

B.Sc Botany

Paper – III: Cell Biology, Genetics, Ecology and Biodiversity

(Total Hours of Teaching: 90 @ 3 h / Week)

Unit - I: Cell Biology (22 h)

1. Plant cell envelopes: Ultra structure of cell wall, molecular organisation of cell membranes. (3 h)
2. Nucleus: Ultrastructure, Nucleic acids - Structure and replication of DNA; types and functions of RNA. (6 h)
3. Chromosomes: Morphology, organisation of DNA in a chromosome, Euchromatin and Heterochromatin. Karyotype. (6 h)
4. Special types of chromosomes: Lampbrush, polytene and B - chromosomes. (2 h)
5. Cell division: Cell cycle and its regulation; mitosis, meiosis and their significance. (5 h)

Unit - II: Genetics (22 h)

6. Mendelism: Laws of inheritance. Genetic interactions - Epistasis, complementary, supplementary and inhibitory genes. (4 h)
7. Linkage and crossing over: A brief account, construction of genetic maps - 2 point and 3 point test cross data. (4 h)
8. Mutations: Chromosomal aberrations - structural and numerical changes; Gene mutations. (5 h)
9. Gene Expression: Organisation of gene, transcription, translation, mechanism and regulation of gene expression in prokaryotes (Lac.and Trp Operons). (7 h)
10. Extra nuclear genome: Mitochondrial and plastid DNA, plasmids. (2 h)

Unit - III: Ecology (25 h)

11. Concept and components of Ecosystem. Energy flow, food chains, food webs, ecological pyramids, biogeochemical cycles - Carbon, Nitrogen, Phosphorus (7 h)
12. Plants and environment: Ecological factors - Climatic (light and temperature), edaphic and biotic. Ecological adaptations of plants. (8 h)
13. Population ecology: Natality, mortality, growth curves, ecotypes, ecads. (3 h)
14. Community ecology: Frequency, density, cover, life forms, biological spectrum, ecological succession (Hydrosere, Xerosere). (5 h)
15. Production ecology: Concepts of productivity, GPP, NPP, CR (Community Respiration) and secondary production, P/R ratio and Ecosystems. (2 h)

Unit - IV: Biodiversity and Conservation

(21 h)

16. Biodiversity: Concepts, Convention on Biodiversity - Earth Summit. Types of biodiversity. (4 h)
17. Levels, threats and value of Biodiversity. (4 h)
18. Hot spots of India – Endemism, North Eastern Himalayas, Western Ghats. (4 h)
19. Agro-biodiversity: Vavilov centres of crop plants. (3 h)
20. Principles of conservation: IUCN threat-categories, RED data book - threatened & endangered plants of India. Role of organisations in the conservation of Biodiversity - IUCN, UNEP, WWF, NBPGR. (6 h)

Suggested Readings:

- Bharucha, E. 2005. Textbook of Environmental Studies for Undergraduate Courses. Universities Press (India) Private Limited, Hyderabad.
- Fukui, K. and S. Nakayama. 1996. Plant Chromosomes: Laboratory Methods. CRC Press, Boca Raton, Florida.
- Harris, N. and K. J. Oparka. 1994. Plant Cell Biology: A Practical Approach. IRL Press at University Press, Oxford. UK.
- Khitoliya, R. K. 2007. Environmental Pollution – Management and Control for Sustainable Development. S. Chand & Company Ltd., New Delhi.
- Kormondye, E. 1989. Concepts of Ecology (3rd Ed.). Printice Hall of India, New Delhi
- Kothari, A. 1997. Understanding Biodiversity: Life, Sustainability and Equity: Tracts for the Times. 11. Orient Longman Ltd., New Delhi.
- Michael, S. 1996. Ecology. Oxford University Press, London.
- Mishra. D. D. 2008. Fundamental Concepts in Environmental Studies. S. Chand & Company Ltd., New Delhi.
- Odum, E. P. 1983. Basics of Ecology. Saunder's International Students Edition, Philadelphia.
- Pandey, B. P. 2007. Botany for Degree Students: Diversity of Microbes, Croptogams, Cell Biology and Genetics. S. Chand & Company Ltd., New Delhi.
- Sharma, P. D. 1989. Elements of Ecology. Rastogi Publications, Meerut.
- Sharma, A. K. and A. Sharma. 1999. Plant Chromosomes: Analysis, Manipulation and Engineering. Harwood Academic Publishers, Australia.
- Shukla, R. S. and P. S. Chandel. 2007. Cytogenetics, Evolution, Biostatistics and Plant Breeding. S. Chand & Company Ltd., New Delhi.
- Singh, H. R. 2005. Environmental Biology. S. Chand & Company Ltd., New Delhi.
- Snustad, D. P. and M. J. Simmons. 2000. Principles of Genetics. John Wiley & Sons, Inc., U S A
- Strickberger, M. W. 1990. Genetics (3rd Ed.). Macmillan Publishing Company.
- Verma, P. S. and V. K. Agrawal. 2004. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. S. Chand & Company Ltd., New Delhi.
- Verma, P. S. and V. K. Agrawal. 2006. Genetics. S. Chand & Company Ltd., New Delhi

Practical - III: Cell Biology, Genetics, Ecology and Biodiversity

(Total Hours of Laboratory Exercises: 90 @ 3 h / Week in 30 Sessions)

Suggested Laboratory Exercises:

1. Demonstration of cytochemical methods: Fixation of plant material and nuclear staining for mitotic and meiotic studies. (6 h)
2. Study of various stages of mitosis using cytological preparation of Onion root tips (12 h)
3. Study of various stages of meiosis using cytological preparation of Onion flower buds (12 h)
4. Karyotype study using cytological preparation of dividing root tip cells of Onion / photographs / permanent slides (3 h)
5. Solving genetic problems related to monohybrid, dihybrid ratio and interaction of genes (minimum of six problems in each topic). (15 h)
6. Construction of linkage maps; two point test cross. (9 h)
9. Knowledge of ecological instruments: Working principles and applications of Hygrometer, rain gauge, anemometer, altimeter, light meter, wet and dry bulb thermometer (with the help of Equipment / diagrams/ photographs). (6 h)
10. Determination of soil texture (composition of clay, sand silt etc.) and p^H . (3 h)
11. Study of morphological and anatomical characteristics of plant communities using locally available plant species: Hydrophytes (*Eichhornia*, *Hidrilla*, *Pistia*, *Nymphaea*, *Vallisneria*), Xerophytes (*Asperagus*, *Opuntia*, *Euphorbia antiquorum*), Halophytes (*Rhizophora*, *Avecenia*). (9 h)
12. Detailed study on macro flora of a local fresh water body. (6 h)
13. Estimation of carbonates and bicarbonates in the given water sample. (3 h)
14. Minimum of two field visits to local areas of ecological / conservation of biodiversity importance (Sacred grove / Reserved forest / Botanical garden / Zoo Park / Lake etc.). (6 h)

**Paper - IV: Physiology, Tissue Culture, Biotechnology,
Seed Technology and Horticulture**

(Total Hours of Teaching: 90 @ 3 h / Week)

Unit - I: Physiology (Part A) (24 h)

1. *Water Relations*: Importance of water to plant life, physical properties of water, diffusion, imbibition, osmosis; water, osmotic and pressure potentials; absorption, transport of water, ascent of sap; transpiration; Stomatal structure and movements. (6 h)
2. *Mineral Nutrition*: Essential macro and micro mineral nutrients and their role; symptoms of mineral deficiency; absorption of mineral ions; passive and active processes. (4 h)
3. *Enzymes*: Nomenclature, characteristics, mechanism and regulation of enzyme action, enzyme kinetics, factors regulating enzyme action. (4 h)
4. *Photosynthesis*: Photosynthetic pigments, absorption and action spectra; Red drop and Emerson enhancement effect; concept of two photosystems; mechanism of photosynthetic electron transport and evolution of oxygen; photophosphorylation; Carbon assimilation pathways: C₃, C₄ and CAM; photorespiration. (8 h)
5. *Translocation of organic substances*: Mechanism of phloem transport; source-sink relationships. (2 h)

Unit - II: Physiology (Part B) (24 h)

6. *Respiration*: Aerobic and Anaerobic; Glycolysis, Krebs cycle; electron transport system, mechanism of oxidative phosphorylation, pentose phosphate pathway. (7 h)
7. *Nitrogen Metabolism*: Biological nitrogen fixation, nitrate reduction, ammonia assimilation, amino acid synthesis and protein synthesis. (7 h)
8. *Growth and Development*: Definition, phases and kinetics of growth. Physiological effects of phytohormones- auxins, gibberellins, cytokinins, ABA, ethylene and brassinosteroids. (7 h)
9. Physiology of flowering and photoperiodism, role of phytochrome in flowering. (3 h)

Unit - III: Tissue Culture and Biotechnology

(22 h)

10. Tissue culture: Introduction, sterilization procedures, culture media - composition and preparation; explants. (4h)
11. Callus culture; cell and protoplast culture, Somatic hybrids and cybrids. (4h)
12. Applications of tissue culture: Production of pathogen free plants and somaclonal variants, production of stress resistance plants, secondary metabolites and synthetic seeds. (4h)
13. Biotechnology: Introduction, history and scope. (3h)
14. rDNA technology: Vectors and gene cloning and transgenic plants. (7h)

Unit - IV: Seed Technology and Horticulture

(20 h)

15. Seed: Structure and types. Seed dormancy; causes and methods of breaking dormancy. (4 h)
16. Seed storage: Seed banks, factors affecting seed viability, genetic erosion. Seed production technology; seed testing and certification. (4 h)
17. Horticulture techniques: Introduction, Cultivation of ornamental and vegetable crops, Bonsai and landscaping (4 h)
18. Floriculture: Introduction. Importance of green house, polyhouse, mist chamber, shade nets; Micro irrigation systems. Floriculture potential and its trade in India (4 h)
19. Vegetative Propagation of plants: Stem, root and leaf cuttings. Layering and bud grafting. Role of plant growth regulators in horticulture. (4 h)

Suggested Readings:

- Adams, C. R., K. M. Banford and M. P. Early. 1993. Principles of Horticulture. Butterworth Heineman Ltd., London.
- Agrawal, P. K. 1993. Hand Book of Seed Technology. Dept. of Agriculture and Cooperation. National Seed Corporation Ltd., New Delhi
- Balasubramanian, D., C. F. A. Bryce, K. Dharmalingam, J. Green and K. Jayaraman. 2004. Biotechnology. Universities Press (India) Private Limited, Hyderabad.
- Bedell, Y. E. Seed Science and Technology. Indian Forest Species. Allied Publishers Limited. New Delhi.
- Channarayappa. 2007. Molecular Biotechnology – Principles and Practices. Universities Press (India) Private Limited, Hyderabad.
- Chawala, H. S. 2002. Introduction to Plant Biotechnology. Oxford & IBH Publishing Company, New Delhi.
- Dubey, R. C. 2001. A Textbook of Biotechnology. S. Chand & Company Ltd., New Delhi
- Edmond, J. B., T. L. Senn, F. S. Adrews and R. J. Halfacre. 1977. Fundamentals of Horticulture (4th Ed.). Tata McGraw-Hill, New Delhi.
- Gorer, R. 1978. The Growth of Gardens. Faber and Faber Ltd., London.
- Hartman, H. T. and D. E. Kestler. 1976. Plant Propagation: Principles and Practices. Prentice & Hall of India, New Delhi.
- Hopkins, W. G. 1995. Introduction to Plant Physiology. John Wiley & Sons Inc., New York, USA
- Jain, J.L., S. Jain and Nitin Jain. 2008. Fundamentals of Biochemistry. S. Chand & Company Ltd., New Delhi.
- Jha, T.B. and B. Ghosh. 2005. Plant Tissue Culture – Basic and Applied. Universities Press (India) Private Limited, Hyderabad.
- Janick Jules. 1979. Horticultural Science. (3rd Ed.). W. H. Freeman and Co., San Francisco, USA.
- Lewin, B. 1994. Genes V. Oxford University Press., Oxford.
- Lewin, B. 2002. Genes VII. Oxford University Press., Oxford.
- Pandey, B. P. 2007. Botany for Degree Students: Plant Physiology, Biochemistry, Biotechnology, Ecology and Utilization of Plants. S. Chand & Company Ltd., New Delhi.
- Ramawat, K. G. 2008. Plant Biotechnology. S. Chand & Company Ltd., New Delhi.
- Rao, K. M. 1991. A Text Book of Horticulture. McMillan India Ltd, New Delhi.
- Salisbury, F. B. and C. W. Ross. 1992. Plant Physiology. 4th edn. (India Edition), Wordsworth, Thomson Learning Inc., USA.
- Taiz, L. and E. Zeiger. 1998. Plant Physiology (2nd Ed.). Sinauer Associates, Inc., Publishers, Massachusetts, USA.
- Tiwari, G. N. and R. K. Goal. Green House Technology – Fundamentals, Design, Modelling and Application. Narosa Publishing House, New Delhi.
- Tunwar, N. S. and S. V. Singh. 1988. Indian Minimum Seed Certification Standards. The Central Seed Certification Board, Govt. of India, New Delhi.

**Practical - IV: Physiology, Tissue Culture, Biotechnology,
Seed Technology and Horticulture**

(Total Hours of Laboratory Exercises: 90 @ 3 h / Week in 30 Sessions)

Suggested Laboratory Exercises:

1. Determination of osmotic potential of vacuolar sap by plasmolytic method using leaves of *Rhoeo / Tradescantia*. (3 h)
2. Determination of rate of transpiration using cobalt chloride method. (3 h)
3. Determination of stomatal frequency using leaf epidermal peelings/impressions. (3 h)
4. Determination of catalase activity using potato tubers by titration method. (6 h)
5. Separation of chloroplast pigments using paper chromatography technique. (6 h)
6. Estimation of protein by biuret method. (6 h)
7. Isolation and estimation of DNA. (6 h)
8. Testing of seed viability using 2, 3, 5-triphenyl tetrazolium chloride (TTC). (3 h)
9. Demonstration of seed dressing using fungicide to control diseases. (3 h)
10. Demonstration of seed dressing using biofertilizer (*Rhizobium*) to enrich nutrient supply. (3 h)
11. Study on tools/equipment used in horticulture: Rake, hoe, spade, trowel, digger, pick-axe, shade net, glass house and mist chamber (6 h)
12. Demonstration of vegetative plant propagation: Rooting of cuttings – Leaf and Stem; layering; stem, bud and wedge grafting (6 h)
13. Study on the application of plant growth regulator (IBA) for rooting of cuttings using ornamental plants (6 h)
14. Knowledge of instruments and facilities used in plant tissue culture Using equipment / photographs). Preparation of plant tissue culture medium. (6 h)
15. Demonstration of micropropagation using explants like axillary buds and shoot meristems (inoculation of explants). (9 h)
16. Study of biotechnology products: Samples of antibiotics, vaccines, biofertilizers, single cell protein, cosmetics; photographs of transgenic plants, multiple shoots and Artificial / synthetic seeds (9 h)
17. Study visits to places of horticultural and biotechnological interest - Commercial nurseries/ Botanical gardens; Biotechnology R & D laboratories/Industries. (6 h)

MODEL QUESTION PAPER FOR ALL THEORY PAPERS

Time: 3 Hrs

Maximum Marks: 100

Instructions to the candidates: Draw neat labeled diagrams wherever necessary.

Section: A

(Instructions to the question PAPER SETTER: Set at least TWO questions from EACH UNIT of the given syllabus).

Define or explain **ALL** of the following (10 X 2 = 20 Marks):

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.
- 8.
- 9.
- 10.

Section: B

(Instructions to the question PAPER SETTER: Set at least ONE question from EACH UNIT of the given syllabus).

Write short answers for **FOUR** of the following (4 X 5 = 20 Marks):

- 11.
- 12.
- 13.
- 14.
- 15.
- 16.

Section: C

(Instructions to the question PAPER SETTER: Set TWO questions from EACH UNIT of the given syllabus).

Write detailed answers for **ALL** of the following (4 X 15 = 60 Marks):

UNIT - I

17. (a) (OR)
(b)

UNIT - II

18. (a) (OR)
(b)

UNIT - III

19. (a) (OR)
(b)

UNIT - IV

20. (a) (OR)
(b)

MODEL QUESTION PAPER & SCHEME FOR VALUATION

B.Sc. BOTANY

Practical Paper - III: Cell Biology, Genetics, Ecology and Biodiversity

Time: 3h

Maximum Marks: 50

- 1. Carry out the cytological preparation and staining of the given material and report any TWO stages of cell division to the Examiners. 15 Marks**

Scheme for valuation: Procedure – 3 marks + Slide preparation – 6 marks + Observations or recording of results (figures) – 3 marks + Inference – 3 marks (*Total: 15 Marks*).
- 2. Solve the TWO given Genetics Problems: 10 Marks**

Scheme for valuation for each problem: Working out – 3 marks + Inference – 2 (Total for each problem = 5 marks (*Total: 5 x 2 = 10 Marks*))
- 3. Ecology: Carry out analysis of the water sample and estimate the amount of 5 Marks**

Scheme for valuation: Analysis– 3 marks + Results and inference – 2 marks (*Total: 5 Marks*)
- 4. Critical notes on (FIVE) spotters of scientific interest: 10 Marks**

Scheme of valuation: Identification – 1 mark + Notes – 1 mark for each spotter (*Total: 10 Marks for five spotters*)
- 5. Viva-Voce (Interactive testing): 5 Marks**
- 6. Record(s) and submissions: 5 Marks**

MODEL QUESTION PAPER & SCHEME FOR VALUATION

B.Sc. BOTANY

**Practical Paper - IV: Physiology, Tissue Culture, Biotechnology,
Seed Technology and Horticulture**

Time: 3h

Maximum Marks: 50

- 1. Conduct the Physiology experiment allotted to you. Give procedure, results and inference.**
Scheme for valuation: Procedure – 3 marks + Experimentation – 6 marks + Observations or recording of results – 3 marks + Inference – 3 marks (*Total: 15 Marks*). **15 Marks**
- 2. Conduct the biotechnological experiment allotted to you and write the procedure:**
Scheme for valuation: Preparation – 5 marks + Identification - 3 + Discussion – 2 marks
(*Total: 10 Marks*) **10 Marks**
- 3. Describe the given horticultural procedure.**
Scheme for valuation: Observation – 2 marks + Identification – 1 mark + analysis – 2 marks
(*Total: 5 Marks*) **5 Marks**
- 4. Critical notes on (FIVE) spotters:**
Scheme of valuation: Identification – 1 mark + Notes – 1 mark for each spotter (*Total: 10 Marks for five spotters*) **10 Marks**
- 5. Viva-Voce :** **5 Marks**
- 6. Record(s)** **5 Marks**