

**B.Sc. Part – III  
BOTANY 2019**

**Theory**

Course	Nomenclature	Number of Papers	Number of Periods per week	Maximum marks	Minimum marks
Paper I	Ecology and Environmental Biology	1	2	50	54
Paper II	Plant Physiology and Biochemistry	1	2	50	
Paper III	Plant Biotechnology and Molecular Biology	1	2	50	
<b>PRACTICAL COURSE</b>			6	75	27

Duration of examination of each theory papers      3 hours  
Duration of examination of practicals                      5 hours

**PAPER I: ECOLOGY AND ENVIRONMENTAL BIOLOGY**

**Unit I:** Plants and Environment: Atmosphere (gaseous composition), water (properties of water cycle), light (global radiation, photosynthetically active radiation), temperature, soil (development, soil profiles, physico-chemical properties) and biota.

Morphological, anatomical and physiological responses of plants to water (hydrophytes and xerophytes) temperature (thermoperiodicity and vernalization), light (photoperiodism, heliophytes and sciophytes) and salinity

**Unit II:** Population ecology: Concept and characters, growth curves, biotic potential, ecotypes and ecads. Seed: The significance, suspended animation; ecological adaptation and dispersal strategies

Community ecology and Succession: Community characteristics, frequency, density, cover, life forms and biological spectrum. Succession: concept, classification and examples (hydrosere & xerosere)

**Unit III:** Ecosystems and Productivity: Ecosystem — Structure, abiotic & biotic components, food chain, food web, ecological pyramids, energy flow, biogeochemical cycles of carbon, nitrogen, phosphorus and Sulphur.

Productivity: Primary productivity, its measurements and factors affecting primary productivity

**Unit IV:** Environmental Biology of Indian Desert: Climate, vegetation types, adaptive strategies of desert plants. Desertification: meanings, causes, critical issues & driving

forces. Agroforestry and its impact on desert agriculture. Desert biodiversity, Geomorphology, natural resources exploitation and their impact on desert environment

**Unit V:** Pollution Ecology: Definitions, classification, air, water and land pollution. Concepts of Industrial Ecology in pollution management. Global warming: Concepts and Current status.

Phytogeography: Vegetation types of India — Forest and Grasslands. Biogeographical regions of India, Remote sensing: The basics and applications in ecological studies

### **Suggested Laboratory Exercises**

1. To determine minimum number of quadrats required for reliable estimation of biomass in herbaceous vegetation
2. To study the frequency of herbaceous species and to compare the frequency distribution with Raunkaier's Standard frequency diagram
3. To estimate Importance Value Index for herbaceous vegetation on the basis of relative frequency, relative density and relative biomass in protected and Gochar land
4. To measure the vegetation cover of grassland through point frame
5. To measure the above ground plant biomass in a natural field
6. To determine diversity indices (richness Simpson, Shannon-Weaver) in natural fields
7. To estimate bulk density and porosity of soil samples
8. To determine moisture contents, water holding capacity and texture of soil samples
9. To estimate qualitatively nitrate, phosphate and potassium in soil samples
10. To study the vegetation structure through profile diagram
11. To estimate transparency and pH of different water bodies
12. To measure dissolved oxygen content in polluted and unpolluted water samples
13. To estimate salinity, hardness, carbonates and bicarbonate in different water samples
14. To determine the percent leaf area injury of different leaf samples collected around polluted site
15. To estimate dust holding capacity of the leaves of different plant species
16. Plant adaptive modifications: Specimens/Slides:
  - i) Succulents: *Opuntia*, *Euphorbia*
  - ii) Salt secretion: *Atriplex*, *Chloris*
  - iii) Salt accumulation: *Suaeda*, *Salsola*, *Zygophyllum*
  - iv) Xerophytes: *Calligonum*, *Capparis*, *Leptadenia*, *Parkinsonia*
  - v) Hydrophytes: *Eichhornia*, *Nymphaea*, *Hydrilla*

### **Suggested Readings**

- Dash, M.C. Fundamental of Ecology, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1996  
Kormondy, E.J. Concepts of Ecology, Prentice – Hall of India Pvt., New Delhi, 1996  
Kumar, H.D. General Ecology, Vikash Publishing House Pvt. New Delhi, 1995  
Mukherjee, B. Environmental Biology, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1997  
Odum, E.P. Basic Ecology, Saunders, Philadelphia, 1983  
Sen, D.N. Environment and Plant Life in Indian Desert, Geobios International, Jodhpur, 1982  
Sharma, P.D. Ecology and Environment, Rastogi Publications, Meerut 2002

**PAPER – II**  
**PLANT PHYSIOLOGY AND BIOCHEMISTRY**

**Unit 1:** Plant-water relations: Importance of water to plant life; physical properties of water; diffusion and osmosis; absorption, transport of water and transpiration; physiology of stomata. Mineral nutrition: Essential macro- and micro-elements and their role, mineral uptake; deficiency and toxicity symptoms. Introduction to phloem transport; source-sink relationship; factors affecting translocation

**Unit 2:** Photosynthesis: Significance; historical aspects; photosynthetic pigments; action spectra and enhancement effects; concept of two photosystems; Z-scheme; photophosphorylation; Calvin cycle; C4 pathway; CAM plants; photorespiration. Rubisco enzyme.

**Unit 3:** Respiration: Aerobic and anaerobic respiration; Krebs's cycle; electron transport mechanism (chemi – osmotic theory); redox potential; oxidative phosphorylation. Pentose phosphate pathway. Basics of enzymology: Discovery and nomenclature; characteristics of enzymes; concept of holoenzyme, apoenzyme, coenzyme and cofactors; regulation of enzyme activity; mechanism of action. Protein structures

**Unit 4:** Nitrogen and lipid metabolism: Biological Nitrogen fixation. Importance of nitrate reductase and its regulation; ammonium assimilation. Structure and function of lipids; fatty acid biosynthesis;  $\beta$ -oxidation; storage and mobilization of fatty acids

**Unit 5:** Growth and development: Definitions; phases of growth and development. Brief account on seed dormancy, seed germination and senescence. Photoperiodism, physiology of flowering; florigen concept, biological clock, vernalization. Plant Hormones-auxins, gibberellins, cytokinins, abscisic acid and ethylene, history of their discovery, Physiological role and general mode of actions. Photomorphogenesis; Brief account on phytochromes and cryptochromes.

**Suggested Laboratory Exercises**

1. To study the permeability of plasma membrane using different concentrations of organic solvents
2. To study the effect of temperature on permeability of plasma membrane
3. To prepare the standard curve of protein and determine the protein content in unknown samples
4. To study the enzyme activity of catalase and peroxidase as influenced by pH and temperature
5. Comparison of the rate of respiration of various plant parts
6. Separation of chloroplast pigments by solvent method
7. Determining the osmotic potential of *vacuolar sap* by plasmolytic method
8. Determining the water potential of *any tuber*
9. Separation of amino acids in a mixture by paper chromatography and their identification by comparison with standards
10. Bioassay of auxin, cytokinin, GA, ABA and ethylene using appropriate plant material

11. To study the regulation of stomatal movement using growth regulators, KCI and anti-transpirants

### **Suggested Readings**

- Dennis, D.T., Turpin, D.H., Lefebvre, D.D. and Layzell (eds.). Plant Metabolism (2nd ed.), Longman, Essex, England, 1997
- Galston, A.W. Life processes in Plants, Scientific American Library, Springer-Verlag, New York, USA, 1989
- Hopkins, W.G. Introduction to plant physiology, John Wiley & Sons, Inc., New York, USA, 1995
- Lea, P.J. and Leegood, R.C. Plant Biochemistry and Molecular Biology, John Wiley & Sons, Chichester, England, 1999
- Mohr, H. and Schopfer, P. Plant Physiology, Springer-Verlag, Berlin, Germany, 1995
- Salisbury, F.B. and Ross, C.W. Plant Physiology (4th ed.), Wadsworth Publishing Co., California, USA, 1992
- Srivastava, H.S. Plant Physiology, Rastogi Publication, Meerut, 2001
- Taiz, L. and Zeiger, E. Plant Physiology (2nd ed.), SinauerAssociats, Inc. Publishers, Massachusetts, USA, 1998

### **Suggested Readings**

(for Laboratory Exercises)

- Amar Singh. Practical Plant Physiology, Kalyani Publishers, New Delhi, 1977
- Moore, T.C. Research Experiences in Plant Physiology: A Laboratory Manual, Springer-Verlag, Berlin, 1974
- Nifa, A.J. and Ballou, D.P. Fundamental Laboratory Approaches for Biochemistry and Biotechnology, Fitzrerald Science Press, Inc., Maryland, USA, 1998
- Robalts and Tucker, G.A. (Eds.) Plant Hormone Protocols, Humana Press, New Jersey, USA, 2000
- Scot, R.P.W. Techniques and Practice of Chromatography Marcel Dekker, Inc., New York, 1995
- Wilson, K. and Goulding, K.H. A Biologists Guide to principles and techniques of Practical Biochemistry, Ed-ward Arnold, London, 1986

**PAPER-III**  
**PLANT BIOTECHNOLOGY AND MOLECULAR BIOLOGY**

- Unit 1:** Cell theory and concept of totipotency and pluripotency. History of plant tissue culture and biotechnology. Basic tools and techniques of Plant tissue culture and molecular biology: General introduction about applications of biotechnology, bioinformatics and Nano Biotechnology.
- Unit 2:** Introduction to Bacterial Genome organization Genetic recombination in bacteria. Introduction to vectors for gene cloning: p-BR322, Cosmids, Phagemids and BAC. c-DNA libraries. Detection and screening of recombinant DNA.
- Unit 3:** Concepts of organogenesis-somatic embryogenesis and androgenesis. Somaclonal variations and its applications. Protoplast isolation, fusion and somatic hybridization. Cryopreservation of germplasm. Introduction to bioreactors and production of secondary metabolites with special reference to alkaloids obtained from *Ephedra*, shikonin, diosgenin and Strategies used to optimize secondary metabolite production.
- Unit-4:** Genetic engineering of plants: *Agrobacterium* mediated gene transfer, t-DNA transfer mechanism integration and expression in plants. Direct method of gene transfer in plants: Chemical methods electroporation, particle gun delivery, lipofection, microinjection, macroinjection, pollen transformation, laser induced and silicon fiber mediated. Reporter (Luciferase, GUS and GFP) and marker genes.
- Unit-5:** Biotechnology and society: Development of transgenic crop plants against biotic and abiotic stresses. Genetically modified crops: Golden rice, Bt cotton (as a model system). Intellectual Property Right (IPR) and Plant Breeder's Rights (PBR) in current regime of WTO. Impact of GM crops on society and environment.

**SUGGESTED LABORATORY EXERCISES**

1. Surface sterilization and aseptic inoculation of suitable explants for activation of axillary shoot bud/induction of cell or callus culture (haploid or somatic cell)
2. Plant (Cauliflower/Onion) DNA extraction by Rapid Method

**Suggested Readings**

- Bhojwani, S.S. Plant Tissue Culture: Application and Limitation, Elsevier Science Publishers, New York, USA, 1990
- Old, R.W. and Primrose, S.B. Principles of Gene Manipulation, Black well Scientific Publications, Oxford, U.K., 1986
- Raghavan, O. Embryogenesis in Angiosperms: A Developmental and Experimental Study, Cambridge University, Press, New York, USA, 1986
- Vasil, I.K. and Thorpe, T.A. Plant Cell and Tissue Culture, Kluwer Academic Publishers, The Netherlands, 1994

### Suggested Readings

(for Laboratory Exercises)

Ball, R.D. (ed.) Plant Cell Culture Protocols, Humana Press, Inc. New Jersey, USA, 1999

Dixon, R.A. (ed.) Plant Cell culture: a Practical Approach, IRL, Press Oxford, 1987

Glick, B.R. and Thompson, J.E. Methods in Plant Molecular Biology and Biotechnology, CRC Press, Boca Raton, Florida, 1993

Roberts, J. and Tucker, G.A. (eds.) Plant Hormone Protocols Humana Press, New Jersey, USA 2000.

### Practical Examination Scheme B.Sc. Botany Part III

Duration: 5 h

		Regular Students	Ex-Students
Q1	Perform the ecological experiments allotted to you by lots and report the results in suitable form.	10	11
	A. Major Experiment	04	05
	B. Minor Experiment		
Q2	Perform the physiological experiments allotted to you by lots and report the results in suitable form.	10	11
	A. Major Experiment	04	05
	B. Minor Experiment		
Q3	Perform Molecular Biology (DNA extraction) and Plant Biotechnology (surface sterilization and aseptic inoculation of explants) exercise and report results in suitable form		
	A. Major Exercise	09	11
	B. Minor Exercise	05	05
Q4	Spots (Two from each paper)	18	18
Q5	Viva voce	07	09
Q6	Records	08	-
	Total	<u>75</u>	<u>75</u>