

## B.Sc. Semester Programme (3 year - 6 Semester)

### Botany

#### Proposed Outline of Papers for all Semesters and Syllabus for Semesters 1 and 2. (To be implemented from Session starting July 2018)

		Max Marks
<b>Year I: Semester I</b>		
Paper I	Diversity of Plant Viruses, Bacteria, & Fungi	100
Paper II	Diversity of Algae, Lichens, and Bryophytes	100
Total		200
<b>Year I: Semester II</b>		
Paper III	Diversity of Pteridophytes, Gymnosperms & Elementary Palaeobotany	100
Practical	Based on Papers I, II and III	100
Total		200
<b>Year II: Semester III</b>		
Paper IV	Angiosperms: Taxonomy, Morphology, and Embryology	100
Practical	Based on Papers IV, V and VI	100
Total		200
<b>Year II: Semester IV</b>		
Paper V	Cytology, Genetics	100
Paper VI	Plant Physiology	100
Total		200
<b>Year III: Semester V</b>		
Paper VII	Plant Biochemistry	100
Paper VIII	Plant Resource Utilization, Palynology and Biostatistics	100
Practical	Based on Papers VII, VIII, IX, X and XI	100
Total		300
<b>Year III: Semester VI</b>		
Paper IX	Ecology, Soil Science and Evolution	100
Paper X	Environmental Botany, Plant Pathology	100
Paper XI	Plant Molecular Biology, Biotechnology	100
Total		300
Grand Total		1400

## *Detailed Syllabus, B.Sc., Semesters I and II*

### **Semester I**

#### **Paper I: Diversity of Plant Viruses, Bacteria, & Fungi (04 Credits, 40 Lectures)**

##### ***Unit I***

Overview of cell structure and function in the prokaryotes (Bacteria) and eukaryotes (Yeast); Classification of prokaryotes based on cell structure (Archaea, Gram positive and Gram negative bacteria, Mollicutes); Nature, classification and structure (helical and icosahedral symmetry) of plant viruses; Classification, thallus organisation and reproduction in fungi; Economic importance of fungi.

##### ***Unit II***

Symptoms (external & internal) of virus infected plants; Transmission of plant viruses; Genome organisation and replication of tobacco mosaic virus; Techniques in plant virology - purification, serology and electron microscopy; Structure and replication of bacteriophage; Structure and replication of viroids.

##### ***Unit III***

Metabolic diversity of bacteria (phototrophy, chemolithotrophy, autotrophy, heterotrophy, nitrogen fixation, fermentation); Bacterial cell division and microbial growth; Bacterial genome and plasmids; Variability in bacteria: Mutation and genetic recombination; Microbial growth control; Bacterial culture and staining; Economic importance of bacteria.

##### ***Unit IV***

The characteristics and life cycles of the following fungi: Oomycota - *Albugo*, *Pythium*; Zygomycota - *Rhizopus*; Chytridiomycota - *Synchytrium*; Ascomycota - *Saccharomyces*, *Aspergillus*, *Ascobolus*; Basidiomycota - *Ustilago*, *Puccinia*, *Agaricus*; Deuteromycota - *Fusarium*.

## **Semester I**

### **Paper II - Diversity of Algae, Lichens, and Bryophytes (04 Credits, 40 Lectures)**

#### ***Unit I***

General features, range of thallus organization, classification; ultrastructure of eukaryotic algal cell and cyanobacterial cell; economic importance of algae.

Lichens: classification, thallus organization, reproduction, physiology and role in environmental pollution.

#### ***Unit II***

Characters and life cycle of: Cyanophyta - *Microcystis*, *Oscillatoria*; Chlorophyta - *Volvox*, *Hydrodictyon*, *Oedogonium*, *Coleochaete*, *Chara*; Bacillariophyta - *Navicula*; Xanthophyta - *Vaucheria*; Phaeophyta - *Ectocarpus*; Rhodophyta – *Polysiphonia*.

#### ***Unit III***

General characters, classification, reproduction and affinities of Bryophytes; Gametophytic and sporophytic organization of Bryophyta - *Pogonatum*; Anthocerotophyta – *Anthoceros*.

#### ***Unit - IV***

General characters of Marchantiophyta; Gametophytic and sporophytic organization of *Riccia*, *Marchantia*, *Frullania*.

## **Semester II**

### **Paper III – Diversity of Pteridophytes, Gymnosperms, and Elementary Palaeobotany (04 Credits, 40 Lectures)**

#### ***Unit I***

General characters, affinities, classification, and stelar system in Pteridophytes; Heterospory and seed habit; Morphology, anatomy, development, vegetative and reproductive parts in Psilopsida – *Rhynia*; Lycopsida - *Lycopodium*, *Selaginella*.

#### ***Unit II***

Morphology, anatomy, development, vegetative and reproductive parts in Sphenopsida - *Equisetum*; Filicopsida - *Adiantum*, *Nephrolepis*, *Marsilea*.

#### ***Unit III***

General characters, affinities, classification, and economic importance of Gymnosperms; Morphology, anatomy, development, vegetative and reproductive parts in Cycadales - *Cycas*

#### ***Unit –IV***

Morphology, anatomy, development, vegetative and reproductive parts in Coniferales - *Pinus*; Ephedrales - *Ephedra*.

Elementary Palaeobotany: General account, types of fossils, methods of fossilization and geological time scale.

## **Semester II Practical**

### **Paper I**

**Plant viruses:** Morphological forms of plant viruses; external symptoms of virus infected plants; viral inclusions.

**Bacteria:** Morphological forms of bacteria; Gram positive and Gram negative bacteria; bacterial colony characters; root nodule.

**Fungi:** Study of the vegetative and reproductive structures in *Albugo*, *Pythium*, *Rhizopus*, *Synchytrium*, *Saccharomyces*, *Aspergillus*, *Ascobolus*, *Ustilago*, *Puccinia*, *Agaricus*, *Fusarium*.

### **Paper II**

**Algae:** Study of the vegetative and reproductive structures in *Microcystis*, *Oscillatoria*, *Volvox*, *Hydrodictyon*, *Oedogonium*, *Choleochaete*, *Chara*, *Navicula*, *Vaucheria*, *Ectocarpus*, *Polysiphonia*.

**Lichens:** Study of the thallus, and reproductive structures in crustose, foliose and fruticose lichens.

**Bryophytes:** Study of the vegetative and reproductive structures in *Pogonatum*, *Anthoceros*, *Riccia*, *Marchantia*, *Frullania*.

### **Paper III**

**Pteridophytes:** Study of the vegetative and reproductive structures of *Lycopodium*, *Selaginella*, *Equisetum*, *Adiantum*, *Nephrolepis*, *Marsilea*.

**Gymnosperms:** Study of the vegetative and reproductive structures in *Cycas*, *Pinus*, *Ephedra*.

**Elementary palaeobotany:** Study of different types of fossil forms (specimens/slides)

## BSc. Botany

### SEMESTER III

#### Paper IV

#### Angiosperms: Taxonomy, Morphology and Embryology

M.M. 100

#### Unit – I

##### **Systematics:**

Principles of classification, nomenclature; Comparative study of different classifications viz. Linnaeus, Bentham and Hooker, Engler and Prantl, Hutchinson and Cronquist. Herbarium, Names and numbers of National and International Botanical gardens, Hot spots.

#### Unit – II

##### **Systematics:**

Taxonomic study of following families and their economic importance:

##### ***Dicots:***

Acanthaceae, Amaranthaceae, Apiaceae, Apocynaceae, Asteraceae, Bombacaceae, Brassicaceae, Caesalpiniaceae, Convolvulaceae, Cuscutaceae, Cucurbitaceae, Euphorbiaceae, Lamiaceae, Malvaceae, Mimosaceae, Myrtaceae, Nelumbonaceae, Nymphaeaceae, Papilionaceae, Ranunculaceae, Rosaceae, Rubiaceae, Rutaceae, Scrophulariaceae, Solanaceae.

##### ***Monocots:***

Arecaceae, Cyperaceae, Liliaceae and Poaceae

#### Unit - III

##### **Development:**

Meristems: Classification, Root Apical Meristem, Shoot Apical Meristem; Growth and differentiation of Root, Shoot and Leaf; Cambium – Tissue differentiation, secondary growth and its anomalies; General morphology and development of the floral organs; Root-shoot transition, Plant modifications; Phylloclade, Phyllode and Cladode.

#### Unit – IV

##### **Reproduction:**

Structure and development of male and female gametophytes – microsporogenesis, microgametogenesis, megasporogenesis, and megagametogenesis; Embryosac types and development; Double fertilization; Endosperm development and its morphological nature; Embryogeny; Apomixis and Polyembryony.

**BSc. Botany**

**SEMESTER IV**

**Paper - V  
Cytology, Genetics**

M.M. 100

**Unit – I**

Cell structure

Cell organelles-Basic organization and function of nucleus, chloroplast, mitochondria, endomembrane system, peroxisomes and lysosomes

Chromosome composition and organization- nucleosome and solenoid model

**Unit- II**

Salivary gland, lampbrush and B chromosomes.

Cell division – mitosis, meiosis and their significance

Principles of inheritance, incomplete dominance, co-dominance

Gene interaction- Complementary gene interaction, Epistasis, Duplicate gene interaction

**Unit-III**

Linkage , Linkage map (basic concept)

Extrachromosomal Inheritance-variegation in four o'clock plant; shell coiling in snail; kappa particles in *Paramecium*.

Sex determination.

Structural variation in chromosomes - Deletion, Duplication, Inversion, Translocation,

**Unit – IV**

Variations in chromosome number- different types of euploids and aneuploids and their evolutionary importance

Mutation- spontaneous, induced mutations, mutagens, molecular mechanism and evolutionary significance

## BSc. Botany

### SEMESTER IV

#### Paper - VI Plant Physiology

M.M. 100

#### Unit - I

**Plant - water relations:** diffusion and osmosis, osmotic potential, absorption of water, ascent of sap.

**Transpiration:** significance and factors affecting it; mechanism of stomatal opening and closing.

**Mineral nutrition:** essentiality of elements; sand and water culture; macro- and micronutrients, their roles and deficiency symptoms; mechanism of ion uptake (passive and active)

#### Unit – II

**Enzymes:** discovery, classification and characteristics of enzymes.

**Photosynthesis:** photosynthetic pigments; photochemical reactions- reaction centres, O<sub>2</sub> evolution, photophosphorylation; CO<sub>2</sub> fixation - C<sub>3</sub> and C<sub>4</sub> carbon cycle, CAM plants, photorespiration and glycolate metabolism, factors affecting photosynthesis.

#### Unit - III

**Respiration:** aerobic and anaerobic respiration; respiratory pathways- glycolysis, Krebs cycle, pentose phosphate pathway; electron transport, oxidative phosphorylation, cyanide resistance .

**Lipid metabolism:** fatty acid synthesis and its oxidation ( $\alpha$  and  $\beta$ ).

**Nitrogen metabolism:** nitrogen cycle, biological nitrogen fixation, nitrite and nitrate reduction, nitrogen assimilation.

#### Unit – IV

**Growth:** general aspects and phases of growth; flowering- photoperiodism and vernalization, circadian rhythm; seed germination; bud and seed dormancy; abscission and senescence.

**Phytohormones:** discovery, physiological roles, mechanism of action and applications of auxins, kinetin, gibberellins, abscisic acid and ethylene.

**Plant movement-** nastic and tropic.



## **B.Sc. Semester III - Botany Practical Syllabus**

### **Angiosperms: Taxonomy, Morphology and Embryology;**

T.S. of stems (eg. *Achyranthus*, *Amaranthus*, *Boerhavia*, *Bougainvillea*, *Cucurbita*, *Cuscuta* on *Lantana*, *Dracaena*, *Helianthus*, *Tinospora*, *Zea mays*); roots (*Ficus* aerial root, *Zea mays*, *Tinospora*), leaves (*Ficus*, *Zea mays*) to study anatomical variation and anomalies in secondary growth

Specimens of modifications (eg. Phyllode, phylloclade, cladode etc.).

Study of representative members of important taxonomic families of angiosperms with regard to their habit, inflorescence, floral characters along with floral diagrams and formulas

### **Cytology, Genetics**

Demonstrations related to cell structure, cell organelles, chromosome structure, salivary gland and lampbrush chromosome; laws of inheritance, gene interaction, inheritance ratio etc.

Stages of mitosis and meiosis .

Problems based on chromosome number, gene interaction, ploidy, linkage maps and mechanism of mutation

### **Plant Physiology**

Experiments related to different physiological processes taking place in plants viz. transpiration, photosynthesis, respiration, growth etc.

**BSc. Botany**

**SEMESTER V**

**Paper– VII  
Plant Biochemistry**

M.M.100

**Unit – I**

**Carbohydrates:** classification, structure and properties of- monosaccharides (aldose and ketose sugars); oligosaccharides (reducing and non-reducing sugars); polysaccharides (storage- starch, inulin; structural- cellulose, pectin, chitin, aminoglycans, peptidoglycans, glycoprotein, glycolipids).

**Unit - II**

**Lipids:** classification, structure and properties of - fatty acids (saturated and unsaturated); simple lipids, compound lipids and derived lipids.

**Vitamins:** structure and properties of vitamins.

**UNIT III**

**Amino acids:** classification, structure and properties of amino acids, essential and non-essential amino acids.

**Proteins:** classification, structural organization of proteins, biological roles of proteins.

**Unit IV**

**Enzymes:** general structure; active sites; action specificity; mode of action; aspects of enzyme kinetics (Michaelis-Menten constant); enzyme inhibition, factors affecting catalytic efficiency of enzyme.

**Bioenergetics:** Laws of thermodynamics; concept of Gibb's free energy in plants; redox reactions; high energy rich compounds.

**BSc. Botany**

**SEMESTER V**

**Paper VIII**

**Plant Resource Utilization, Palynology and Biostatistics**

M.M. 100

**Unit- I**

Centres of diversity of plants, origin of crop plants, domestication and introduction of crop plants. Cultivation, production and uses of - wheat, rice, legumes, sugarcane

**Unit-II**

A general account of plants yielding oils, spices, beverages. An account of major fiber, medicinal and petro plants of Uttar Pradesh.

**Unit-III**

Conservation of plant resources for agriculture and forestry.

*In situ* conservation sanctuaries, national parks, biosphere reserves, wetlands, mangroves.

*Ex situ* conservation; field gene banks, seed banks, cryobanks.

**Unit-IV**

An introductory knowledge to palynology, morphology, viability and germination of pollen.

Classification of data, mean, median and mode, standard deviation, standard error, variance, co-relation,  $X^2$  test.

**BSc. Botany**

**SEMESTER VI**

**Paper – IX  
Ecology, Soil Science and Evolution**

M.M 100

**Unit- I**

Ecology: definition and scope.

Ecological adaptations and ecological groups: hydrophytes, xerophytes , halophytes

Mineral resources of planet earth, conservation of mineral resources.

**Unit-II**

Ecosystem: Concepts and components.

Kinds of ecosystems; Food chains, webs and ecological pyramids.

Plant community and Plant succession - hydrosere, xerosere etc.

**Unit-III**

Soil science: soil formation, profile development; soil composition.

Properties of soil (Texture, density, temperature, organic matter, soil pH, ion exchange)

Soil types of India.

Soil erosion,soil conservation.

Problem soils and their reclamation.

**Unit-IV**

Evolution and Origin of life

Evidences of organic evolution-from anatomy, taxonomy, distribution, embryology, palaeontology, physiology and biochemistry, genetics and molecular biology

Theories of organic evolution- Darwinism, Lamarckism, Mutation theory, Synthetic theory

**BSc. Botany**

**SEMESTER VI**

**Paper - X**  
**Environmental Botany and Plant Pathology**

M.M 100

**Unit – I**

Mineral resources of planet earth, conservation of mineral resources.  
The source of water, physico-chemical and biological properties of water.  
Sustainable management of water.  
Energy resources in India  
Forests: global forest wealth, importance of forests, deforestation.

**Unit – II**

Environmental pollution: air, water, soil, radioactive, thermal and noise pollutions, their sources, effects and control.  
Greenhouse effect, ozone depletion and acid rain.  
CO<sub>2</sub> enrichment and climate change.

**Unit – III**

Biodiversity and Phytogeography.  
Biotic communities and populations, their characteristics and population dynamics.  
Natural vegetation of India, static and dynamic plant geography.  
Basic principles governing geographical distribution of plants, endemism.

**Unit – IV**

Etiology of viral, bacterial, fungal and insect-pest diseases.  
Mosaic diseases on tobacco and cucumber, yellow vein mosaic of bhindi, citrus canker, potato scab, little leaf of brinjal, damping off of seedlings, late blight of potato, red rot of sugarcane.  
Integrated pest disease management.

**BSc. Botany**

**SEMESTER VI**

**Paper – XI  
Plant Molecular Biology and Biotechnology**

M.M. 100

**Unit – I**

Nucleic acid as genetic material.  
Structure and properties of nucleic acids and their functions.  
Replication of DNA in Prokaryotes and Eukaryotes.  
Cell cycle.

**Unit – II**

Central Dogma and Genetic code.  
Transcription in Prokaryotes and Eukaryotes.  
Processing and modification of RNA, Structure of t RNA.  
Translation- Ribosome structure and assembly in prokaryotes and eukaryotes; Various steps in protein synthesis, proteins involved in initiation, elongation and termination of polypeptides.

**Unit - III**

Regulation of Gene expression in Prokaryotes and Eukaryotes- Regulation of lactose metabolism and tryptophan synthesis in E.coli.; Britten Davidson approach, Transcription factors, Hormonal control and second messengers Ca<sup>+</sup>, Cyclic AMP, IP<sub>3</sub> etc.

**Unit IV**

Introduction to biotechnology.  
Recombinant DNA technology.  
Plant tissue culture –methods and applications.  
Methods of gene transfer, relevance of transgenic plants.  
Biotechnology and healthcare.  
Microbial and environmental biotechnology.

## B.Sc. Semester V - Botany Practical Syllabus

Plant Biochemistry; Plant Resource Utilization, Palynology and Biostatistics;  
Ecology, Soil Science and Evolution; Environment Botany and Plant Pathology;  
Plant Molecular Biology and Biotechnology

- Q. 1.** Experiments on enzyme (catalase) activity and various factors affecting it; isolation of proteins and carbohydrates and their qualitative tests; isoelectric point determination, solubility of proteins and lipids.
- Q. 2.** (a) Demonstrations of plants and plant parts yielding commercially important products viz. cereals, pulses, oil species, fibers, medicines etc.
- (b) Biochemical tests for starch, cellulose, lignin etc.; Study of morphology and viability of pollen.
- Q. 3.** (a) Ecological adaptations (anatomical & morphological) of Hydrophytes (*Hydrilla*, *Eichhornia*, *Nymphaea*, *Typha*) and Xerophytes (*Casuarina*, *Nerium*, *Saccharum*, *Begonia*).
- (b) Demonstration of soil types and soil forming minerals (for spotting).  
Demonstration of soil texture by touch/sieve method.  
Determination of water capability rise rate, water infiltration rate, water percolation rate, soil pH by pH paper method, calcareousness by effervescence method, base deficiency test, soil fertility evaluation for N and P .
- Q. 4.** (a) Demonstration of instruments for measuring environmental parameters (for spotting).  
Determination of acidity, alkalinity, hardness, dissolved oxygen in water sample.
- (b) Representative material/ specimens for study of symptoms (external and internal) of fungal, bacterial and viral diseases, based on morphological/anatomical study as applicable eg. Leaf spot of crucifers, red rot of sugarcane, late blight of potato, fruit rot, damping off, TMV, vein clearing, citrus canker etc.,
- Q. 5.** Demonstrations of diagrams/ electron micrographs/ photographs/ flow schemes of all the topics related to molecular biology and biotechnology.