# BOTANY (ELECTIVE)

## APPENDIX 'A'

## CURRICULUM OF B.Sc BOTANY FOR SESSION 2004-2006 & ONWARDS.

**AIMS AND OBJECTIVES:**

1. To develop the understanding of the problems of Plant Sciences by means of observations & experimentations & thus finding out solutions of the problems.
2. To equip the students with sufficient basic information on different aspects of plant life so that they are able to manage basic human problems such as Sanitation, Health, Agriculture, Plant Breeding, Forestry and Wild life etc.
3. To give them enough scientific training which would be necessary for them to serve on different positions in Forestry, Plant Science, Botanical survey ,Pest Control ,Primary and secondary education, Wildlife, Health Education , Botanical Gardens , Environments and other related professions.
4. To provide them with all necessary information required for higher education in various disciplines of Botany.

**Scheme of Studies:**

*There will be three papers. For every paper a minimum of 85 lectures must be delivered during the academic session.

| **Theory:** | **Title** | | **Marks** |
|---|---|---|---|
| Paper A: | Microbiology and diversity in plants | | 45 |
| Paper B: | Cell Biology, Genetics, Anatomy and Taxonomy of Angiosperms | | 50 |
| Paper C: | Physiology and Ecology | | 45 |
| | | **Total:** | **140** |
| **Practicals:** | | | |
| Practical-A | Will cover Paper A. | | 20 |
| Practical-B | Will cover paper B. | | 20 |
| Practical-C | Will cover paper C. | | 20 |
| | | **Total:** | **60** |
| | | **Grand Total:** | **200** |

## APPENDIX 'B'

(Syllabi and courses of Reading)

### PAPER A: MICROBIOLOGY AND DIVERSITY IN PLANTS:

Definition, scope and classification of the plant kingdom.

### 1. Microbiology:

**Bacteria**

a. General structure, classification and biological importance (Role of Bacteria in Rhizosphere, Nodulation).
b. Transmission of Gentic material in Bacteria: conjugation . transduction and transformation.
c. Cyanophyta (Cyanobacteria) General account with special emphasis on nitrogen fixation and soil building, life cycle of oscillatoria / Anabaena.
d. General economic importance of Bacteria.

**Viruses**

a. General structure and biochemical nature.
b. Introduction to viral diseases: Tobacco Mosaic disease.

### 2. Diversity of Plants:

**Algae**

General structure, occurrence, reproduction and classification.

a. Chlorophyta: General account, economic importance, life cycle of Volvox. Oedogonium.
b. Charophyta: Chara
c. Xanthophyta: General account and life cycle of Vaucheria.

d. Bacillariophyta: General account, economic importance, life cycle of pinnularia.

e. Phaeophyta : General account, economic importance , life cycle of Ectocarpus.
f. Rhodophyta: General account, economic importance, life cycle of Batrachospermum.

**Fungi**

General structure, occurrence, reproduction and classification, life cycle, economic importance with Emphasis on industrial and medicinal significance. Method of control of pathogenic forms (Smuts and Rust).

| | | |
|---|---|---|
| a. | Mastigomycotina | Albugo |
| b. | Ascomycotina | Penicillium, Phyllactinia, Yeast |
| c. | Basidomycotina | Ustilago Puccinia and Agaricus |
| d. | Dueteoromycotina | Alternaria |

**Lichens**

General account, structure and life history of Physcia.

**Bryophyta (Atracheophyta)**

General account, reproduction, classification, affinities and ecological importance with special Reference to the life cycle of Anthoceros and Funaria.

**Pteridophyta**

a. Psilopsida: General account, structure and life history of Psilotum and its affinities.
b. Lycopsida: General account, structure and life history of Selaginella and its affinities.
c. Sphenopsida: General account, structure and life history of Equisetum.
d. Pteropsida: Filicinae (Ferns), general account, life history of Adiantum and Marsilea.

**3. Gymnosperms:**

General account with reference to structure and life history of Cycas, Pinus and Ephedra and their affinities.

**4. Angiosperms:**

Life cycle of a typical angiosperm.

**PRACTICALS**

i. Bacterial culture and staining. Identification of Gram Positive and Gram negative bacteria.

ii. Study of the morphology and reproductive structures of the types mentioned in theory paper (cyanobacteria, Algae, Fungi, Lichens, Bryophyta, Pteridophyta & Gymnosperms).

iii. Identification of prepared slides of various types mentioned.

**BOOKS RECOMMENDED (latest editions):**

1. Smith, G.M. Cryptogamic Botany, Vol. I & II, National Book Foundation, Islamabad.
2. Mclean. RC. And Ivemey Cook, Text book of Theoretical Botany, Longman's Green and Co.
3. Bold, H.C., Morphology of Plants. Harper & Row, N.Y.
4. Webster, J.W. An introduction to Fungi, National Book Foundation, Islamabad.
5. Pandey, S.N. Text Book of Botany vol.II. S.Chand & Co, New Dehli.
6. Ross, F.C. Introductin to Microbiology. John Wiley.

## *PAPER B*

### *THEORY*

### CELL BIOLOGY; GENETICS; ANATOMY AND TAXONOMY OF ANGIOSPERMS

**1. Cell Biology:**

1. The ultra-structure of plant cell with a brief description and functions of the following:

| | | | |
|---|---|---|---|
| i. | Plasma membrane | ii. | Endoplasmic retriculum |
| iii. | Plastids | iv. | Mitochondria |
| v. | Ribosomes | iv. | Dictyosomes |
| vii. | Vacuole | viii. | Microbodies (Glyoxysome and Paroxysm) |

3. Nucleus: Nuclear membrane. Chromosome morphology and karyotype analysis.
4. Reproduction in somatic and embryogenic cell, with details of different phases (Mitosis & Meiosis).
5. Chromosomal aberrations.
   i. Changes in the number of chromosomes.Aneuploidy and Euploidy.
   ii. Changes in the structure of chromosomes , deficiency, duplication, inversion and translocation.

**2. Genetics:**

1. Sex linked inheritance, sex linkage in Drosophila and man (colour blindness) , xo,xy,wz mechanism, sex limited and sex linked characters, sex determination.
2. Linkage and crossing over: Defination, linkage groups, construction of linkage maps, detection of linkage.
3. Molecular genetics: Chemical structure of nucleic acids (DNA, RNA); DNA replication. Nature of gene, genetic code, transcription, translation, Protein synthesis, regulation of gene expression (e.g. lc operon).
4. Principles of genetic engineering / Biotechnology; Basic genetic engineering techniques.
5. Application of genetics in plant improvement: Induction of genetic variability (gene mutations recombination), physical and chemical mutagens, selection, hybridization and plant breeding techniques, establishment of varieties, release of new varieties.
6. Evolution: The concept of evolution.

**3. Anatomy:**

1. Scope of plant anatomy.
2. Cell wall: Gross structure and chemical composition.
3. Apical meristerms: Types of meristems, structure of root and shoot apical meristems.
4. Tissue and tissue system: Concept, structure and function of the following tissues: Parenchyma, collenchyma, sclerenchyma, xylem, phloem and epidermis.
5. Primary structure of a dicot and moniocot root, stem and leaf.
6. Vascular Cambium: secondary growth in a dicot stem. A brief account of periderm.

**4. Taxonomy:**

1. Binomial nomenclature.
2. Systems of classification (Engler and Prantel)
3. Study, Distribution, diagnostic characters and economic importance of the following families:

| | | | |
|---|---|---|---|
| i. | Chenopodiaceae | ii. | Ranunculaceae |
| iii. | Brassicaceae | iv. | Euphorbiaceae |
| v. | Mimocaceae | vi. | Papillionaceae |
| vii. | Cesalpinaceae | viii. | Rutaceae |
| ix. | Malvaceae | x. | Cucurbitaceae |
| xi. | Rosaceae | xii. | Salicaceae |
| xiii. | Solanaceae | xiv. | Liliaceae |
| xv. | Poaceae | xvi. | Asteraceae |

**PRACTICALS:**

1. Study of cell structure using compound microscope.
2. Measurement of size of cell.
3. Fixation and staining of plant material.
4. Study of mitosis and meiosis by smear method.
5. Genetical problems related to transmission and distribution of genetic material.
6. Identification of DNA in plant material (Feulgen staining).
7. Study of Chromosome morphology and variation in chromosome number.
8. Study of salivary gland chromosomes of Drosophila.
9. Preparation and study of cross sections of sunflower and corn root and stem. Study of cross section of a bifacial leaf.
10. Technical description of common flowering plants belonging to families mentioned in theory syllabus.
11. Field trips will be undertaken to study and collect local plants. Students shall submit 40 properly preserved and fully identified plants at the time of examination.

**BOOKS RECOMMENDED:**


1. Dyonsager, V.R. Cytology and Genetics. Talar and McGraw Hill Publications Co.Ltd., New Dehli.
2. Verma and Agarwal. Tet book of Cytology, Chand and Co.,New Dehli.
3. De Robertis, E.P. and De Robertis, E.M.F. Cell and Molecular Biology. Hoet Lae and Febiger, New York.
4. Norman V.Rothwell. Understanding Genetics, Oxford Univerity Press, Inc., London.
5. R.P. Burke and Richardson. H. Introduction to Modern Genetics, John Wiley and Sons, New York.
6. Laura Livingston Mays. Genetics. Holt, Rinehart and Winston, U.S.A.
7. Strichberger, M.V. Genetics, MacMillan Press LTD., London.
8. Esau, K.An introduction to Anatomy of Seed Plants. John Wiley & Sons Inc New York, London.
9. Fahn. A. Plant Anatomy. Pergamon Pres, Oxford.
10. Lawson and Sahni. Text book of Botany. University Tutorial Press, London.
11. Zahur, M.S. Taxonomy of Angiosperms. IImi Kutab Khana, Lahore.
12. M.Tahir Rajput, S.Hasney.K.M. Khan . Plant Taxonomy. Nasim Book Depot, Hyderabad.


## PAPER C

### PHYSIOLOGY AND ECOLOGY

**PHYSIOLOGY**

1. 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.
2. Diffusion. imbibition, Osmosis and osmotic components (Osmotic potential, pressure potential, water potential, matric potential). Absorption and translocation of water. Transpiration, factors affecting transpiration. Stomatal Physiology.
3. Mineral uptake: Soil as a source of minerals, Passive and active transport. Essential mineral elements, their role and deficiency symptoms with emphasis on Ca, N, K and P.
4. Enzymes: Definition, nature, properties and classification.
5. Photosynthesis: Measurement, factors affecting this process: concept of limiting factors, absorption and action spectra. Mechanism (Photophosphorylation and dark fixation of $CO^2$ – $C^3$, $C^4$ & CAM Plants) Products of photosynthesis.
6. Respiration: Definition and mechanism, Glycolysis, Anaerobic respiration. Krebs cycle. Electron Transport system and oxidative phosphorylation. Respiratory substrates and respiratory quotients.
7. Nitrogen Metabolism: Biological nitrogen fixation.
8. Growth: Definition: role of auxins, gibberellins and cytokinins in controlling growth. Introduction to plant tissue culture.
9. Photoperiodism: Definition, historical background, short days, long day and day neutral plants . Night interruption experiments. Hormonal concept inphotoperiodism, Role of phytochromes.
10. Dormancy: Definition and causes of dormancy: methods of breaking dormancy.
11. Vernalization: Annual and biennial forms Hormonal concept and phasic development theory.
12. Plant Movements: Tropic movements- Phototropism, gravitropism and their mechanisms. Nastic movements.

**ECOLOGY:-**

1. Ecology: Definition, scope and applications.
2. Species and population: Level of organizations (organism, population, community, ecosystem and biosphere definitions only).
3. Ecological factors:

**Soil:** Difinition of soil, different soil types, parent material and its weathering, soil texture and classification, soil microorganism, soil organic matter (humus, its properties, accumulation and loss). Importance of organic matter; waterlogging and salinity, causes and reclamation, soil erosion different types of erosion, methods of control and conservation.

**Light:** Light measurement and variation, Ecophysiological responses of plants to light.

**Water:** Water cycle in nature, atmospheric moisture, its measurement and its importance to plants. Precipitation, its causes and measurement. Their importance to plant. Drought and drought resistance of plants.

**Temperature:** Importance of temperature to plants, physiological responses and adaptations.

**Wind:** Effects on plant growth and distribution. Soil erosion by wind and its control.

4. Methods of study of plant communities.
5. Plant succession and climax concept (hydrosere and xerosere).
6. Ecosystem: concept of an ecosystem, pond, forest and grassland as examples of aquatic and terrestrial ecosystems.
7. Ecological energetics: Efficiency pyramids, food chains and food web, trophic levels.
8. Productivity: concept, types and measurements.
9. Biogeochemical Cycles of P and N.
10. Environmental pollution: Its kinds (Air, water and land).
11. Conservation of natural resources.
12. Vegetation types of Pakistan in relation to Environmental factors.

**PRACTICALS**

1. Preparation of solutions of specific normality of acids / bases, salts, sugars, molal / molar solutions and their standardization.
2. Determination of water potential of a massive tissue such as potato tuber.
3. Measurement of leaf water potential by the dye method.
4. Determination of the temperature at which beet root cells lose their semi-permeability.
5. Determination of the effects of environmental factors on the rate of transpiration of a leafy shoot by means of a photometer.
6. Test for sugars (Reducing and non-reducing). Glucose, sucrose, maltose, fructose.
7. Chemical tests for the following cell constituents:
   i. Starch ii. Cellulose
   iii. Lignin iv. Proteins

8. Extraction of chlorophyll from the leaves and separation of component pigments on a paper chromatogram. Study of absorption spectra using spectrophotometer.
9. Comparison of the effects of green, red and blue-coloured light on the amount of oxygen evolved by a photosynthesizing plant.
10. Oxygen estimation in photosynthesis by Winkler's method.
11. Extraction of amylase from germinating wheat seed and study of its effect on starch breakdown.
12. Measurement of carbon dioxide evolution during respiration of germinating seeds by the titration method.
13. Determination of the total acidity in Bryophyllum leaves kept in dark and light.
14. Determination of leaf area index.
15. Measurement of Growth by leaf area increase method.
16. Study of different stages of seed germination (zones of growth).
17. Determination of soil organic matter contents by wet digestion method.
18. Test for the presence of nitrates in a soil sample.
19. Soil texture determination by hydrometer method.
20. Determination of soil carbonate by acid neutralization method.
21. Measurement of local vegetation types by Quadrat method.
22. Study of pond, grassland and forest ecosystems.
23. Determination of carbonates and bicarbonates in tap water.
24. Determination of the Chloride contents of irrigation water.
25. Determination of soil pH.
26. Measurement of productivity by harvest method.
27. Field trips for familiarization with natural vegetation.

**BOOKS RECOMMENDED (Latest editions):**


1. Akhtar, M.A., Introductionary plant physiology, Qureshi brothers, urdu bazaar , Lahore.
2. Mayer B.S. & Anderson, D.B.Plant physiology, McGraw-Hill , book Co.Inc,.New York.
3. Bonner, J. and Galston, A.W.Principles of physiology.Freeman Press.
4. Bidwel, R.G.S., Plant physiology, Macmillan press London and New York.
5. Oosting , H.J.The study of plant communities. W.H. Freeman, Francisco.
6. Odum, E.P., Basic Ecology. W.B. Saunders & Co . Philadelphia int. ed.
7. I. llahi. Plant Growth, University Grants Commission Press, Islamabad.
8. Odum, E.P. Fundamentals of Ecology, W.B. Saunders & Co, Philadelphia.
9. Daubenmire, R.F. Plant & Environment. Text Book of Autecology. John Wiley, New York.
10. Hussain, F. Field and Laboratory Manual for Plants Ecology, University Grants Commission Press, Islamabad.
11. Hussain, F. & I.llahi. Ecolgy and vegetationof lesser Himalayas (Pakistan), Jadoon Press , Peshawar.
12. I.IIahi. Pllatn Physiology: Biochemical Processes in Plants. University Grants Commission Press, Islamabad.


## BASIC REQUIRETNS FOR B.Sc (PRACTICALS)

Autoclave
Low temperature incubators
Inoculation chamber
Incubator
Microscope

i. Student Microscope
ii. Research microscope
iii. Dissecting microscope
iv. Projection microscope

**Electrical balance.**

Waterbath (Constant temp).
Inoculating needles and wire loops for bacterial culture.
Rotary Microtome.
Spectroscope.
Water distillation plant.
Mechanical stirrer
Prism camera Lucida
Leaf area meter`
Prepared slides and specimens of types mentioned in the syllabus
Hydrometer
Ganong's photometer
Transparencies required for elaborating the tissues more clearly.
Thremo couples

Humidifier
pH meter
Oxygen meter
Ovens
Incubators
Autoclaves 30-40 litres capacity

Freezers 20 $^{o}$ C.
Flask shaker
Shaking water bath with temperature control.
Controled environment incubator
Cooled water circulator of compressors
Bench ambient incubator
Bench top centrifuge
Warburg's Appparatus
Nitrogen digesting and distillation apparatus (Kjeldahal's apparatus)
Spectronic 20 – Spectrophotometer
Audio-Visual aid equipments: slide projector, overhead projector,
Epidiascope, video recording and projection system.

**BOOKS RECOMMENDED (Latest editions):**


1. Smith, G.M. Cryptogamic Botany (Vol. 1&1)National Book Foundation, Islamabad.
2. Mclean, R.C. & Ivimey-cook, Textbook of Theoretical Botany, Longmans, Green & Co.
3. Bold, H.C. Morphology of plants, Harper & Row, New York.
4. Webster, J.W. An introduction to Fungi, National Book Foundation Islamabad.
5. Nawaz, M. General Botany (Vol. 1,2 & 3), IImi Kutab Khana, Lahore.
6. Lawson & Sahni. Textbook of Botany, University Tutorial Press, Lahore.
7. Eames, A.J. An introductionto plant anatomy, Tata McGraw-Hill Publishing Co.Ltd., New Dehli.
8. Sinnott, E.W. & & Dunn, L.C. Principles of Genetics, McGraw-Hill book Co. New York, Tokyo.
9. Akhtar, M.A. introduction to plant physiology.
10. Bonner, J.& Glaston. A.W. Principles of plant physiology, W.H. Freeman & Co., San Francisco & London.
11. Mayer, B.S. & Anderson, D.B. & Bohniing, R.H.Introduction to plant physiology, D.VanNostrand Co., New York.
12. Oosting, H.J. Study of plant Communities, Freeman & Co., San Francisco & London.
13. Billings, R.D.M. Plant and the Ecosystem. Wadsworth Co., California.
14. Bidwell, R.G.S. Plant Physiology, Macmillan publishing Co., Inc., New York.
15. U.S.D.A. Diagnosis and Improvement of Saline and Alkali Soils.
16. Agriculture Hand book No.60, United States Department of Agriculture, USA.
17. Hussain,F. Field and Laboratory Mannual for Plant Ecology, UGC, Press, Islamabad.
18. Hussain, F. & I. IIahi. Ecology and Vegetation of Lesser Himalayas, Pakistan , Jadoon Press, Peshawar.
19. IIahi, I. Plant Growth, University Grants Commission press, Islamabad.
20. I.IIahi. Plant physiology: Biochemical processes in plants, University Grants Commission Press, Islamabad.