

**SRIDEV SUMAN UTTARAKHAND UNIVERSITY, BADSHAHITHAUL, TEHRI,  
GARHWAL**

**SYLLABUS: BOTANY COURSE FOR B.Sc. STUDENTS (3 Years)  
UNDER ANNUAL SYSTEM**

To teach the fundamental concept of Botany and their applications the syllabus pertaining to B.Sc (3 year degree course) in the subject of Botany has been prepared as per provision of UGC module and demand of academic environment. The syllabus concepts are duly arranged unit wise and contents are included in a such manner so that due importance is given to requisite intellectual and laboratory skills. This B.Sc course of Botany consists of 3 year course (Annual System). Total marks 600(200 per year).

**B.Sc Ist Year**

S.NO.	TITLE	PAPER CODE	MAX. MARKS
I	Fungi, Elementary Microbiology and Plant Pathology	BBO-101	50
II	Algae and Bryophytes	BBO-102	50
III	Pteridophytes, Gymnosperm and Elementary Palaeobotany	BBO-103	50
	Lab Course	BBO-10P	50

**B.Sc IIInd Year**

S.NO.	TITLE	PAPER CODE	MAX. MARKS
I	Taxonomy of Angiosperms and Economic Botany	BBO-201	50
II	Anatomy, Embryology and Elementary Morphogenesis	BBO-202	50
III	Ecology and Remote Sensing	BBO-203	50
	Lab Course	BBO-20P	50

**B.Sc IIIrd Year**

S.NO.	TITLE	PAPER CODE	MAX. MARKS
I	Cytogenetics, Molecular Biology and Biotechnology	BBO-301	50
II	Plant Physiology and Elementary Biochemistry	BBO-302	50
III	Plant Breeding and Biostatistics	BBO-303	50
	Lab Course	BBO-30P	50

Note : Examiner should follow the below given pattern covering all the unit for each section compulsory :

- a) Twelve Compulsory subject objective type questions of one mark each,  $12 \times 1 = 12$ .
- b) Examinees to solve 6 short answer questions out of 10 questions (3 marks each)  $3 \times 6 = 18$  marks.
- c) Examinees to solve 4 long answer questions out of seven (5 marks each)  $4 \times 5 = 20$  Marks.

## **B.Sc Ist Year**

### **PAPER I: (BBO-101) FUNGI, ELEMENTARY MICROBIOLOGY AND PLANT PATHOLOGY**

#### **UNIT I**

1. Brief history and salient features of Fungi.
2. A broad outline of classification of Fungi (Ainsworth) and salient features of the important groups.
3. Structure, methods of reproduction and life history of following Genera:  
*Synchytrium, Saprolegnia, Albugo, Rhizopus, Penicillium,*  
*Saccharomyces, Phyllactinia, Erysiphe, Puccinia, Ustilago, Agaricus and Alternaria.*
4. Heterothallism, Parasexuality and Economic importance of Fungi.

#### **UNIT II**

1. Lichens: Habitats, characteristics, general structure and classification.
2. Physiology (Symbiotic relationship) and reproduction in Lichens.
3. Economic importance of Lichens.

#### **UNIT III**

1. General account of diversity of microorganisms.
2. Elementary principles of isolation and purification of microorganisms.
3. Role of microorganisms in carbon and nitrogen cycles in nature.

#### **UNIT IV**

1. Bacteria: Structure, classification, nutrition, reproduction, gram positive and gram negative bacteria; Economic importance of bacteria.
2. Viruses: Structure, transmission and multiplication. Economic importance of viruses. Brief idea of Bacteriophages.
3. General account of Mycoplasma.

#### **UNIT V**

1. General symptoms of plant diseases and principles of infection and resistance.
2. General methods of chemical and biological control of the plant diseases.
3. The symptoms, morphology of the causal organism, disease cycle and control measures of the following diseases : Wart disease of Potato, White rust of Crucifers, Powdery mildew of Shisham, Black rust of Wheat, Red rot of Sugarcane.

#### **Suggested Readings**

- Vashistha, B.R., Sinha, A.K. 2014. Botany for degree students: Fungi. S. Chand Publication, New Delhi
- Singh, V., Pandey, P.C. and Jain, D.K. 1998. A text book of Botany. Rastogi Publication Meerut
- Gangulee, H.C. and Kar, A.K. 1992. College Botany. Vol 2, Kolkatta
- Dubey, R.C. and Maheshwari, D.K. 2014. A text book of Microbiology. S. Chand Publication, New Delhi.
- Matthews, R.E. 2013. Fundamentals of Plant Virology, Elsevier India

## **PAPER II (BBO-102): ALGAE AND BRYOPHYTES**

### **UNIT I**

1. General characteristics of the group (Algae) and its position in Plant Kingdom.
2. Classification of algae, basic outlines of Fritsch's and Smith's classification.
3. Elementary knowledge of organisation of thallus in algae.

### **UNIT II**

1. Structure, reproduction and life cycles of the following Genera:

*Chlamydomonas, Volvox, Oedogonium, Vaucheria, Chara, Sargassum, Ectocarpus, Batrachospermum and Polysiphonia.*

2. General account of Bacillariophyceae.
3. Cyanobacteria : General account of *Nostoc*.

### **UNIT III**

1. Types of life cycles – Haplontic, Diplontic, Diplohaplontic, Haplodiplontic and Diplobiontic; Alternation of generation in Algae.
2. Ecology of Algae: Brief idea of freshwater and marine, terrestrial, epiphytic, parasitic, symbiotic algae and phytoplankton.
3. Economic importance of algae as food, fodder, in agriculture, industry and public health.

### **UNIT IV**

1. Outlines and basic principles of classification of the Bryophytes in accordance with the International Code of Botanical Nomenclature.
2. Comparative account of the gross morphology, anatomy, vegetative and sexual reproduction, development and structure of the sporophyte and mechanism of spore dispersal based on *Riccia* and *Marchantia*.
3. Habitat, distribution and economic importance of Bryophytes.

### **UNIT V**

1. Comparative account of the gross morphology and anatomy of the gametophytes, vegetative and sexual reproduction, development and structure of the sporophyte and mechanism of spore dispersal in *Anthoceros* and Mosses (*Funaria*).
2. General account of Jungermanniales (*Porella*).
3. A brief account of the alternation of generation in Bryophytes.

### **Suggested readings**

- Kumar, H.D. 1999. Introductory Phycology, Affiliated East West Press, New Delhi  
Vashistha, B.R., Sinha, A.K. and Singh, V.P. 2014. Botany for degree students: Algae. S. Chand Publication, New Delhi  
Vashistha, B.R., Sinha, A.K and Kumar, Adarsh 2014. Botany for degree students: Bryophyta. S. Chand Publication, New Delhi  
Parihar, N.S. 1991. An Introduction to Bryophyta. Vol 1&2. Central Book Depot, Allahabad  
Puri, P. 1980. Bryophytes. Atma Ram and Sons, New Delhi

**PAPER III: (BBO-103) PTERIDOPHYTES, GYMNOSPERMS AND ELEMENTARY  
PALAEOBOTANY**

**UNIT I**

1. General characters of the Pteridophytes and classification as proposed by Pichi-Sermanni.
2. A comparative study of *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 Genera:  
*Cycas*, *Pinus* and *Ephedra*
3. General anatomy- Types of wood thickening, tracheids, medullary rays, pitting and resin canals, mesarch and pseudomesarch, foliar bundles and types of stomata.

**UNIT IV**

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

**UNIT V**

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

**Suggested Readings**

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

Vashistha, P.C., Sinha, A.K and Kumar, Anil 2012. Botany for degree students: Pteridophyta. S. Chand Publication, New Delhi

Bhatnagar, S.P. and Moitra, A.1996, Gynmosperms, New Age International Pvt. Ltd, New Delhi

Vashistha, P.C., Sinha, A.K and Kumar, Anil 2012. Botany for degree students: Gynmosperms. S. Chand Publication, New Delhi

## **Lab Course (BBO-10P)**

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

### **FUNGI, ELEMENTARY MICROBIOLOGY & PLANT PATHOLOGY**

1. To study identify and comment upon the following fungal materials by preparing the temporary slides/ specimens: *Saprolegnia, Albugo, Rhizopus, Saccharomyces, Phyllactinia, Morchella, Agaricus, Puccinia, Ustilago, and Alternaria*.
2. Study of morphology and structure of different types of lichens: Foliose, Fruticose, and Crustose.
3. Symptoms, morphology of pathogen and host parasite relationship of plant diseases: White rust of crucifers, Wart disease of potato, Loose smut of wheat, Black rust of wheat, Red rot of sugar cane and Powdery mildew of shisham
4. Different methods of isolation of microbes.
5. Staining of bacteria with gram stain.
6. Morphological features of viral infected plants; study of bacterial infections in plants.

### **ALGAE AND BRYOPHYTES**

1. To study, identify and comment upon the following algal materials by preparing temporary slides/specimens: *Nostoc, Chlamydomonas, Volvox, Oedogonium, Vaucheria, Chara, Sargassum, Batrachospermum And Polysiphonia*.
2. To study the morphological and anatomical features of the following material and identify them by preparing temporary slides: *Riccia, Marchantia, Anthoceros, Jungermanniales and Funaria*.

### **PTERIDOPHYTES, GYMNOSPERMS AND ELEMENTARY PALAEOBOTANY**

1. Study of the external features, internal structures, rhizome, leaves, roots, sporangia and strobili of *Selaginella* and *Equisetum*, sporocarp of *Marsellia* and prothallus of *Selaginella, Equisetum, Adiantum* and *Marselia*.
2. Study of the morphological features and anatomical structures of vegetative and reproductive parts of *Cycas, Pinus* and *Ephedra*.
3. Study the fossil specimen: Impression, Casts and Petrification.

## **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. Comparasion 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 Prakashan, 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. Comparasion 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, 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)

### **TAXONOMY 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  $\chi^2$  test.
10. Study of types of aerial photographs and satellite data products.
11. Study of types of stereoscopes

### 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**

### **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, Kreb's 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 osmosecope. 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. Comparasion 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.

