Andhra Pradesh State Council of Higher Education

B.Sc., Honours in BOTANY:MAJOR

w.e.f AY2023-24onwards

COURSE STRUCTURE

Year	Semester	Course	Title	No. Hrs./ Week	No. of Credits
I	I	1	Introduction to Classical Biology	5	4
		2	Introduction to Applied Biology	5	4
	II	3	Non-vascular Plants –(T) Non-vascular Plants –(P) Origin of Life and Diversity of Microbes –(T) Origin of Life and Diversity of Microbes –(P) Vascular Plants –(T) Vascular Plants –(P)	3	3
				2	1
		4		3	3
				2	1
II	III	5	Plant Pathology and Plant Diseases–(T) Plant Pathology and Plant Diseases –(P) Plant Breeding–(T) Plant Breeding –(P) Plant Biotechnology–(T) Plant Biotechnology–(P) Anatomy and Embryology of Angiosperms–(T) Anatomy and Embryology of Angiosperms–(P) Plant Ecology, Biodiversity and Phytogeography–(T) Plant Ecology, Biodiversity and Phytogeography–(P) Plant Resources and Utilization–(T) Plant Resources and Utilization–(P) Cell Biology and Genetics–(T) Cell Biology and Genetics–(P)	3	3
				2	1
		6		3	3
				2	1
		7		3	3
				2	1
		8		3	3
				2	1
	IV	9		3	3
				2	1
		10		3	3
				2	1
		11		3	3
				2	1
III	V	12	Cell Biology and Genetics–(P)	3	3
		13	Plant Physiology and Metabolism–(T)	2	1
		14 A	Plant Physiology and Metabolism–(P)	3	3
				2	1
			Organic Farming–(T)	3	3
			Organic Farming–(P)	2	1
			OR	3	3
		14 B	Seed Technology–(T) Seed Technology–(P)	2	1
		15 A	Mushroom Culture Technology–(T)	3	3
			Mushroom Culture Technology–(P)	2	1
			OR	3	3
		15 B	Plant Propagation Techniques–(T)		

			Plant Propagation Techniques–(P)	2	1

VII & VIII semesters detailed Syllabus will be available in due course of time.

Semester	Course No. & Title of the course	Hours/ week (Th.)	No. credits (Th.)	Hours/ week (Pr.)	No. credits (Pr.)
VII Core Courses	16 (A) Plant Systematics (OR) 16 (B) Plant Developmental Biology 17 (A) Plant Molecular Biology	3	3	2	1
	(OR) 17 (B) Plant Genetic Engineering 18 (A) Crop Physiology	3	3	2	1
	(OR) 18 (B) Plant Biochemistry 19 (A) Phyto-medicines and Ethnobotany	3	3	2	1
VII Skill Enhanced Courses (SEC)	(OR) 19 (B) Herbal Technology 20 (A) Soil fertility and Conservation (OR) 20 (B) Agroforestry	3	3	2	1
VIII Core Courses	21 (A) Phyto-biodiversity and Conservation (OR) 21 (B) Phytochemistry and Pharmacognosy	3	3	2	1
	22 (A) Bioinformatics and Computational Biology (OR) 22 (B) Omics in Plant Science	3	3	2	1
	23 (A) Plant Cytogenetics (OR) 23 (B) Biostatistics and Intellectual Property Rights	3	3	2	1
	24 (A) Biofertilizers and Biopesticides (OR) 24 (B) Industrial and Environmental Biotechnology.	3	3	2	1
VIII Skill Enhanced Courses (SEC)	25 (A) Gardening and Landscaping (OR) 25 (B) Floriculture	3	3	2	1
		3	3	2	1

III Semester

Course 5 : Vascular Plants

(Pteridophytes, Gymnosperms and Taxonomy of Angiosperms)

Credits -3

I.Learning Objectives: By the end of this course the learner has:

1. To recognize the morphology, anatomy and reproduction in two groups of archegoniates.
2. To acquire knowledge of the taxonomic aids and classification systems.
3. To read the vegetative and floral characteristics of some forms of angiospermic families along with their economic value.
4. To study the significance of other branches of botany in relation to plant taxonomy.

II. Learning Outcomes: On completion of this course students will be able to:

1. Infer the evolution of vasculature, heterospory and seed habit in Pteridophytes.
2. Illustrate the general characteristics of Gymnosperms along with their uses
3. Discuss about some Taxonomic aids and their applications in plant systematics.
4. Compare and contrast the vegetative and floral characteristics of some angiospermic families
5. Evaluate the economic value of plant species from the families under the study.
6. Defend the utility of evidences from different branches of botany in solving the taxonomic lineages of some species.

III. Syllabus of Theory:

Unit-1: Pteridophytes **10Hrs.**

1. General characteristics of Pteridophyta; Smith (1955) classification.
2. Occurrence, morphology,anatomy, reproduction (developmental details are notneeded) and life history of: (a) Lycopsida:*Lycopodium* and (b) Filicopsida: *Marsilea*
3. Stelar evolution in Pteridophytes; Heterospory and seed habit.
4. Ecological and economic importance of Pteridophytes.

Unit-2: Gymnosperms **10Hrs.**

1. General characteristics of Gymnosperms; Sporne (1965) classification.
2. Occurrence, morphology, anatomy, reproduction (developmental details are not needed) and life history of:(a) Cycadopsida: *Cycas* and (b) Gnetopsida: *Gnetum*
3. Ecological and economic importance of Gymnosperms.

Unit-3: Principles of Plant Taxonomy **10 Hrs.**

1. Aim and scope of taxonomy, species concept, taxonomic hierarchy-major and minor categories.
2. Plant nomenclature: Binomial system, ICBN- rules for nomenclature.
3. Herbarium and its techniques, BSI herbarium and Kew herbarium; concept of digital herbaria.
4. Bentham and Hooker system of classification.
5. Phylogenetic systematics: primitive and advanced, homology and analogy, parallelism and convergence, monophyly, paraphyly, polyphyly, clades. synapomorphy, symplesiomorphy, apomorphy. APG-IV classification.

Unit-4: Descriptive Plant Taxonomy **8 Hrs.**

Systematic description and economic importance of the following families:

1. Polypetalae: (a) Annonaceae (b) Curcurbitaceae
2. Gamopetalae: (a) Asteraceae (b) Asclepiadaceae
3. Monochlamydae: (a) Amaranthaceae (b) Euphorbiaceae
4. Monocotyledonae: (a) Arecaceae (b) Poaceae

Unit-5: Evidences for Plant systematics **7Hrs.**

1. Anatomy and embryology in relation to plant systematics.
2. Cytology and cytogenetics in relation to plant systematics.
3. Phytochemistry in relation to plant systematics.
4. Numerical taxonomy
5. Origin and evolution of angiosperms.

IV. Text Books:

1. Acharya, B.C., (2019) Archchegoniates, Kalyani Publishers, New Delhi
2. Bhattacharya, K., G. Hait&Ghosh, A. K., (2011) A Text Book of Botany, VolumeII, New Central Book Agency Pvt. Ltd., Kolkata
3. Hait,G., K.Bhattacharya&A.K.Ghosh (2011) A Text Book of Botany, Volume-I, New Central Book Agency Pvt. Ltd., Kolkata
4. Pandey, B.P. (2013) College Botany, Volumes-I&II, S. Chand Publishing, New Delhi

V. Reference Books:

1. Smith, G.M. (1971) CryptogamicBotanyVol. II., Tata McGraw Hill, New Delhi
2. Sharma,O.P.(2012) Pteridophyta. Tata McGraw-Hill, New Delhi
3. Sporne, K.R. (1971) The Morphology of Gymnosperms.Hutchinsons Co. Ltd.,London
4. Coulter, J.M. & C.J.Chamberlain(1910) Morphology of Gymnosperms,The University of Chicago Press, Chicago, Illinois
5. Bhatnagar, S.P. &AlokMoitra (1996) Gymnosperms. New Age International, NewDelhi
6. Sambamurty, A.V.S.S. (2005) Taxonomy of Angiosperms I. K .InternationalPvt. Ltd., New Delhi
7. Singh, G. (2012). Plant Systematics: Theory and Practice.Oxford& IBH Pvt.Ltd., NewDelhi.
8. Simpson, M.G. (2006). Plant Systematics. Elsevier Academic Press, San Diego, CA,U.S.A.

VI. Suggested activities and evaluation methods:

Unit-1: Activity: Makingtemporaryslides/models/drawings of Pteridophytes in the syllabus.

Evaluation method: Assessmentofthetemporaryslides/model/drawing.

Unit-2: Activity: Studyofwoodelementsinlocally available Gymnosperms and making temporary slides.

Evaluation method: Validation of prepared slides submitted by the learner.

Unit-3: Activity: Botanical field trip and collecting plant specimens for herbarium.

Evaluation method: Attendance in field trip and submission of field note book and herbarium sheets with filled in labels.

Unit-4: Activity: Making good models or drawings or collection of photographs of some important plant species from the families included in the syllabus.

Evaluation method: Authorize the quality of the work and conferring reward.

Unit-5: Activity: Collection of scientific literature on solving taxonomic problems by taking evidences from other branches of Botany.

Evaluation method: Validation of the collection submitted along with summary.

Botany Major: III Semester

Course 5 : Vascular Plants (Pteridophytes, Gymnosperms and Angiosperm Taxonomy)

Practical 02 hours /Week Credits -1

I. Course Outcomes: On successful completion of this practical course, student shall be able to:

1. Distinguish the Pteridophytes and Gymnosperms based on their morphological, anatomical and reproductive structures.
2. Make systematic classification of plant species using vegetative and floral characters.
3. Identify angiosperm plant species and make herbarium specimens.

II Laboratory/field exercises:

I. Study/ microscopic observation of vegetative, sectional/anatomical and reproductive structures of the following using temporary or permanent slides/specimens/ mounts:

1. Pteridophyta: *Lycopodium* and *Marselia*
2. Gymnosperms: *Cycas* and *Gnetum*

II. Technical description of locally available plant species from the following angiosperm families:

1. Annonacae	2. Cucurbitaceae	3. Asteraceae	4. Asclepiadaceae
5. Amaranthaceae	6. Euphorbiaceae	7. Arecaceae	8. Poaceae

III. Demonstration of herbarium techniques.

IV. Field trip to a local floristic area/forest (Submission of 30 number of Herbarium sheets of wild plants with the standard system are mandatory).

II Semester

Course 6: Plant Pathology and Plant Diseases

Credits -3

I. Learning Objectives: By the end of this course the learner has:

1. To study various plant pathogens, their survival and dispersal mechanisms.
2. To understand the processes involved in infection and pathogenesis in plants.
3. To study the common diseases of some important field and horticultural crops.

II. Learning Outcomes:

1. Identify major groups of plant pathogens and classify plant diseases.
2. Explain various stages in infection, plant pathogenesis and responsible factors.
3. Elaborate the preventive and control measures for plant diseases.
4. Discuss about some diseases of field crops and their management.
5. Discuss about some diseases of horticultural crops and their management.

III. Syllabus of Theory:

Unit-1: Plant pathogens, survival and dispersal **8 Hrs.**

1. Plant pathology: definition, importance of plant diseases, important famines in world; scope and objectives of plant pathology.
2. Important plant pathogenic organisms with examples of diseases caused by them.
3. Classification of plant diseases based on important criteria.
4. A brief account on survival of plant pathogens.
5. Dispersal of plant pathogens – active and passive processes.

Unit-2: Infection and pathogenesis in plants **8 Hrs.**

1. Infection process – pre-penetration, penetration and post-penetration.
2. Role of enzymes in plant pathogenesis.
3. Role of toxins in plant pathogenesis.
4. Role of growth regulators in plant pathogenesis.
5. Defense mechanisms in plants against pathogens.

Unit-3: Plant disease management **8 Hrs.**

1. Plant disease epidemiology; plant disease forecasting; remote sensing in plant pathology.
2. General principles of plant diseases management.

3. Regulatory methods, cultural methods; biological control and PGPR.

4. Physical methods, chemical methods; host plant resistance.

5. Integrated plant disease management (IDM) – Concept, advantages and importance.

Unit-4: Diseases of field crops **12 Hrs.**

Symptoms, etiology, disease cycle and management of major diseases of following crops:

a) Rice: Blast of rice, bacterial blight and Tungro

b) Bajra: Downy mildew and Ergot

c) Pigeon-pea: Phytophthora blight, wilt and sterility mosaic

d) Groundnut: Tikka leaf spot, rust and root rot

Unit-4: Diseases of horticultural crops **9 Hrs.**

Symptoms, etiology, disease cycle and management of major diseases of following crops:

a) Brinjal: Phomopsis blight and Little leaf

b) Okra: Powdery mildew and Yellow vein mosaic

c) Pomegranate: Alternaria fruit spot and Anthracnose

d) Coconut: Bud rot and Basal stem rot

IV. Text Books:

1. P.D. Sharma (2011) Fundamentals of Plant Pathology, Tata McGraw-Hill Education, New Delhi

2. R.S. Singh and U.S. Singh (2017) Plant Pathology: An Introduction, CRC Press, Boca Raton, Florida, USA

3. R.S. Mehrotra (2008) Plant Pathology, Tata McGraw-Hill Education, New Delhi

4. M. S. Reddy and Gopal Singh (2016) Plant Pathology: Concepts and Laboratory Exercises, Scientific Publishers, Jodhpur, India

V. Reference Books:

1. Agrios, G. N. (2005). Plant Pathology (5th ed.). Academic Press, San Diego, California.

2. Dehne, H. W. (Ed.). (2012). Plant Pathology: From Molecular Biology to Biological Control. Springer, Dordrecht, Netherlands.

3. Dicklow, M. B., & Beaudry, R. M. (Eds.). (2013). Plant Pathology Concepts and Laboratory Exercises (2nd ed.). CRC Press, Boca Raton, Florida.

4. Lucas, J. A. (1998). Plant Pathology and Plant Pathogens. Blackwell Science, Oxford, UK.
5. Lucas, J. A. (1998). Plant pathology and plant pathogens. Blackwell Science, Oxford, UK.
6. Schumann, G. L., & D'Arcy, C. J. (2010). Essential Plant Pathology (2nd ed.). APS Press, St. Paul, Minnesota.
7. Schumann, G. L., and C. D'Arcy (2010). Essential plant pathology. APS Press, St. Paul, MN.
8. Singh, R. P., and U. S. Singh (2020). Plant diseases: Identification, management and challenges. Springer, Singapore.

VI. Suggested activities and evaluation methods:

Unit-1: Activity: Field Survey and making a report on various plant pathogens, their survival and dispersal mechanisms.

Evaluation method: Field reports, presentations and visual documentation based on a rubric.

Unit-2: Activity: Case studies on plant infections and factors contributing to disease development.

Evaluation method: Diagnostic evaluation of case study report for problem-solving and critical thinking skills.

Unit-3: Activity: A survey report on various preventive and control measures for plant diseases practiced by the farmers in their locality.

Evaluation method: Peer review by students on the quality of report.

Unit-4: Activity: Field survey and data collection on diseases of local field crops.

Evaluation method: Assessment of the quality of report bases on a rubric.

Unit-5: Activity: Microscopic observations and making drawings of diseased samples.

Evaluation method: Formative assessment of presentation of findings through visuals/ drawings.

III Semester

Course 6: Plant Pathology and Plant Diseases

Credits -1

I. Course Outcomes: On successful completion of this practical course, student shall be able to:

1. Handle equipment and instruments in plant pathology laboratory.
2. Isolate plant pathogenic microbes.
2. Identify the plant diseases based of histopathological observations.

II. Laboratory/field exercises:

1. Familiarity with general plant pathological laboratory and field equipment.
2. Isolation and Identification of plant pathogenic fungi.
3. Isolation and Identification of plant pathogenic bacteria.
4. Identification of phanerogamic plant parasites.
5. Isolation and Identification of plant pathogenic nematodes.
6. Demonstration of Koch's postulates
7. Identification and histopathological studies of selected diseases of field crops.
8. Identification and histopathological studies of selected diseases of horticultural crops.

III Semester

Course 7: Plant Breeding

Credits -3

I. Learning Objectives: By the end of this course the learner has:

1. To learn the objectives and scope of plant breeding along with reproductive methods in plants.
2. To understand the breeding methods in plant for production of new varieties.
3. To have a comprehensive knowledge on tools and techniques in plant breeding.

II. Learning Outcomes:

1. Compare and contrast the methods of reproduction and also pollination mechanisms.
2. Design appropriate pollination method for a given crop plant.

3. Recommend the best possible breeding method for a crop species.
4. Propose the steps for production of hybrid varieties of crop plants.
5. Apply molecular techniques to develop a tailored plant variety.

III. Syllabus of Theory:

Unit-1: Basic concepts of plant breeding **8 Hrs.**

1. Definition, aim, objectives and scope of plant breeding; concepts in plant breeding: genetic variation, heritability, and selection.
2. Advantages and disadvantages of asexual and sexual reproduction; apomixis: definition, types and significance.
3. A brief account of self and cross-pollination, their genetic consequences and significance; classification of crop plants based on mode of pollination and mode of reproduction.

Unit-2: Contrivances for cross pollination **7 Hrs.**

1. Self-incompatibility in plants – Definition, heteromorphic and homomorphic systems; exploitation of self-incompatibility in hybrid production.
2. Male sterility- Genetic, cytoplasmic and cytoplasmic-genetic, utilization in plant breeding.
3. Domestication of plants, centres of origin of crop plants.

Unit-3: Breeding methods in plants **9 Hrs.**

1. Plant introduction – types, objectives, plant introduction agencies in India, procedure, merits and demerits; germplasm collections, genetic erosion, gene sanctuaries.
2. Selection – natural and artificial selection – basic principles of selection.
3. Self-pollinated crops: pure line selection method – procedure, advantages and disadvantages, achievements.
4. Vegetatively propagated crops: Clonal selection - procedure, advantages and disadvantages, achievements.

Unit-4: Breeding methods in cross-pollinated plants **12 Hrs.**

1. Hybridization – objectives, types, procedure, advantages and disadvantages, achievements.
2. Cross-pollinated crops: back cross method - procedure, advantages and disadvantages, achievements.

3. Heterosis: definition, genetic bases of heterosis – dominance, over dominance and epistasis hypotheses; physiological bases of heterosis – commercial utilization.
4. Synthetics and composites – production procedures – merits, demerits and achievements.

Unit-5: Modern methods in plant breeding 9 Hrs.

1. Mutation breeding: spontaneous and induced mutations – characteristic features of mutations – procedure of mutation breeding – applications – advantages, limitations and achievements.
2. Polyploidy breeding: auto-polyploids and allopolyploids – applications in crop improvement and limitations.
3. DNA markers and their applications in plant breeding: RFLP, SSR, and SNP
4. Marker Assisted Selection (MAS) and its applications in plant breeding.

IV. Text Books:

1. Singh, B. D. (2001) Plant breeding: Principles and methods. Kalyani Publishers, New Delhi, India.
2. Poehlman, J. M. and Sleper, D. A. (1995) Breeding field crops, 4th ed. Iowa State University Press, Ames, Iowa, USA.
3. Patil, J.V., S.S. Patil, and R.A. Balikai (2019) Principles and Methods in Plant Breeding, Scientific Publishers (India), Jodhpur
4. Purohit, S.S. (2014) Plant Breeding: Principles and Methods, Agrobios (India), Jodhpur

V. Reference Books:

1. Acquaah, G. 2012. Principles of plant genetics and breeding, 2nd ed. Wiley-Blackwell, Ames, Iowa, USA.
2. Allard, R. W. 1999. Principles of plant breeding. John Wiley & Sons, New York, USA.
3. Stuber, C. W., Edwards, M. D. and Wendel, J. F. 1987. Molecular markers in plant breeding: Applications and potential. Science 238: 1659-1664.
4. Hayes, H. K., R. E. Kirk, and R. H. Jones (1951). Methods for the Statistical Analysis of Plant Breeding Experiments. Iowa State College Press, Ames, IA.
5. Simmonds, N. W. (1979). Principles of Crop Improvement (2nd ed.). Longman, Harlow, UK.

VI. Suggested activities and evaluation methods:

Unit-1: Activity: Written assessment on reproduction and pollination mechanisms in plants.

Evaluation method: Awarding grade based on writing appropriate points in a descriptive way.

Unit-2: Activity: Collection of scientific literature on contrivances in plants to promote cross fertilization.

Evaluation method: Quality and organization of the report in a systematic way with data collected and analysis made. **Unit-3: Activity:** Hands on activity of selection procedure for a given crop plant. **Evaluation method:** Assessment of understanding and applying appropriate selection procedure. **Unit-4: Activity:** Field trip to an agriculture or a horticulture research station to learn hybridization techniques. **Evaluation method:** Active participation and learning skills on production of hybrid plants. **Unit-5: Activity:** Case studies of modern applications of molecular techniques in crop
improvement. **Evaluation method:** learner.

Based on a rubric with specified criteria and performance levels of the

III Semester

Course 7: Plant Breeding

Credits -1

I. Course Outcomes: On successful completion of this practical course, student shall be able to:

1. Distinguish self and cross-pollinated plant species based on floral biology.
2. Perform skills related to self and cross pollination in plants.
3. Make hybridization to produce new varieties.

II. Laboratory/field exercises:

1. Floral biology in a self and a cross pollinated plant species.
2. Identification and classification of plants based on pollination mechanism.
3. Pollen viability test.
4. Observation on pollen germination.
5. Practicing emasculation technique.
6. Practicing selfing and crossing techniques.

7. Assessment of genetic variability.
8. Estimation of heterosis and inbreeding depression.
9. Studying mutant and polyploids in crop plants.

III Semester

Course 8: Plant Biotechnology

Credits -3

I. Learning Objectives: By the end of this course the learner has:

1. To acquire knowledge of sterilization techniques used in plant tissue culture.
2. To learn about various types of plant tissue culture practices.
3. To know the applications of plant biotechnology in production of novel plants.

II. Learning Outcomes: Students at the successful completion of the course will be able to:

1. Explain the scientific techniques and tools used in plant tissue culture laboratories.
2. Appraise the applications of plant tissue culture in agriculture and horticulture sectors.
3. Acquire skills related to various aspects in plant tissue culture.
4. Evaluate the role of transgenic plants in solving certain plant related beneficiary issues.
5. Justify the role of plant biotechnology in bioenergy and phytoremediation.
6. Judge the biosafety and bioethics related to plant biotechnology.

III. Syllabus of Theory:

UNIT-1: Basic techniques in plant tissue culture 10 Hrs.

1. Plant tissue culture: Definition, scope and significance; infrastructure and equipment required to establish a tissue culture laboratory.
2. Sterilization techniques; formulation of media for plant tissue culture.
3. Concept of totipotency, initiation and maintenance of callus cultures; induction of morphogenesis in vitro.
4. Somatic embryogenesis and organogenesis; factors affecting somatic embryogenesis and organogenesis synthetic seeds and their applications.

UNIT-2: Organ and haploid culture techniques 8 Hrs.

1. Importance and applications of meristem culture, zygotic embryo culture, endosperm culture.
2. Micropropagation and its uses, commercial exploitation of micropropagation.
3. Production of haploids using anther, pollen and unfertilized ovule cultures -

characterization and applications.

UNIT-3: Cell and protoplast cultures **12 Hrs.**

1.Cell suspensions – continuous and batch cultures; mass cultivation of plant cells using bioreactors.

2. Production of secondary metabolites from cell cultures, strategies used for enhanced production of secondary metabolites. Biotransformation using plant cell cultures.

3. Isolation, purification and culture of protoplasts; methods used for protoplast fusion.

4. Somatic hybridization/cybridization –selection systems for somatic hybrids/cybrids, their characterization and applications.

UNIT-4: Transgenic plants **8 Hrs.**

1. Transgenic plants – definition, biosafety and ethical issues associated with transgenic plants.

2. Herbicide resistance (glyphosphate), insect resistance (alpha amylase inhibitor).

3. Virus resistance (coat protein mediated, nucleocapsid gene), disease resistance (antifungal proteins, PR proteins).

4. Quality improvement (Golden rice), Shelf-life enhancement (Flavr savr tomato).

UNIT-5: Advances in plant biotechnology **7 Hrs.**

1. Plant synthetic biology and its applications; plant-based vaccines and therapeutics.

2. Biofortification and genetically modified foods.

3. Biodegradable plastics, polyhydroxybutyrate.

4. Applications of plant biotechnology in bioenergy production and environmental remediation.

IV. Text Books:

1. Ignacimuthu , S., (2003) Plant Biotechnology. Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.

2. Kalyan Kumar De., (1997) Plant Tissue Culture – New Central Book Agency (P) Ltd., Calcutta.

3. Mascarenhas A.F., (1991) Hand book of Plant Tissue Culture. Indian Council of Agricultural Research. New Delhi.

4. Narayanaswamy, S (1994) Plant Cell and Tissue Culture, Tata –Mc Graw Hill Publishing Co., Ltd., New Delhi.

V. Reference Books:

1. C. Neal Stewart Jr.(2018) Plant Biotechnology and Genetics: Principles, Techniques, and Applications JohnWiley & Sons, Inc. in Hoboken, New Jersey, USA.
2. Adrian Slater, NigelW. Scott, and Mark R. Fowler (2008) Plant Biotechnology: The Genetic Manipulation of Plants Oxford University Press in Oxford, UK.
3. S. Mohan Jain and Pramod K. Gupta (2010) Plant Biotechnology: Methods and Applications CRC Press, Taylor & Francis Group in Boca Raton, Florida, USA.
4. Ram Lakhan Singh (2017) Plant Biotechnology: Recent Advances and Future Prospects Springer International Publishing AG in Cham, Switzerland.
5. Altman and P.M. Hasegawa (2013) Plant Biotechnology and Agriculture: Prospects for the 21st Century Elsevier Inc. in Amsterdam, Netherlands.

VI. Suggested activities and evaluation methods:

Unit-1: Activity: Preparation of media for tissue culture.

Evaluationmethod: Assessment of skill in preparation of media in an effective manner.

Unit-2: Activity: Group discussion on various tissue culture practices.

Evaluationmethod: Active participation, critical thinking, content presentaion, collaboration skills etc., based on a rubric.

Unit-3: Activity: Designing a bioreactor system for mass cultivation of plant cells.

Evaluation method: Awarding grade based on **s**kills performed in designing a prototype bioreactor.

Unit-4: Activity: Collection of scientific literature on various transgenic plants developed.

Evaluation method: Assess credibility and relevance of literature collected, analysis and conclusions made.

Unit-5: Activity: Case studies on applications of plant biotechnology.

Assessment method: Based on data and Information collected, analysis and interpretation made, presentation and organization of the report.

III Semester

Course 8: Plant Biotechnology

Credits -1

I. Course Outcomes: On successful completion of this practical course, student shall be able to:

1. Operate all the equipment and instruments in a plant tissue culture laboratory.
2. Establish callus and organ culture.
3. Obtain quality plants using micro-propagation techniques.

II. Laboratory/field exercises:

1. Equipment used in plant tissue culture.
2. Sterilization techniques in plant tissue culture laboratory.
3. Preparation of culture media
4. Callus induction and subculturing.
5. Organogenesis using PGRs'
6. Demonstration of cell and protoplast culture.
7. Demonstration of organ cultures.
8. Demonstration of anther and pollen cultures.

IV Semester

Course 9: Anatomy and Embryology of Angiosperms

Credits -3

I.Learning Objectives: By the end of this course the learner has:

1. To know about various types of tissues in plants and their organization.
2. To obtain awareness on anomalous secondary growth in plants and economic value of woods.
3. To acquire knowledge on development of male and female gametophytes in plants.
4. To probe into embryogenesis in angiosperms.

II. Learning Outcomes: On completion of thiscourse students will be able to:

1. Categorize various tissues and evaluate their role in plants.
2. Explain anomalous secondary growth in some plants and justify the value of timber plants.
3. Summarize the events in micro-sporogenesis and development of male gametophyte.
4. Discuss the events in mega-sporogenesis and development of female gametophyte.
5. Propose the incidents in embryogenesis of an angiospermic plant species.
6. Compile the aspects of developmental and reproductive biology in plants.

III. Syllabus of Theory:

Unit – 1: Tissues in plants **8 Hrs.**

1. Meristematic tissues: Definition, classification, structure and functions.
2. Apical meristems: Generalised structure of shoot apex, theories on organization of Shoot Apical Meristem (SAM) - Apical cell theory, Tunica-Corpus theory and Histogen theory.
3. Permanent tissues (simple and complex).
4. A brief account of plant secretory tissues/cells.

Unit-2: Anomalous growth in plants **10Hrs.**

1. Tissue systems–Epidermal, ground and vascular.
2. Anomalous secondary growth in root of *Beta vulgaris*
3. Anomalous secondary growth in stems of *Boerhaavia* and *Dracaena*
4. Study of timbers of economic importance - Teak, Red-sanders and Rosewood.
5. Applications of anatomy in plant systematics, forensics and pharmacognosy.

Unit-3: Anther and pollen **10Hrs.**

1. Anther: Structure and functions of anther wall, micro-sporogenesis, callose deposition and its significance.
2. Pollen wall structure, MGU (male germ unit) structure, NPC system; a brief account of Palynology and its scope; development of male gametophyte.
3. Pollen wall proteins; Pollen viability, storage and germination; Abnormal features: pseudomonads, polyads, massulae, pollinia.

Unit-4: Ovules, fertilization and endosperm **10Hrs.**

1. Structure and types of ovules, megasporogenesis; monosporic (*Polygonum*), bisporic (*Allium*) and tetrasporic (*Peperomia*) types of embryo sacs.
2. Outlines of pollination; self-incompatibility- basic concepts; methods to overcome self-incompatibility (mixed pollination, bud pollination, stub pollination).
3. Double fertilization in angiosperms – process and consequences.
4. Perisperm; endosperm – types (free nuclear, cellular, helobial and ruminate) and biological importance.

Unit-5: Embryogeny and seeds **7Hrs.**

1. Embryogeny in dicot (*Capsella bursa-pastoris*)
2. Embryogeny in monocot (*Sagittariasagittifolia*).
3. Seed structure in monocot and dicot.
4. Importance of seed and seed dispersal mechanisms.
5. Polyembryony and apomixes: Introduction, classification, causes and applications.

IV. Text Books:

1. Pandey, B.P. (2013) College Botany, Volumes-II& III, S. Chand Publishing, New Delhi
2. Bhattacharya, K., G. Hait & Ghosh, A. K., (2011) A Text Book of Botany, Volume-II, New Central Book Agency Pvt. Ltd., Kolkata

V. Reference Books:

1. Esau, K. (1971) Anatomy of Seed Plants. John Wiley and Son, USA.
2. Fahn, A. (1990) Plant Anatomy, Pergamon Press, Oxford.
3. Cutler, D.F., T. Botha & D. Wm. Stevenson (2008)Plant Anatomy: An Applied

Approach, Wiley, USA
4. Paula Rudall (1987) Anatomy of Flowering Plants: An Introduction to Structure and Development. Cambridge University Press, London
5. Bhojwani, S. S. and S. P. Bhatnagar (2000) The Embryology of Angiosperms (4th Ed.),Vikas Publishing House, Delhi.
6. Pandey, A. K. (2000) Introduction to Embryology of Angiosperms. CBS Publishers & Distributors Pvt. Ltd., New Delhi
7. Maheswari, P. (1971) An Introduction to Embryology of Angiosperms. McGraw Hill Book Co., London.
8. Johri, B.M. (2011) Embryology of Angiosperms. Springer-Verlag, Berlin

VI. Suggested activities and evaluation methods:

Unit-1: Activity: Microscopic observations on different tissues in plants and recording characteristics.

Evaluation method: Judgement of the report/seminar on comparative and contrasting features of various tissues in plants.

Unit-2: Activity: Visits to timber depots and furniture shops and making a report on various woods.

Evaluation method: Assessment of report submitted with data, photographs and summary.

Unit-3: Activity: Study of pollen structure, germination and viability in some local plant species.

Evaluation method: Evaluating the report/seminar presentation with collected data.

Unit-4: Activity: Group discussion/quiz on endosperm types and functions.

Evaluation method: Assessment of the best performing group.

Unit-5: Activity: Drawings of embryogeny in some angiosperms and making comparative report.

Evaluation method: Evaluating the best drawings and comparative report.

IV Semester

Course 9: Anatomy and Embryology of Angiosperms

Credits-1

Course Outcomes: On successful completion ofthis practical course, student shall be able to:

1. Conduct dissections of various plant organs andstudy the internal structures by staining.
2. Look into the embryological characteristics fromsex organs to seeds in angiosperms.

Laboratory/field exercises:

1. Observation of meristems in dicot and monocot plants.
2. Tissue organization in shoot apices using permanent slides.
3. Anomalous secondary growth in root of *Beta vulgaris*
4. Anomalous secondary growth in stems of *Boerhaavia* and *Dracaena.*
5. Study of anther and ovule s using permanent slides/photographs.
6. Study of pollen germination and pollen viability.
7. Dissection and observation of embryo sac haustoria in *Santalum* or *Argemone*.
8. Structure of endosperm (nuclear and cellular) using permanent slides/photographs.
9. Dissection and observation of Endosperm haustoria in *Crotalaria* or *Coccinia.*
10. Developmental stages of dicot and monocot embryos using permanent slides /photographs.

IV Semester

Course 10: Plant Ecology, Biodiversity and Phytogeography

Credits -3

I. Learning Objectives: By the end of this course the learner has:

1. To figure-out the components of ecosystem and energy flow among different trophic levels.
2. To apprise the characteristics of autecology and synecology.
3. To understand the climatic change and associated impacts on biotic components.
4. To discern the value of biodiversity, threats and conservation strategies.
5. To know the distribution of various plant groups in different geographical areas.

II. Learning Outcomes: On completion of this course students will be able to:

1. Explain the interactions among the biotic and abiotic components in an ecosystem.
2. Summarize the characteristics of a population and a community.
3. Anticipate the environmental problems arising due to climate change.
4. Assess the value of biodiversity and choose appropriate conservation strategy.
5. Make a survey on the distribution of various plant groups in a specified geographical area.

III. Syllabus of Theory:

Unit-1: Basic concepts in ecology **10 Hrs.**

1. Ecology: definition, branches and significance; relation with other sciences.
2. Structure and functions of ecosystems- abiotic and biotic components; flow of energy.
3. Cycling of materials: water, carbon, nitrogen and phosphorus; trophic pyramids, food chains and food webs.
4. Plants and environment: Climatic (light and temperature) and edaphic.
5. Interactions among plants; interactions between plants and animals.

Unit-2: Population and community ecology **10Hrs.**

1. Population ecology: definition, characteristics -natality, mortality, growth curves, ecotypes, ecads.
2. Community ecology: characteristics -frequency, density, cover, life forms, competition, biological spectrum.

3. Ecological succession: Hydrosere and Xerosere.

4. Concepts of productivity: GPP, NPP and Community Respiration

5. Secondary production, P/R ratio and Ecosystems.

Unit-3: Climate change-impacts **8Hrs.**

1. Soil degradation – causes, consequences and management strategies.

2. Deforestation, forest fires – causes, consequences and management strategies.

3. Global warming, ozone layer depletion, acid rains, ocean acidification – causes and effects.

4. Carbon foot prints and carbon credits; The Montreal and the Kyoto protocol.

5. Plant indicators and their role in environmental monitoring.

Unit-4: Concepts of Biodiversity **10Hrs**

1.Biodiversity: Basic concepts, Convention on Biodiversity - Earth Summit.

2. Value of Biodiversity; types and levels of biodiversity and Threats to biodiversity

3. Biodiversity Hot spots in India: North Eastern Himalayas and Western Ghats.

4. Principles of conservation: IUCN threat-categories, RED data book

5. Role of NBPGR and NBA in the conservation of Biodiversity.

Unit-5: Phytogeography **7 Hrs.**

1. Principles of Phytogeography, Distribution (wides, endemic, discontinuous species)

2. Endemism – types and causes.

3. Phytogeographic regions of World.

4. Phytogeographic regions of India.

5. Vegetation types in Andhra Pradesh.

IV. Text Books:

1. Pandey, B.P. (2013) College Botany, Volumes- II & III, S. Chand Publishing, New Delhi

2. Bhattacharya, K., G. Hait & Ghosh, A. K., (2011) A Text Book of Botany, VolumeII, New Central Book Agency Pvt. Ltd., Kolkata

3. N.S.Subrahmanyam& A.V.S.S. Sambamurty (2008) Ecology Narosa Publishing House, New Delhi

4. Sharma, P.D. (2012) Ecology and Environment. Rastogi Publications, Meerut, India.

5. U. Kumar (2007) Biodiversity: Principles & Conservation, Agrobios (India),

Jodhpur
6. Mani, M.S (1974) Ecology & Biogeography of India Dr. W. Junk Publishers, The Hague

V. Reference Books:

1. Kormondy, Edward J. (1996) Concepts of Ecology,Prentice-Hall of India Private Limited, New Delhi
2. Begon, M., J.L. Harper & C.R. Townsend (2003) Ecology, Blackwell Science Ltd., U.S.A.
3. Eugene P. Odum (1996) Fundamentals of Ecology, Natraj Publishers, Dehradun
4. Kumar, H.D. (1992) Modern Concepts of Ecology (7th Edn.,)Vikas Publishing Co.,New Delhi.
5. Newman, E.I. (2000): Applied Ecology Blackwell Scientific Publisher, U.K.
6. Chapman, J.L&M.J. Reiss (1992): Ecology - Principles & Applications. Cambridge University Press, U.K.
7. Kumar H.D. (2000) Biodiversity & Sustainable Conservation Oxford & IBH Publishing Co Ltd. New Delhi.
8. Cain, S.A . (1944) Foundations of Plant Geography Harper & Brothers, N.Y.
9. Good, R. (1997) The Geography of flowering Plants (2nd Edn.) Longmans, Green & Co., Inc., London & Allied Science Publishers, New Delhi

VI. Suggested activities and evaluation methods:

Unit-1: Activity: Field visit to local ecosystems and making a report on biotic and abiotic components and their interactions.

Evaluation method: Valuation of record of attendance and report submission with conclusions

Unit- 2: Activity: Case studies on population and community ecologies and making a comprehensive report

Evaluation method: Assessing the report and awarding grade

Unit -3: Activity: Case studies on global and local climatic changes and their impacts, preparing a comprehensive report.

Evaluation method: Assessing the report and awarding grade.

Unit- 4: Activity: Making a survey in their locality to identify endangered and threatening species.

Evaluation method: Assessing the survey report and assigning a grade based on a rubric.

Unit-5: Activity: Collection of data on flora of their locality and preparing a project report.

Evaluation method: Assessing the project report and awarding a grade.

IV Semester

Course 10: Plant Ecology, Biodiversity and Phytogeography

Credits -1

I. Course Outcomes: On successful completionof this practical course, student shall be able to:

1. Handle instruments used in ecological studies.
2. Perform experiments and collect data on autecology and synecology.
3. Identify various plant groups based on their morphological and anatomical adaptations.
4. Collect data on biodiversity and phytogeography.

II. Laboratory/field exercises:

1. Study of instruments used to measure microclimatic variables;
    a. Soil thermometer,
    b. Maximum and minimum thermometer,
    c. Anemometer,
    d. Rain gauze
    e. Lux meter.
2. Visit to the nearest/local meteorology station where the data is being collected regularly and record the field visit summary for the submission in the practical.
3. Study of morphological and anatomical adaptations of any two hydrophytes.
4. Study of morphological and anatomical adaptations of any two xerophytes.
5. Quantitative analysis of herbaceous vegetation in the college campus for frequency, density and abundance
6. Identification of vegetation/various plants in college campus and comparison with Raunkiaer's frequency distribution law.

7. Find out the alpha-diversity of plants inanarea
8. Mapping of biodiversity hotspots of theworld and India.
9. Mapping of phytogeographical regionsofthe globe and India.

IV Semester

Course 11: Plant Resources and Utilization

Credits -3

I. Learning Objectives: By the end of this course the learner has:

1. To know different plants domesticated by humans and utility of their products.
2. To gain knowledge on commercial and timber products obtained from plants.
3. To know the facts on economic value of plants products in relation to human welfare.

II. Learning Outcomes: Students at the successful completion of the course will be able to:

1. Explain the significance of plants in human nutrition.
2. List out different plant products used by human beings.
3. Evaluate the commercial plant products and their utilization
4. Discuss the uses of medicinal and aromatic plants for human health care.
5. Appraise the importance of timber and non-timber products for value added products.

III. Syllabus of Theory:

UNIT-1: Food plants **10 Hrs.**

1. Centres of diversity of plants, origin of crop plants.
2. Domestication and introduction of crop plants; concepts of sustainable development.
3. Cultivation, production, and uses of cereals (rice and wheat), major (jowar and bajra) and minor millets (finger millet, fox tail millet), pulse crops (red gram and black gram) and sugarcane.

UNIT-2: Other economic plant products **8 Hrs.**

1. A general account of oil seed crops and vegetable oils.
2. A general account of fruit and vegetable yielding plants.
3. Plant sources and economic importance of rubber, latex, gums, resins, dyes, alkaloids and tannins.
4. A general account of major fibre crops in India; textile productionfrom plant fibres.

UNIT-3: Commercial plant products **8 Hrs.**

1. A general account and economic potential of spices and condiments.

2. Plant sources and economic importance of flavouring products, beverages, fumitories and masticatories and narcotics.
3. Utilization of some important ornamentals, flowering plants andorchids.

UNIT-4: Medicinal and aromatic plant products 10 Hrs.

1. Traditional and modern uses of some medicinal plants of India. 2. Active compounds in medicinal plants and their pharmacologicaleffects. 3. Essential oils and their uses; aromatic plants in perfumery and cosmetics. 4. Phytochemicals and their potential health benefits.

UNIT-5: Timber products and energy crops 9 Hrs.

1. Important timber yielding plants of India; wood as a constructionand manufacturing material.
2. Other uses of wood products, such as paper and fuel.
3. Energy crops, biofuels and bioplastics.
4. Bamboos, *Eucalyptus, Casuarina* - generation of paper industry raw material.

IV. Textbooks:

1. S. K. JainandR. A. Jain, (2015) Handbook of Plant Resources, Springer, New York.
2. H. PandaandA. K. Padhi, (2017) Medicinal Plants and Their Utilization, Springer, Singapore.
3. G.E. Wickens(1998) Economic Botany: Principles and Practices, Chapman & Hall, London.
4. S.L. Kochhar(1990) The Economic Botany of the Tropics, Macmillan, London.

V. Reference Books:

1. K. V. Peter, (2004)Handbook of Herbs and Spices, CRC Press, Boca Raton.
2. J. E. Simon, J. A.Duke, and E. A. L. Bobilya, (1990) Handbook of Edible Weeds, CRC Press, Boca Raton.
3. J. Smartt and N.Haq, (2016) Handbook of Industrial Crops, Springer, New York.
4. P. N. Ravindran,(2017) The Encyclopaedia of Herbs and Spices, CABI, Wallingford.
5. Beryl B. Simpson(2010) Economic Botany: Plants in Our World, Academic Press, London.

6. Michael J. Balick and Paul Alan Cox (1996) Plants, People, and Culture: The Science of Ethnobotany, Scientific American Library, New York.
7. Ben-Erik van Wyk (2016) Food Plants of the World: An Illustrated Guide, Timber Press, Portland.
8. Jo Homan (2012) Plants That Changed History, Chartwell Books, New York.
9. Gary J. Martin (2004) Ethnobotany: A Methods Manual, Earthscan Publications, London.

VI. Suggested activities and evaluation methods:

Unit-1: Activity: A critical assignment on origin of crop plants.

Evaluationmethod: Evaluate the extent and quality of data collected to support the assignment's arguments.

Unit-2: Activity: Group discussion on various plant products and their source plants.

Evaluation method: Assess the logical flow and coherence of the group's discussion based on a grading scale.

Unit-3: Activity: A survey report on commercial plant products available in local markets.

Evaluation method: Evaluate the clarity and comprehensibility of the survey questions.

Unit-4: Activity: A case study report on phytomedicines used in human health care.

Evaluation method: Examine the depth and coherence of the discussion and interpretation based on a rubric.

Unit-5: Activity: A field trip to timber depots and silviculture plantations in their locality.

Evaluation method: Evaluate the level of student engagement and active participation during the trip based on a grading scale.