

## **SCHEME OF STUDY OF B.Sc. BOTANY TWO YEAR PROGRAM**

The Following syllabus has been prepared in accordance with the criteria announced by the Higher Education Commission of Pakistan.

### **3<sup>rd</sup> YEAR**

<b>Paper/ (Practical)</b>	<b>Course Title</b>	<b>Marks</b>	<b>Time</b>
Paper-I	Diversity of plants	40 marks	<b>3 hr</b>
Paper-II	Plant Systematic, Anatomy & Development	40 marks	<b>3 hr</b>
Practical	Practical based on Paper-I & II	20 marks	
<b>Total marks</b>		<b>100</b>	

### **4<sup>th</sup> YEAR**

<b>Paper/ (Practical)</b>	<b>Course Title</b>	<b>Marks</b>	<b>Time</b>
Paper-III	Cell Biology and Genetics	40 marks	<b>3 hr</b>
Paper-IV	Physiology & Ecology	40 marks	<b>3 hr</b>
Practical	Practical based on Paper-III & IV	20 marks	
<b>Total marks</b>		<b>100</b>	

**NOTE:** Students will be asked to attempt FIVE questions of equal marks including a compulsory question comprising of parts with short answers from the whole syllabi and another four question for the remaining questions.

## OUTLINE OF STUDY

### 3<sup>rd</sup> Year

#### PAPER-I

#### DIVERSITY OF PLANTS

**Theory:** Definition, scope and classification of kingdoms, Basic concepts of evaluation in plant diversity; Viruses; General structure, types and reproduction of viruses, Viral diseases and their economic importance, Kingdom Monera Prokaryotae (Bacteria and Cyanobacteria), General structure, reproduction, classification and economic importance (such as Nitrogen Cycle and industrial role), Kingdom Protista / Protoctista. **Algae:** General structure, occurrence, reproduction and economic importance, Classification of algae with specific examples: **Chlorophyta:** *Volvox*, **Charophyta:** *Chara*, **Xanthophyta:** *Vaucheria*, **Bacillariophyta:** *Pinnularia*, **Phaeophyta:** *Laminaria*, **Phodophyta:** *Polysiphonia*

**Kingdom Fungi:** General structure, Life cycle, classification with specific examples: Plasmodiophoromycota *Plasmodiophora*, Oomycota *Pythium*, Ascomycota *Pencililum*, *Saccharomyces*, *Alternaria*, Basidiomycota *Ustilago*, *Pussinia* and *Agaricus*. Role of fungi in agriculture, disease of major economic crop plants: rusts, smuts, downy- and powdery mildews, damping off, root rots food and industry.

**Lichens:** General account, structure and life history of *Physcia*

**Kingdom Plantae:** Bryophyta (Atracheophyta); General account, reproduction, classification, affinities and ecological importance with special references to the life cycle of *Anthoceros*, *Porella* and *Polytricum*.

**Pteridophyta (Tracheophyta):** General account, structure, life cycle and biological importance with specific examples: Psilopsida: *Psilotum*, Lycopsida: *Selaginella*, Sphenopsida: *Equisetum*, Pteropsida: *Adiantum* and *Marsilia*.

**Gymnospermae** (seed plants): General account with reference to structure and life history of *Cycas*, *Pinus* and *Ephedra* and their affinities.

**Angiospermae:** Introduction, distinguishing features of Angiosperms.

**Practical:**

Experiment = marks

Viva Voce = marks

- General culturing, maintenance, preservation and staining of microorganisms.
- Study of the morphology and reproductive structures of the types mentioned in theory paper.
- Identification of various types mentioned from prepared slides and fresh collection. Collection of diseased specimens of plants and their identification.

**Book Recommended**

- Bold, H.C., Morphology of Plants, 2<sup>nd</sup> ed. Harper & Row, N.Y.
- Hafiz, A. (1986). Plant Disease. Pakistan Agricultural Research Council, Islamabad, Pakistan.
- Lee, R.E. (1999). Phycology. Cambridge University Press, U.K.
- Mauseth, J.D-(1998). An introduction to Plant Biology: Multimedia Enhanced. Jones and Barlett Pub. U.K.
- Moore, R.C., W.D. and Vodopich, D.S. (1998). Botany. McGraw Hill Company, U.S.A.
- Pandey, S.N. (1994). Text Book of Botany Vol. 11 S. Chand & Co, New Dehli.
- Raven, P.H., Evert, R.E. and Eichom, S.E. (1999). Biology of Plants. W.H. Freeman and company worth publishers.
- Ray, P.M., Stevees, TA. And Fultz, TA. (1998). Botany. Saunders College Publishing, USA.
- Ross, F.C. (1994). Introduction to Microbiology. Jhon Willy, USA.

**PAPER-II PLANT SYSTEMATICS, ANATOMY AND DEVELOPMENT**

**Theory:**

**Plant Systematic:** Introduction to plant systematic its aims, objective and importance. Classification: Importance brief history, introduction various systems of classification, Engler and Prantels System, Bentham and Hooker's System. Brief introduction to nomenclature; Importance of Latin names, systems with an introduction to international code of Botanical Nomenclature (ICBN). Morphology and Phytography – a detailed account of various morphological characters of root, leaf, inflorescence, flower, placentation and fruit types. Diagnostics characters, economic importance and distribution pattern of the following families: Ranunculaceae, Brassicaceae (Cruciferae), Fabaceae (Leguminosae), Rosaceae, Euphorbiaceae, Rutaceae, Cucurbitaceae, Solanaceae, Lamiaceae (Labiatae), Asteraceae (Compositae), Liliaceae, Poaceae.

**Anatomy and Development:** Cell wall; structure and chemical composition. Tissue and Tissue System: Concept; structure and function of various tissues. e.g, Parenchyma, Chlorenchyma, Collenchyma, Sclerenchyma, Xylem and phloem. Primary Structure of root, stem and leaf. Definition and various type of meristems. Primary and secondary growth of dicot stem. Early development of plant body (embryology) *Capselabursa-pastoris* or *Arabidopsis*

### **Practical based on Paper-II**

- Study of simple and compound tissue in macerated and sectional material.
- Study of cross section of bifacial leaf.
- To Study the prepared slides of secondary growth in dicot stem.
- Identification of families given in syllabus with the help of keys.
- Technical description of common flowering plants belonging to families mentioned in theory syllabus.
- Field trips shall be undertaken to study and collect local plants. Students shall submit 40 fully identified herbarium specimens.
- Study of cross section of monocot and dicot stem.

### **Books Recommended**

- Bold, H.C., (1997). Morphology of Plants. Harper & Row, N.Y.
- Dickison, W.C. (2000). Integrative Plant Anatomy, Academic Press, UK.

- Fahn, A. (1990) Plant Anatomy. Pergamon Press, UK.
- Mauseth, J.D. (1998). An Introduction to Plant Biology: Multimedia Enhanced. Jones and BartlettPub. UK
- Moore, R.C., W.D. Clarke and Vodopich, D.S. (1998) Botany. McGraw Hill Company, USA.
- Raven, P.H., Evert, R.E. and Eichhom, S.E. (1999). Biology. Saunders College Publishing, USA.
- Stuessy, T.F. (1990). Plant Taxonomy. Columbia University Press.

#### 4<sup>th</sup> Year

### PAPER-III

### CELL BIOLOGY, GENETICS AND EVOLUTION

#### Theory:

**Cell Biology:** Structures and Functions of Bio-molecules; Carbohydrates, Lipids, Proteins, Nucleic Acids. Cell: The Physico-chemical nature of plasma membrane and cytoplasm. The ultrastructure of plant cell with a brief description and functions of the following organelles; Endoplasmic reticulum, Plastids, Mitochondria, Ribosomes, Dictyosomes, Vacuole, Microbodies (Glyoxysomes + Peroxysomes), Nucleus: Nuclear membran, nucleolus, ultrastructure and morphology of chromosomes, karyotype analysis. Reproduction is somatic and embryogenic cell, mitosis & meiosis, cell cycle. Chromosomal aberrations. Changes in the number of chromosomes. Aneuploidy and euploidy. Changes in the structure of chromosomes, deficiency, duplication, inversion and traslocation.

**Genetics:** Introduction, scope and brief history of genetics. Mendelian inheritance; Laws of segregation and independent assortment, back cross, test cross, dominance and incomplete dominance. Sex linked inheritance, sex linkage in Drosophila and man (colour blindness), XO, XY, WZ mechanism, sex limited and sex linked characters, sex determination. Linkage and crossing over: Definition, linkage groups, construction of linkage, maps, detection of linkage. Molecular genetics: DNA replication. Nature of gene, genetic code, transcription, translation, protein synthesis, regulation of gene expression (e.e. *lac* operon). Transmission of genetic material in Bacteria: Conjugation and gene recombination in *E.coli* transduction and transformation. Principles of genetic engineering/ biotechnology; Basic genetic engineering

techniques. Application of genetics in plant improvement: # Induction of genetic variability (Gene mutation, recombination), physical and chemical mutagens, selection, hybridization and plant breeding techniques, establishment of varieties, release of new varieties. Introduction of genetic conservation. Evolution.

**Practical:**

- Study of cell structure using compound microscope of ultrastructure 'from electron microphotographs and elucidation.
- Measurement of cell size.
- Study of mitosis and meiosis by smear/squash method and from prepared slides.
- Study of chromosome morphology and variation in chromosome number.
- Extraction and estimation of carbohydrate, protein, RNA, DNA from plant sources.
- Genetical problems related to transmission and distribution of genetic material.
- Identification of DNA in plant material. Carmine, orcein staining.
- Study of salivary gland chromosomes of *Drosophila*.

**Books Recommended:**

- Hoelzel, A.R. 2001. Conservation Genetics. Kluwar Academic Publishers.
- Dyonsager, V.R. (1986). Cytology and Genetics. Tata and McGraw Hill Publication C6. Ltd., New Dehli.
- Lodish. H. 2001. Molecular Cell Biology. W.H. Freeman and Co.
- Sinha, U. and Sinha, S. (1988). Cytogenesis Plant Breeding and Evolution, Vini Educational Books, New Delhi.
- Strickberger, M.V. (1988) Genetics, MacMillan Press Ltd., London.
- Carroll, S.B., Grenier, J.K. and Welnerbee, S.d. 2001. From DNA to Diversity Molecular Genetics and the Evolution of Animal Design. Blackwell Science.
- L-ewin", R. 1997. Principles of Human Evolution. Blackwell Science.

**PAPER-IV**

**PHYSIOLOGY AND ECOLOGY**

**Physiology:** Types and properties of solutions. Electrolytes and non-electrolytes. SI units for expressing concentration of solutions, acids, bases and salts pH. Definition of buffers and their

role in biological systems. Colloidal systems, their nature, properties, and biological significance. **Water relations** (water potential, osmotic potential, pressure potential, matric potential). Absorption and translocation of water. Transpiration, factors affecting transpiration. Stomatal structure and functions. **Mineral nutrition:** Soil as a source of minerals. Passive and active transport of nutrients. Essential mineral elements, their role and deficiency symptoms with emphasis on N, K,P & Ca. **Enzymes:** Definition, nature, classification and properties. **Photosynthesis:** The process; absorption and action spectra. Mechanism: light reactions (electron transport and photophosphorylation) and dark reactions (Calvin cycle). Factors affecting this process; concept of limiting factors, Products of photosynthesis. **Respiration:** Definition and mechanism, Glycolysis, Krebs cycle. Electron transport system and oxidative phosphorylation. Anaerobic respiration. Respiratory substrates and respiratory quotients. **Nitrogen Metabolism:** Biological nitrogen fixation. **Growth:** Definition; role of auxins, gibberellins, cytokinins, abscisic acid and ethylene in controlling growth. Introduction to plant tissue culture. Photoperiodism: Definition, historical background, short day, long day and day neutral plants. Role of phytochromes and hormones in photoperiodism. **Dormancy:** Definition and causes of seed dormancy; methods of breaking seed dormancy. **Vernalization:** Annual and biennial forms - Hormonal concept and phasic development theory. **Plant Movements:** Tropic movements - phototropism, gravitropism and their mechanisms. Nastic movements.

**Ecology:** Concepts of Ecology, Brief history of Ecology (General, Pakistan), Ecophysiology **Light and temperature responses:** Quantity of light, Variation in light (temperature), Ecophysiological responses. **Edaphology;** Brief introduction of soil forming process, Texture, structure, and water, Chemical Properties, Biological components: Soil Organisms, Organic matters. **Water:** Precipitation: kinds, and affectivity. Distribution of vegetation in relation to moisture. **Wind** - Ecological importance of wind,. Population Ecology: A brief introduction, history and background. Seed dispersal, Seed bank, demography, reproductive strategy. **Community Ecology:** Concept of plant community- attributes, Sampling methods Succession- history, concept, development and modern theories of succession, Brief concept of productivity, Local vegetation. **Ecosystem:** Definition and background, Ecological energetic, Biogeochemical cycle (Hydrologic and nitrogen cycle). **Applied Ecology;** Aridity, biodiversity, conservation, water logging and salinity, pollution, erosion, desertification, management.

## **Practical:**

- Preparation of solutions of specific normality of acids/bases salts, sugars, molal and molar solutions and their standardization.
- Determination of uptake of water by swelling seeds when placed in sodium chloride solution of different concentrations.
- Measurement of leaf water potential by the dye method.
- Determination of the temperature at which beet-root cells lose their permeability.
- Determination of the effects of environmental factors on the rate of transpiration of a leafy shoot by means of a photometer/by cobalt chloride paper method.
- Tests for sugars (Reducing and non-reducing). Glucose, sucrose, maltose, fructose.
- Chemical tests for the following cell constituents: Starch, Cellulose, Lignin, Proteins.
- Extraction of chlorophyll from the leaves and separation of component pigments on a paper chromatogram. Study of absorption spectra using spectrophotometer.
- Comparison of the effects of green, red and blue-coloured light on the amount of oxygen evolved by a photosynthesizing plant.
- Estimation of oxygen utilized by a respiring plant by winklers method.
- Extraction of amylase from germinating wheat seeds and study of its effect on starch breakdown.
- Measurement of carbon dioxide evolution during respiration of germinating seeds by the titration method.
- Determination of leaf area index.
- Measurement of growth by leaf area increase method.
- Study of different stages of seed germination.
- Measurement of light and temperature
- Effect of light and temperature on seed germination
- Determination of soil texture by hydrometer method
- Determination of maximum water holding capacity.
- Determination of carbonates, electrical conductivity and pH in Soil and Water.
- Measurement of wind velocity
- Population demographic techniques



- Measurement of vegetation by Quadrat and plotless methods
- Determination of productivity by harvest method
- Several trips to ecologically diverse vegetations.

### **Books Recommended**

- Ihsen Ellahi (1995). Plant Physiology, Biochemical Processes in Plants, UGC Press.
- Witham & Devlin. 1986 Exercises in Plant Physiology, AWS Publishers, Boston.
- Taiz, L. and Zeiger, E. 1998. Plant Physiology. 2nd Ed. Sinauers Publ. Co. Inc. Calif.
- Salisbury F.B and Ross C.B. 1999. Plant Physiology. 5th Edition. Wadsworth Publishing Co. Belmont CA.
- W.B. Hopkins. 1999. Introduction to Plant Physiology. 2nd Ed. John Wiley & Sons. New York.
- Ricklefs, R.E. 2000. Ecology. W.H. Freeman & Co., UK.
- Ricklefs, R.E. 2001. The Economy of Nature. W.H. Freeman & Co., UK.
- Barbour, M. G., J. H. Burke and W.D. Pitts. 1999. Terrestrial Plant Ecology, The Benjamin, Cumming Publishing Co. Palo Alto, California, USA.
- Chapman, J.L. and Reiss, M.J. 1999 Ecology: principles and applications: Cambridge University Press.
- Hussain F. 1989. Field and Laboratory Manual of Plan Ecology. National Academy of Higher Education, Islamabad.
- Krebs, C. J. 1997. Ecology. Harper and Row Publishers.
- Moore, P. D. and S. B. Chapman. 1986. Methods in Plant Ecology. Blackwell Scientific Publication, Oxford.
- Smith, R. L. 1996. Ecology and Field Biology. Addison Wesley Longman, Inc., New York.
- Smith, R: L. 1998. Elements of Ecology. Harper & Row Publishers, New York.
- Stiling O.D. 1996. Ecology: Theories and applications. Prentice Hall, New Jersey.

- Subrahmanyarn, N.S. and Sambamurthy, A.V.S.S. 2000. Ecology. Narosa Publishing House, New Delhi.
- Townsend, C.R., Harper, J.L. and Began, M.E. 2000. Essentials of Ecology. Blackwell Scientific Publications, UK.