the effects of three levels of fertilizer and three levels of irrigation in a cropland.
9. To determine the pH of cropland soil and compare with natural ecosystem.
- 10 To determine the nitrate, carbonate and base deficiency of a cropland soil and compare with natural ecosystem soil, using rapid test method.

