

S.V.K.P & Dr. K.S. RAJU ARTS & SCIENCE COLLEGE (A)

PENUGONDA - 534 320, W. G. Dt., A. P.

MSc BOTANY

SEMESTER – I

PAPER CODE: 19BOYY11: CRYPTOGRAMS AND GYMNASPERMS

Theory

UNIT I (ALGAE)

General account, Criteria employed in Classification. Classification given by Fritsch, Bold and Wynne. Thallus organization, reproduction and life cycles in algae, General account on structure and reproduction of Chlorophyta, Charophyta, Xanthophyta, Bacillariophyta, Phaeophyta, Rhodophyta and Cyanophyta, Economic importance of Algae.

UNIT II (BRYOPHYTES)

General account, Classification of Bryophytes, Classification, general characters, range of thallus organization and reproduction in Hepaticopsida, Anthcerotopsida and Bryopsida. Evolutionary trends in gametophytes and sporophytes of Bryophytes, Ecological and Economic importance.

UNIT - III (PTERIDOPHYTES)

General characters and classification of Pteridophytes. Salient features of Psilophytopsida, Psilotopsida, Lycopsida, Sphenopsida and Pteropsida.

Origin and phylogeny of pteridophytes - Stellar Evolution, Heterospory and seed habit. Economic importance of Pteridophytes.

UNIT - IV (GYMNOSPERMS)

General account and classification of Gymnosperms Geological periods, fossil formation and their types. General account of Pteridospermales, Bennettitales, Pentoxylales, Cordaitales. Structure and Reproduction of living Gymnosperms: Cycadales, Coniferales and Gnetales; their economic importance .

Suggested Readings & Text Books

1. Bold, H.C and Wynne.M.J. 1978. Introduction to the algae
2. Chapman, V.J.1962. The Algae
3. Graham, J.E, Lee W. Wilcox &L.E.Graham 2008. Algae. 2nd ed. Benjamin Cummings
4. Britsch,F.E.1945. The structure and reproduction of Algae Vols. 1& II. Cambridge University Press, London
5. Kumar, H.D.1988.Introductory Phycology
6. Kashyap, S. 1929. Liverworts of the Western Himalayas and Punjab Plains Part I and Part II.
7. Lewin,R.A. 1962. Physiology and Biochemistry of Algae
8. Morris, I 1967. An Introduction to the Algae
9. Presscot, G.W. 1969. The Algae- a review
10. Bernard Goffinet& A. Jonathan Shaw. 2008. Bryophyte Biology. 2nd ed. Cambridge
11. Parihar, N.S. 1991. Bryophyta
12. Puri,P. 1980. Bryophytes
13. Round, E.E. 1986. The Biology of Algae
14. Round, E.E. 1962. Ecology of algae
15. Smith, G.M. 1955. Cryptogamic Botany Vol. II

16. Chopra, R.N. & P.K. Kumar, 1988. Biology of Bryophytes. Wiley Eastern.
17. Arnold, C.A. 1974. An introduction to Paleobotany, New York
18. Agashe, S.N. 1995. Palaeobotany. Oxford & IBH, New Delhi.
19. Bhatnagar, S.P. & Alok Mitra 1997. Gymnosperms. New Age Int. (P) Ltd.
20. Charles C. Beck and Charles B. Beck (Ed.). 1988. Origin and Evolution of Gymnosperms. CUP.
21. Kramer, K.U., P. S. Green & Erich Gvtz. 2008. Pteridophytes and Gymnosperms. Springer.
22. Sambamurthy AVSS. 2005. A Textbook of Bryophytes, Pteridophytes, Gymnosperms and Paleobotany. Ik International Pvt Ltd.
23. Vashista, P.C. 2005. Gymnosperms. S. Chand & Co, New Delhi.
24. Vashista, P.C. 2005. Pteridophyta. Rev. ed. By Sinha & Anil, S. Chand & Co, New Delhi.
25. Saxena P and Pathak C. 2012. A Text Book of Pteridophyta., Wisdom Press, New Delhi.
26. Chamberlain, C.J. 1935. Gymnosperms structure and evolution, University of Chicago Press
27. Coulter, J.M. and Chamberlain, C.J. Morphology of Gymnosperms, Central Book Depot, Allahabad
28. Evans, A.J. 1936. Morphology of Vascular Plants (Lower groups) McGraw Hill Book Company, New York
29. Maheswari, P. and Vasil, V. Genetum CSIR (Monographs)
30. Parihar, N.S. 1996. Biology and Morphology of Pteridophytes, Central Book Depot, Allahabad
31. Sporne, K.R. 1962. The Morphology of Pteridophytes, Hutchinson University Library

PAPER CODE: 19B0TT12: MICROBIOLOGY

Theory

UNIT – I

Introduction: Discovery and Evolution of microbiology as a discipline. A brief idea of microbial diversity. General account of Archaeobacteria, Eubacteria, Cyanobacteria, Fungi. Fungal classification and phylogeny.

Cell wall of Bacteria – Gram+ve and Gram-ve bacterial cell walls, cell wall of Fungi. Viruses: Structure, Isolation and purification of viruses, Replication and transmission of Viruses.

UNIT – II

Nutritional requirements of microorganisms: types (autotrophs and heterotrophs), requirements, uptake of nutrients and types of nutrient media. Nutrition of Fungi : Saprobic, biotrophic, and symbiotic.

Microbial growth: Principles of growth, Kinetics of growth methods of measuring growth, Batch and continuous growth, Synchronous culture and Diauxic growth.

UNIT - III

Genetics of Bacteria: An overview of genetic recombination; Mechanism of transformation, conjugation and transduction in bacteria. Lytic cycle in T even phages and lysogenic cycle in lambda phage. A brief account on virioids and prions.

Reproduction in Fungi : Vegetative, Asexual and Sexual. Heterothallism, Heterokaryosis and Parasexuality.

UNIT - IV

Microbial ecology, Denitrification, free living nitrogen fixation, symbiotic nitrogen fixation, plant-microbe interactions, mycorrhizae.

Basic design of a Fermentor, Biosensors, Bioremediation. Mushroom cultivation. Economic importance of Microbes.

Suggested Readings & Text Books

1. Kaursethi I and Surinder KW 2011. **Text Book of Fungi and their Allies**. Macmillan publishers, New Delhi, India.
2. Ram Reddy S & Reddy SM 2007. **Essentials of Virology**. Scientific publishers, Jodhpur, India.
3. Sharma K 2005. **Manual of Microbiology Tools and Techniques**. Ane Book, New Delhi, India.
4. Matthew RH 2004. **Plant virology**. 4th edition. Academic press an imprint of Elsevier, California, USA.
5. Prescott et al. 2003. **Microbiology**. McGraw Hill Education, New York.
6. Aneja KR 2003. **Experiments in Microbiology, Plant pathology and Biotechnology**. New Age International publishers, New Delhi.
7. Verma HN 2003. **Basics of plant Virology**. IBH publishing co. Pvt. Ltd., New Delhi.
8. Mehrotra KS and Aneja KR 2003. **An Introduction to Mycology**. New Age International Publishers, New Delhi.
9. Sullia SB and Shantharam S 2001. **General Microbiology**. Oxford and IBH publishing Co. Pvt. Ltd, New Delhi.
10. Reddy SM and Ram Reddy S 2000. **Microbiology a Laboratory Manual**. BSC Publishers and Distributors, Hyderabad.
11. Flint SJ, Enquist LW, Krug RM, Racaniello VR, Skalka AM 2000. Principles of Virology

Rao AS 1999. **Introduction to Microbiology**. Prentice Hall of India Pvt. Ltd., Delhi.

12. Paul S 1995. **Bacteria in Biology**, Biotechnology and Medicine. 5th edition. John Wiley and son Ltd., UK.

13. Pelczar, Chan and Krieg 1993. **Microbiology**. 5th edition. McGraw Hill Education, New York.

14. Stainer RT, Ingraham JL, Wheelis ML and Painter PR 1987. **General Microbiology**. 5th Edition. Macmillan, London.

Smith KM 1968. **Plant viruses**. Elsevier, New York.

15. Rangaswamy G 1962. **Bacterial Plant disease in India**. Asia Publishing House, Bombay.

Agrios, G.N. 2005. **Plant pathology**. 5th ed. Academic press.

16. Allen T. Bull. 2004. **Microbial diversity and Bioprospecting**. ASM Press, Washington.

Brock, T.D. & Madigan. 1991. **Biology of Microorganisms**. Prentice-Hall.

17. Dube, R.C. & D.K. Maheswari 2005. **Microbiology**. S.Chand & Co. Ltd., New Delhi.

18. Gilbert, O.L. 2000. **Lichens**. Collins New Naturalist.

19. Ainsworth, G.C. Sparrow, F.K. and Susman, A.S. 1973. **The Fungi-An advance treatise**, Vol. I to VIB.

20. Alexopoulos, C.J. Mims, C.W. and Blackwell, M. 1996. **Introductory Mycology**, John Wiley & Sons Inc.

21. Ananthanarayanan, R. and Dayaram Panikar, C.K. 1998. **A textbook of Microbiology**, VI edition Orient Longman

22. Carpenter, 1977. Microbiology

23. Clifton, A. 1958. **Introduction to the Bacteria**, McGraw-Hill Book Co. New York

24. Landecker, E.M. 1972. Fundamentals of the Fungi Mehrota, R.S. and Aneja, R.S. 1998. **An introduction to microbiology**, Prentice Hall of India Pvt.Ltd., New Delhi.

PAPER CODE: 19B0TT13: CELL BIOLOGY OF PLANTS

Theory

UNIT - I

The Cell theory : Origin and development of cell biology as a separate branch. Structure and organization of Prokaryotic and Eukaryotic cells. Specialized cell types.

Chemical Foundation: Macromolecules - Structure, shape and information. Non- covalent interactions in relation to function of Nucleic acids and Proteins. Biochemical energetics : Laws of thermodynamics as applicable to biological systems.

UNIT – II

Cell wall: Structure and functions, Cell wall architecture, Biogenesis and Growth.

Plasmodesmata : Structure and function, Plasmodesmata in comparison with gap junctions of animal cells.

Plasma membrane: Structure, models and functions, ATPases, Receptors, Carriers, Channels and Pumps. Vacuole structure and function, Vacuolar ATPases, Transporters.

Cytoskeleton: Microtubules and Microfilaments, their role in cell division and motility;

Intermediate filaments role in providing strength.

UNIT - III

Chloroplast and Mitochondria : Structure and function, Genome organization, Nucleo-cytoplasmic interactions, RNA editing.

Other organelles : Structure and functions of Endoplasmic reticulum, Golgi apparatus, Lysosomes, Ribosomes, Microbodies and Peroxisomes.

UNIT - IV

Tools in cell Biology I - Microscopy : Working principles of Light Microscopy, Scanning Electron Microscopy, Transmission Electron Microscopy, STEM. Preparation of specimens for Microscopy Freeze fracture and Freeze etching techniques.

Tools in Cell Biology II- Subcellular fractionation - Principles of centrifugation. Spectroscopic techniques: principles and applications of UV- visible, ESR, Nuclear Magnetic Resonance, Spectrofluorimetry, Circular Dichroism (CD).

Suggested Readings & Text Books

1. Alberts B, Breyer D, Hopkin K, Johnson AD, Lewis J, Raff M, Roberts K and Watter P 2014. **Essential Cell Biology**. 4th Edition. Garland publishers, New York.
2. Sharp D, Ploppe G and Sikorski E 2014. **Lewin's Cells**. 3rd Edition. Viva Books, New Delhi.
3. Cooper GM, Hausman RE 2013. **The Cell – A Molecular Approach**. 6th Edition. Sinauer Associates, Incorporated, USA.
4. Karp G 2013. **Cell and Molecular Biology – Concepts and Experiments**. 7th Edition. Wiley Global Education, USA
5. McLennan A, Bates A, Turner P, White M 2013. **Bios Instant Notes in Molecular Biology**. 4th Edition. Garland publishers, New York.
6. Cowling G, Allen T 2011. **The Cell. A very Short Introduction**. Oxford University Press, USA.
7. Alberts B, Johnson A, Lewis J, Raff M, Roberts K, Walker P 2007. **Molecular Biology of the Cell**. 5th Edition. Garland publishers, New York.
8. Schaffer SW 2007. **Mitochondria: The Dynamic Organelle**. 1st Edition. Springer Verlag.
9. Wilson J, Hunt T 2007. **Molecular Biology of the Cell** 5th edition. **The Problems Book**. 2nd Edition. Garland publishers, New York..
10. Celis JE (ed) 2006. **Cell Biology–A Laboratory Hand Book**. 3rd Edition. Elsevier, USA.
11. Lodish H, Berk A, Kaiser CA, Kreiger M, Scott P M, Bretcher A, Ploegh H, Matsudaira P. 2004.

12. Alberts, B. Bray D. Lewis J. Ralf, M. Roberts, K. and Watson, J.D. 1999: Molecular Biology of the Cell, Garland Publishing Inc., New York.
13. De, D.N. 2000: Plant Cell Vacuoles. An Introduction. CSIRO Publication. Collingwood, Australia.
14. C.J. Avers 1986: Molecular Cell Biology. Addison Wesley Publishing Company.
Lodish, Berk A, Zipursky, S.L. Matsdaira P, Baltimore D and Darnell, J. 2000; Molecular

PAPER CODE: 19B0TT14: CYTOLOGY AND CYTOGENETICS

Unit I :

Nucleus – Structure of nuclear membrane, Nuclear pore complex; Chromosome structure, molecular organization of chromatin, centromeres and telomeres; Special types of chromosomes (lampbrush, Polytene). Chromosome identification - Karyotype analysis; Chromosome banding techniques; Flow cytometry and confocal microscopy in karyotype analysis; computer assisted karyotype analysis – chromosome micro-dissection and micro- cloning

Unit II:

Chromosomal structural aberrations: Origin, meiosis and breeding behavior of duplications, deficiencies and inversions and interchanges; types of inversions. Robertsonian translocations; Basic concept of Complex translocation heterozygotes. Chromosomal numerical aberrations I – Classification of numerical aberrations; Aneuploids–Trisomics (Primary, Secondary, Tertiary), Monosomic and nullisomics – meiotic behavior and chromosome mapping

Unit III:

Chromosomal numerical aberration II: Polyploids – Origin and production of auto and allopolyploids; Meiosis in autotetraploid ; Genome analysis in *Tobacco*, wheat and *Arabidopsis*. Nuclear DNA content – C-value paradox, hyperchromicity, Cot curves and significance- Molecular organization of nuclear genome

Unit IV:

Cell Cycle and its regulation – check points, cyclins and cyclin dependent kinases, experimental control of cell division. Apoptosis - mechanism and significance; Initiation of cancer at cellular level – proto oncogenes and oncogenes

Text Books

1. C. B. Powar. 1992. Cell Biology. Himalaya Publishers, New Delhi
2. Gupta, P.K. 1995. Cytogenetics. Rastogi & Company, Meerut
3. Swanson, Merz and Young. Cytogenetics. Prentice Hall. India
4. Sybenga, J. 1973. General Cytogenetics. North Hall and American Elsevier
5. De Robertis E.D.P and E.M.F. De Robertis. Cell and Molecular Biology 2001. CBS Publishers and Distributors

Reference Books

1. David M. Prescott. Cells. 1988. Jones and Bartlett Publ. Boston
2. Pierce BA. 2013. Genetics: A Conceptual Approach. 5th Edition. W. H. Freeman, California.
3. Darnell, Lodish and Baltimore: Molecular Biology, Scientific American Books, New York
4. Bass H and Birchler J. 2011. Plant cytogenetics: Genome structure and chromosome Function. Springer, New York

PAPER CODE: 19BOTP15: CRYPTOGAMS AND GYMNOSPERMS

Suggested Laboratory Exercises

- 1 Examination of vegetative and reproductive morphology of Chlophyceae members.
- 2 Examination of Thallus structure and reproductive bodies of Xanthophyceae, Bacillariophyceae and Phaeophyceae members.
- 3 Examination of external and internal structure and reproductive organs of Rhodophyceae and Cyanophyceae members.
- 4 Field work to get acquaintance with locally available algae.

Bryophytes

- 1 . An examination of the external and internal structure and reproductive organs of the genera, Riccia, Targionia,, Plagiochasma, Marchantia, Pellia, Porella, Anthoceras, Notothylus, Sphagnum, Funaria, Polytrichum.

Pteridophytes

01. Examination of the external features, anatomy and reproductive structures of Psilotum, Lycopodium, Selaginella, Isoetes, Equisetum, Adiantum, Salvinia and Azolla. Observations of the slides of the following fossil plants: Rhynia, Lepidodendron, Lepidocarpon, Miadnesia, Sphenophyllum, Calamites.

Gymnosperms

02. Examination of the external features, anatomy (TS, TLS&RLS) and reproductive structures of Ginkgo, Pinus, Cupressus, Cryptomeria, Araucaria, Ephedra & Gnetum. Study of fossil gymnosperms from prepared slides. Lyginopteris, Lagenostoma, Medullosa, Trigonocarpus, Conostoma, Heterangium, Cordaites

PAPER CODE: 19B0TP16: MICROBIOLOGY

Suggested Laboratory Exercises

1. Microbiological culture techniques
2. Types of media, Preparation of media and stains
3. Sterilization methods
4. Gram staining of bacteria
5. Morphological study of Stemonitis, Saprolegnia, Mucor, Morchella, Aspergillus, Agaricus, Cyathus, Synchitrium, Helminthosporium

PAPER CODE: 19B0TP17: CELL BIOLOGY OF PLANTS

Suggested Laboratory Exercises

1. Staining techniques – Study of mitosis using acetocarmine.
2. Isolation of mitochondria and the activity of its marker enzyme, Succinate dehydrogenase (SDM).
3. Isolation of chloroplasts and photographs SDS – PAGE technique and photographs - profile of proteins to demonstrate (2) the two subunits of Rubisco.
4. Isolation of nuclei and identification of histones by SDS-PAGE technique.
5. Fluorescence staining with FDA for cell viability and wall staining with calcofluor.
6. Immunofluorescence technique –observation of cytoskeleton.
7. Demonstration Photographs of SEM and TEM.

PAPER CODE: 19B0TP18: CYTOLOGY AND CYTOGENETICS

Suggested Laboratory Exercises

1. Observation and identification of meiotic stages
2. Preparation of karyotypes and construction of idiograms
3. Observation of slides/photographs showing structural and numerical aberrations and chromosome banding.

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MSc., BOTANY

SEMESTER – II

PAPER CODE-19BOTT21:GENETICS

Theory

Unit-I

Concept of Genetic markers and their types – application of probability Laws of Mendelian principles. Chi-square testing for goodness of fit. Allelic and gene interactions; Multiple allelism – Penetrance and expressivity – Pleiotropism, pseudoalleles, phenocopies

Unit II:

Gene mapping methods based on test-cross and F₂ progenies; LOD score analysis; Tetrad analysis and its significance; somatic cell genetics and its use in mapping; correlation of genetic and physical maps; Sex-linked inheritance, sex-influenced and sex-limited characters. Recombination and its molecular mechanism; role of rec A,B,C,D enzymes; Holliday's model

Unit III:

Mutations – types – molecular basis; site-directed mutagenesis – DNA damage and repair mechanisms; examples of inherited defects in DNA repair. Multigene families and their organization and significance; Transposable elements in pro- and eukaryotes, Mechanism of transposition; significance of transposable elements

Unit IV:

Mapping in bacteria and phages – methods using conjugation; Transformation and transduction; Fine structure analysis of gene - Benzer's work; concept of gene; Nature and variant forms of eukaryotic genes. Maternal inheritance – Distinction between nuclear and cytoplasmic types of inheritances-Distinction - Genetics of mitochondrial and chloroplast characters; Male sterility, types and significance

Text Books

1. Strickberger, Genetics, Prentice Hall
2. Lewin, B. 2008. Gene IX. Jones and Barlette publishers, London
3. Brooker R. 2008. Genetics, Analysis and Principles. 3rd edition. McGraw Hill science
4. Snustad, D.P. and Simons, M.J., 2000. Principles of Genetics John Wiley and Sons Inc., USA
5. Russel PJ. 2009. Genetics–A Molecular Approach. 3rd Edition. Pearson Benjamin Cummings, San Francisco, USA
6. William K, Cummings S, Spencer MR and Charlotte A. 2013. Essentials of Genetics. Pearson Books, Delhi
7. P.S. Verma and V.K. Agarwal, 2005. Cell Biology, Genetics,

Molecular Biology, Evolution and Ecology. S. Chand and Company Ltd, New Delhi

8. Pierce BA. 2013. Genetics: A Conceptual Approach. 5th Edition. W. H. Freeman, California

Reference Books

1. Griffiths, A.J.F., Miller, H.T., Suzuki, Lewontin, Gelbart Intd. Genetic analysis, H.F. Freeman and Co.
2. Hartl, D.L. and Jones, E.W. 1998. Genetics: Principles and Analysis (4th edition) Jones and Bartlett Publishers, Massachusetts, USA
3. Lewis, R. 1997. Human Genetics: Concepts and Applications, WCB Mc Graw Hill,
4. Malacinski, G.M. and Freifelder, D. 1998. Essentials of Molecular Biology(3rd edition). Jones and Bartlet Publishers Inc. London

PAPER CODE:19BOTT22 MOLECULAR BIOLOGY OF PLANTS

UNIT - I

Composition and structure of Biomolecules: Carbohydrates, Lipids and Proteins (Ramachandran plot, secondary structures, domains, motifs and folds). Nucleic acids, DNA structure and duplex model. A, B and Z forms of DNA. Types of small RNAs
– Si RNA, micro RNA and catalytic RNA

UNIT - II

DNA replication, Semi-conservative, Semi-discontinuous and uni and bi directional mode of replication. RNA Priming, Enzymes for DNA replication Helicases, SSBs, Topoisomerases and Polymerases. Mechanism of DNA replication. Rolling circle and Theta mode of replication. Replication of ends of chromosomes
Transcription Promoters, Activators, Transcription factors and Mechanism of Transcription in Prokaryotes and Eukaryotes. Post Transcriptional modifications.

UNIT - III

Translation : Structure of tRNA, Ribosome as a Translation factory, Genetic code, Mechanism of Translation - Initiation, elongation and termination. Post translational modifications
Protein sorting and targeting of proteins into Chloroplasts, Mitochondria, Vacuoles and Peroxisomes. Protein trafficking.

UNIT – IV

Regulation of gene expression in Prokaryotes. Basic models: Lac, Arabinose and Trp operons. Positive and Negative controls. Regulation in Viruses : Lytic and Lysogenic cycle.
Regulation of gene expression in Eukaryotes. Britten Davidson model. Role of chromatin in gene expression. DNA methylation. Temporal and spatial regulation. Gene silencing

Suggested Readings & Text Books

1. Alberts B, D. R. Bray, J. Lewis, M. Raff, K. Roberts and J.D. Watson. 2004. *Molecular Biology of the Cell* Garland Publishing New York and London
2. Fritsch, E.F. and J. Sambrook. 1992. *Molecular cloning: Laboratory Manual*. Maniatis, Cold Spring Harbor Laboratory New York.
3. George M. Malacinski & D. Freifeilder 2005. *Essentials of Molecular Biology*.
4. Schecleif, R.F. and P.C. Wensik 1991. *Practical Methods in Molecular Biology* Springer-Verlag
5. Walker, J. and W. Castra. 1992. *Techniques in Molecular Biology*. Goom Helms, London.
6. Buchaman B.B., Gruissem W and Jones R.I. 2000. *Biochemistry and Molecular Biology of Plants: American Societies of plant Physiologists*, Maryland USA
7. Gupta, P.K. 2002. *Cell and Molecular Biology*, 3rd Edition, Rastogi Publications, Shivaji Road, Meerut, India
8. Glick, B.R. and Thompson J.E. 1992. *Methods in Plant Molecular Biology and Biotechnology*, CRC Press, Boca Raton Florida.
9. Lodish, B.A., Zipursky S.L., Matsudaira P, Baltimore D. and Darnell J. 2000. *Molecular Cell Biology* (4th edition). W.H. Freeman & co. New York, USA.
10. Lewin B, 2000. *Genes VII* Oxford University Press, New York.
11. R F Weaver 1999, *Molecular Biology*, WCB McGraw-Hill.
12. Shaw, C.H. 1998. *Plant Molecular Biology. A practical approach*, IRL Press, Oxford.
13. Raghavan V. 1997. **Molecular Biology of Flowering plants**. Cambridge University Press, New York, USA.

PAPER CODE: 19BOTT23: PLANT DEVELOPMENTAL BIOLOGY AND EMBRYOLOGY

Unit I:

Introduction- comparison of Plant and animal development, Plant Cell Division and Expansion, Plant cell cycle- Endoreduplication and control of plant cell size, Plant Architecture, Theories of Organization of meristems; Root growth and Development: Root apical meristem (RAM); Tissue Differentiation, Root hair and Lateral roots formation.

Unit II:

Stem growth and development: organization of the shoot apex; cytological and molecular analysis of shoot apical meristems. Leaf and flower development: Development of leaf and Phyllotaxy, specialized cells and tissue differentiation. Development and Anatomy of flower, including transition to Flowering and reproductive shoot apex.

Unit III:

Reproduction and Flower: Vegetative options and reproduction; Genes controlling floral organ Differentiation. Male Gametophyte: Structure of Anther, Microsporogenesis, Role of Tapetum; Pollen development, Pollen germination, Pollen tube growth and Guidance; Pollen storage. Female Gametophyte: Ovule- Structure and development; Megasporogenesis; Development and Organization of the mature Embryo sac; Structure of the Embryo sac cells; Embryo sac haustoria.

Unit IV:

Fertilization, Seed and Fruit Development: Pollination mechanisms and Vectors; Structure of the Pistil; Pollen- Stigma Interactions, Sporophytic and Gametophytic Self-Incompatibility; Double Fertilization. Endosperm development; Types of Endosperm; Functions; Embryogenesis-Dicot types; Monocot embryo; Polyembryony; Apomixis; Parthenocarpy, Dynamics of Fruit growth and Seed Development. Outlines of Experimental Embryology.

Text Books:

1. Pullai, T., Naidu, K. C., Lakshminarayana, K. & Hanumantha Rao, B. 2007. Plant Development. Regency Publications, New Delhi.
2. Fahn, A. 1982. Plant Anatomy (3rdEd.), Pergamon Press, Oxford.
3. Murphy, T.M. and Thompson, W.F. 1988. Molecular Plant Development, PrenticeHall, New Jersey.
4. Bhojwani, S. S. and Bhatnagar, S.P. 2000. The embryology of Angiosperms (4th Revised and Enlarged Ed.). Vikas Publishing House, New Delhi.
5. Pullaiah, T. Lakshminarayana, K. & Hanumantha rao, B. 2008. plant reproduction. Scientific publishers, Jodhpur.

Reference Books:

1. Biochemistry & Molecular Biology of Plants by Bob Buchanan, Gruissen W and Jones RL
2. Howell, S.H. 1998. Molecular Genetics of Plant Development, Cambridge Univ. Press, Cambridge.
3. The plant cell. Special issue on Reproductive Biology of Plants, Vol. 5. 1993. The American Society of plant physiologist, Rockville, Maryland, USA.
4. Shivanna, K.R. and Rangaswamy, N.S. 1992. Pollen Biology, A Laboratory Manual. Springer-Verlag, Berlin

PAPER CODE: 19B0TT24: MOLECULAR PLANT PATHOLOGY

UNIT - I

An overview on plant diseases. A brief history, terminology involved. Flor's hypothesis, Koch postulates. Causal agents- Bacteria, Viruses, Fungi, phytoplasmas.

Colonization of pathogen in host – Different stages: Inoculum, Penetration, infection, invasion, Reproduction, Spread and survival of pathogens.

UNIT-II

Plant Defense mechanisms: performed, induced, biochemical and physiological responses, Host- pathogen interactions, disease signaling, pathogen recognition and signal transduction. Physiological changes in diseased plants.

Molecular determinants of pathogenicity, virulence, effectors, elicitors, defensins, phytoalexins, common phenolics, plant cell wall degrading enzymes, host specific toxins, host non-specific toxins, hormones and their role in cell signaling and immunity.

UNIT-III

Symptoms, etiology, epidemiology and control measures of certain plant diseases: Citrus canker, Bacterial leaf blight of rice, Angular leaf spot of cotton, Grassy shoot disease of sugarcane, Little leaf of Brinjal, Rice tungro, Club root of Crucifers, Damping off of seedlings, Whip smut of Sugarcane, Coffee rust, Bean rust, Wilt of Cotton, Leaf spot of Turmeric.

UNIT-IV

Plant Disease management: Plant Quarantine, Cultural practices, Chemical control, Biological control, Integrated Pest Management (IPM). Plant Disease resistance, classes of resistance genes. Transgenic and genetic manipulation approaches, molecular marker to tag disease resistance and avirulence genes. Use of databases and application of bioinformatics in plant pathology.

Suggested Readings & Text Books

01. Agrios GN 2001. **Plant Pathology**. Academic Press, London.
02. Richard N Strange 2003. **Introduction to Plant Pathology**. Springer.
03. Lucas 2001. **Host Pathogen Interactions**. Blackwell.
04. Bilgrami KS and Dube HC 2000. **A Text Book of Modern Plant Pathology**. Vikas Publications, New Delhi.
05. Rangaswami G 1988. **Disease of Crop Plants in India**. Prentice-Hall of India.
06. Wood RKS 1967. **Physiological Plant Pathology**.
07. Kelman A 1967. **Source Book of Laboratory Exercise in Plant Pathology**.
08. Mehrotra RS 1994. **Plant Pathology**.
09. Mukerji KG and Garg KL 1993. **Bio-control of Plant Diseases**. Vol.I&II CBS Publishers and Distributors Delhi.
10. Butler EJ 1973. **Fungi and Diseases in Plants**.
11. Roberts RR and Booth Royd LR 1972. **Fundamentals of Plant Pathology**.

PAPER CODE: 19B0TP25: GENETICS

Suggested Laboratory Exercises

1. Observation of types of chlorophyll mutants
2. Problems in Mendelian Genetics, Gene interactions and Epistasis
3. Probability Laws and Chi-Square test
4. Chromosome Mapping and Tetrad Analysis

PAPER CODE: 19B0TP26: MOLECULAR BIOLOGY OF PLANTS

Suggested Laboratory Exercises

1. Isolation of DNA from Onion bulbs/Banana
2. Isolation of DNA using CTAB method
3. Biochemical Tests of Carbohydrates, Proteins and Fats in the plant cells
4. Assignments on problems related to DNA replication, Transcription, Translation and Gene regulation
5. **Electrophoresis of seed proteins**
6. **Diagrams/Photographs display related to all units**

PAPER CODE: 19B0TP27: PLANT DEVELOPMENTAL BIOLOGY AND EMBRYOLOGY

Suggested Laboratory Exercises Plant Development

1. Representative types of roots -Diarch, Triarch, and Polyarch types — transverse sections with double staining, ex. *Vicia*, *Ficus*, *Tinospora* (aerial root), *Vanda* (velamen root).
2. Types of Stems: For transverse sections with double staining methods — showing Primary and Abnormal Secondary Growth. Ex. *Aristolochia*, *Bignonia*, *Amaranthus*, *Achyranthus*, *Boerhaavia*, *Dracaena*.
3. Maceration of wood: For observation of Individual Xylem elements with single staining.
4. Leaf types: Dorsiventral leaf, Isobilateral leaf, Xeromorphic leaves - *Nerium*, *Casuarina*, *Ficus* leaves, *Nymphaea*, leaves. *Sorghum* and *Saccharum* leaves for C4 anatomy.

Plant Reproduction

1. Examination of Modes of Anther Dehiscence and collection of Pollen grains for microscopic examination (*Maize*, *Grasses*, *Cannabis sativa*, *Crotalaria*, *Tradescantia*, *Brassica*, *Petunia*, *Solanum melongena* etc.
2. Tests for Pollen Viability using stains and in vitro Germination. Pollen Germination using Hanging drop and Sitting drop cultures, Suspension culture and Surface culture.
3. Estimation of Percentage and Average Pollen tube Growth *in vitro*.
4. Field study of several types of flowers with different pollination mechanisms (Wind Pollination, Thrips pollination, Bee / Butterfly Pollination, Bird Pollination).
5. Study of Nuclear and Cellular endosperm through dissections and staining.

6. Isolation of Zygotic Globular, Heart-shaped, Torpedo stage and mature embryos from suitable seeds.
7. Polyembryony in Citrus, Jamun (*Syzygium cumini*) etc. by Dissections.

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Suggested Laboratory Exercises:

1. Acquaintance with general techniques used in phytopathological work.
2. Study of symptoms, microscopic examination of diseased parts and identification of the pathogens involved in different plant diseases included in the theory part of syllabus.
3. Isolation and Identification of pathogens