Category II

Botany Courses for Undergraduate Programme of study with Botany as one of the Core Disciplines

DISCIPLINE SPECIFIC CORE COURSE (DSC-.....): Plant Cell and Developmental Biology

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Plant Cell and Developmental Biology DSC	**4**	**2**	**0**	**2**	Class XII pass	**Nil**

Learning objectives:
To understand the basics of plant cell structure, development, growth and organisation of plant body.

Learning outcomes:
On completion of the course, the students will

- become familiar with the structure and functions of various components of plant cell
- understand the processes of cell growth and its regulation
- comprehend the structure, organization and functions of various tissues of the plant organs
- get acquainted with the reproductive processes in the life cycle of angiosperms
- appreciate the interactions between the developmental pathways resulting in the differentiation of plant body
- recognise the importance of plant developmental biology in the improvement and conservation of plants

Unit 1. Introduction to Plant Cell: structure and function **5 hour**
Cell as the basic unit of life; differences between plant and animal cell, prokaryotic and eukaryotic cell; Cell Theory.
Structure and functions of cell wall; cell membrane; cell organelles- nucleus, chloroplast, mitochondria, dictyosomes, endoplasmic reticulum, microbodies, cytoskeleton.

Unit 2: **Cell growth** **3 hours**

Cell cycle, regulation (in brief) and significance; mitosis and meiosis; cytokinesis.

Unit 3. **Polarity in plant growth** **3 hours**
Plant body as a bipolar structure; apical, basal and radial patterns of body plan; growth through primary and secondary meristems; organisation of shoot and root apices.

Unit 4. **Differentiation of tissues: vegetative organs** **6 hours**
Structure and functions of tissues (simple and complex); structure of stem, root, and leaf (dicot and monocot); principles of organ differentiation: role of transcription factors in cell, tissue, organ identity and development, cell fate determination by position, and cell-cell signalling; hormones involved in organ differentiation (very briefly).

Unit 5. Differentiation of tissues: reproductive organs **6 hours**
Anther, microsporogenesis and microgametogenesis, general structure of pollen grains and male gametes, male germ unit; ovule, megasporogenesis (monosporic, bisporic, tetrasporic) and megagametogenesis (Polygonum type), ultrastructure and significance of female germ unit; Flower development (ABC model).

Unit 6. Pollination and Fertilization **3 hours**
Pollination types, agents and adaptation; pollen germination; path of pollen tube in pistil; double fertilization

Unit 7. **Development of Embryo and Seed** **4 hours**
Endosperm types, functions; development of embryo from zygote, establishment of apical-basal and radial organisation; development of seed, modes of seed dispersal.

Practicals (60 hours)
1. Study of plant cell - through peel mount (*Tradescantia,* or any other); whole mount (*Hydrilla*) - cytoplasmic streaming.
2. Study of cell components - nucleus (Feulgen/acetocarmine staining); mitochondria (Janus green B staining); cell wall (PAS staining).
3. To study mitotic index. (pictures or permanent slides -24h-period or under different temperatures/environmental conditions may be used).
4. Study tissues and organs structure through temporary preparations of macerated material and sections - T.S. of dicot stem- *Helianthus/ Cucurbita*, *Hydrilla/ Nympaea petiole, Casuarina,* stem with secondary growth - *Helianthus, Salvadora/ Bignonia;* T.S. of monocot stem - *Zea mays*, *Dracaena;* T.S. of dicot root with and without secondary growth- *Cicer*, monocot root - *Zea mays*, V.S. of dicot leaf- *Vernonia/Hamelia*etc., *Nerium, Hydrilla;* V.S. of monocot leaf- *Zea mays, Triticum/Dracaena/Crinum;* peel mountstostudy epidermal structures - types of stomata, trichomes, laticifers; Shoot apex and root apex through micrographs.
5. Study Reproductive structures (i) Anther - T.S. of anther of any large flower like *Datura/ Hamelia/ Kigelia*); whole mounts of pollen grains; ii) pollen development through micrographs of T.S. anther at different stages of development (with secretory, amoeboid tapetum); (iii) types of ovule through permanent slides/specimens/ micrographs; (iv) Polygonum type of embryo sac development through micrographs; (v) ultrastructure of egg apparatus and central cell through micrographs.
6. Study (i) pollen viability (TTC/FDA); (ii) pollen germination; (iii) growth of pollen tube in cleared pistil.

7. Study (i) dicot and monocot embryo development (through permanent slides); (ii) structure of seed (L.S. of seed)

Suggested Readings:

1. Beck, C.B. (2010). An Introduction to Plant Structure and Development. Second edition. Cambridge University Press, Cambridge, UK.
2. Dickison, W.C. (2000). Integrative Plant Anatomy. Harcourt Academic Press, USA
3. Fahn, A. (1974). Plant Anatomy. Pergamon Press, USA
4. Mauseth, J.D. (1988). Plant Anatomy. The Benjammin/Cummings Publisher, USA
5. Esau, K. (1977). Anatomy of Seed Plants. John Wiley & Sons, Inc., Delhi.
6. Taiz, L., Zeiger, E., Moller, I.M., Murphy, A. (2015). Plant Physiology. 6th edition. Sinauer Associates, Sunderland. USA.
7. Hopkins, W.G., Huner, N.P.A. (2009). Introduction to Plant Physiology. Fourth edition, John Wiley & Sons, Inc. USA.
8. Bhojwani, S.S., Bhatnagar, S.P., Dantu, P.K. (2015). The Embryology of Angiosperms, 6th edition. New Delhi, Delhi: Vikas Publishing House.
9. Johri, B.M. (1984). Embryology of Angiosperms. Netherlands: Springer-Verlag.
10. Raghavan, V. (2000). Developmental Biology of Flowering plants. Netherlands: Springer.
11. Shivanna, K.R. (2003). Pollen Biology and Biotechnology. New Delhi, Delhi: Oxford and IBH Publishing Co. Pvt. Ltd.

Additional Resources:

1. Cutler, D.F., Botha, T., Stevenson, D.W. (2007). Plant Anatomy - An Applied Aspect. Blackwell Publishing, USA
2. Bahadur, B. Rajam, M.V., Sahijram, L., Krishnamurthy, K.V. (2015). Plant Biology and Biotechnology. Volume 1: Plant Diversity, Organization, Function and Improvement. Springer (India) Pvt. Ltd. New Delhi, Heidelberg, New York, Dordrecht, London.
3. Shivanna, K.R., Tandon, R. (2014). Reproductive Ecology of Flowering Plants: A Manual. Springer (India) Pvt. Ltd. New Delhi, Heidelberg, New York, Dordrecht, London
4. Moza M. K., Bhatnagar A.K. (2007). Plant reproductive biology studies crucial for conservation. Current Science 92:1907.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.