Kalindi College

DEPARTMENT OF BOTANY

Curriculum/Teaching Plan (2024-25)

(ODD Semesters : I, III, V)

Dr. Pratibha Thakur

Course : B. Sc. (H) Botany, 3rd year, Sem. V [1st August 2024 – 28th Nov. 2024]
Paper : Reproductive Biology of Angiosperms – DSC-14 – THEORY (NEP)
UPC: 32161501

Name of Paper : Reproductive Biology of Angiosperms, & Code (32161501)	**Allocation of Lectures**	**Month wise schedule**	**References**
Unit 1 Introduction : Introduction about Reproductive biology and its scope; significant contributors to the field (SG Nawaschin, Heslop-Harrison, Jensen, Strasburger, P Maheswari, BM Johri, Amici, KR Shivanna); structure of flower.	1 lecture	August 2024	**Suggested readings:** ● Bhojwani S.S., Bhatnagar S.P. & Dantu P.K. (2015). The Embryology of Angiosperms, 6th Edition. By VIKAS PUBLISHING HOUSE. ISBN: 978-93259-8129-4. ● P. Maheshwari, (2004). An introduction to the embryology of Angiosperms. Tata McGraw-Hill Edition, ISBN: 0-07-099434-X. ● Johri, B.M. (1984). Embryology of Angiosperms. Netherlands: Springer-Verlag. ISBN: 13:978-3-642- 69304-5 ● Raghavan, V. (2000). Developmental Biology of Flowering plants. Netherlands: Springer. ISBN: 978-1- 4612-7054-6. ● Shivanna, K.R. (2003). Pollen Biology and Biotechnology. New Delhi, Delhi: Oxford and IBH Publishing Co. Pvt. Ltd. ● Mangla,Y., Khanduri, P., Gupta, C.K. 2022. Reproductive Biology of Angiosperms: Concepts and Methods. Cambridge University Press ISBN 978-1-009-16040-7. ● Tandon R, Shivanna KR, Koul M Reproductive Ecology of Flowering Plants: Patterns and Processes 1st ed. 2020 Edition ISBN 978-9811542091.Springer Verlag ● Kapoor, R., Kaur, I. Koul M.2016. Plant Reproductive Biology and Conservation IK International Publishing House Ltd. India ISBN: 9789382332909 36.
Unit 2 Anther and Pollen : Anther wall: Structure and functions, microsporogenesis, microgametogenesis; Pollen wall: Structure and functions, Number Position Character (NPC), pollen viability and storage, Male Germ Unit (MGU) – structure and significance.	5 lectures	August 2024	
Unit 3 Pistil : General structure and types of pistil and ovules; megasporogenesis (monosporic, bisporic and tetrasporic -*Fritillaria* and *Plumbago* type) and megagametogenesis (details of Polygonum type); Organization and ultrastructure of mature embryo sac; cell specification; Female Germ Unit – structure and significance.	4 lectures	September 2024	
Unit 4 Pollination : Types (Self, cross, geitonogamy, xenogamy), significance; Structure of the stigma and style; Pollen-pistil interactions- capture, adhesion, hydration, pollen tube penetration; Path of pollen tube in the pistil; Role of synergids in pollen tube attraction; Double fertilization; Polytubey block.	4 lectures	September 2024	
Unit 5 Self-Incompatibility : Basic concepts (interspecific, intraspecific, homomorphic, heteromorphic, GSI and SSI); Methods to overcome self-incompatibility (in brief): mixed-pollination, intraovarian and in vitro pollination and fertilization, modification of stigma surface, parasexual hybridization.	4 lectures	October 2024	
Unit 6 Endosperm : Types (2 examples each), development, structure and functions; Genomic imprinting.	2 lectures	October 2024	

Name of Paper : Reproductive Biology of Angiosperms, & Code (32161501)	Allocation of Lectures	Month wise schedule	References
Unit 7 Embryo : General pattern and comparison of development of dicot and monocot embryo (initial apical cell and basal cell polarity, globular embryo with radial polarity, mature embryo); Suspensor: structure and functions; Embryo-endosperm relationship; Nutrition of embryo, haustorial systems: Embryo patterning.	4 lectures	October 2024	Additional Resources: ● Shivanna, K.R., Tandon, R. (2020). Reproductive Ecology of Flowering Plants: A Manual. Springer (India) Pvt. Ltd. New Delhi, Heidelberg, New York, Dordrecht, London ● Shivanna, K. R., & Rangaswamy, N. S. (2012). Pollen biology: a laboratory manual. Springer Science & Business Media.
Unit 8 Seed : Structure and importance of seed as diaspore, as storage organ; germination and seedling formation.	2 lectures	November 2024	
Unit 9 Polyembryony and apomixis : Introduction, types, causes and applications.	2 lectures	November 2024	
Unit 10 Applications of Reproductive Biology : Haploid embryos (androgenesis and gynogenesis in brief)- concept and significance; crop productivity and conservation (5-6 points with special reference to reproductive biology).	2 lectures	November 2024	
• Revision • Assignment/Presentation • Mock		November 2024	

Course : B. Sc. (H) Botany, 3rd year, Sem. V [1st August 2024 – 28th Nov. 2024]
Paper : Reproductive Biology of Angiosperms – DSC-14 – PRACTICALS (NEP) ALL
UPC: 32161501

Name of Paper : Reproductive Biology of Angiosperms, & Code (32161501)	Allocation of Lectures	Month wise schedule	References
1. Anther: Wall and its ontogeny (permanent slides/photomicrographs of pollen wall layers: epidermis, middle layer and endothecium can be studied in young anther and mature anther), tapetum (amoeboid and glandular), Microspore mother cell, spore tetrads, uninucleate, bicelled, and dehisced anther; Temporary stained mounts of T.S. anther to study the organization.	2 Practicals	August 2024	
2. Pollen: General morphology, dyad, pseudomonads, polyads, massulae, pollinia (slides/digital resources, fresh material); Ultrastructure of pollen wall (micrograph); Pollen viability: tetrazolium test/FDA; Pollen fertility test: acetocarmine test; Germination: calculation of percentage germination in different media using hanging drop/sitting method. (Suggestion: Standard medium should	2 Practicals	August 2024	

be Brew-Baker & Kwack's medium. Comparison can be made between Brew-Baker & Kwack's medium with calcium/ Boron/ Sucrose and without calcium/ Boron/ Sucrose. This will help students to comprehend the importance of Calcium Sucrose and/or Boron in pollen germination).			
3. Temporary mounts of pollen grains cleared with 1N HCl/KOH to study germ pores; Ultrastructure of male germ unit (MGU) through micrographs.	1 Practical	September 2024	
4. Ovule: Types-anatropous, orthotropous, amphitropous/campylotropous, circinotropous, unitegmic, bitegmic; tenuinucellate and crassinucellate; Special structures: endothelium, obturator, hypostase, caruncle, elaiosomes, and aril (permanent slides/specimens/digital resources).	2 Practicals	September 2024	
5. Female gametophyte: developmental sequence of monosporic embryo sac only; Ultrastructure of Female Germ Unit (transmission electron micrographs of: egg cell, synergid); central cell; antipodals.	1 Practical	September 2024	
6. Pollination Adaptations/Syndrome (1 example of each): Diurnal: (Insect {any 1-2 types} and Bird), Nocturnal (Bat and Moth)); bagging experiment (only demonstration); **project on pollination.	1 Practical	October 2024	
7. Intra-ovarian pollination; Test tube pollination (through digital resources).	1 Practical	October 2024	
8. Endosperm: Dissections of developing seeds for endosperm with free-nuclear haustoria (Suggested material: *Cucumis sativa*, *Grevillea robusta*, *Croton*).	1 Practical	October 2024	
9. Apomixis: Study of organization of aposporous and diplosporous embryo sac using photomicrographs of cleared ovule (DIC and/or confocal generated images).	1 Practical	October 2024	
10. Embryogenesis: Study of development of dicot embryo through permanent slides; dissection of developing seeds for embryos at various developmental stages (Suggested material: Crotalaria, Calendula); Study of suspensor through electron micrographs.	2 Practicals	November 2024	
11. Seed dispersal mechanisms (adaptations through live specimens/e resources: Autochory, Anemochory, Hydrochory, Zoochory, Myrmecochory, describe any 3 of them with 2 examples each), **project on seed dispersal. ** The projects can be on pollination/ seed dispersal or any other topic based on the scope of reproductive biology. It can be a write-up with	2 Practicals	November 2024	

photographs. The students can also make a digital project submission in the form of a documentary of 5-10 min			
• Revision • Project • Mock Practical Exam		November 2024	

Course : B.Sc. (H) Botany, 1st year, Sem. - I [29th Aug. 2024 – 24th Dec. 2024]
Paper : Plant Diversity and Evolution – THEORY (NEP)
DSC - 01

Name of Paper : Plant Diversity and Evolution	**Allocation of Lectures**	**Month wise schedule**	**Reading suggestions**
Unit 1: Origin of life : Principles and concepts of evolution, Tree of Life, and classification (upto six kingdoms)	1.5 Weeks	August 2024	• Campbell, N.A., Reece,J.B. (2008) Biology, 8 th edition, Pearson Benjamin Cummings, San Francisco. • Evert, R. F., Eichhorn,S.E. (2012). • Raven Biology of Plants, 8 th edition, New York, NY: W.H.Freeman and Company. • Bhatnagar, S.P., Moitra, A. (1996).Gymnosperms. New Delhi, Delhi, New Age International (P) Ltd. Publishers. • Kumar, H.D. (1999). Introductory Phycology, 2 nd edition .Delhi, Delhi, Affiliated East-West. Press Pvt. Ltd. • Pelczar, M. J. (2001). Microbiology, 5 th edition. NewDelhi, Delhi:TataMcGraw-HillCo. • Puri,P. (1985). Bryophytes. New Delhi, Delhi, Atma Ram and Sons. • Sethi, I.K. and Walia, S.K. (2018). Textbook of Fungi and Their Allies. (2nd Edition), Medtech Publishers, Delhi. • Tortora,G.J., Funke, B.R., Case, C.L. (2007). Microbiology. San Francisco, U.S.A, Pearson Benjamin Cummings. • Vashishta, P.C., Sinha, A.K., Kumar, A. (2010). Pteridophyta. New Delhi, Delhi, S.Chand & Co Ltd. • Singh, G. (2019) Plant Systematics-An Integrated Approach. 4 th edition. CRC Press, Taylor and Francis Group. • Blackmore, S., Crane, P. (2019) How Plants Work–Form, Diversity, Survival, Princeton University Press; Illustrated edition. • Ingrouille, M., Eddie, B. (2006) Plants: Evolution and Diversity. Cambridge University Press. • Parihar, N.S. (1991). An Introduction to Embryophyta.
Unit 2: Bacteria : General characteristic features, cell structure, asexual reproduction and modes of gene transfer (conjugation, transformation and transduction), brief introduction to Archaebacteria.	1 Week	August 2024	
Unit 3: Viruses : General characteristic features, replication, RNA virus (structure of TMV), DNA virus (structure of T-phage), Lytic and Lysogenic life cycle (Lambda phage).	1 Week	August 2024	
Unit 4: Algae : General characteristic features, cell structure, range of thallus, methods of reproduction and evolutionary classification (only upto groups). Brief account of *Spirogyra*, *Sargassum*.	1.5 Weeks	September 2024	
Unit 6: Bryophytes : General characteristic features and reproduction, adaptation to land habit, broad classification, evolutionary trends in Bryophytes. Brief account of *Marchantia*, and *Funaria*.	2 Weeks	September 2024	
Unit 7: Pteridophytes : General characteristic features and reproduction, broad classification, evolutionary trends in Pteridophytes, affinities with Bryophytes. Brief account of *Adiantum*, *Selaginella*.	2 Weeks	October 2024	
Unit 8: Gymnosperms : General characteristic features and reproduction, broad classification, evolutionary trends in Gymnosperm, affinities with Pteridophytes. Brief account of *Gnetum*, *Ephedra*.	2 Weeks	October 2024	

Unit 9: Angiosperms : General characteristic features and reproduction, Concept of natural, artificial and phylogenetic system of classification. Affinities with Gymnosperms. • Revision • Mock Theory Exam	2 Weeks	November 2024 November 2024	Vol.II. Pteridophytes. Prayagraj: U.P.: Central Book Depot. • Singh,V., Pandey,P.C., Jain,D.K. (2001).A Text Book of Botany. Meerut, UP: Rastogi and Co. • Webster, J., Weber, R. (2007). Introduction to Fungi. Cambridge, Cambridge University Press.

Course : B.Sc. (H) Botany, 1st year, Sem. I [29th Aug. 2024 – 24th Dec. 2024]
Paper : Plant Diversity and Evolution – PRACTICALS (NEP) Group - 2
DSC – 01

Name of Paper : Plant Diversity and Evolution	**Allocation of Lectures**	**Month wise schedule**	**Reading suggestions**
1. To study structure of TMV and Bacteriophage (electron micrographs/models).	1 Practical	August 2024	
2. To study morphology of *Volvox*, *Oedogonium*, *Chara*, *Fucus* and *Polysiphonia* (Temporary preparation/specimens/slides).	2 Practicals	August 2024	
3. To study *Rhizopus*, *Penicillium*, *Alternaria* (Temporary preparations), symptoms of rust of wheat, white rust of crucifer (specimen).	2 Practicals	August 2024	
4. To study *Marchantia* (morphology, WM of rhizoids and scales), *Anthoceros* (morphology), *Sphagnum* (morphology, WM of leaf), *Funaria* (morphology WM of rhizoid and leaf).	2 Practicals	September 2024	
5. To study *Selaginella* (morphology, WM of strobilus and spores), *Equisetum* (morphology, WM of spores), *Pteris* (morphology, tease mount of sporangia and spores).	2 Practicals	September 2024	
6. To study *Cycas* (morphology, leaf, leaflet anatomy, coralloid root, bulbils, megasporophyll and microsporophyll); *Pinus* (morphology of dwarf shoot, needle anatomy, male and female cones, WM pollen grains).	2 Practicals	October 2024	
7. To study variation in leaf venations in dicots and monocots (at least two specimens each).	2 Practicals	October 2024	
8. To study the types of inflorescences in angiosperms (through specimens).	1 Practical	November 2024	

9. To study the types of fruits in angiosperms (through specimens). • Revision • Mock Practical Exam	1 Practical	November 2024 November 2024	

Course : B. Sc. (Prog.) Life Science Botany, 2nd year, Sem. III [1st August 2024 – 28th Nov. 2024]
Paper : Plant Cell and Developmental Biology – Practical (NEP) Group - 4
DSC – 03

Name of Paper : Plant Cell and Developmental Biology	**Allocation of Lectures**	**Month wise schedule**	**Reading suggestions**
1. To study cytoplasmic streaming in *Hydrilla*.	1 Practical	August 2024	• Beck, C.B. (2010). An Introduction to Plant Structure and Development. Second edition. Cambridge University Press, Cambridge, UK. • Dickison, W.C. (2000). Integrative Plant Anatomy. Harcourt Academic Press, USA • Fahn, A. (1974). Plant Anatomy. Pergamon Press, USA • Mauseth, J.D. (1988). Plant Anatomy. The Benjammin/Cummings Publisher, USA • Esau, K. (1977). Anatomy of Seed Plants. John Wiley & Sons, Inc., Delhi. • Taiz, L., Zeiger, E., Moller, I.M., Murphy, A. (2015). Plant Physiology. 6th edition. Sinauer Associates, Sunderland. USA. • Hopkins, W.G., Huner, N.P.A. (2009). Introduction to Plant Physiology. Fourth edition, John Wiley & Sons, Inc. USA. • Bhojwani, S.S., Bhatnagar, S.P., Dantu, P.K. (2015). The Embryology of Angiosperms, 6th edition. New Delhi, Delhi: Vikas Publishing House. • Johri, B.M. (1984). Embryology of Angiosperms. Netherlands: Springer-Verlag. • Raghavan, V. (2000). Developmental Biology of Flowering plants. Netherlands: Springer. • Shivanna, K.R. (2003). Pollen Biology and Biotechnology. New Delhi, Delhi: Oxford and IBH Publishing Co. Pvt. Ltd.
2. a. Study of cell organelles through electron micrographs – nucleus, mitochondria, chloroplast, mitochondria, dictyosomes, endoplasmic reticulum b. Study of cell organelles (through permanent slides/photographs)– nucleus (Feulgen/acetocarmine staining); mitochondria (Janus green B staining); cell wall (PAS staining)	2 Practicals	August 2024	
3. Study of plant cells: types of stomata (through peel mounts), trichomes, sclerenchyma, xylem (through maceration).	2 Practicals	September 2024	
4. Study of shoot apical meristem and root apical meristem, parenchyma, collenchyma, phloem, laticifers through permanent slides/micrographs.	2 Practicals	September 2024	
5. Study organs structure through temporary preparations- a. Transverse section of dicot stem- *Helianthus/Cicer*, stem with secondary growth – *Helianthus/Cicer* etc., Transverse section of monocot stem - *Zea mays* b. Transverse section of dicot root: primary and with secondary growth- *Cicer/Vigna* etc., monocot root - *Zea mays* c. Vertical section of dicot and monocot leaf	3 Practicals	October 2024	

6. Study anomalous secondary growth through permanent slides/photomicrographs: *Salvadora/ Bignonia, Dracaena*	1 Practical	October 2024	**Additional Resources:** • Cutler, D.F., Botha, T., Stevenson, D.W. (2007). Plant Anatomy - An Applied Aspect. Blackwell Publishing, USA • 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. • Shivanna, K.R., Tandon, R. (2014). Reproductive Ecology of Flowering Plants: A Manual. Springer (India) Pvt. Ltd. New Delhi, Heidelberg, New York, Dordrecht, London • Moza M. K., Bhatnagar A.K. (2007). Plant reproductive biology studies crucial for conservation. Current Science 92:1907.
7. Study reproductive structures through photographs/ micrographs/permanent slides/specimens: a. Transverse section of anther with wall layers, secretory and amoeboid tapetum b. Microsporogenesis through micrographs of transverse section anther c. Pollen exine patterns (any four types) d. Types of ovule, associated structure (obturator, aril, caruncle) e. Mature Polygonum type of embryo sac and ultrastructure of egg apparatus	1 Practical	October 2024	
8. Study of pollen viability (TTC/FDA).	1 Practical	November 2024	
9. Calculation of percent pollen germination in any one medium through sitting drop culture/ /Hanging drop culture.	1 Practical	November 2024	
10. Dissection of embryo/endosperm from developing seeds.	1 Practical	November 2024	
• Revision • Mock Practical Exam		November 2024	

Course : B. Sc. (Prog.) Life Science Botany, 3rd year, Sem. V [1st August 2024 – 28th Nov. 2024]
Paper : Plant Physiology and Metabolism – Practical (NEP) Group - 2
DSC – 05

Name of Paper : Plant Physiology and Metabolism	Allocation of Lectures	Month wise schedule	Reading suggestions
1. Determination of osmotic potential of plant cell sap by plasmolytic method.	1 Practical	August 2024	• Taiz, L., Zeiger, E., Moller, I. M., Murphy, A. (2018). Plant Physiology and Development, International 6th edition, Oxford University Press, Sinauer Associates, New York, USA. • Bajracharya, D. (1999). Experiments in Plant Physiology: A
2. To study the effect of the environmental factor light on transpiration by excised twig.	1 Practical	August 2024	

3. Calculation of stomatal index and stomatal frequency of a mesophyte and a xerophyte.	1 Practical	August 2024	Laboratory Manual, Narosa Publishing House, New Delhi. • Hopkins, W. G., Huner, N. P. A. (2009). Introduction to Plant Physiology, 4th edition, Wiley India Pvt. Ltd, New Delhi. **Additional Resources:** • Jones, R.,Ougham, H., Thomas,H.,Waaland, S. (2013). *The molecular life of plants.* Chichester, England: Wiley-Blackwell. • Kochhar, S.L. & Gujral, S.K. 2020. Plant Physiology: Theory and Applications, 2nd Edition. Cambridge University Press, UK. • Bhatla, S.C., Lal, M.A. (2018). *Plant Physiology, Development and Metabolism.* Singapore: Springer.
4. To study the activity of catalase and study the effect of pH on the activity of enzyme.	1 Practical	August 2024	
5. To Study Hill's reaction.	1 Practical	September 2024	
6. To study the effect of light intensity on O_2 evolution in photosynthesis.	1 Practical	September 2024	
7. Comparison of the rate of respiration in any two parts of a plant.	1 Practical	September 2024	
8. To separate photosynthetic pigments by paper chromatography.	1 Practical	September 2024	
9. Bolting / Effect of auxins on rooting.	1 Practical	October 2024	
10. To demonstrate the delay of senescence by cytokinins/ effect of ethylene on fruit ripening.	1 Practical	October 2024	
11. To study the phenomenon of seed germination (effect of light and darkness).	1 Practical	October 2024	
12. To demonstrate Respiratory Quotient (RQ)	1 Practical	November 2024	
• Revision • Mock Practical Exam		November 2024	