

# BOTANY

## PAPERS AND DISTRIBUTION OF MARKS

Paper I	: Plant Diversity-1 : Fungi, Microbiology and Elementary Plant Pathology	50
Paper II	: Plant Diversity-2 : Algae and Bryophytes	50
Paper III	: Plant Diversity-3 : Pteridophytes, Gymnosperms and Elementary Palaeobotany	50
Practical	:	50

### PAPER-I : FUNGI, MICROBIOLOGY AND ELEMENTARY PLANT PATHOLOGY

Note : The Paper will comprise of three sections A, B and C for objective type, short answer and long answer respectively. Section A will have sixteen questions of one mark each, three questions will be from each unit and the remaining one from any unit. Section B will have seven questions of two marks each, one from each unit and the remaining two from any of the units. In section C, eight questions should be given at least one from each unit and the remaining three can be from any of the units. The examinees should be asked to attempt any five questions.

#### UNIT I

1. Brief history and salient features of fungi.
2. Outlines of classification of Alexopoulos and salient features of the important group.
3. Habit, habitat, structure and methods of reproduction of fungi based on the following representatives. *Stemonitis*, *Synchytrium*, *Saprolegnia*, *Mucor*, *Penicillium*, *Phyllactinia*, *Eurotium*, *Saccharomyces*, *Morchella*, *Puccinia*, *Agaricus* and *Alternaria*.

#### UNIT II

1. Distribution and classification of the microorganisms.
2. Elementary principles of isolation and purification of the microorganisms. Identification and differentiation of bacteria on the basis of morphology and stains (Negative staining, Gram's stain and Acid Fast).
3. Decomposition of the organic matter in soil and the role of the microorganisms in carbon and nitrogen cycles in nature.

and structure of the sporophyte and mechanism of spore dispersal in *Anthoceros*.

2. General account of the jungermanniales (*Pellia* and *Porella*) and Mosses (*Funaria* and *Pogonatum*).
3. A brief account of the alternation of generation in Bryophytes.

**Books Recommended :**

Ganguly and Kar. College Botany Vol II. Calcutta

Khan, M. 1983 Fundamentals of phycology. Bishen Singh Mahendra Pal Singh, Dehradun.

Parihar, N.S. The Biology and Morphology of Bryophytes, Central Book Depo. Allahabad.

Pure, P. 1980. Bryophytes. Atma Ram & Sons, Delhi.

Sharma, O.P.A Text Book of Bryophyta.

Singh, V., Pandey, P.C. and Jain, D.K. A Textbook of Botany

Vashishta, B.R. Text Book of Algae. New Delhi.

**PAPER-III : PTERIDOPHYTES, GYMNASPERMS AND ELEMENTARY PALAEOBOTANY**

**Note :** The Paper comprise of three sections A, B and C for objective type, short answer and long answer question, respectively. Section A will have sixteen question of one marks each, three questions will be from each unit and the remaining one from any unit. Section B will have seven question of two marks each, one from each unit and the remaining two from any of the units. In section C, eight question should be given and remaining three can be from any of units. The examinees should be asked to attempt any five question.

**UNIT I**

1. General characters of the Pteridophytes and classification as proposed by Pichi-Sermolli.
2. A comparative study *Rhynia*, *Selaginella*, *Lycopodium*, *Equisetum*, *Adiantum*, and *Marsilea* on the basis of following features:
3. Morphology and anatomy of the vegetative plant body and spore production organs (strobilus, sporocarp, sporophyll, sporangium and spores), sexual reproduction, male and female gametophytes, fertilization.

**UNIT II**

1. A brief account of Telome theory, Stelar system and its evolution.
2. Heterospory and seed habit in Pteridophytes.
3. Apogamy, agamospory and apospory in ferns.

**UNIT III**

1. Outlines of classification as proposed by D.D Pant and distinguishing features of Gymnosperms.
2. Comparative account of the structure, life history and evolutionary trends based on the following examples. Cycas, Pinus and Ephedra.
3. General anatomy-types of wood thickening, tracheids, medullary rays, pitting and resin canals, mesarch and pseudomesarch, foliar bundles and stomata in the three types.

**UNIT IV**

1. Distribution of Gymnosperms in India.
2. Economic importance of the Gymnosperms.

**UNIT V**

1. Fossils : Process of fossilization and types of fossils.
2. A general idea about Geological era.
3. Living fossils.

**Books Recommended :**

Parihar, N.S. 1996 Biology & Morphology of Pteridophytes. Central Book Depot, Allahabad.

Pandey, S. N. A Textbook of Pteridophyta

Sharma, O. P. An Introduction to Gymnosperms, Pragati Prakashan, Meerut.

Vashishta, P. C. A Textbook of Pteridophyta. New Delhi

Vashishta, P. C. Textbook of Gymnosperm

**PRACTICAL**

Prepared slides and materials should be shown to the students for demonstration of the general features. Students are required to make preparation of the important material themselves. They are also required to prepare a collection of plant species studied by them either on herbarium sheets or as specimens or live planted material as directed by the Department.

## Second Year

**PAPER I (BBO-201) TAXONOMY OF ANGIOSPERMS AND ECONOMIC BOTANY****UNIT I**

1. Angiosperms origin and evolution. Some examples of primitive angiosperms. Angiosperm taxonomy- fundamental components.
2. Comparison and evolution of the system of classification as proposed by Linnaeus, Betham and Hooker and Hutchinson.
3. Nomenclature: International Code of Botanical Nomenclature (ICBN), History, scientific naming of plants, priority, types, validity, *nomina conservanda*.
4. Collection and preservation techniques of specimens for Herbarium and Museum, Botanical gardens and Herbaria, Botanical Survey of India (BSI).

**UNIT II**

1. Taxonomy, important distinguishing characters, classification and economics importance of the following families:

Dicotyledonae

Polypetalae : Ranunculaceae, Brassicaceae, Caryophyllaceae, Rutaceae, Malvaceae, Rosaceae and Apiaceae

**UNIT III**

1. Gamopetalae: Solanaceae, Apocynaceae, Acanthaceae, Lamiaceae
2. Monochlamydae: Euphorbiaceae, Polygonaceae
3. Monocotyledonae: Orchidaceae, Liliaceae, and Poaceae

**UNIT IV**

1. Origin of cultivated plants, monophyletic and polyphyletic origin, centres of origin of some important crop plants.
2. Origin, history, botanical features and cultivation of cereals and millets: Wheat, Rice, Maize and Bajra.
3. Legumes: An introduction to the economically important legumes.
4. Oils: Castor oil, linseed oil and mustard oil.

**UNIT V**

1. General account of fruits (Apple, Banana, Citrus, Mango) and Vegetables (Root, stem, leaf, and fruit vegetables).
2. Fibres (Coir, Cotton, Flax, Jute) and Medicinal plants (*Aconitum*, *Atropa*, *Cinchona*, *Rauwolfia*, *Ephedra*).
3. Common Timber yielding plants of Western Himalayas (Chir, Deodar, Sal, Shisham and Teak).

**Suggested Readings**

- Singh, V. And Jain, D.K.2012. Taxonomy of Angiosperms. Rastogi Publications,, Meerut
- Singh, G.2012. Plant Systematic: Theory and Practice. Oxford and IBH Pvt Ltd, New Delhi
- Pandey, B.P.2001. A text book of Angiosperms. S. Chand Publication, New Delhi
- Sharma, O.P.2016. Plants and Human Welfare, Pragati Prakshnan, Meerut
- Sharma, A.K. and Sharma, R. Taxonomy of Angiosperms and Utilization of Plants

## PAPER II: (BBO-202) ANATOMY, EMBRYOLOGY AND ELEMENTARY MORPHOGENESIS

### UNIT I

1. The techniques for the study of plant anatomy.
2. Meristems: Primary and secondary meristems, characteristics and functions. Various types of permanent tissues- Simple and complex tissues.
3. Structure of dicot and monocot root, stem and leaf.

### UNIT II

1. Secretory structures
2. Origin structure and function of vascular cambium including anomalous behaviour with special reference to the following taxa: *Bougainvillea*, *Salvadora*, *Nyctanthes*, *Dracaena*, *Orchids* and *Tinospora*.
3. Structure of xylem and phloem.

### UNIT III

1. Structure of anther, micro sporogenesis and development of male gametophyte in angiosperms.  
Structure of ovule, mega sporogenesis and development of the female gametophyte with reference to the *Polygonum* type. Comparison with the bio sporic and tetra sporic types
2. Pollination, fertilization and life history of a typical angiosperm.

### UNIT IV

1. Endosperm and embryo development with special reference to the onagrad type.
2. Polyembryony and apomixis.
3. Seed germination and dormancy, elementary plant movements.

### UNIT V

1. Basic body plan of a flowering plant- modular type of growth.
2. Diversity in plant forms in annuals, biennials and perennials. **Development of tree habit in higher plants**
3. **Plant growth regulators: Auxin, Gibberellin, Cytokinin and Abscissic acid.**
4. **Physiology of flowering: Photoperiodism and vernalization.**

#### **Suggested Readings**

- Pandey, S.N. 1992, Plant Anatomy, Rastogi Publication, Meerut  
Tayal, M.S. 1996, Plant Anatomy, Rastogi Publication, Meerut  
Bhojwani, S.S. and Bhatnagar, S.P. 1994. Embryology of Angiosperms  
Maheshwari, P. An Introduction to Embryology of Angiosperms

### PAPER III: (BBO-203) ECOLOGY AND REMOTE SENSING

#### UNIT I

1. Definition and scope of ecology, Principles of environment, atmosphere, light, temperature, water and soil.
2. Ecosystem: Types, biotic and abiotic components, food chain, food web, ecological pyramids and ecological niche.
3. Productivity, type, measurement of primary productivity, energy flow and ecological energetics, Lindeman's concept of Energy Flow.

#### UNIT II

1. Biogeochemical cycles: A brief discussion of concept by citing examples of carbon, nitrogen and phosphorous cycles.
2. Population ecology: Definition, population characteristics, growth curves, carrying capacity and population fluctuation.
3. Community ecology: Structure and community characteristics, <sup>quantitative</sup> quantitative, qualitative and synthetic features, life forms, biological spectrum and ecological succession.

#### UNIT III

1. Pollution of air, water and soil, noise incidence, thermal and radioactive pollution; prevention and control of pollution.
2. Global warming, desertification and ozone depletion. ✓
3. Biogeographical regions of India; Vegetation types in Uttarakhand

#### UNIT IV

1. Biodiversity: Basic concept, types, causes and loss of biodiversity.
2. Biodiversity conservation: In situ and ex situ conservation, gene bank, introductory account of Biosphere reserves, National parks and Sanctuaries
3. Soil erosion and conservation, conservation and management of some natural resources: forest and rangeland management.

#### UNIT V

1. Definition of remote sensing, aerial photography, principles and fundamentals of aerial photo interpretation.
2. Electromagnetic spectrum, satellite and sensors, remote sensing data acquisition, physical basis of remote sensing, aerial and space platforms.
3. Image interpretation, role of remote sensing in ecology.

#### **Suggested Readings**

- Odum, E.P. 1983, Basics of Ecology, Saunders College Publication, New York
- Tiwari, S.C. 2005. Concepts of Modern Ecology, Bishen Singh Mahendra Pal Singh, Dehradun
- Sharma, P. D, 2014. Ecology and Environment, Rastogi Publications, Meerut
- Shukla, R.S. and Chandel. P.S. 2014. Plant Ecology. S Chand Publications, New Delhi
- Shukla, R.S. and Chandel. P.S. Biostatistics. S Chand Publications, New Delhi

## LAB COURSE (BBO-20P)

B.Sc. II

### **ANATOMY OF ANGIOSPERMS AND ECONOMIC BOTANY**

1. Identification of locally available plants belonging to the families mentioned in the syllabus, their description in semi technical language.
2. Collection of plant specimens: Herbarium and/live specimens. Excursions should be organised to acquaint the students with the local flora.
3. To identify study and comment upon the economically important plants and their economic products mentioned in the syllabus.

### **ANATOMY, EMBRYOLOGY AND ELEMENTARY MORPHOGENESIS**

1. Demonstration of usual techniques of plant anatomy, section cutting, TS, LS of dicot and monocot leaf, stem and root.
2. Normal and abnormal secondary growth in *Boerhavia*, *Bougainvillia*, *Nyctanthes*, *Dracaena*, *Orchid* and *Tinospora*.
3. TS of anther.
4. Study of various types of pollen grains, placentations, embryo sacs, ovules and stages of embryo development using temporary and permanent preparations.
5. Influence of growth regulators on root formation, senescence and pollen germination (hanging drop method).
6. Structure and organization of the shoot apex/ root apex.

### **ECOLOGY AND REMOTE SENSING**

1. To determine the minimum size of quadrat by species area curve method.
2. To determine the minimum number of quadrats to be laid down for the vegetation analysis of the given area.
3. To determine the frequency, density and abundance of each species in a community by quadrat method.
4. To prepare frequency diagram and compare it with that of the Raunkiaer's normal frequency diagram.
5. To determine the mean basal cover and total basal cover.
6. To study the physical characters of soil in terms of temperature, colour, texture and pH.
7. To find out bulk density and porosity of different soils.
8. To estimate the moisture percentage of various soil samples.
9. Statistical problems of central tendencies, standard deviation, Correlation and  $X^2$  test.
10. Study of types of aerial photographs and satellite data products.
11. Study of types of stereoscopes

(R)

3. To determine the diffusion pressure deficit of plant cells.
4. To set up a Wilmott's bubbler and to study the effect of the following on the rate of photosynthesis  
(a) varying CO<sub>2</sub> concentration and (b) different wavelengths of light.
5. To extract the four pigments i.e. chlorophyll a & b, carotene and xanthophylls from the green leaves and preparation of their absorption spectrum.
6. To separate the four pigments i.e. chlorophyll a & b, carotene and xanthophylls from the green leaves by paper chromatography and column chromatography.
7. To separate the amino acids by paper chromatography.
8. Principles of colorimetry, spectrophotometry and fluorimetry.

**Plant Ecology and Remote Sensing**

1. To determine the minimum size of the quadrat by species area curve method and minimum number of quadrats to be laid down in the field under study.
2. To determine the frequency, density and abundance of each species present in community.
3. To calculate relative frequency and relative density of each species in a given area.
4. To calculate mean basal cover and total basal cover of each species in a given area.
5. To compute the relative dominance and IVI (Importance Value Index) of each species in a given area.
6. To calculate the Alpha ( $\alpha$ ) diversity, Beta ( $\beta$ ) diversity and total diversity of given community.
7. To calculate water holding capacity of three samples of various soil types and to find the percolation percentage of water in the given soil.
8. To find out the bulk density and porosity of different soil types
9. To test the pH and the buffering properties of soils.
10. Study of types of aerial photos and satellite data products.
11. Orientation of stereo model under mirror stereoscope.

**Biotechnology:**

1. Tissue culture activities
2. Growth characteristics of *E. coli* using plating and turbidimetric methods.
3. Isolation of plasmid of *E. coli* by alkaline lysis method and its quantitation spectrophotometrically.
4. Restriction digestion of plasmid and estimation of the size of different DNA fragments.
5. Cloning of a DNA fragment in a plasmid vector, transformation of the given bacterial population and selection of recombinants.
6. Demonstration of DNA sequencing by Sanger's dideoxy method.
7. Demonstration of protoplast fusion employing PEG.
8. Organogenesis and somatic embryogenesis using appropriate explants and preparation of artificial seed.
9. Co-cultivation of the plant material (e.g. leaf discs) with *Agrobacterium* and study GUS activity histo-chemically.

\*Additional Lab course of selected elective paper.

Samal

Prasanna

Prasanna

SDS · B.Sc III<sup>rd</sup> year

**THIRD YEAR**

**Paper I (BBO- 301) CYTOGENETICS, MOLECULAR BIOLOGY AND BIOTECHNOLOGY**

**UNIT I**

1. Structure and functions of Nucleus: Ultra structure, nuclear membrane, nucleolus, structure and functions of other cell organelles: Golgi body, endoplasmic reticulum, peroxysomes and vacuoles. The cell envelope: Plasma membrane, bilayer lipid structure and functions of cell wall.
2. Cell division: Comparison of mitosis and meiosis.
3. Chromosome organization: Morphology, centromere and telomere, chromosome alteration in chromosome numbers, aneuploidy, polyploidy and sex chromosomes.
4. Extra nuclear genome: Presence and functions of mitochondrial and plastid DNA, plasmids.

**UNIT II**

1. Genetic Inheritance: Mendelism: Law of segregation and independent assortment, incomplete dominance.
2. Interaction of genes: Linkage- complete and incomplete linkage and crossing over.
3. Sex linked inheritance: Determination of sex.
4. Genetic variation: Mutations, transposable genetic elements, DNA damage and repair.

**UNIT III**

1. DNA,-the genetic material: DNA structure, replication, DNA- protein interaction, the nucleosome model, satellite and repetitive DNA.
2. RNA: Structure and types.
3. Gene concept: Classical and modern concept of gene, operon concept.

**UNIT IV**

1. Protein Structure: 1D, 2D and 3D structure.
2. Genetic code and protein synthesis.
3. Regulation and gene expression in prokaryotes and eukaryotes.

**UNIT V**

1. Introduction to Biotechnology: Functional definition, role in modern life, history and ethical issues connected with biotechnology.
2. Genetic engineering: Tools and techniques of DNA technology, cloning vectors, genome, cDNA libraries, transposable elements and techniques of gene mapping.
3. Basic concept of tissue culture, cryopreservation, differentiation and morphogenesis, biology of *Agrobacterium*, vectors for gene delivery and marker genes.
4. A brief account of Industrial biotechnology (fermentation and alcohol production), Agricultural biotechnology (biofertilizers and biopesticides) and Nutritional biotechnology (Mycotoxins and health hazards, control of mycotoxin production, single cell protein).

**Suggested Readings**

- Gupta P.K. 2000. Cytology, Genetics And Evolution. Rastogi Publication, Meerut  
Gupta P.K. 2012. Genetics. Rastogi Publication, Meerut  
Gupta P.K. 2001. Elements of Biotechnology. Rastogi Publication, Meerut  
Power, C.B. 1994. Cell Biology. Himalaya Publishing House, New Delhi



**PAPER II (BBO- 302): PLANT PHYSIOLOGY AND ELEMENTARY BIOCHEMISTRY**

B.Sc III<sup>rd</sup> year

**UNIT I**

1. Cell physiology, diffusion, permeability, plasmolysis, imbibition, water potential and osmotic potential.
2. Types of soil water, water holding capacity, water requirement, wilting coefficient.
3. Active and passive absorption, anatomical features of xylem in relation to path of water transport and ascent of sap.

**UNIT II**

1. Loss of water from plants, transpiration, factors affecting transpiration, Guttation, anatomy of the leaf with special reference to the loss of water.
2. Structure of stomata, mechanism of stomatal
3. Movement and diffusion capacity of the stomata.
4. Mechanism of absorption of mineral salts.
5. Translocation of solutes, theories and mechanism of translocation. Anatomical features of the phloem tissue with reference to the translocation of solutes.

**UNIT III**

1. Elementary knowledge of macro and micro nutrients.
2. Symptoms on mineral deficiency, techniques of water and sand culture.
3. Nitrogen cycle and nitrogen fixation, importance of nitrate reductase and its regulation, ammonium assimilation.

**UNIT IV**

1. Photosynthesis: Historical background and importance of the process, role of primary pigments, concept of two photosystems, Z- scheme, photophosphorylation, Calvin cycle, factors affecting photosynthesis, chemosynthesis.
2. Respiration, glycolysis, Krebs' cycle, Electron transport mechanism (Chemiosmotic theory), ATP- the biological energy currency, redox potential, oxidative phosphorylation, pentose phosphate pathway, CAM plants, factors affecting respiration, fermentation.

**UNIT V**

1. Types and strength of solutions, acid base and salts, pH, buffer solutions and their importance.
2. Enzyme action, active sites, Michaelis-Menton constant, classification of enzymes, factors affecting the enzyme activity, coenzymes and co factors.
3. Carbohydrates: Classification, properties, structure and biological role.
4. Protein and amino acids: Classification, structure and chemical bonds in protein structure and properties.
5. Lipids: Structure and functions, fatty acid biosynthesis, beta- oxidation, saturated and unsaturated fatty acids, storage and mobilization of fatty acids.

**Suggested Readings**

- Jain, V.K. 2014. Fundamentals of Plant Physiology. S. Chand Publications, New Delhi  
Verma, S.K. and Verma M. 2014. A text book of Plant Physiology and Biochemistry. S. Chand Publications, New Delhi  
Devlin, R.M. 1996, Plant Physiology. Indian Print New Delhi  
Pandey, S.N. 2000. Plant Physiology.  
Srivastava, H.S. Biochemistry. Rastogi Publication, Meerut

## **PAPER III: (BBO– 303) PLANT BREEDING AND BIOSTATISTICS**

### **UNIT 1**

1. Plant breeding: Aims and objectives, basic techniques of plant breeding.
2. Methods of plant breeding in relation to self pollinated and cross pollinated plants.

### **UNIT 2**

1. Crop improvement methods: Plant introduction, selection, acclimatization and hybridization, vegetative propagation and grafting.
2. Heterosis: Genetic and physiological basis
3. Mutational breeding and breeding for disease resistance.

### **UNIT 3**

1. Improved seed production, multiplication and distribution.
2. Maintenance and seed testing.
3. National Seed Corporation (NSC), seed testing laboratories, International and National Centre for plant breeding.

### **UNIT IV**

1. Bio-statistics and its applications.
2. Methods of representation of statistical data diagrams:
3. Measurements of Central tendencies: Mean, Median and Mode

### **UNIT V**

1. Measures of dispersion: Range, mean deviation, standard deviation and standard error.
2. Coefficient of correlation.
3. Test of significance: Chi- square test.

### **Suggested Readings**

Singh, B.D. 2002. Plant Breeding: Principles and Methods. Kalyani Publishers, New Delhi

Chaudhary, H.C. Plant Breeding

Banerjee, P.K. 2007. Introduction to Biostatistics

Prasad, Satguru, 1992. Fundamentals of Biostatistics

## LAB COURSE (BBO30P)

### CYTOGENETICS, MOLECULAR BIOLOGY AND BIOTECHNOLOGY

1. To study Prokaryotic cells (Bacteria) and Eukaryotic cells with the help of light and electron micrographs.
2. To study cell structure from onion leaf peels, demonstration of staining and mounting methods.
3. Study of mitosis and meiosis (temporary mounts and permanent slides).
4. Exercises on genetical problems out of the following : Mendel's Law Of Inheritance, Incomplete Dominance, Sex Linked Inheritance, Sex Determination, Cytoplasmic Inheritance.
5. To study the working of following instruments: Incubator, Water Bath, Spectrophotometer, Oven and Centrifuge.
6. To study about life history of various scientists and their contribution in the field of molecular biology.
7. To study the working of the following instruments PCR, Laminar Airflow, Autoclave, etc
8. Culture media preparation.
9. Comment upon the given photograph, specimens, slides etc.

### **PLANT PHYSIOLOGY AND ELEMENTARY BIOCHEMISTRY**

1. To perform endosmosis and exosmosis using potato tuber and egg osmoscope. Demonstration of imbibition, plasmolysis and deplasmolysis.
2. To study the effects of temperature on the permeability of plasma membrane.
3. Structure of stomata, their opening and closing, stomatal frequency.
4. Comparison of the rate of transpiration using four leaf method, cobalt chloride paper or by different types of potometers under different climatic conditions.
5. Separation of photosynthetic pigments by circular paper and strip chromatography.
6. To study the effect of light and darkness on starch synthesis.
7. To study the effect of intensity and quality of light on the rate of photosynthesis by Wilmott's bubbler.
8. Study of R.Q by Ganong's respirometer in different seeds.
9. Comparison of the rate of respiration of various plants.
10. Demonstration of colour tests and micro- chemical tests for carbohydrates, proteins and lipids.

### **PLANT BREEDING AND BIostatISTICS**

1. Study of the floral biology of some of the locally available crops such as Wheat, Pea, Bean, Mustard, Brinjal, Orka, Tomato etc.
2. Emasculation techniques in the field along with bagging and labelling.
3. Estimation of dockage percentage in seed samples.
4. Estimation of moisture content in seed samples.
5. National and International Institutes of crop research and improvement, their abbreviations.
6. Representation of data through graphs and diagrams.
7. Comment upon given graphs and diagrams.
8. Statistical problems of Central Tendencies, Standard Deviation, Correlation and Chi Square Test.