



ADIKAVI NANNAYA UNIVERSITY :: AJAHMAHENDRAVARAM  
B.Sc Botany Syllabus (w.e.f: 2020-21 A.Y)

UG PROGRAM (4 Years Honors)  
CBCS - 2020-21

SUBJECT
BOTANY



## Syllabus and Model Question Papers



**ADIKAVI NANNAYA UNIVERSITY :: AJAHMAHENDRAVARAM**  
**B.Sc Botany Syllabus (w.e.f: 2020-21 A.Y)**

**DETAILS OF COURSE TITLES & CREDITS**

Sem	Course No	Course Name	Course Type (T/P/L)	Hrs/Week	Credits	Max. Marks	Max. Marks
				Science: 4+2	Science: 4+2	Count/Internal/ Mid Assessment	Sem- End Exam
<b>I</b>	1	Fundamentals of Microbes and Non-vascular Plants	T	4	4	25	75
	2	Fundamentals of Microbes and Non-vascular Plants	L	2	1	-	50
<b>II</b>	3	Basics of Vascular plants and Phytogeography	T	4	4	25	75
	4	Basics of Vascular plants and Phytogeography	L	2	1	-	50
<b>III</b>	5	Anatomy and Embryology of Angiosperms, Plant Ecology and Biodiversity	T	4	4	25	75
	6	Anatomy and Embryology of Angiosperms, Plant Ecology and Biodiversity	L	2	1	-	50
<b>IV</b>	7	Plant Physiology and Metabolism	T	4	4	25	75
	8	Plant Physiology and Metabolism	L	2	1	-	50
	9	Cell Biology, Genetics and Plant Breeding	T	4	4	25	75
	10	Cell Biology, Genetics and Plant Breeding	L	2	1	-	50
<b>V</b>	11 & 12	Three (3) pairs of courses (each pair has 2 related courses) will be offered, student has to choose a pair of courses.					

**Note:** \*Course type code: T: Theory, L: Lab, P: Problem solving



*Annexure*

**Objectives and General Outcomes of Programme and Domain Subject**

**Programme(B.Sc.) Objectives:** The objectives of bachelor's degree programmewith Botany are:

1. To provide a comprehensive knowledge on various aspects related to microbes and plants.
2. To deliver knowledge on latest developments in the field of Plant sciences with a practical approach.
3. To produce a student who thinks independently, critically and discuss various aspects of plant life.
4. To enable the graduate to prepare and pass through national and international examinations related to Botany.
5. To empower the student to become an employee or an entrepreneur in the field of Botany /Biology and to serve the nation.

**Programme Outcomes :**

1. Understand the basic concepts of Botany in relation to its allied core courses.
2. Perceive the significance of microbes and plants for human welfare, and structural and functional aspects of plants.
3. Demonstrate simple experiments related to plant sciences, analyze data, and interpret them with the theoretical knowledge.
4. Work in teams with enhanced inter-personal skills.
5. Develop the critical thinking with scientific temper.
6. Effectively communicate scientific ideas both orally and in writing.

**Domain Subject(Botany) Objectives :**

1. To impart knowledge on origin, evolution, structure, reproduction and interrelationships of microbes and early plant groups.
2. To provide knowledge on biology and taxonomy of true land plants within a phylogenetic framework.
3. To teach aspects related to anatomy, embryology and ecology of plants, and importance of Biodiversity.
4. To explain the structural and functional aspects of plants with respect to the cell organelles, chromosomes and genes, and methods of plant breeding.
5. To develop a critical understanding on SPAC, metabolism and growth and development in plants.
6. To enable the students proficient in experimental techniques and methods of analysis appropriate for various sub-courses in Botany.

**Domain Subject(Botany) Outcomes:**

1. Students will be able to identify, compare and distinguish various groups of microbes and primitive plants based on their characteristics.
2. Students will be able to explain the evolution of trachaeophytes and also distribution of plants on globe.
3. Students will be able to discuss on internal structure, embryology and ecological adaptations of plants, and want of conserving Biodiversity.
4. Students will be able to interpret life processes in plants in relation to physiology and metabolism.
5. Students will be able to describe ultrastructure of plant cells, inheritance and crop improvement methods.
6. Students will independently design and conduct simple experiments based on the knowledge acquired in theory and practicals of the different sub-courses in Botany.



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<b>B.Sc.</b>	<b>Semester - I</b>	<b>Credits: 4</b>
<b>Course: 1</b>	<b>Fundamentals of Microbes and Non-vascular Plants</b>	<b>Hrs/Wk: 4</b>

**Learning Outcomes:** On successful completion of this course, the students will be able to:

- Explain origin of life on the earth.
- Illustrate diversity among the viruses and prokaryotic organisms and can categorize them.
- Classify fungi, lichens, algae and bryophytes based on their structure, reproduction and life cycles.
- Analyze and ascertain the plant disease symptoms due to viruses, bacteria and fungi.
- Recall and explain the evolutionary trends among amphibians of plant kingdom for their shift to land habitat.
- Evaluate the ecological and economic value of microbes, thallophytes and bryophytes

**UNIT I: Origin of life and Viruses:**

**12Hrs.**

1. Origin of life, concept of primary Abiogenesis; Miller and Urey experiment. Five kingdom classification of R.H. Whittaker
2. Discovery of microorganisms, Pasteur experiments, germ theory of diseases.
3. Shape and symmetry of viruses; structure of TMV and Gemini virus; multiplication of TMV; A brief account of Prions and Viroids.
4. A general account on symptoms of plant diseases caused by Viruses. Transmission of plant viruses and their control.
5. Significance of viruses in vaccine production, bio-pesticides and as cloning vectors.

**UNIT II: Special groups of Bacteria and Eubacteria**

**12Hrs.**

1. Brief account of Archaeobacteria, Actinomycetes and Cyanobacteria.
2. Cell structure and nutrition of Eubacteria.
3. Reproduction- Asexual (Binary fission and endospores) and bacterial recombination (Conjugation, Transformation, Transduction).
4. Economic importance of Bacteria with reference to their role in Agriculture and industry (fermentation and medicine).
5. A general account on symptoms of plant diseases caused by Bacteria; Citrus canker.

**UNIT III: Fungi & Lichens**

**12 Hrs.**

1. General characteristics of fungi and Ainsworth classification (upto classes).
2. Structure, reproduction and life history of (a) *Rhizopus* (Zygomycota) and (b) *Puccinia* (Basidiomycota).
3. Economic uses of fungi in food industry, pharmacy and agriculture.
4. A general account on symptoms of plant diseases caused by Fungi; Blast of Rice.
5. Lichens- structure and reproduction; ecological and economic importance.

**UNIT IV: Algae**

**12 Hrs.**

1. General characteristics of Algae (pigments, flagella and reserve food material); Fritsch classification (upto classes).
2. Thallus organization and life cycles in Algae.
3. Occurrence, structure, reproduction and life cycle of (a) *Spirogyra* (Chlorophyceae) and (b) *Polysiphonia* (Rhodophyceae).
4. Economic importance of Algae.



**UNIT V: Bryophytes**

**12 Hrs.**

1. General characteristics of Bryophytes; classification upto classes.
2. Occurrence, morphology, anatomy, reproduction (developmental details are not needed) and life cycle of (a) *Marchantia* (Hepaticopsida) and (b) *Funaria* (Bryopsida).
3. General account on evolution of sporophytes in Bryophyta.

**TEXT BOOKS :**

1. Botany – I (Vrukshasastram-I) : Telugu Akademi, Hyderabad
2. Pandey, B.P. (2013) *College Botany, Volume-I*, S. Chand Publishing, New Delhi
3. Hait, G., K. Bhattacharya & A.K. Ghosh (2011) *A Text Book of Botany, Volume-I*, New Central Book Agency Pvt. Ltd., Kolkata .
4. Bhattacharjee, R.N., (2017) *Introduction to Microbiology and Microbial Diversity*, Kalyani Publishers, New Delhi.

**REFERENCE BOOKS:**

1. Dubey, R.C. & D.K. Maheswari (2013) *A Text Book of Microbiology*, S. Chand & Company Ltd., New Delhi
2. Pelczar Jr., M.J., E.C.N. Chan & N.R. Krieg (2001) *Microbiology*, Tata McGraw- Hill Co, New Delhi.
3. Prescott, L. Harley, J. and Klein, D. (2005) *Microbiology, 6th edition*, Tata McGraw –Hill Co. New Delhi.
4. Alexopoulos, C.J., C.W. Mims & M. Blackwell (2007) *Introductory Mycology*, Wiley & Sons, Inc., New York
5. Mehrotra, R.S. & K. R. Aneja (1990) *An Introduction to Mycology*. New Age International Publishers, New Delhi
6. Kevin Kavanagh (2005) *Fungi ; Biology and Applications* John Wiley & Sons, Ltd., West Sussex, England
7. John Webster & R. W. S. Weber (2007) *Introduction to Fungi*, Cambridge University Press, New York
8. Fritsch, F.E. (1945) *The Structure & Reproduction of Algae (Vol. I & Vol. II)* Cambridge University Press Cambridge, U.K.
9. Bold, H.C. & M. J. Wynne (1984) *Introduction to the Algae*, Prentice-Hall Inc., New Jersey
10. Robert Edward Lee (2008) *Phycology*. Cambridge University Press, New York
11. Van Den Hoek, C., D.G. Mann & H.M. Jahns (1996) *Algae : An Introduction to Phycology*. Cambridge University Press, New York
12. Shaw, A.J. & B. Goffinet (2000) *Bryophyte Biology*. Cambridge University Press, New York.



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<b>B.Sc.</b>	<b>Semester - I</b>	<b>Credits: 1</b>
<b>Course: 1(L)</b>	<b>Fundamentals of Microbes and Non-vascular Plants Lab</b>	<b>Hrs/Wk: 2</b>

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

1. Demonstrate the techniques of use of lab equipment, preparing slides and identify the material and draw diagrams exactly as it appears.
2. Observe and identify microbes and lower groups of plants on their own.
3. Demonstrate the techniques of inoculation, preparation of media etc.
4. Identify the material in the permanent slides etc.

**Practical Syllabus:**

1. Knowledge of Microbiology laboratory practices and safety rules.
2. Knowledge of different equipment for Microbiology laboratory (Spirit lamp, Inoculation loop, Hot-air oven, Autoclave/Pressure cooker, Laminar air flow chamber and Incubator) and their working principles. (In case of the non- availability of the laboratory equipment the students can be taken to the local college/clinical lab. with required infrastructural facilities or they can enter a linkage with the college/lab for future developments and it will fetch credits during the accreditation by NAAC).
3. Demonstration of Gram's staining technique for Bacteria.
4. Study of Viruses (Corona, Gemini and TMV) using electron micrographs/ models.
5. Study of Archaeobacteria and Actinomycetes using permanent slides/ electron micrographs/diagrams.
6. Study of *Anabaena* and *Oscillatoria* using permanent/temporary slides.
7. Study of different bacteria (Cocci, Bacillus, Vibrio and Spirillum) using permanent or temporary slides/ electron micrographs/ diagrams.
8. Study/ microscopic observation of vegetative, sectional/anatomical and reproductive structures of the following using temporary or permanent slides/ specimens/ mounts :
  - a. Fungi : *Rhizopus*, *Penicillium* and *Puccinia*
  - b. Lichens: Crustose, foliose and fruiticose
  - c. Algae : *Volvox*, *Spirogyra*, *Ectocarpus* and *Polysiphonia*
  - d. Bryophyta : *Marchantia* and *Funaria*
9. Study of specimens of Tobacco mosaic disease, Citrus canker and Blast of Rice.



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**Model Question Paper for Practical Examination**

Semester – I/ Botany Core Course – 1

**Fundamentals of Microbes and Non-vascular Plants Lab**

(Viruses, Bacteria, Fungi, Lichens, Algae and Bryophytes)

**Max. Time : 3 Hrs.**

**Max. Marks : 50**

1. Take the T.S. of material 'A' (Fungi), make a temporary mount and make comments about identification. 10 M
2. Identify any 2 algae from the mixture (material 'B') given with specific comments about identification. 10 M
3. Take the T.S. of material 'C' (Bryophyta), make a temporary mount and make comments about identification. 10 M
4. Identify the following with specific reasons.  $4 \times 3 = 12$  M
  - D. A laboratory equipment of Microbiology
  - E. Virus
  - F. Archaeobacteria /Ascomycete /Cyanobacteria/ Eu-Bacteria
  - G. Lichen
5. Record + Viva-voce  $5+3 = 8$  M

**Suggested co-curricular activities for Botany Core Course-1 in Semester-I :**

**A. Measurable :**

**a. Student seminars :**

1. Baltimore classification of Viruses.
2. Lytic and lysogenic cycle of T- even Bacteriophages.
3. Viral diseases of humans and animals.
4. Retroviruses
5. Bacterial diseases of humans and animals.
6. Significance of Bacteria in Biotechnology and Genetic engineering.
7. Fungi responsible for major famines in the world.
8. Poisonous mushrooms (Toad stools).
9. Algae as Single Cell Proteins (SCPs)
10. Parasitic algae
11. Origin of Bryophytes through : Algae vsPteridophytes
12. Fossil Bryophytes
13. Evolution of gametophytes in Bryophyta.
14. Ecological and economic importance of Bryophytes.

**b. Student Study Projects :**

1. Isolation and identification of microbes from soil, water and air.
2. Collection and identification of algae from fresh /estuarine /marine water.
3. Collection and identification of fruiting bodies of Basidiomycetes and Ascomycetes.
4. Collection and identification of Lichens from their native localities.
5. Collection of diseased plants/parts and identification of symptoms.
6. Collection and identification of Bryophytes from their native localities.

**c. Assignments:** Written assignment at home / during '0' hour at college; preparation of charts with drawings, making models etc., on topics included in syllabus.

**B. General :**

1. Visit to Agriculture and/or Horticulture University/College/Research station to learn about microbial diseases of plants.
2. Visit to industries working on microbial, fungal and algal products.
3. Group Discussion (GD)/ Quiz/ Just A Minute (JAM) on different modules in syllabus of the course.





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**B.Sc Botany Syllabus (w.e.f: 2020-21 A.Y)**

<b>B.Sc.</b>	<b>Semester - II</b>	<b>Credits: 4</b>
<b>Course: 2</b>	<b>Basics of Vascular plants and Phytogeography</b>	<b>Hrs/Wk: 4</b>

**Learning Outcomes:** On successful completion of this course, the students will be able to:

- Classify and compare Pteridophytes and Gymnosperms based on their morphology, anatomy, reproduction and life cycles.
- Justify evolutionary trends in tracheophytes to adapt for land habitat.
- Explain the process of fossilization and compare the characteristics of extinct and extant plants.
- Critically understand various taxonomical aids for identification of Angiosperms.
- Analyze the morphology of the most common Angiosperm plants of their localities and recognize their families.
- Evaluate the ecological, ethnic and economic value of different tracheophytes and summarize their goods and services for human welfare.
- Locate different phytogeographical regions of the world and India and can analyze their floristic wealth.

**UNIT I: Pteridophytes**

**12 Hrs.**

1. General characteristics of Pteridophyta; classification of Smith (1955) up to divisions.
2. Occurrence, morphology, anatomy, reproduction (developmental details are not needed) and life history of (a) *Lycopodium* (Lycopsidea) and (b) *Marsilea* (Filicopsida).
3. Stelar evolution in Pteridophytes;
4. Heterospory and seed habit.

**UNIT II: Gymnosperms**

**14 Hrs.**

1. General characteristics of Gymnosperms; Sporne classification up to classes.
2. Occurrence, morphology, anatomy, reproduction (developmental details are not needed) and life history of (a) *Cycas* (Cycadopsida) and (b) *Gnetum* (Gnetopsida).
3. Outlines of geological time scale.
4. A brief account on *Cycadeoidea*.

**UNIT III: Basic aspects of Taxonomy**

**13Hrs.**

1. Aim and scope of taxonomy; Species concept: Taxonomic hierarchy, species, genus and family.
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. Systematic description and economic importance of the following families:  
(a) Annonaceae (b) Curcubitaceae

**UNIT IV: Systematic Taxonomy**

**13 Hrs.**

1. Systematic description and economic importance of the following families:  
(a) Asteraceae (b) Asclepiadaceae (c) Amaranthaceae (d) Euphorbiaceae  
(e) Arecaceae and (f) Poaceae
2. Outlines of Angiosperm Phylogeny Group (APG IV).

**UNIT V: Phytogeography**

**08 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.





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**TEXT BOOKS :**

1. Botany – I (Vrukshasastram-I) : Telugu Akademi, Hyderabad
2. Botany – II (Vrukshasastram-II) : Telugu Akademi, Hyderabad
3. Acharya, B.C., (2019) *Archchegoniates*, Kalyani Publishers, New Delhi
4. Bhattacharya, K., G. Hait&Ghosh, A. K., (2011) *A Text Book of Botany, Volume- II*, New Central Book Agency Pvt. Ltd., Kolkata
5. Hait,G., K.Bhattacharya&A.K.Ghosh (2011) *A Text Book of Botany, Volume-I*, New Central Book Agency Pvt. Ltd., Kolkata
6. Pandey, B.P. (2013)*College Botany, Volume-I*, S. Chand Publishing, New Delhi
7. Pandey, B.P. (2013)*College Botany, Volume-II*, S. Chand Publishing, New Delhi

**REFERENCE BOOKS:**

1. Smith, G.M. (1971)*Cryptogamic Botany Vol. II.*, Tata McGraw Hill, New Delhi
2. Sharma, O.P. (2012) *Pteridophyta*. Tata McGraw-Hill, New Delhi
3. Kramer, K.U. & P. S. Green (1990) *The Families and Genera of Vascular Plants, Volume-I: Pteridophytes and Gymnosperms* (Ed. K. Kubitzki) Springer-Verlag, New York
4. Bhatnagar, S.P. & Alok Moitra (1996) *Gymnosperms*. New Age International, New Delhi
5. Coulter, J.M. & C.J. Chamberlain (1910) *Morphology of Gymnosperms*, The University of Chicago Press, Chicago, Illinois
6. Govil, C.M. (2007) *Gymnosperms : Extinct and Extant*. KRISHNA Prakashan Media (P) Ltd. Meerut & Delhi
7. Sporne, K.R. (1971) *The Morphology of Gymnosperms*. Hutchinsons Co. Ltd., London
8. Arnold, C.A., (1947) *An introduction to Paleobotany* McGraw –Hill Book Company, INC, New York
9. Stewart, W.N., and G.W. Rothwell (2005) *Paleobotany and the evolution of plants* Cambridge University Press, New York
10. Lawrence, George H.M. (1951) *Taxonomy of Vascular Plants*. The McMillan Co., New York
11. Heywood, V. H. and D. M. Moore (1984) *Current Concepts in Plant Taxonomy*. Academic Press, London.
12. Jeffrey, C. (1982) *An Introduction to Plant Taxonomy*. Cambridge University Press, Cambridge. London.
13. Sambamurty, A.V.S.S. (2005) *Taxonomy of Angiosperms I*. K .International Pvt. Ltd., New Delhi
14. Singh, G. (2012). *Plant Systematics: Theory and Practice*. Oxford & IBH Pvt. Ltd., New Delhi.
15. Simpson, M.G. (2006). *Plant Systematics*. Elsevier Academic Press, San Diego, CA, U.S.A.
16. Cain, S.A. (1944) *Foundations of Plant Geography* Harper & Brothers, N.Y.
17. Good, R. (1997) *The Geography of flowering Plants (2nd Edn.)* Longmans, Green & Co., Inc., London & Allied Science Publishers, New Delhi
18. Mani, M.S (1974) *Ecology & Biogeography of India* Dr. W. Junk Publishers, The Hague



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<b>B.Sc.</b>	<b>Semester - II</b>	<b>Credits: 1</b>
<b>Course: 2(L)</b>	<b>Basics of Vascular plants and Phytogeography Lab</b>	<b>Hrs/Wk: 2</b>

**Course Outcomes :** On successful completion of this course students shall be able to :

- Demonstrate the techniques of section cutting, preparing slides, identifying of the material and drawing exact figures.
- Compare and contrast the morphological, anatomical and reproductive features of vascular plants.
- Identify the local angiosperms of the families prescribed to their genus and species level and prepare herbarium.
- Exhibit skills of preparing slides, identifying the given twigs in the lab and drawing figures of plant twigs, flowers and floral diagrams as they are.
- Prepare and preserve specimens of local wild plants using herbarium techniques.

**Practical Syllabus:**

1. Study/ microscopic observation of vegetative, sectional/anatomical and reproductive structures of the following using temporary or permanent slides/ specimens/ mounts :
  - a. Pteridophyta : *Lycopodium* and *Marselia*
  - b. Gymnosperms : *Cycas* and *Gnetum*
2. Study of fossil specimens of *Cycadeoidea* and *Pentoxylon* (photographs /diagrams can be shown if specimens are not available).
3. Demonstration of herbarium techniques.
4. Systematic / taxonomic study of locally available plants belonging to the families prescribed in theory syllabus. (Submission of 30 number of Herbarium sheets of wild plants with the standard system is mandatory).
5. Mapping of phytogeographical regions of the globe and India.



**Model Question Paper for Practical Examination**

Semester – II/ Botany Core Course – 2

**Basics of Vascular plants and Phytogeography**

(Pteridophytes, Gymnosperms, Taxonomy of Angiosperms and Phytogeography)

**Time : 3 Hrs.**

**Max. Marks : 50**

1. Take T.S. of the material 'A' (Pteridophyta), make a temporary slide and justify the identification with apt points. 10 M
2. Take T.S. of the material 'B' (Gymnosperms), make a temporary slide and justify the identification with apt points. 10 M
3. Describe the vegetative and floral characters of the material 'C' (Taxonomy of Angiosperms) and derive its systematic position. 10 M
4. Identify the specimen 'D' (Fossil Gymnosperm) and give specific reasons. 5 M
5. Locate the specified phytogeographical regions (2x2M) in the world / India (E) map supplied to you. 4 M
6. Record + Herbarium & Field note book + Viva-voce 5 +4+3 = 12 M

**Suggested co-curricular activities for Botany Core Course-2 in Semester-II :**

**A. Measurable :**

**a. Student seminars :**

1. Fossil Pteridophytes.
2. Aquatic ferns and tree ferns
3. Ecological and economic importance of Pteridophytes
4. Evolution of male and female gametophytes in Gymnosperms.
5. Endemic and endangered Gymnosperms.
6. Ecological and economic importance of Gymnosperms.
7. Floras and their importance :Flora of British India and Flora of Madras Presidency.
8. Botanical gardens and their importance :National Botanic garden and Royal Botanic garden.
9. Artificial, Natural and Phylogenetic classification systems.
10. Molecular markers used in APG system of classification.
11. Vessel less angiosperms.
12. Insectivorous plants.
13. Parasitic angiosperms.
14. Continental drift theory and species isolation.

**b. Student Study Projects :**

1. Collection and identification of Pteridophytes from their native locality/ making an album by collecting photographs of Pteridophytes.
2. Collection and identification of Gymnosperms from their native locality/ making an album by collecting photographs of Gymnosperms.
3. Collection of information on famous herbaria in the world and preparation of a report.
4. Collection of information on famous botanic gardens in the world and preparation of a report.
5. Collection of data on vegetables (leafy and fruity) plants in the market and preparation of a report on their taxonomy.
6. Collection and identification of fresh and dry fruits plants in the market and preparation of a report on their taxonomy.
7. Collection of data on plants of ethnic and ethnobotanical importance from their native locality.
8. Preparation of a local flora by enlisting the plants of their native place.

**c. Assignments:** Written assignment at home / during '0' hour at college; preparation of charts with drawings, making models etc., on topics included in syllabus.



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**B. General :**

1. Visit to Botanic garden in a Research institute/University to see the live plants.
2. Virtual tour in websites for digital herbaria and botanic gardens.
3. Acquaint with standard floras like – Flora of Madras Presidency, Flora of their respective district in Andhra Pradesh.
4. Looking into vegetation of different phytogeographical regions using web resources.
5. Group Discussion (GD)/ Quiz/ Just A Minute (JAM) on different modules in syllabus of the course.



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<b>B.Sc.</b>	<b>Semester - III</b>	<b>Credits: 4</b>
<b>Course: 3</b>	<b>Anatomy and Embryology of Angiosperms, Plant Ecology and Biodiversity</b>	<b>Hrs/Wk: 4</b>

**Learning outcomes:** On successful completion of this course, the students will be able to;

1. Understand on the organization of tissues and tissue systems in plants.
2. Illustrate and interpret various aspects of embryology.
3. Discuss the basic concepts of plant ecology, and evaluate the effects of environmental and biotic factors on plant communities.
4. Appraise various qualitative and quantitative parameters to study the population and community ecology.
5. Correlate the importance of biodiversity and consequences due to its loss.
6. Enlist the endemic/endangered flora and fauna from two biodiversity hot spots in India and assess strategies for their conservation

**UNIT I: Anatomy of Angiosperms**

**12 Hrs.**

1. Organization of apical meristems: Tunica-carpus theory and Histogen theory.
2. Tissue systems—Epidermal, ground and vascular.
3. Anomalous secondary growth in *Boerhaavia* and *Dracaena*.
4. Study of timbers of economic importance - Teak, Red sanders and Rosewood.

**UNIT II: Embryology of Angiosperms**

**12 Hrs.**

1. Structure of anther, anther wall, types of tapetum. Microsporogenesis and development of male gametophyte.
2. Structure of ovule, megasporogenesis; monosporic (*Polygonum*), bisporic (*Allium*) and tetrasporic (*Peperomia*) types of embryo sacs.
3. Outlines of pollination, pollen – pistil interaction and fertilization.
4. Endosperm - Types and biological importance - Free nuclear, cellular, helobial and ruminate.
5. Development of Dicot (*Capsella bursa-pastoris*) embryo.

**UNIT III: Basics of Ecology**

**12 Hrs.**

1. Ecology: definition, branches and significance of ecology.
2. Ecosystem: Concept and components, energy flow, food chain, food web, ecological pyramids.
3. Plants and environment: Climatic (light and temperature), edaphic and biotic factors.
4. Ecological succession: Hydrosere and Xerosere.

**UNIT IV: Population, Community and Production Ecology**

**12 Hrs.**

1. Population ecology: Natality, mortality, growth curves, ecotypes, ecads
2. Community ecology: Frequency, density, cover, life forms, biological spectrum
3. Concepts of productivity: GPP, NPP and Community Respiration
4. Secondary production, P/R ratio and Ecosystems.

**UNIT V: Basics of Biodiversity**

**12 Hrs.**

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. Biodiversity in 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.



**ADIKAVI NANNAYA UNIVERSITY :: AJAHMAHENDRAVARAM**  
**B.Sc Botany Syllabus (w.e.f: 2020-21 A.Y)**

**TEXT BOOKS :**

1. Botany – III (Vrukshasastram-I) : Telugu Akademi, Hyderabad
2. Botany – IV (Vrukshasastram-II) : Telugu Akademi, Hyderabad
3. Pandey, B.P. (2013) *College Botany, Volume-II*, S. Chand Publishing, New Delhi
4. Pandey, B.P. (2013) *College Botany, Volume-III*, S. Chand Publishing, New Delhi
5. Bhattacharya, K., G. Hait & Ghosh, A. K., (2011) *A Text Book of Botany, Volume- II*, New Central Book Agency Pvt. Ltd., Kolkata

**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.
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9. Pandey, B.P. (2013) *College Botany, Volume-III*, S. Chand Publishing, New Delhi
10. Bhattacharya, K., A. K. Ghosh, & G. Hait (2011) *A Text Book of Botany, Volume- IV*, New Central Book Agency Pvt. Ltd., Kolkata
11. Kormondy, Edward J. (1996) *Concepts of Ecology*, Prentice-Hall of India Private Limited, New Delhi
12. Begon, M., J.L. Harper & C.R. Townsend (2003) *Ecology*, Blackwell Science Ltd., U.S.A
13. Eugene P. Odum (1996) *Fundamentals of Ecology*, Natraj Publishers, Dehradun
14. Sharma, P.D. (2012) *Ecology and Environment*. Rastogi Publications, Meerut, India.
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16. A. K. Agrawal & P.P. Deo (2010) *Plant Ecology*, Agrobios (India), Jodhpur
17. Kumar, H.D. (1992) *Modern Concepts of Ecology (7th Edn.)*, Vikas Publishing Co., New Delhi.
18. Newman, E.I. (2000): *Applied Ecology* Blackwell Scientific Publisher, U.K.
19. Chapman, J.L. & M.J. Reiss (1992): *Ecology - Principles & Applications*. Cambridge University Press, U.K.
20. Kumar H.D. (2000) *Biodiversity & Sustainable Conservation* Oxford & IBH Publishing Co Ltd. New Delhi.
21. U. Kumar (2007) *Biodiversity : Principles & Conservation*, Agrobios (India), Jodhpur



**ADIKAVI NANNAYA UNIVERSITY :: AJAHMAHENDRAVARAM**  
**B.Sc Botany Syllabus (w.e.f: 2020-21 A.Y)**

<b>B.Sc.</b>	<b>Semester - III</b>	<b>Credits: 1</b>
<b>Course: 3(L)</b>	<b>Anatomy and Embryology of Angiosperms, Plant Ecology and Biodiversity Lab</b>	<b>Hrs/Wk: 2</b>

**Course Outcomes:** On successful completion of this practical course students shall be able to :

- Get familiarized with techniques of section making, staining and microscopic study of vegetative, anatomical and reproductive structure of plants.
- Observe externally and under microscope, identify and draw exact diagrams of the material in the lab.
- Demonstrate application of methods in plant ecology and conservation of bio diversity and qualitative and quantitative aspects related to populations and communities of plants.

**Practical Syllabus**

1. Tissue organization in root and shoot apices using permanent slides.
2. Anomalous secondary growth in stems of *Boerhavia* and *Dracaena*.
3. Study of anther and ovule using permanent slides/photographs.
4. Study of pollen germination and pollen viability.
5. Dissection and observation of Embryo sac haustoria in *Santalum* or *Argemone*.
6. Structure of endosperm (nuclear and cellular) using permanent slides / Photographs.
7. Dissection and observation of Endosperm haustoria in *Crotalaria* or *Coccinia*.
8. Developmental stages of dicot and monocot embryos using permanent slides / photographs.
9. Study of instruments used to measure microclimatic variables; soil thermometer, maximum and minimum thermometer, anemometer, rain gauge, and lux meter. (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).
10. Study of morphological and anatomical adaptations of hydrophytes and xerophytes (02 each).
11. Quantitative analysis of herbaceous vegetation in the college campus for frequency, density and abundance.
12. Identification of vegetation/various plants in college campus and comparison with Raunkiaer's frequency distribution law.
13. Find out the alpha-diversity of plants in the area
14. Mapping of biodiversity hotspots of the world and India.





**ADIKAVI NANNAYA UNIVERSITY :: AJAHMAHENDRAVARAM**  
**B.Sc Botany Syllabus (w.e.f: 2020-21 A.Y)**

**Model paper for Practical Examination**

Semester – III/ Botany Core Course – 3

**Anatomy and Embryology of Angiosperms, Plant Ecology and Biodiversity**

**Max. Time : 3 Hrs.**

**Max. Marks : 50**

1. Take T.S. of the material 'A' (Anatomy), prepare a temporary slide and justify the identification with specific reasons. 10 M
2. Write the procedure for the experiment 'B' (Embryology) and demonstrate the same. 10 M
3. Take T.S. of the material 'C', prepare a temporary slide and justify the identification with specific reasons. 10 M
4. Identify the following with specific reasons.  $4 \times 3 = 12$  M
  - a. Anatomy/Embryology
  - b. Ecology instrument
  - c. Mapping of Biodiversity hot spot
  - d. Endemic/endangered plant/animal
5. Record + Viva-voce  $5 + 3 = 8$  M

**Suggested co-curricular activities for Botany Core Course-3 in Semester-III :**

**A. Measurable :**

**a. Student seminars :**

1. Anatomy in relation to taxonomy of Angiosperms.
2. Nodal anatomy
3. Floral anatomy
4. Embryology in relation to taxonomy of Angiosperms.
5. Apomictics and polyembryony.
6. Biogeochemical cycles- Carbon, Nitrogen and Phosphorous.
7. Deforestation and Afforestation.
8. Green house effect and ocean acidification.
9. The Montreal protocol and the Kyoto protocol.
10. Productivity of aquatic ecosystems.
11. Mangrove ecosystems in India.
12. Kollerulake – Ramsar site.
13. Biodiversity hotspots of the world.
14. Origin of Crop plants - Vavilov centers
15. Agrobiodiversity
16. International organizations working on conservation of Biodiversity
17. Nagoya protocol – ABS system.
18. Endemic and endangered plants in Andhra Pradesh.

**b. Student Study Projects :**

1. Stomata structure in plants from college campus/ their native place.
2. Report on xylem elements in plants using maceration technique.
3. Collection of information on famous herbaria in the world and preparation of a report.
4. Microscopic observations on pollen morphology from plants in college campus/ their native locality.
5. Study report on germination and viability of pollen in different plants.
6. Observation of anthesis time in different plants and their pollinators.
7. A report on autecology and synecology of some plants in college campus or their native place.
8. Collection of photos of endemic/endangered plant and animal species to make an album.
9. Biodiversity of the college or their own residential/ native area.
10. Collection of seeds/vegetative organs of rare plant species from their localities and to raise/grow in college garden



**ADIKAVI NANNAYA UNIVERSITY :: AJAHMAHENDRAVARAM**  
**B.Sc Botany Syllabus (w.e.f: 2020-21 A.Y)**

**c. Assignments:** Written assignment at home / during '0' hour at college; preparation of charts with drawings, making models etc., on topics included in syllabus.

**B. General :**

1. Visit to an arboretum/silviculture station/Forest research institute to see the live timber yielding plants or to visit a local timber depot. to observe various woods.
2. Field visit to a nearby ecosystem to observe the abiotic-biotic relationships.
3. Visit to National park/Sanctuary/Biosphere reserve etc., to observe in-situ conservation of plants and animals.
4. Visit to a Botanical garden or Zoo to learn about ex-situ conservation of rare plants or animals.
5. Group Discussion (GD)/ Quiz/ Just A Minute (JAM) on different modules in syllabus of the course.



**ADIKAVI NANNAYA UNIVERSITY :: AJAHMAHENDRAVARAM**  
**B.Sc Botany Syllabus (w.e.f: 2020-21 A.Y)**

<b>B.Sc.</b>	<b>Semester - IV</b>	<b>Credits: 4</b>
<b>Course: 4</b>	<b>Plant Physiology and Metabolism</b>	<b>Hrs/Wk: 4</b>

**Learning outcomes:** On successful completion of this course, the students will be able to;

- Comprehend the importance of water in plant life and mechanisms for transport of water and solutes in plants.
- Evaluate the role of minerals in plant nutrition and their deficiency symptoms.
- Interpret the role of enzymes in plant metabolism.
- Critically understand the light reactions and carbon assimilation processes responsible for synthesis of food in plants.
- Analyze the biochemical reactions in relation to Nitrogen and lipid metabolisms.
- Evaluate the physiological factors that regulate growth and development in plants.
- Examine the role of light on flowering and explain physiology of plants under stress conditions.

**UNIT I: Plant-Water relations**

**10 Hrs.**

1. Importance of water to plant life, physical properties of water, diffusion, imbibition, osmosis, water potential, osmotic potential, pressure potential.
2. Absorption and lateral transport of water; Ascent of sap
3. Transpiration: stomata structure and mechanism of stomatal movements ( $K^+$  ion flux).
4. Mechanism of phloem transport; source-sink relationships.

**UNIT II: Mineral nutrition, Enzymes and Respiration**

**14 Hrs.**

1. Essential macro and micro mineral nutrients and their role in plants; symptoms of mineral deficiency
2. Absorption of mineral ions; passive and active processes.
3. Characteristics, nomenclature and classification of Enzymes. Mechanism of enzyme action, enzyme kinetics.
4. Respiration: Aerobic and Anaerobic; Glycolysis, Krebs cycle; electron transport system, mechanism of oxidative phosphorylation, Pentose Phosphate Pathway (HMP shunt).

**UNIT III: Photosynthesis and Photorespiration**

**12 Hrs.**

1. Photosynthesis: Photosynthetic pigments, absorption and action spectra; Red drop and Emerson enhancement effect.
2. Concept of two photosystems; mechanism of photosynthetic electron transport and evolution of oxygen; photophosphorylation
3. Carbon assimilation pathways ( $C_3$ ,  $C_4$  and CAM);
4. Photorespiration -  $C_2$  pathway

**UNIT IV: Nitrogen and lipid metabolism**

**12 Hrs.**

1. Nitrogen metabolism: Biological nitrogen fixation – symbiotic and symbiotic nitrogen fixing organisms. Nitrogenase enzyme system.
2. Lipid metabolism :Classification of Plant lipids, saturated and unsaturated fatty acids.
3. Anabolism of triglycerides,  $\beta$ -oxidation of fatty acids, Glyoxylate cycle.



**ADIKAVI NANNAYA UNIVERSITY :: AJAHMAHENDRAVARAM**  
**B.Sc Botany Syllabus (w.e.f: 2020-21 A.Y)**

**UNIT V: Plant growth - development and stress physiology**

**12 Hrs.**

1. Growth and Development: Definition, phases and kinetics of growth.
2. Physiological effects of Plant Growth Regulators (PGRs) - auxins, gibberellins, cytokinins, ABA, ethylene and brassinosteroids.
3. Physiology of flowering :Photoperiodism, role of phytochrome in flowering.
4. Seed germination and senescence.
5. Physiological changes during water stress.

**TEXT BOOKS :**

1. Botany – IV (Vrukshasastram-II) : Telugu Akademi, Hyderabad
2. Pandey, B.P. (2013) *College Botany, Volume-III*, S. Chand Publishing, New Delhi
3. Ghosh, A. K., K. Bhattacharya &G. Hait (2011) *A Text Book of Botany, Volume- III*, New Central Book Agency Pvt. Ltd., Kolkata

**REFERENCE BOOKS:**

1. Aravind Kumar & S.S. Purohit (1998) *Plant Physiology – Fundamentals and Applications*, AgroBotanica, Bikaner
2. Datta, S.C. (2007) *Plant Physiology*, New Age International (P) Ltd., Publishers, New Delhi
3. Hans Mohr & P. Schopfer (2006) *Plant Physiology*, Springer (India) Pvt. Ltd., New Delhi
4. Hans-Walter Heldt (2005) *Plant Biochemistry*, Academic Press, U.S.A.
5. Hopkins, W.G. & N.P.A. Huner (2014) *Introduction to Plant Physiology*, Wiley India Pvt. Ltd., New Delhi
6. Noggle Ray & J. Fritz (2013) *Introductory Plant Physiology*, Prentice Hall (India), New Delhi
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9. Sinha, R.K. (2014) *Modern Plant Physiology*, Narosa Publishing House, New Delhi
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ADIKAVI NANNAYA UNIVERSITY :: AJAHMAHENDRAVARAM  
B.Sc Botany Syllabus (w.e.f: 2020-21 A.Y)

<b>B.Sc.</b>	<b>Semester - IV</b>	<b>Credits: 1</b>
<b>Course: 4(L)</b>	<b>Plant Physiology and Metabolism Lab</b>	<b>Hrs/Wk: 2</b>

**Course outcomes:** On successful completion of this practical course, students shall be able to:

- Conduct lab and field experiments pertaining to Plant Physiology, that is, biophysical and biochemical processes using related glassware, equipment, chemicals and plant material.
- Estimate the quantities and qualitative expressions using experimental results and calculations
- Demonstrate the factors responsible for growth and development in plants.

**Practical Syllabus**

1. Determination of osmotic potential of plant cell sap by plasmolytic method using *Rhoeo/ Tradescantia* leaves.
2. Calculation of stomatal index and stomatal frequency of a mesophyte and a xerophyte.
3. Determination of rate of transpiration using Cobalt chloride method / Ganong's potometer (at least for a dicot and a monocot).
4. Effect of Temperature on membrane permeability by colorimetric method.
5. Study of mineral deficiency symptoms using plant material/photographs.
6. Demonstration of amylase enzyme activity and study the effect of substrate and Enzyme concentration.
7. Separation of chloroplast pigments using paper chromatography technique.
8. Demonstration of Polyphenol oxidase enzyme activity (Potato tuber or Apple fruit)
9. Anatomy of C3, C4 and CAM leaves
10. Estimation of protein by biuret method/Lowry method
11. Minor experiments – Osmosis, Arc-auxonometer, ascent of sap through xylem, cytoplasmic streaming.



**ADIKAVI NANNAYA UNIVERSITY :: AJAHMAHENDRAVARAM**  
**B.Sc Botany Syllabus (w.e.f: 2020-21 A.Y)**

**Model Question Paper for Practical Examination**

Semester – IV/ Botany Core Course – 4

**Plant Physiology and Metabolism**

**Max. Time : 3 Hrs.**

**Max. Marks : 50**

1. Conduct the experiment 'A' (Major experiment), write aim, principle, material and apparatus/equipment, procedure, tabulate results and make conclusion. 20 M
2. Demonstrate the experiment 'B' (Minor experiment) , write the principle, procedure and give inference. 10 M
3. Identify the following with apt reasons.  $3 \times 4 = 12$  M
  - C. Plant water relations / Mineral nutrition
  - D. Plant metabolism
  - E. Plant growth and development
4. Record + Viva-voce  $5 + 3 = 8$  M

**Suggested co-curricular activities for Botany Core Course-4 in Semester-IV :**

**A. Measurable :**

**a. Student seminars :**

1. Antitranspirants and their significance in crop physiology and horticulture.
2. Natural chelating agents in plants.
3. Criteria of essentiality of elements and beneficial elements.
4. Hydroponics, aquaponics and aeroponics.
5. Mycorrhizal association and mineral nutrition in plants.
6. Non-proteinaceous enzymes.
7. Respiratory inhibitors.
8. Structure of ATPase and Chemiosmotic hypothesis.
9. Transpiration and photosynthesis – a compromise.
10. Amphibolic pathways and bypass pathways in plants.
11. Non-biological nitrogen fixation.
12. Role of Hydrogenase in nitrogen fixation.
13. Plant lectins – their role in plants and use in medicine and medical research.

**b. Student Study Projects :**

1. Stomatal densities among different groups of plants.
2. Various treatments (salt, cold, high temperature, heavy metals) and their effects on seed germination.
3. Effects of plant hormones (IAA, Gibberellin and Kinetin) on Seed Germination.
4. Diurnal variation of stomatal behavior in CAM and C3 plants found in local area.
5. Effects of nitrogen fertilizer on plant growth.
6. Enumeration of C3, C4 and CAM plants in the local area.
7. Effect of different light wavelengths (red light, green light, blue light) on apparent photosynthesis in terms of growth.
8. Light effects on leaf growth and leaf orientation.
9. Artificial Fruit Ripening Process by various treatments (carbide and ethylene).
10. Study of relative water content and water retention by leaves under different environments.
11. Study of soil nutrients in local agricultural fields.
12. Study of mineral deficiency symptoms of various crops of local area.
13. Study of local weeds in crop fields.
14. Studies on seed storage proteins, oils and starch in local millets and pulse crops.
15. Making a report on LDPs, SDPs and DNP in their locality.



**ADIKAVI NANNAYA UNIVERSITY :: AJAHMAHENDRAVARAM**  
**B.Sc Botany Syllabus (w.e.f: 2020-21 A.Y)**

**c. Assignments:** Written assignment at home / during '0' hour at college; preparation of charts with drawings, making models etc., on topics included in syllabus.

**B. General :**

1. Group Discussion (GD)/ Quiz/ Just A Minute (JAM) on different modules in syllabus of the course.
2. Visit to a Plant Physiology laboratory in a University or Physiology division in a Agriculture/Horticulture University/Research station.





**ADIKAVI NANNAYA UNIVERSITY :: AJAHMAHENDRAVARAM**  
**B.Sc Botany Syllabus (w.e.f: 2020-21 A.Y)**

<b>B.Sc.</b>	<b>Semester - IV</b>	<b>Credits: 4</b>
<b>Course: 5</b>	<b>Cell Biology, Genetics and Plant Breeding</b>	<b>Hrs/Wk: 4</b>

**Learning outcomes:** On successful completion of this course, the students will be able to:

- Distinguish prokaryotic and eukaryotic cells and design the model of a cell.
- Explain the organization of a eukaryotic chromosome and the structure of genetic material.
- Demonstrate techniques to observe the cell and its components under a microscope.
- Discuss the basics of Mendelian genetics, its variations and interpret inheritance of traits in living beings.
- Elucidate the role of extra-chromosomal genetic material for inheritance of characters.
- Evaluate the structure, function and regulation of genetic material.
- Understand the application of principles and modern techniques in plant breeding.
- Explain the procedures of selection and hybridization for improvement of crops.

**UNIT I: The Cell**

**12 Hrs.**

1. Cell theory; prokaryotic vs eukaryotic cell; animal vs plant cell; a brief account on ultra-structure of a plant cell.
2. Ultra-structure of cell wall.
3. Ultra-structure of plasma membrane and various theories on its organization.
4. Polymorphic cell organelles (Plastids); ultrastructure of chloroplast. Plastid DNA.

**UNIT II: Chromosomes**

**12 Hrs.**

1. Prokaryotic vs eukaryotic chromosome. Morphology of a eukaryotic chromosome.
2. Euchromatin and Heterochromatin; Karyotype and ideogram.
3. Brief account of chromosomal aberrations - structural and numerical changes
4. Organization of DNA in a chromosome (solenoid and nucleosome models).

**UNIT III: Mendelian and Non-Mendelian genetics**

**14Hrs.**

1. Mendel's laws of inheritance. Incomplete dominance and co-dominance; Multiple allelism.
2. Complementary, supplementary and duplicate gene interactions (plant based examples are to be dealt).
3. A brief account of linkage and crossing over; Chromosomal mapping - 2 point and 3 point test cross.
4. Concept of maternal inheritance (Corren's experiment on *Mirabilis jalapa*); Mitochondrial DNA.

**UNIT IV: Structure and functions of DNA**

**12 Hrs.**

1. Watson and Crick model of DNA. Brief account on DNA Replication (Semi- conservative method).
2. Brief account on Transcription, types and functions of RNA. Gene concept and genetic code and Translation.
3. Regulation of gene expression in prokaryotes - Lac Operon.

**UNIT V: Plant Breeding**

**12 Hrs.**

1. Plant Breeding and its scope; Genetic basis for plant breeding. Plant Introduction and acclimatization.
2. Definition, procedure; applications and uses; advantages and limitations of : (a) Mass selection, (b) Pure line selection and (c) Clonal selection.
3. Hybridization – schemes, and technique; Heterosis (hybrid vigour).
4. brief account on Molecular breeding – DNA markers in plant breeding. RAPD, RFLP.



**ADIKAVI NANNAYA UNIVERSITY :: AJAHMAHENDRAVARAM**  
**B.Sc Botany Syllabus (w.e.f: 2020-21 A.Y)**

**TEXT BOOKS :**

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2. Pandey, B.P. (2013) *College Botany, Volume-III*, S. Chand Publishing, New Delhi
3. Ghosh, A.K., K.Bhattacharya & G. Hait (2011) *A Text Book of Botany, Volume-III*, New Central Book Agency Pvt. Ltd., Kolkata
4. Chaudhary, R. C. (1996) *Introduction to Plant Breeding*, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi

**REFERENCE BOOKS:**

1. S. C. Rastogi (2008) *Cell Biology*, New Age International (P) Ltd. Publishers, New Delhi
2. P. K. Gupta (2002) *Cell and Molecular biology*, Rastogi Publications, New Delhi
3. B. D. Singh (2008) *Genetics*, Kalyani Publishers, Ludhiana
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5. Cooper, G.M. & R.E. Hausman (2009) *The Cell – A Molecular Approach*, A.S.M. Press, Washington □
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9. Gardner, E.J., M. J. Simmons & D.P. Snustad (2004) *Principles of Genetics*, John Wiley & Sons Inc., New York
10. Micklos, D.A., G.A. Freyer & D.A. Cotty (2005) *DNA Science: A First Course*, I.K. International Pvt. Ltd., New Delhi
11. Chaudhari, H.K. (1983) *Elementary Principles of Plant Breeding*, TMH publishers Co., New Delhi
12. Sharma, J.R. (1994) *Principles and Practice of Plant Breeding*, Tata McGraw- Hill Publishers, New Delhi
13. Singh, B.D. (2001) *Plant Breeding : Principles and Methods*, Kalyani Publishers, Ludhiana
14. Pundhan Singh (2015) *Plant Breeding for Undergraduate Students*, Kalyani Publishers, Ludhiana □
15. Upta, S.K. (2010) *Plant Breeding : Theory and Techniques*, Agrobios (India), Jodhpur □
16. Hayes, H.K., F.R. Immer & D.C. Smith (2009) *Methods of Plant Breeding*, Biotech Books, Delhi □



ADIKAVI NANNAYA UNIVERSITY :: AJAHMAHENDRAVARAM  
B.Sc Botany Syllabus (w.e.f: 2020-21 A.Y)

<b>B.Sc.</b>	<b>Semester - IV</b>	<b>Credits: 1</b>
<b>Course: 5(L)</b>	<b>Cell Biology, Genetics and Plant Breeding Lab</b>	<b>Hrs/Wk: 2</b>

**Course Outcomes:** After successful completion of this practical course the student shall be able to:

- Show the understanding of techniques of demonstrating Mitosis and Meiosis in the laboratory and identify different stages of cell division.
- Identify and explain with diagram the cellular parts of a cell from a model or picture and prepare models
- Solve the problems related to crosses and gene interactions.
- Demonstrate plant breeding techniques such as emasculation and bagging

**Practical Syllabus:**

1. Study of ultra structure of plant cell and its organelles using Electron microscopic Photographs /models.
2. Demonstration of Mitosis in *Allium cepa*/*Aloe vera* roots using squash technique; observation of various stages of mitosis in permanent slides.
3. Demonstration of Meiosis in P.M.C.s of *Allium cepa* flower buds using squash technique; observation of various stages of meiosis in permanent slides.
4. Study of structure of DNA and RNA molecules using models.
5. Solving problems monohybrid, hybrid, back and test crosses.
6. Solving problems on gene interactions (atleast one problem for each of the gene interactions in the syllabus)
7. Chromosome mapping using 3- point test cross data.
8. Demonstration of emasculation, bagging, artificial pollination techniques for hybridization.



**ADIKAVI NANNAYA UNIVERSITY :: AJAHMAHENDRAVARAM**  
**B.Sc Botany Syllabus (w.e.f: 2020-21 A.Y)**

**Model paper for Practical Examination**  
**Semester-IV / Botany Core Course – 5**  
**Cell Biology, Genetics and Plant Breeding**

**Max. Time : 3 Hrs.**

**Max. Marks : 50**

1. Make a cytological preparation of given material 'A' (mitosis or meiosis in Onion) by squash technique, report any two stages, draw labeled diagrams and write the reasons. 15 M
2. Solve the given Genetic problem (Dihybrid cross/ Interaction of genes/ 3-point test cross) 'B' and write the conclusions. 15 M
3. Identify the following and justify with apt reasons.  $3 \times 4 = 12$  M
  - C. Cell Biology (Cell organelle)
  - D. Genetics (DNA/RNA)
  - E. Plant Breeding
4. Record + Viva-voce  $5 + 3 = 8$  M

**Suggested co-curricular activities for Botany Core Course- 5 in Semester-IV :**

**A. Measurable :**

**a. Student seminars :**

1. Light microscopy : bright field and dark field microscopy.
2. Scanning Electron Microscopy (SEM).
3. Transmission Electron Microscopy (TEM).
4. Mitosis and Meiosis
5. Cell cycle and its regulation.
6. Cell organelles bounded by single membrane.
7. Prokaryotic chromosomes
8. Special types of chromosomes :Polytene, Lampbrush and B-chromosomes.
9. Different forms of DNA.
10. Gene mutations.
11. DNA damage and repair mechanisms.
12. Reverse transcription.
13. Protein structure.
14. Modes of reproduction in plants.
15. Modes of pollination in plants

**b. Student Study Projects :**

1. Study of mitotic cell cycle in roots of *Allium cepa*
2. Study of mitotic cell cycle in roots of *Aloe vera*
3. Observation of chromosomal aberrations in *Allium cepa* root cells exposed to industrial effluent(s).
4. Observation of chromosomal aberrations in *Allium cepa* root cells exposed to heavy metal(s).
5. Observation of polyembryony in *Citrus* spp. and *Mangifera indica*.

**c. Assignments:** Written assignment at home / during '0' hour at college; preparation of charts with drawings, making models etc., on topics included in syllabus.

**B. General :**

- Field visit to Agriculture/Horticulture University/ Research station to observe Plant breeding methods.
- Group Discussion (GD)/ Quiz/ Just A Minute (JAM) on different modules in syllabus of the course.



**RECOMMENDED ASSESSMENT OF STUDENTS:**

**Recommended continuous assessment methods for all courses:**

Some of the following suggested assessment methodologies could be adopted. Formal assessment for awarding marks for Internal Assessment in theory.

**(a) Formal:**

1. The oral and written examinations (Scheduled and surprise tests),
2. Simple, medium and Critical Assignments and Problem-solving exercises,
3. Practical assignments and laboratory reports,
4. Assessment of practical skills,
5. Individual and group project reports,
6. Seminar presentations,
7. Viva voce interviews.

**(b) Informal:**

1. Computerized adaptive testing, literature surveys and evaluations,
2. Peers and self-assessment, outputs from individual and collaborative work
3. Closed-book and open-book tests,



**MODEL QUESTION COURSE**

**B. Sc DEGREE EXAMINATION**

**SEMESTER: I**

**Course 1: Fundamentals of Microbes and Non-vascular Plants**

**Time: 3Hrs.**

**Max. Marks: 75**

**SECTION - A**

**Answer any 5 questions. Each question carries 5 marks**

**5 x 5 =25M**

1. (a) Prions (b) Viroids
2. Archaeobacteria
3. (a) Basidiocarp (b) Ascocarp
4. Economic importance of Lichens
5. Reserve food material in Algae
6. (a) Scalariform conjugation (b) Lateral conjugation
7. General characteristics of Bryophytes
8. Anatomy of thallus in *Marchantia*

**SECTION - B**

**Answer all the questions. Each question carries 10 marks**

**5X10 =50M**

9. a) Describe the structure of TMV and Gemini virus with neat labeled diagrams.  
(OR)  
b) Write a general account on symptoms of plant diseases caused by Viruses.
10. a) Describe the cell structure of a eubacterium with neat labeled diagram.  
(OR)  
b) Discuss the economic importance of bacteria in agriculture and industrial sectors with suitable examples.
11. a) Explain the life cycle in *Puccinia* with the help of a schematic diagram.  
(OR)  
b) Discuss the economic uses of fungi in food industry, pharmacy and agriculture.
12. a) Write an essay on sexual reproduction in *Polysiphonia*.  
(OR)  
b) Discuss the economic importance of Algae with suitable examples.
13. a) Describe the sexual reproduction in *Funaria* with neat labeled diagrams.  
(OR)  
b) Write an essay on classification of Bryophytes upto classes.



**MODEL QUESTION COURSE**

**B. Sc DEGREE EXAMINATION**

**SEMESTER: II**

**Course2 : Basics of Vascular plants and Phytogeography**

**Time: 3Hrs.**

**Max. Marks: 75**

**SECTION - A**

**Answer any 5 questions. Each question carries 5 marks**

**5 x 5 =25M**

1. a) Eusporangium (b) Leptosporangium
2. Geological time scale.
3. Binomial system
4. (a) Synandrous condition (b) Syngenesious condition
5. Essential organs in flower of Arecaceae family
6. Economic importance of Arecaceae family
7. (a) Wides (b) Discontinuous species
8. Vegetation types in Andhra Pradesh

**SECTION - B**

**Answer all the questions. Each question carries 10 marks**

**5X10 =50M**

- 9.a) Describe the sexual reproduction in Lycopodium with neat labeled diagrams.  
(OR)  
b) Explain the stellar evolution in Pteridophytes with neat labeled diagrams and suitable examples.
10. a) Write an essay on general characteristics of Gymnosperms.  
(OR)  
b) Discuss the structure of ovule in *Gnetum* with a neat labeled diagram.
11. a) What is a herbarium? Explain the techniques of herbarium.  
(OR)  
b) Discuss the vegetative and floral characters of Annonaceae family. Add a note on economic importance of that family.
12. a) Discuss the vegetative and floral characters of Asteraceae family.  
(OR)  
b) Discuss the vegetative and floral characters of Poaceae family. Add a note on economic importance of that family.
13. a) Explain different types Endemism and causes for it.  
(OR)  
b) Describe different phytogeographic regions of India with examples of flora.





**MODEL QUESTION COURSE**

**B. Sc DEGREE EXAMINATION  
SEMESTER: III**

**Course 3: Anatomy and Embryology of Angiosperms, Plant Ecology and Biodiversity**  
**Time: 3Hrs. Max. Marks: 75**

**SECTION - A**

**Answer any 5 questions. Each question carries 5 marks**

**5 x 5 =25M**

1. (a) Xylem tracheids (b) Xylem vessels
2. (a) Periplasmodial tapetum (b) Glandular tapetum
3. (a) Helobial endosperm (b) Ruminant endosperm
4. Pyramids of numbers
5. (a) Ecotypes (b) Ecads
6. P/R ratio
7. Earth Summit.
8. Role of NBPGR in conservation of Biodiversity

**SECTION - B**

**Answer all the questions. Each question carries 10 marks**

**5X10 =50M**

9. a) Write an essay on organization of apical meristems with theories proposed.  
(OR)  
b) Discuss the anomalous secondary growth in stem of *Boerhaavia* with the help of a neat labeled diagram.
10. a) Explain monosporic and bisporic types of embryo sac development in angiosperms.  
(OR)  
b) Describe the embryogeny in a dicot plant with neat labeled diagrams.
11. a) Explain various effects of light factor plants and their communities?  
(OR)  
b) Define ecological succession. Discuss hydrosere with suitable diagrams and examples.
12. a) Describe Raunkiaer's life forms with suitable examples.  
(OR)  
b) Write an essay on primary productivity.
13. a) Write an essay on value of biodiversity with appropriate examples.  
(OR)  
b) Define biodiversity hotspot. Discuss the biodiversity in Western Ghats of India.



**MODEL QUESTION COURSE**

**B. Sc DEGREE EXAMINATION  
SEMESTER: IV**

**Course 4: Plant Physiology and Metabolism**

**Time: 3Hrs.**

**Max. Marks: 75**

**SECTION - A**

**Answer any 5 questions. Each question carries 5 marks**

**5 x 5 =25M**

1. (a) Diffusion (b) Imbibition
2. (a) Macro nutrients (b) Micro nutrients
3. (a) Anaerobic respiration (b) Aerobic respiration
4. (a) Absorption spectrum (b) Action spectrum
5. C2 pathway
6. Fatty acids
7. Physiological effects of Brassinosteroids
8. Sigmoid growth curve

**SECTION - B**

**Answer all the questions. Each question carries 10 marks**

**5X10 =50M**

9. a) Explain how ascent of sap occur in plants with suitable theory.  
(OR)  
b) Discuss the phloem transport in plants. Add a note on source-sink relationship.
- 10.a) Write an essay on classification of enzymes.  
(OR)  
b) Describe the Krebs cycle with the help of schematic diagram.
11. a) Define photophosphorylation. Explain the non-cyclic photophosphorylation with the help of a schematic diagram.  
(OR)  
b) Discuss the carbon assimilation in CAM plants.
12. a) Write an essay on biological nitrogen fixation.  
(OR)  
b) Describe the Glyoxylate cycle with the help of a schematic diagram.
13. a) Define photoperiodism. Write an essay on role of phytochrome in photoperiodic responses of plants.  
(OR)  
b) Discuss the physiological changes in plants during water stress.



**MODEL QUESTION COURSE**

**B. Sc DEGREE EXAMINATION**

**SEMESTER: IV**

**Course 5: Cell Biology, Genetics and Plant Breeding**

**Time: 3Hrs.**

**Max. Marks: 75**

**SECTION - A**

**Answer any 5 questions. Each question carries 5 marks**

**5 x 5 =25M**

1. Differences between prokaryotic and eukaryotic cells.
2. (a) Karyotype (b) Ideogram
3. (a) Incomplete dominance (b) Co-dominance
4. Maternal inheritance
5. Double helical structure of DNA
6. Genetic code
7. Objectives and scope of plant breeding
8. Plant introduction

**SECTION - B**

**Answer all the questions. Each question carries 10 marks**

**5X10 =50M**

9. a) Describe the ultrastructure of cell wall.  
(OR)  
b) Write an essay on plastid DNA with a well labeled diagram.
10. a) Discuss the structure of a eukaryotic chromosome with a neat labeled diagram.  
(OR)  
b) Explain the organization of DNA in chromosomes with suitable theories.
11. a) Discuss complementary and duplicate gene interactions with suitable examples.  
(OR)  
b) Explain mapping of genes with the help of 3-point test cross.
12. a) Describe the semi-conservative mode of DNA replication.  
(OR)  
b) Define an operon. Explain the regulation of Lac-operon.
13. a) Write an essay on procedure; applications and uses; advantages and limitations mass selection.  
(OR)  
b) Give an account of utilization of RFLP and RAPD in molecular plant breeding.

# ANDHRA PRADESH STATE COUNCIL OF HIGHER EDUCATION

(A Statutory body of the Government of Andhra Pradesh)

## REVISED UG SYLLABUS UNDER CBCS

(Implemented from Academic Year 2020-21)

PROGRAMME: FOUR YEAR B.Sc. (Hons)

Domain Subject: BOTANY

*Skill Enhancement Courses (SECs) for Semester V, from 2022-23 (Syllabus with Learning Outcomes, References, Co-curricular Activities & Model Q.P. Pattern)*

### Structure of SECs for Semester – V

(To choose One pair from the Four alternate pairs of SECs)

Univ. Code	Course NO. 6 & 7	Name of Course	Th. Hrs. / Week	IE Mar-ks	EE Mar-ks	Credits	Prac. Hrs./ Wk	Mar-ks	Credits
	6A	Plant Propagation	3	25	75	3	3	50	2
	7A	Seed Technology	3	25	75	3	3	50	2

OR

	6B	Vegetable Crops – Cultivation Practices	3	25	75	3	3	50	2
	7B	Vegetable Crops – Post Harvest Practices	3	25	75	3	3	50	2

OR

	6C	Plant Tissue Culture	3	25	75	3	3	50	2
	7C	Mushroom Cultivation	3	25	75	3	3	50	2

OR

	6D	Gardening and Landscaping	3	25	75	3	3	50	2
	7D	Agroforestry	3	25	75	3	3	50	2

**Note-1:** For Semester–V, for the domain subject Botany, any one of the four pairs of SECs shall be chosen as courses 6 and 7, i.e., 6A & 7A or 6B & 7B or 6C & 7C or 6D & 7D. The pair shall not be broken (ABCD allotment is random, not on any priority basis).

**Note-2:** One of the main objectives of Skill Enhancement Courses (SEC) is to inculcate skills related to the domain subject in students. The syllabus of SEC will be partially skill oriented. Hence, teachers shall also impart practical training to students on the skills embedded in syllabus citing related real field situations.

A.P. State Council of Higher Education  
Semester-wise Revised Syllabus under CBCS, 2020-21

Course Code:

Four-year B.Sc. (Hons)  
Domain Subject: **BOTANY**  
IV Year B. Sc. (Hons) – Semester – V

Max Marks: 100

**Course-6A: Plant Propagation**

(Skill Enhancement Course (Elective), Credits: 05)

**I. Learning Outcomes:**

Students at the successful completion of the course will be able to:

1. Explain various plant propagation structures and their utilization.
2. Understand advantages and disadvantages of vegetative, asexual and sexual plant propagation methods.
3. Assess the benefits of asexual propagation of certain economically valuable plants using apomictics and adventive polyembryony.
4. Demonstrate skills related to vegetative plant propagation techniques such as cuttings, layering, grafting and budding.
5. Apply a specific macro-propagation technique for a given plant species.

**II. Syllabus:** (Hours: Teaching: 50, Lab: 30, Field training: 05, others incl. unit tests: 05)  
(*Syllabi of theory, practical and lab (skills) training together shall be completed in 80 hours*)

**Unit – 1: Basic concepts of propagation** (10h)

1. Propagation: Definition, need and potentialities for plant multiplication; asexual and sexual methods of propagation - advantages and disadvantages.
2. Propagation facilities: Mist chamber, humidifiers, greenhouses, glasshouses, cold frames, hot beds, poly-houses, phytotrons nursery - tools and implements.
3. Identification and propagation by division and separation: Bulbs, pseudobulbs, corms, tubers and rhizomes; runners, stolons, suckers and offsets.

**Unit – 2: Apomictics in plant propagation** (10h)

1. Apomixis: Definition, facultative and obligate; types – recurrent, non-recurrent, adventitious and vegetative; advantages and disadvantages.
2. Polyembryony: Definition, classification, horticultural significance; chimera and bud sport.
3. Propagation of mango, *Citrus* and *Allium* using apomictic embryos.

**Unit – 3: Propagation by cuttings** (10h)

1. Cuttings: Definition, different methods of cuttings; root and leaf cuttings.

2. Stem cuttings: Definition of stem tip and section cuttings; plant propagation by herbaceous, soft wood, semi hard wood, hard wood and coniferous stem cuttings.
3. Physiological and bio chemical basis of rooting; factors influencing rooting of cuttings; Use of plant growth regulators in rooting of cuttings.

**Unit – 4: Propagation by layering** (10h)

1. Layering: Definition, principle and factors influencing layering.
2. Plant propagation by layering: Ground layering – tip layering, simple layering, trench layering, mound (stool) layering and compound (serpentine layering).
3. Air layering technique – application in woody trees.

**Unit – 5: Propagation by grafting and budding** (10h)

1. Grafting: Definition, principle, types, graft incompatibility, collection of scion wood stick, scion-stock relationship, and their influences, bud wood certification; micrografting.
2. Propagation by veneer, whip, cleft, side and bark grafting techniques.
3. Budding: Definition; techniques of ‘T’, inverted ‘T’, patch and chip budding.

**III. References:**

1. Sharma RR and Manish Srivastav.2004. Plant Propagation and Nursery Management International Book Distributing Co. Lucknow.
2. Hartman, HT and Kester, D.E.1976. Plant Propagation: Principles and Practices, Prentice Hall of India Pvt. Ltd. Bombay.
3. Sadhu, M.K. 1996. Plant Propagation. New Age International Publishers, New Delhi.
4. Web resources suggested by the teacher concerned and college librarian including reading material.

**Course -6A: Plant Propagation - Practical syllabus**

**IV. Learning Outcomes:** On successful completion of this practical course, student will be able to:

1. Make use of different plant propagation structures for plant multiplication.
2. Explore the specialized organs or asexual propagules in some plants for their proliferation.
3. Demonstrate skills on micropropagation of plants through vegetative propagation techniques.
4. Evaluate and use a suitable propagation technique for a given plant species.

**V. Practical (Laboratory) syllabus:** (30hrs): The following experiments/practices shall be conducted by students in the lab.

1. Preparation of nursery beds – flat, raised and sunken beds.
2. Propagation through apomictic.
3. Propagation by separation and division technique.

4. Propagation by cuttings.
5. Propagation by layering
6. Propagation by grafting.
7. Propagation by budding.
8. Preparation of potting mixture, potting and repotting.

#### **VI. Lab References:**

1. Prasad, V. M. and Balaji Vikram, 2018. Practical Manual on Fundamentals of Horticulture and Plant Propagation, Write & Print Publications, New Delhi
2. Upadhyay S. K. (Ed.) 2013. Practical Manual Basic Horticulture-I, Akashdeep Printers, New Delhi
3. Web sources suggested by the teacher concerned.

#### **VII. Co-Curricular Activities:**

**a) Mandatory:** (*Lab/field training of students by teacher: (Lab: 10 + field: 05 hours):*)

1. **For Teacher:** Training of students by the teacher in the laboratory/field for a total of not less than 15 hours on the field techniques/skills of different plant propagation structures, containers, preparation of soil, plant propagation through separation and division, apomictics, cuttings, layering, grafting and budding.
2. **For Student:** Students shall (individually) visit horticulture nurseries in a University/, research institute /private nursery and observe propagation structures, propagation techniques etc., write their observations and submit a hand-written Fieldwork/Project work/Project work Report not exceeding 10 pages in the given format to the teacher.
3. Max marks for Fieldwork/Project work Report: 05.
4. Suggested Format for Fieldwork/Project work Report: Title page, student details, index page, details of place visited, observations, findings and acknowledgements.
5. Unit tests (IE).

#### **b) Suggested Co-Curricular Activities:**

1. Training of students by experts in plant vegetative propagation methods.
2. Assignments (including technical assignments like identifying propagation structures and their operational techniques for a specific plant species.
3. Seminars, Group discussions, Quiz, Debates etc. (suggested topics):
4. Preparation of videos on plant propagation techniques in relation to different economically useful plants.
5. Collection of material/figures/photos related to plant propagation methods, writing and organizing them in a systematic way in a file.
6. Visits to Horticulture/Agriculture/Forest nurseries, research organizations, universities etc.
7. Invited lectures and presentations on related topics by experts in the specified area.



**Model Question Paper pattern for Practical Examination**

Semester – V/ Botany Skill Enhancement Course

**Course -6A: Plant Propagation**

Max. Time: 3 Hrs.

Max. Marks: 50

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- |  |            |
|--|------------|
| 1. Demonstration plant propagation using separation and division /apomictics ‘A’ | 10         |
| 2. Demonstration plant propagation using cuttings/layering technique ‘B’         | 10         |
| 3. Demonstration of plant propagation using grafting/budding technique ‘C’       | 10         |
| 4. Scientific observation and data analysis                                      | 4 x 3 = 12 |
| D. Plant propagation structure model/photograph                                  |            |
| E. Plant Growth Regulator  |            |
| F. Nursery bed model /photograph   |            |
| G. Asexual propagule/container/pot mixture for propagation                       |            |
| 5. Record + Viva-voce  | 5+3 = 8    |

A.P. State Council of Higher Education  
Semester-wise Revised Syllabus under CBCS, 2020-21

Course Code:

Four-year B.Sc. (Hons)  
Domain Subject: **BOTANY**  
IV Year B. Sc. (Hons) – Semester – V

Max Marks: 100

**Course-7A: Seed Technology**

(Skill Enhancement Course (Elective), Credits: 05)

**I. Learning outcomes:**

Students at the successful completion of the course will be able to:

1. Explain the causes for seed dormancy and methods to break dormancy.
2. Understand critical concepts of seed processing and seed storage procedures.
3. Acquire skills related to various seed testing methods.
4. Identify seed borne pathogens and prescribe methods to control them.
5. Understand the legislations on seed production and procedure of seed certification.

**II. Syllabus:** (Hours: Teaching: 50, Lab: 30, Field training: 05, others incl. unit tests: 05)

*(Syllabi of theory, practical and lab (skills) training together shall be completed in 80 hours)*

**Unit - 1: Seed dormancy**

(10h)

1. Seed and grain: Definitions, importance of seed; structure of Dicot and Monocot seed.
2. Role and goals of seed technology; characteristics of quality seed material.
3. Dormancy: Definition, causes for seed dormancy; methods to break seed dormancy.

**Unit – 2: Seed processing and storage**

(10h)

1. Principles of seed processing: seed pre-cleaning, precuring, drying, seed extraction; cleaning, grading, pre-storage treatments; bagging and labelling, safety precautions during processing.
2. Seed storage; orthodox and recalcitrant seeds, natural longevity of seeds.
3. Factors affecting longevity in storage; storage conditions, methods and containers.

**Unit – 3: Seed testing**

(10h)

1. Definition of seed vigour, viability and longevity; seed sampling and equipment; physical purity analysis.
2. Seed moisture – importance – methods of moisture determination.
3. Seed germination tests using paper, sand or soil – standard germination test; TZ test to determine seed viability; seed health testing.

**Unit – 4: Seed borne diseases**

(10h)

1. A brief account of different seed borne diseases and their transmission.
2. Different seed health testing methods for detecting microorganisms.
3. Management of seed borne diseases; seed treatment methods: spraying and dusting.

**Unit – 5: Seed certification**

(10h)

1. Objectives - Indian seed Act; seed rules and seed order; new seed policy (1988).
2. Seed Inspector: Duties and responsibilities; classes of seeds, phases of certification standards (i.e., Land requirement, isolation distance) etc.
3. Issue of certificates, tags and sealing; pre and post control check: Genetic purity verification, certification, records and reporting.

**III. References:**

1. Umarani R, Jerlin R, Natarajan N, Masilamani P, Ponnuswamy AS 2006. Experimental Seed Science and Technology, Agrobios, Jodhpur
2. Agrawal, 2005. Seed Technology. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi
3. Desai B D 2004. Seeds Hand Book: Processing and Storage, CRC Press
4. Agarwal V K and J B Sinclair 1996, Principles of Seed Pathology, CRC Press
5. Tunwar NS and Singh SN. 1988. Indian Minimum Seed Certification Standards. CSCB, Ministry of Agriculture, New Delhi.
6. McDonald, M.B. and L.O. Copland. 1999. Seed Science and Technology Laboratory Manual. Scientific Publishers, Jodhpur
7. Web resources suggested by the teacher concerned and the college librarian including reading material.

**Course -7A: Seed Technology Practical syllabus**

**IV. Learning Outcomes:** On successful completion of this practical course, student will be able to:

1. Demonstrate skills on various methods to break the seed dormancy.
2. Determine seed moisture, seed germination percentage, seed viability and vigour.
3. Identify the seed borne pathogens and prescribe methods to prevent or control them.
4. Evaluate various methods to produce healthy seeds.

**V. Practical (Laboratory) syllabus: (30hrs)**

1. Determination of physical properties of seeds of 3 select local crops (1 each from cereals, millets, pulses and oil seeds).
2. Breaking seed dormancy in 3 select local crops.
3. Measurement of seed moisture content by O S W A or moisture meter or oven drying method.
4. Seed germination tests and evaluation.
5. Seed vigour - conductivity test.
6. Accelerated ageing tests.
7. Tetrazolium test.
8. Priming and invigoration treatments for improving germination and vigour.

9. Techniques of seed health testing - visual examination of seeds, washing test, incubation methods, embryo count method, seed soak method for the detection of certain seed borne pathogens.
10. Using various types of tools for dusting and spraying pesticides/insecticides.

#### **VI. Lab References:**

1. Sanjeev Kumar, 2019. Practical Manual Seed Technology of Vegetable Crops, M/s Asian Printery, Ahmedabad
2. Divakara Sastry, E.V., Dharendra Singh and S.S.Rajput, 2013. Seed Technology: Practical Manual, Swami Keshwanand Rajasthan Agricultural University, Jobner
3. Web sources suggested by the teacher concerned.

#### **VII. Co-Curricular Activities:**

**Mandatory:** (*Lab/field training of students by teacher: (Lab: 10 + field: 05 hours)*)

1. **For Teacher:** Training of students by the teacher in the laboratory/field for a total of not less than 15 hours on the field techniques/skills of identifying and drawing seed structure, methods of breaking seed dormancy, seed cleaning, seed storage, identification of seed borne diseases, seed certification procedure.
2. **For Student:** Students shall (individually) visit horticulture/agriculture/ forest nursery/commercial seed production firms/ seed testing laboratories in government or private sector, observe seed production techniques, processing and storage, seed testing and certification procedures etc., write their observations and submit a hand-written Fieldwork/Project work Report not exceeding 10 pages in the given format to the teacher.
3. Max marks for Fieldwork/Project work Report: 05.
4. Suggested Format for Fieldwork/Project work Report: Title page, student details, index page, details of place visited, observations, findings and acknowledgements.
5. Unit tests (IE).

#### **a) Suggested Co-Curricular Activities:**

1. Training of students by experts in seed technology.
2. Assignments (including technical assignments like seed processing and storage techniques, seed testing, seed certification, seed borne diseases- prevention and control).
3. Seminars, Group discussions, Quiz, Debates etc. (suggested topics):
4. Preparation of videos on various aspects related to seed technology.
5. Collection of material/figures/photos related to seed technology, writing and organizing them in a systematic way in a file.
6. Visits to seed production units in Industries/Horticulture/Agriculture/Forest universities/colleges; research organizations, seed testing laboratories etc.
7. Invited lectures and presentations on related topics by experts in the specified area.

**Model Question Paper pattern for Practical Examination**

Semester – V/ Botany Skill Enhancement Course

**Course – 7A: Seed Technology**

Max. Time: 3 Hrs.

Max. Marks: 50

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- |  |            |
|--|------------|
| 1. Demonstration of a method to break seed dormancy ‘A’              | 10         |
| 2. Determination of seed moisture content/ seed germination test ‘B’ | 10         |
| 3. Demonstration of test for seed viability/ seed vigour ‘C’         | 10         |
| 4. Scientific observation and data analysis                          | 4 x 3 = 12 |
| D. Monocot / Dicot seed  |            |
| E. Seed sampling equipment   |            |
| F. Seed borne pathogen specimen/photograph                           |            |
| G. Seed certification agency/procedure                               |            |
| 4. Record + Viva-voce  | 5+3 = 8    |

A.P. State Council of Higher Education  
Semester-wise Revised Syllabus under CBCS, 2020-21

Course Code:

Four-year B.Sc. (Hons)  
Domain Subject: **BOTANY**  
IV Year B. Sc. (Hons) – Semester – V

Max Marks: 100

**Course 6B: Vegetable Crops – Cultivation Practices**  
(Skill Enhancement Course (Elective), Credits: 05)

**I. Learning Outcomes:**

Students at the successful completion of the course will be able to:

1. Identify different vegetable plants and realize their value in human nutrition.
2. Analyse the types of soils to cultivate vegetable crops.
3. Demonstrate skills on agronomic practices for cultivation of vegetable crops.
4. Acquire knowledge on water, weed and disease managements in vegetable farming.
5. Comprehend aspects related to harvesting and storage of produce.

**II. Syllabus:** (Hours: Teaching: 50, Lab: 30, Field training: 05, others incl. unit tests: 05)  
(*Syllabi of theory, practical and lab (skills) training together shall be completed in 80 hours*)

**Unit – 1: Introduction to Olericulture** (10h)

1. Vegetables and Olericulture: Definitions, nutritive value of vegetables and economic significance of vegetable farming.
2. Classification of vegetable crops (Botanical, based on climatic zones and economic parts used).
3. Types of vegetable gardens (kitchen gardening, terrace gardening, market gardening and truck gardening); implements used in vegetable gardening; vegetable forcing – a brief concept.

**Unit – 2: Cultivation of leafy vegetables** (10h)

1. Leafy vegetables: Definition and a brief account of locally cultivated crops.
2. Study of the following leafy vegetable crops: (a) *Amaranthus* (b) Palak (c) *Hibiscus cannabinus* (d) Fenugreek: systematic position, nutritive value, origin, area, production, improved varieties.
3. General cultivation practices such as sowing, planting distance, fertilizer requirements, irrigation, weed management, harvesting.
4. Crop specific yield, storage, disease and pest control and seed production.

**Unit – 3: Cultivation of fruity vegetables** (10h)

1. Fruity vegetables: Definition and a brief account of locally cultivated crops.
2. Study of the fruity vegetable crops: (a) Okra (b) Tomato (c) Chillies (d) Brinjal: systematic position, nutritive value, origin, area, production, improved varieties.
3. General cultivation practices such as sowing, planting distance, fertilizer requirements, irrigation, weed management, harvesting.
4. Crop specific yield- storage, disease and pest control and seed production

**Unit – 4: Cultivation of peas and beans** (10h)

1. A brief account of locally cultivated peas and beans.

2. Study of the following crops: (a) *Dolichos* (b) Cluster bean (c) French bean: Systematic position, nutritive value, origin, area, production, improved Varieties.
3. General cultivation practices such as sowing, planting distance, fertilizer requirements, irrigation, weed management, harvesting.
4. Crop specific yield, storage, disease and pest control and seed production.

**Unit – 5: Cultivation of root and tuber crops** (10h)

1. A brief account of locally cultivated root and tuber crops.
2. Study of the following crops: (a) Carrot (b) Radish (c) Sweet potato (d) Potato: Systematic position, family, nutritive value, origin, area, production, improved varieties.
3. General cultivation practices such as sowing, planting distance, fertilizer requirements, irrigation, weed management, harvesting.
4. Crop specific yield, storage, disease and pest control and seed production.

**III. References:**

1. Bose T K et al. (2003) Vegetable crops, Naya Udhyog Publishers, Kolkata.
2. Singh D K (2007) Modern vegetable varieties and production, IBN Publisher Technologies, International Book Distributing Co, Lucknow.
3. Premnath, Sundari Velayudhan and D P Sing (1987) Vegetables for the tropical region, ICAR, New Delhi
4. Shanmugavelu, K. G. 1989. Production Technology of Vegetable Crops. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.
5. Rana MK. 2008. Scientific Cultivation of Vegetables. Kalyani Publ., New Delhi
6. Rubatzky VE and Yamaguchi M. (Eds.). 1997. World Vegetables: Principles, Production and Nutritive Values. Chapman & Hall, London.
7. Web resources suggested by the teacher concerned and the college librarian including reading material.

**Course 7B: Vegetable Crops – Cultivation Practices – Practical syllabus**

**IV. Learning Outcomes:** On successful completion of this practical course, student will be able to:

1. List out, identify and handle different garden implements.
2. Identify the important vegetable crops grown in their locality.
3. Demonstrate various skills in cultivation of vegetable crops.
4. Identify pests, diseases and their remedies that are specific to a vegetable crop.

**V. Practical (Laboratory) Syllabus: (30 hrs)**

1. Identification of seeds of important local vegetable plants and preparation of herbarium.
2. Identification of local vegetable crops and handling of garden tools.
3. Analysis of garden soil for ratios of physical characteristics by sieve separation.
4. Determination of chemical characters of garden soil (pH, EC, Organic Carbon, SAR).
5. Planning and layout of a vegetable crop farm.

6. Preparation of nursery bed (raised, sunken and flat beds) and sowing of seeds.
7. Transplanting and care of vegetable seedlings.
8. Intercultural operations in vegetable plots.
9. Estimation of Total Soluble Solids (TSS) by Refractometer in a fruit and a leafy vegetable.
10. Estimation of Vitamin - C in a fruit and a leafy vegetable by DCIP method.
11. Identification of pests and disease-causing organisms on any two vegetable plants.
12. Seed extraction in tomato and brinjal.

#### **VI. Lab References:**

1. Akhilesh Sharma (Ed.), 2013. Practical Manual Olericulture-I, Sheel Packers, New Delhi
2. Biswajit Saha and Shri Dharampal Singh, 2013. Practical Manual Olericulture-I, Sheel Packers, New Delhi
3. Saini RS, K.D. Sharma, O.P, Dhankhar and R.A. Kaushik (Eds.). 2001. Laboratory Manual of Analytical Techniques in Horticulture. Agrobios, Jodhpur
4. Ranganna S. 1986. Handbook of Analysis and Quality Control for Fruit and Vegetable Products. Tata-McGraw Hill, New Delhi
5. Web sources suggested by the teacher concerned.

#### **VII. Co-Curricular Activities:**

##### **a) Mandatory:** (*Lab/ field training of students by teacher: (Lab: 10 + field: 05 hours)*)

1. **For Teacher:** Training of students by the teacher in the laboratory/field for a total of not less than 15 hours on the field techniques/skills of vegetable plants identification, vegetable gardening, agronomic practices, water, weed and disease management; harvesting and storage of produce.
2. **For Student:** Students shall (individually) visit a horticulture university/ research station or vegetable crop farm in their locality, observe different vegetable crops/ varieties of a vegetable crop, intercultural operations, pests and diseases, harvesting and storage etc., write their observations and submit to the teacher a hand-written Fieldwork/Project work Report not exceeding 10 pages in the given format.
3. Max marks for Fieldwork/Project work Report: 05.
4. Suggested Format for Fieldwork/Project work Report: Title page, student details, index page, details of place visited, observations, findings and acknowledgements.
5. Unit tests (IE).

##### **b) Suggested Co-Curricular Activities:**

1. Training of students by related industrial experts or farmers.
2. Assignments (including technical assignments like tools in vegetable gardening and their handling, agronomic practices, modern irrigation methods, organic farming practices etc.)
3. Seminars, Group discussions, Quiz, Debates etc. (on related topics).
4. Preparation of videos on cultivation practices for vegetable crops.
5. Collection of material/figures/photos related to different vegetable crop species, writing and organizing them in a systematic way in a file.



6. Visits to horticulture universities, research organizations, private vegetable farming units etc.
7. Invited lectures and presentations on related topics by field/industrial experts

### **Model Question Paper Pattern for Practical Examination**

Semester – V/ Botany Skill Enhancement Course

#### **Vegetable Crops – Cultivation Practices**

Max. Time: 3 Hrs.

Max. Marks: 50

- |   |            |
|---|------------|
| 1. Demonstration of nursery bed making/transplanting of seedlings ‘A’   | 8          |
| 2. Determination of physical or chemical characters of a given soil sample / Preparation of slide and identification of pest/disease-causing organism in plant part given ‘B’ | 10         |
| 3. Estimation of Total Soluble Solids/Vitamin-C in a given plant sample ‘C’   | 12         |
| 4. Scientific observation and data analysis   | 4 x 3 = 12 |
| D. Identification of a garden tool  |            |
| E. Identification of seed/specimen of a vegetable crop species  |            |
| F. Identification of a weed/irrigation method   |            |
| G. Identification of a pest/disease causing organism  |            |
| 5. Record + Viva-voce   | 5+3 = 8    |

A.P. State Council of Higher Education  
Semester-wise Revised Syllabus under CBCS, 2020-21

Course Code:

Four-year B.Sc. (Hons)  
Domain Subject: **BOTANY**  
IV Year B. Sc. (Hons) – Semester – V

Max Marks: 100

**Course 7B: Vegetable Crops – Post Harvest Practices**  
(Skill Enhancement Course (Elective), Credits: 05)

**I. Learning Outcomes:**

Students at the successful completion of the course will be able to:

1. Understand various practices for vegetable produce from harvesting to marketing.
2. Demonstrate skills on storage, processing and preservation of vegetables.
3. Summarize causes for spoilage of vegetables before and during storage and methods to prevent and control them.
4. Make use of preservation methods to reduce the loss of vegetable produce.
5. Explain about value added products, packaging and marketing of vegetables.

**II. Syllabus:** (Hours: Teaching: 50, Lab: 30, Field training: 05, others incl. unit tests: 05)  
(*Syllabi of theory, practical and lab (skills) training together shall be completed in 80 hours*)

**Unit – 1: Introduction to Post Harvest Practices** (10h)

1. Post-harvest technology: Definition; importance, scope and future status of post-harvest management of vegetables.
2. Study of maturity standards of vegetables; harvest techniques of vegetables, methods stages, signs of harvesting; harvesting and its relationship with quality, sorting and grading.
3. Careful handling of harvested vegetables; pre-harvest and post-harvest factors responsible for ripening.

**Unit – 2: Methods of storage** (10h)

1. Climacteric and non-climacteric types of vegetables.
2. Methods of storage to prolong shelf life of harvested vegetables; on-farm storage, evaporatively cooled stores, ventilated storage, pit storage etc.
3. Refrigerated storage, refrigeration cycle, controlled and modified atmosphere, hypobaric storage.

**Unit – 3: Processing of vegetables** (10h)

1. Causes for spoilage of vegetables and control measures during storage; post-harvest disease and pest management.
2. Techniques to prevent deterioration; vegetable processing equipment; minimal processing of vegetables.
3. Safe chemicals and microbial limits; application of growth regulators for quality assurance; grading.

**Unit -4: Preservation and value-addition** (10h)

1. Importance and scope of vegetable preservation in India; principles underlying general methods of preservation.
2. Methods of preservation; food additives and food colours.

3. Fried products, process of frying; dried vegetables; sauces and chutneys, pickles and salted vegetables; by-product and waste utilization.

#### **Unit – 5: Marketing**

(10h)

1. Packing line operations, packaging of vegetables and their products; transportation; codex norms for export of perishables.
2. Demand supply analysis of important vegetables; market potential of various vegetables products.
3. Important marketing agencies and institutions; importance of cooperative marketing.

#### **III. References:**

1. Salunkhe DK and Kadam SS. (Ed.). 1998. Hand Book of Vegetable Science and Technology: Production, Composition, Storage and Processing. Marcel Dekker, New York.
2. Arthey D and Dennis C. 1996. Vegetable Processing. Blackie/Springer-Verlag, New York
3. Verma LR and Joshi VK. 2000. Post-harvest Technology of Fruits and Vegetables: Handling, Processing, Fermentation and Waste Management. Indus Publishing Company, New Delhi
4. Srivastava RP and Kumar S. 2003. Fruit and Vegetable Preservation: Principles and Practices. International Book Distribution Company, Lucknow.
5. Giridharilal GS, Siddappa and Tandon GL. 1986. Preservation of Fruits and Vegetables. ICAR, New Delhi.
6. Web resources suggested by the teacher concerned and the college librarian including reading material.

#### **Course 7B: Vegetable Crops – Post harvest Practices – Practical syllabus**

**IV. Learning Outcomes:** On successful completion of this practical course, student will be able to:

1. Identify stages of maturity in vegetable crops.
2. Handle material for storage of vegetables.
3. Identify physical and biological causes for spoilage of vegetables.
4. Make some value-added products of vegetables.

#### **V. Practical (Laboratory) Syllabus: (30 hrs)**

1. Maturity selection and harvest, harvesting practices.
2. List and cost of equipment, utensils, and additives required for small scale processing industry.
3. Study of different types of spoilages in fresh as well as processed vegetables.
4. Identification and classification of spoilage organisms.
5. Estimation of total carbohydrates (Anthrone method) in a stored vegetable and un-stored vegetable.
6. Estimation of protein (Lowry method) in a stored vegetable and un-stored vegetable.
7. Sensory evaluation of fresh and processed vegetables.
8. Assessment of quality and grading, pre-packaging and protective treatments.
9. Identification of packaging materials, containers for packaging.
10. Preparation of pickle from a vegetable.

11. Preparation of tomato sauce, ketchup and chutney.

**VI. Lab References:**

1. Swati Barche, Reena Nair and P. K. Jain, 2016. A Practical Manual on Post Harvest Value Addition and Processing of Horticulture Crops. Agrobios (India), Jodhpur
2. Antonio L. Acedo Jr., Md. Atiqur Rahman, Borarin Buntong and Durga Mani Gautam, 2016. Vegetable Postharvest Training Manual, AVRDC - The World Vegetable Center, Taiwan
3. Akhilesh Sharma (Ed.), 2013. Practical Manual Olericulture-I, Sheel Packers, New Delhi
4. Biswajit Saha and Shri Dharampal Singh, 2013. Practical Manual Olericulture-I, Sheel Packers, New Delhi
5. Web sources suggested by the teacher concerned.

**VII. Co-Curricular Activities:**

**a) Mandatory:** (*Lab/field training of students by teacher: (Lab: 10 + field: 05 hours)*)

1. **For Teacher:** Training of students by teacher in the laboratory/field for a total of not less than 15 hours on the field techniques/skills of harvesting indices of vegetables, storage methods, tools and techniques for processing, causes for spoilage and methods to control, preservation methods, marketing chain and in making value added products.
2. **For Student:** Students shall (individually) visit any one of the places like horticulture university/ research station; vegetable storage units in public and private sector; vegetable processing industries in their locality and observe harvesting practices, storage methods, processing and preservation; grading, value added products and marketing. Write their observations and submit to the teacher a hand-written Fieldwork/Project work Report not exceeding 10 pages in the given format.
3. Max marks for Fieldwork/Project work Report: 05.
4. Suggested Format for Fieldwork/Project work Report: Title page, student details, index page, details of place visited, observations, findings and acknowledgements.
5. Unit tests (IE).

**b). Suggested Co-Curricular Activities:**

1. Training of students by related industrial experts or farmers.
2. Assignments (including technical assignments like tools and techniques for storage, processing and preservation, causes for spoilage and methods to avoid losses, value added products of some vegetables, packaging and marketing etc.)
3. Seminars, Group discussions, Quiz, Debates etc. (on related topics).
4. Preparation of videos on cultivation practices for vegetable crops.
5. Collection of material/figures/photos related to harvesting, storage, processing and preservation of vegetable crop produce, writing and organizing them in a systematic way in a file.

6. Visits to horticulture universities, research organizations; storage, processing industries in public or private sector; industries making value added products of vegetables etc.
7. Invited lectures and presentations on related topics by field/industrial experts.

### **Model Question Paper Pattern for Practical Examination**

Semester – V/ Botany Skill Enhancement Course

#### **Vegetable Crops – Post Harvest Practices**

Max. Time: 3 Hrs.

Max. Marks: 50

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|--|------------|
| 1. Identification of organism(s) responsible for spoilage of vegetable ‘A’             | 8          |
| 2. Assessment of quality and grading/ technique of packaging and protective treatment. | 10         |
| 3. Estimation of carbohydrates/protein content in a vegetable sample ‘C’               | 12         |
| 4. Scientific observation and data analysis  | 4 x 3 = 12 |
| D. Identification of harvesting stage  |            |
| E. Identification of equipment for processing  |            |
| F. Identification of PGR/chemical used for PHT of vegetables.                          |            |
| G. Identification of a packaging material/value added product.                         |            |
| 5. Record + Viva-voce  | 5+3 = 8    |

A.P. State Council of Higher Education  
Semester-wise Revised Syllabus under CBCS, 2020-21

Course Code:

Four-year B.Sc. (Hons)  
Domain Subject: **BOTANY**  
IV Year B. Sc. (Hons) – Semester – V

Max Marks: 100

**Course 6C: Plant Tissue Culture**  
(Skill Enhancement Course (Elective), Credits: 05)

**I. Learning Outcomes:**

Students at the successful completion of the course will be able to:

1. Comprehend the basic knowledge and applications of plant tissue culture.
2. Identify various facilities required to set up a plant tissue culture laboratory.
3. Acquire a critical knowledge on sterilization techniques related to plant tissue culture.
4. Demonstrate skills of callus culture through hands on experience.
5. Understand the biotransformation technique for production of secondary metabolites.

**II. Syllabus:** (Hours: Teaching: 50, Lab: 30, Field training: 05, others incl. unit tests: 05)  
(Syllabi of theory, practical and lab (skills) training together shall be completed in 80 hours)

**Unit - 1: Basic concepts of plant tissue culture** (10h)

1. Plant tissue culture: Definition, history, scope and significance.
2. Totipotency, differentiation, dedifferentiation, and redifferentiation; types of cultures.
3. Infrastructure and equipment required to establish a tissue culture laboratory.

**Unit - 2: Sterilization techniques and culture media** (10h)

1. Aseptic conditions – Fumigation, wet and dry sterilization, UV sterilization, ultrafiltration.
2. Nutrient media: Composition of commonly used nutrient culture media with respect to their contents like inorganic chemicals, organic constituents, vitamins, amino acids etc.
3. Composition and preparation of Murashige and Skoog culture medium.

**Unit - 3: Callus culture technique** (10h)

1. Explant: Definition, different explants for tissue culture: shoot tip, axillary buds, leaf discs, cotyledons, inflorescence and floral organs, their isolation and surface sterilization; inoculation methods.
2. Callus culture: Definition, various steps in callus culture.
3. Initiation and maintenance of callus - Growth measurements and subculture; somatic clonal variations.

**Unit - 4: Micropropagation** (10h)

1. Direct and indirect morphogenesis, organogenesis, role of PGRs; somatic embryogenesis and synthetic seeds.
2. Greenhouse hardening unit operation and management; acclimatization and hardening of plantlets - need, process, packaging, exports.
3. Pathogen (Virus) indexing- significance, methods, advantages, applications.

**Unit - 5: Applications of plant tissue culture** (10h)

1. Germplasm conservation: cryopreservation methods, slow growth, applications and limitations; cryoprotectants.
2. Plant transformation techniques and bioreactors; production of secondary metabolites-optimization of yield, commercial aspects, applications, limitations.
3. Transgenic plants- gene transfer methods; BT cotton.

### **III. References:**

1. Kalyan Kumar De (2001) An Introduction to Plant Tissue Culture, New Central Book Agency (P) Ltd., Calcutta
2. Razdan, M.K. (2005) Introduction to Plant Tissue Culture, Oxford & IBH Publishers, Delhi
3. Bhojwani, S.S. (1990) Plant Tissue Culture: Theory and Practical (a revised edition). Elsevier Science Publishers, New York, USA.
4. Vasil, I.K. and Thorpe, T.A. (1994) Plant Cell and Tissue Culture. Kluwer Academic Publishers, the Netherlands.
5. Web resources suggested by the teacher concerned and the college librarian including reading material.

### **Course 6C: Plant Tissue Culture – Practical syllabus**

**IV. Learning Outcomes:** On successful completion of this practical course, student will be able to:

1. List out, identify and handle various equipment in plant tissue culture lab.
2. Learn the procedures of preparation of media.
3. Demonstrate skills on inoculation, establishing callus culture and Micro propagation.
4. Acquire skills in observing and measuring callus growth.
5. Perform some techniques related to plant transformation for secondary Metabolite production.

### **V. Practical (Laboratory) Syllabus: (30 hrs)**

1. Principles and applications of- Autoclave, Laminar Airflow, Hot Air Oven.
2. Sterilization techniques for glass ware, tools etc.,
3. MS medium - Preparation of different stock solutions; media preparation
4. Explant preparation, inoculation and initiation of callus from carrot.
5. Callus formation, growth measurements.
6. Induction of somatic embryos, preparation of synthetic seeds.
7. Multiplication of callus and organogenesis.
8. Hardening and acclimatization in green house.

### **VI. Lab References:**

1. Reinert, J. and M.M. Yeoman, 1982. Plant Cell and Tissue Culture - A Laboratory Manual, Springer-Verlag Berlin Heidelberg
2. Robert N. Trigiano and Dennis J. Gray, 1999. Plant Tissue Culture Concepts and Laboratory Exercises. CRC Press, Florida

4. Ashok Kumar, 2018. Practical Manual for Biotechnology, College of Horticulture & Forestry, Jhalawar, AU, Kota
5. Chawla, H.S., 2003. Plant Biotechnology: A Practical Approach, Nova Science Publishers, New York
6. Web sources suggested by the teacher concerned.

## **VII. Co-Curricular Activities:**

### **a) Mandatory:** (*Lab/field training of students by teacher: Lab: 10 + field: 05 hours*)

1. **For Teacher:** Training of students by teacher in the laboratory/field for a total of not less than 15 hours on the field techniques/skills of sterilization procedures, preparation of media, establishment of callus culture, growth measurements; morphogenesis and organogenesis; acclimatization and hardening of plantlets.
2. **For Student:** Students shall (individually) visit anyone of plant tissue culture laboratories in universities/research organizations/private facilities, write their observations on tools, techniques, methods and products of plant tissue culture; and submit a hand-written Fieldwork/Project work Report not exceeding 10 pages to the teacher in the given format.
3. Max marks for Fieldwork/Project work Report: 05
4. Suggested Format for Fieldwork/Project work Report: Title page, student details, index page, details of place visited, observations, findings and acknowledgements.
5. Unit tests (IE).

### **b) Suggested Co-Curricular Activities:**

1. Training of students by related industrial experts.
2. Assignments (including technical assignments like identifying tools in plant tissue culture and their handling, operational techniques with safety and security, IPR)
3. Seminars, Group discussions, Quiz, Debates etc. (on related topics).
4. Preparation of videos on tools and techniques in plant tissue culture.
5. Collection of material/figures/photos related to products of plant tissue culture, writing and organizing them in a systematic way in a file.
6. Visits to plant tissue culture/biotechnology laboratories in universities, research organizations, private firms, etc.
7. Invited lectures and presentations on related topics by field/industrial experts



**Model Question Paper Pattern for Practical Examination**

Semester – V/ Botany Skill Enhancement Course

**Plant Tissue Culture**

Max. Time: 3 Hrs.

Max. Marks: 50

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|--|------------|
| 1. Demonstration of a sterilization technique 'A'                    | 8          |
| 2. Preparation of MS medium 'B'                                      | 10         |
| 3. Demonstration of callus culture technique/growth measurements 'C' | 12         |
| 4. Scientific observation and data analysis                          | 4 x 3 = 12 |
| D. Tissue culture equipment /photograph                              |            |
| E. Morphogenesis or organogenesis - photograph                       |            |
| F. Bioreactor/Secondary metabolite                                   |            |
| G. Transgenic plant/photograph                                       |            |
| 5. Record + Viva-voce  | 5+3 = 8    |

A.P. State Council of Higher Education  
Semester-wise Revised Syllabus under CBCS, 2020-21

Course Code:

Four-year B.Sc. (Hons)  
Domain Subject: **BOTANY**  
IV Year B. Sc. (Hons) – Semester – V

Max Marks: 100

**Course 7C: Mushroom Cultivation**  
(Skill Enhancement Course (Elective), Credits: 05)

**I. Learning Outcomes:**

Students at the successful completion of the course will be able to:

1. Understand the structure and life of a mushroom and discriminate edible and poisonous mushrooms.
2. Identify the basic infrastructure to establish a mushroom culture unit.
3. Demonstrate skills preparation of compost and spawn.
4. Acquire a critical knowledge on cultivation of some edible mushrooms.
5. Explain the methods of storage, preparation of value-added products and marketing.

**II. Syllabus:** (Hours: Teaching: 50, Lab: 30, Field training: 05, others incl. unit tests: 05)  
(Syllabi of theory, practical and lab (skills) training together shall be completed in 80 hours)

**Unit – 1: Introduction and value of mushrooms** (10h)

1. Mushrooms: Definition, structure of a mushroom and a brief account of life cycle; historical account and scope of mushroom cultivation; difference between edible and poisonous mushrooms.
2. Morphological features of any four edible mushrooms, Button mushroom (*Agaric us Bosporus*), Milky mushroom (*Calocybe indica*), Oyster mushroom (*Pleurotus sajor-caju*) and Paddy straw mushroom (*Volvariella volvacea*).
3. Nutraceutical value of mushrooms; medicinal mushrooms in South India - *Ganoderma lucidum*, *Phellinus rimosus*, *Pleurotus florida* and *Pleurotus pulmonaris* – their therapeutic value; Poisonous mushrooms - harmful effects.

**Unit – 2: Basic requirements of cultivation system** (10h)

1. Small village unit and larger commercial unit; layout of a mushroom farm - location of building plot, design of farm, bulk chamber, composting, equipment and facilities, pasteurization room and growing rooms.
2. Compost and composting: Definition, machinery required for compost making, materials for compost preparation.
3. Methods of composting- long method of composting and short method of composting.

**Unit – 3: Spawning and casing** (10h)

1. Spawn and spawning: Definition, facilities required for spawn preparation; preparation of spawn substrate.
2. Preparation of pure culture, media used in raising pure culture; culture maintenance, storage of spawn.

3. Casing: Definition, Importance of casing mixture, Quality parameters of casing soil, different types of casing mixtures, commonly used materials.

#### **Unit – 4: Mushroom cultivation**

(10h)

Raw material, compost, spawning, casing, cropping, and problems in cultivation (diseases, pests and nematodes, weed molds and their management strategies), picking and packing for any Four of the following mushrooms:

- (a) Button mushroom (b) Oyster mushroom (c) Milky mushroom and (d) Paddy straw mushroom

#### **Unit – 5: Post harvest technology**

(10h)

1. Shelf life of mushrooms; preservation of mushrooms - freezing, dry freezing, drying and canning.
2. Quality assurance and entrepreneurship - economics of different types of mushrooms; value added products of mushrooms.
3. Management of spent substrates and waste disposal of various mushrooms.

### **III. References:**

1. Tewari Pankaj Kapoor, S. C. (1988). Mushroom Cultivation. Mittal Publication, New Delhi.
2. Pandey R.K, S. K Ghosh, (1996). A Hand Book on Mushroom Cultivation. Emkey Publications
3. Nita Bhal. (2000). Handbook on Mushrooms (Vol. I and II). Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi
4. Pathak, V. N. and Yadav, N. (1998). Mushroom Production and Processing Technology. Agrobios, Jodhpur.
5. Tripathi, D.P. (2005) Mushroom Cultivation, Oxford & IBH Publishing Co. Pvt. Ltd, New Delhi.
6. Pathak V.N., Nagendra Yadav and Maneesha Gaur (2000), Mushroom Production and Processing Technology Vedams Ebooks Pvt. Ltd., New Delhi
7. Web resources suggested by the teacher concerned and the college librarian including reading material.

### **Course 7C: Mushroom Cultivation – Practical syllabus**

**IV. Learning Outcomes:** On successful completion of this practical course, student will be able to:

1. Identify and discriminate different mushrooms based on morphology.
2. Understand facilities required for mushroom cultivation.
3. Demonstrate skills on preparation of spawn, compost and casing material.
4. Exhibit skills on various cultivation practices for an edible mushroom.

#### **V. Practical (Laboratory) Syllabus: (30 hrs)**

1. Identification of different types of mushrooms.
2. Preparation of pure culture of an edible mushroom.
3. Preparation of mother spawn.

4. Production of planting spawn and storage.
5. Preparation of compost and casing mixture.
6. Demonstration of spawning and casing.
7. Hands on experience on cropping and harvesting.
8. Demonstration of storage methods.
9. Preparation of value-added products.

#### **VI. Lab References:**

1. Sushma Sharma Sapna Thakur Ajar Nath Yadav, 2018. Mushroom Cultivation: A Laboratory Manual, Eternal University, Sirmour, H.P.
2. Kadhila-Muandingi, N.P., F. S. Mubiana and K. L. Halueendo, 2012. Mushroom Cultivation: A Beginners Guide, The University of Namibia
3. Gajendra Jagatap and Utpal Dey, 2012. Mushroom Cultivation: Practical Manual, LAMBERT Academic Publishing, Saarbrücken, Germany
4. Deepak Som, 2021. A Practical Manual on Mushroom Cultivation, P.K. Publishers & Distributors, Delhi
5. Web sources suggested by the teacher concerned.

#### **VII. Co-Curricular Activities:**

##### **a) Mandatory:** (*Lab/field training of students by teacher: Lab: 10 + field: 05 hours*)

1. **For Teacher:** Training of students by teacher in the laboratory/field for not less than 15 hours on the field techniques/skills of identification of edible and poisonous mushrooms, basic facilities of a mushroom culture unit, preparation of compost and spawn, cultivation practices of edible mushrooms, storage and marketing of produce.
2. **For Student:** Students shall (individually) visit mushroom culture units in universities/research organizations/private sector write their observations on infrastructure, cultivation practices and products of a mushroom culture unit etc., and submit to the teacher a hand-written Fieldwork/Project work Report not exceeding 10 pages in the given format.
3. Max marks for Fieldwork/Project work Report: 05.
6. Suggested Format for Fieldwork/Project work Report: Title page, student details, index page, details of place visited, observations, findings and acknowledgements.
4. Unit tests (IE).

##### **b) Suggested Co-Curricular Activities:**

1. Training of students by related industrial experts.
2. Assignments (including technical assignments like identifying various mushrooms, tools and techniques for culture, identification and control of diseases etc.,
3. Seminars, Group discussions, Quiz, Debates etc. (on related topics).
4. Preparation of videos on tools and techniques in mushroom culture.
5. Collection of material/figures/photos related to edible and poisonous mushrooms, cultivation of mushrooms in cottage industries, writing and organizing them in a systematic way in a file.
6. Visits to mushroom culture units in universities, research organizations, private firms, etc.
7. Invited lectures and presentations on related topics by field/industrial experts.

**Model Question Paper Pattern for Practical Examination**

Semester – V/ Botany Skill Enhancement Course

**Mushroom Cultivation**

Max. Time: 3 Hrs.

Max. Marks: 50

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- |  |            |
|--|------------|
| 1. Demonstration of preparing pure culture/mother spawn 'A'                          | 8          |
| 2. Preparation method for planting spawn and storage/compost and casing material 'B' | 10         |
| 3. Demonstration of spawning and casing/storage and making a value-added product 'C' | 12         |
| 4. Scientific observation and data analysis  | 4 x 3 = 12 |
| D. Edible/poisonous mushroom specimen/photograph                                     |            |
| E. Infrastructure/tool used in mushroom cultivation                                  |            |
| F. Material for compost/casing   |            |
| G. Storage practice/ a value-added product   |            |
| 5. Record + Viva-voce  | 5+3 = 8    |

A.P. State Council of Higher Education  
Semester-wise Revised Syllabus under CBCS, 2020-21

Course Code:

Four-year B.Sc. (Hons)  
Domain Subject: **BOTANY**  
IV Year B. Sc. (Hons) – Semester – V

Max Marks: 100

**Course 6D: Gardening and Landscaping**

(Skill Enhancement Course (Elective), Credits: 05)

**I. Learning Outcomes:**

Students at the successful completion of the course will be able to:

1. Acquire a critical knowledge about the aesthetic value, types and styles of gardens.
2. Perform field operations in a garden by understanding the role of a gardener.
3. Identify various ornamental plants and explain the growth habits.
4. Propagate garden plants through various propagation techniques.
5. Demonstrate skills of designing and developing a garden.

**II. Syllabus:** (Hours: Teaching: 50, Lab: 30, Field training: 05, others incl. unit tests: 05)  
(*Syllabi of theory, practical and lab (skills) training together shall be completed in 80 hours*)

**Unit -1: Basics of Gardening**

(10h)

1. Garden and gardening: Definitions, objectives and scope; types of gardens (domestic garden, flower garden, woodland garden, rock garden, water garden and herb and vegetable garden).
2. Speciality gardens (vertical garden, roof garden and scented garden); principles of gardening; garden components and adornments;
3. Styles of garden: formal, informal, free style and wild; some famous gardens of India.

**Unit -2: Garden operations**

(10h)

1. Bio-aesthetic planning, eco-tourism, theme parks, indoor gardening, therapeutic gardening.
2. Gardening operations: soil laying, manuring, watering, management of pests and diseases and harvesting.
3. Lawn making, methods of designing rockery and water garden.

**Unit-3: Ornamental plants**

(10h)

1. Ornamental plants: flowering annuals and perennials; climbers and creepers; shade and ornamental trees.
2. Bulbous and foliage ornamental plants; cacti and succulents; palms, ferns.
3. Bonsai: definition, types and styles, art of making bonsai.

**Unit-4: Propagation techniques**

(10h)

1. Propagation of ornamental plants by rhizomes, corms tubers, bulbs and bulbils.
2. Vegetative propagation techniques – a brief account of cuttings, layering and grafting.
3. Types of seed beds; sowing of seeds and raising seedlings, transplanting of seedlings; growing plants in pots, potting and repotting.

**Unit-5: Landscaping**

(10h)

1. Landscaping: definition, landscaping of parks and public gardens.
2. Urban planning and planting avenues; Landscaping highways and educational institutions; beautifying villages and colonies.
3. Computer Aided Designing (CAD) for outdoor and indoor-scaping.

### **III. References:**

1. Bose T.K. and Mukherjee, D., 1972, Gardening in India, Oxford & IBH Publishing Co., New Delhi.
2. Sandhu, M.K. 1989 Plant Propagation, Wiley Eastern Ltd., Bengaluru.
3. Nambisan, K. M. P. 1992. Design Elements of Land Scape Gardening Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
4. Bose, T. K. Malti, R. G. Dhua, R. S and Das, P. 2004. Floriculture and Landscaping. Nayaprakash, Calcutta.
5. Arora, J.S. 2006. Introductory Ornamental Horticulture. Kalyani Publishers, Ludhiana.
6. Web resources suggested by the teacher concerned and the college librarian including reading material.

### **Course 6D: Gardening and Landscaping – Practical syllabus**

**IV. Learning Outcomes:** On successful completion of this practical course, student will be able to:

1. Perform various skills related to gardening.
2. Identify the living and non-living components required for garden development.
3. Identify the pests and diseases of garden plants and control the same.
4. Demonstrate skills of making bonsai and developing lawn.
5. Make landscape design using CAD.

### **V. Practical (Laboratory) Syllabus: (30 hrs)**

1. Preparation of beds for growing nursery of herbs, shrubs and trees.
2. Tools, implements and containers used for propagation and nursery techniques.
3. Identification of different ornamental plants.
4. Demonstration of types and styles of gardens using photos or videos.
5. Gardening operations: soil laying, manuring, watering.
6. Identification of pathogenic and non-pathogenic diseases of garden plants and grasses.
7. Propagation by cutting, layering, budding and grafting.
8. Planning and designing of gardens, functional uses of plants in the landscape.
9. Preparation of land for lawn and planting.
10. Exposure to CAD (Computer Aided Designing)
11. Demonstration of bonsai making.
12. Making of topiaries.

### **VI. Lab References:**

1. Paul Wagland, 2011. Garden Landscaping Manual: A Step-by-Step Guide to Landscaping & Building Projects in Your Garden, Haynes Publishing UK
2. Misra Kaushal Kumar, 2016. Practical Manual of Horticulture, Biotech Books, Open Library.org
3. Hemla Naik, B., S.Y. Chandrashekhar and M. Jawaharlal, 2013. Principles of Landscape Gardening, TNAU, Agrimoon.Com.
4. Web sources suggested by the teacher concerned.

## **VII. Co-Curricular Activities:**

### **a) Mandatory:** (*Lab/field training of students by teacher: (Lab: 10 + field: 05 hours)*)

1. **For Teacher:** Training of students by the teacher in the laboratory/field for a total of not less than 15 hours on the field techniques/skills of garden operations, lawn making, art of bonsai, plant propagation methods, Using CAD.
2. **For Student:** Students shall (individually) visit the parks in public and private places, study the living and non-living elements of gardening – landscaping; write their observations (on various plants, growth habit, propagation, design of garden etc.,) and submit a hand-written Fieldwork/Project work Report not exceeding 10 pages in the given format to the teacher.
3. Max marks for Fieldwork/Project work Report: 05
4. Suggested Format for Fieldwork/Project work Report: Title page, student details, index page, details of place(s) visited, observations, findings, and acknowledgements.
5. Unit tests (IE).

### **b) Suggested Co-Curricular Activities:**

1. Training of students by related industrial experts.
2. Assignments (including technical assignments like identifying ornamental plants, types and styles of gardens, propagation of garden plants, landscaping)
3. Seminars, Group discussions, Quiz, Debates etc. (on related topics).
4. Preparation of videos on plant propagation, garden operations, ornamental gardening.
5. Collection of material/figures/photos related to gardening and landscaping, writing and organizing them in a systematic way in a file.
6. Visits to gardens and parks in public places and/or private firms; famous gardens in A.P. and India etc.
7. Invited lectures and presentations on related topics by field/industrial experts.



## Model Question Paper Pattern for Practical Examination

Semester – V/ Botany Skill Enhancement Course

### Gardening and Landscaping

Max. Time: 3 Hrs.

Max. Marks: 50

- 
- |   |            |
|---|------------|
| 1. Demonstration a vegetative propagation technique ‘A’         | 8          |
| 2. Demonstration of bed making/ garden operations’ ‘B’          | 10         |
| 3. Demonstration of bonsai technique/ designing a landscape ‘C’ | 12         |
| 4. Scientific observation and data analysis                     | 4 x 3 = 12 |
| D. Type or style of garden                                      |            |
| E. Ornamental plant   |            |
| F. Garden adornments  |            |
| G. Pest or disease of garden plants                             |            |
| 5. Record + Viva-voce   | 5+3 = 8    |

A.P. State Council of Higher Education  
Semester-wise Revised Syllabus under CBCS, 2020-21

Course Code:

Four-year B.Sc. (Hons)  
Domain Subject: **BOTANY**  
IV Year B. Sc. (Hons) – Semester – V

Max Marks: 100

**Course 7D: Agroforestry**

(Skill Enhancement Course (Elective), Credits: 05)

**I. Learning Outcomes:**

Students at the successful completion of the course will be able to:

1. Understand the concepts and economic value of agroforestry.
2. Acquire a critical knowledge on systems and design of agroforestry.
3. Explain silviculture practices in relation to agroforestry.
4. Understand the role of agroforestry to reclaim the waste lands.
5. Perform skills in relation to tree measurement techniques.

**II. Syllabus:** (Hours: Teaching: 50, Lab: 30, Field training: 05, others incl. unit tests: 05)  
(*Syllabi of theory, practical and lab (skills) training together shall be completed in 80 hours*)

**Unit-1: Basic concepts of Agroforestry** (10h)

1. Forest and Agroforestry. Definition, objectives, scope and advantages of agroforestry; classification of agroforestry; differences between social forestry and agroforestry.
2. Agroforestry practices as existing in India and Andhra Pradesh.
3. Criteria for selection and screening of tree species; design and diagnosis methodology in relation to agroforestry.

**Unit-2: Systems of Agroforestry** (10h)

1. Global agroforestry system: shifting cultivation, taungya cultivation, shelter belt and wind breaks, and energy plantation and homestead gardens.
2. Multipurpose tree species and their characteristics; criteria for selection of agroforestry design, role tree architecture and management in agroforestry.
3. Alley cropping, high density short rotation plantation systems, silvicultural woodlots, energy plantations.

**Unit-3: Silviculture of Agroforestry trees** (10h)

1. Silviculture: Definition, objectives and scope and its place in agroforestry.
2. Choice of species, site selection, and pure versus mixed crop, planting techniques and methods, protection of seedlings/ plantations from environmental and biological adversaries, tending operations, concept of coppice etc.
3. Silviculture of agroforestry trees with special reference to: (a) *Azadirachta indica*, (b) *Tectona grandis* (c) *Embolica officinalis* and (d) *Tamarindus indica*.

**Unit-4: Waste land reclamation** (10h)

1. Wasteland definition, types: ecological characteristics, landslides, soil erosion, hoods, drought, salinity, water logging and fire.
2. Biological causes of deforestation, grazing, shifting cultivation and faulty agricultural practices.

3. Reclamation of wastelands, scientific land use practices, afforestation, soil conservation practices, improvement of water catchment areas and development of recreational and amenity areas.

**Unit-5: Measurements in Agroforestry** (10h)

1. Tree measurement techniques: Instruments and methods for measurement of tree diameter, height, bark thickness, crown volume crown surface area.
2. Tree stem form, yield tables, volume tables, concept of sustained yield, and kind of tree rotation, increment and yield; estimation of biomass.
3. Determination of tree age and introduction of working plan.

**III. References:**

1. Dwivedi, A.P. 1992. Agroforestry: Principles and Practices. Oxford & IBH
2. Nair, P.K.R. 1993. An Introduction to Agroforestry. Kluwer.
3. Nair P.K.R., M.R. Rai and L.E.Buck, 2004. New Vistas in Agroforestry. Kluwer
4. Rajeshwar Rao G., M. Prabhakar, G. Venkatesh, I. Srinivas and K. Sammi Reddy (2018) Agroforestry Opportunities for Enhancing Resilience to Climate Change in Rainfed Areas, ICAR-CRIDA, Hyderabad
5. Young, A. 1997. Agroforestry for Soil Management. CABI
6. Web resources suggested by the teacher concerned and the college librarian including reading material.

**Course 7D: Agroforestry – Practical syllabus**

**IV. Learning Outcomes:** On successful completion of this practical course, student will be able to:

1. Identify suitable tree species for agroforestry and their products.
2. Demonstrate skills on raising tree species from seeds and by vegetative propagation.
3. Perform skills on measurements related to wood-based products.
4. Estimate biomass in an energy plantation.

**V. Practical (Laboratory) Syllabus:** (30 hrs)

1. Identification of agroforestry tree-species.
2. Identification of important major and minor agroforest products.
3. Collection and maintenance of agro-forest products and herbarium
4. Nursery lay out seed sowing and pre-sowing seed treatments.
5. Vegetative propagation techniques – hard wood cuttings and air layering.
6. Diameter measurements using calipers and tape; diameter measurements of forked, buttressed, fluted and leaning trees.
7. Height measurement of standing trees by shadow method, single pole method and hypsometer.
8. Volume measurement of logs using various formulae.
9. Biomass estimation in energy plantations.

**VI. Lab References:**

1. Meena, R. N. and R.K. Singh, 2014. A Practical Manual on Agroforestry, Srijan Samiti Publication, Varanasi
2. Dadhwal, K.S., P.Panwar, R.Kaushal, H.S.Saralch and R.Chauhan, 2014. Practical Manual on Agroforestry, Jaya Publishing House, Delhi

3. Sen, N. L., R. C. Dadheech, L. K. Dashora and T. S. Rawat, 2010. Manual of Agroforestry and Social forestry, Agrotech Publishing Academy, Udaipur
4. Web sources suggested by the teacher concerned.

## **VII. Co-Curricular Activities:**

**a) Mandatory:** (*Lab/field training of students by teacher: (Lab: 10 + field: 05 hours)*)

1. **For Teacher:** Training of students by the teacher in the laboratory/field for not less than 15 hours on techniques like selection and screening of tree species, design and diagnosis methodology in agroforestry, silviculture practices for some selected tree species and measurements in agroforestry.
2. **For Student:** Students shall (individually) visit to nurseries of forest department, agroforestry division in Horticulture university/research station, agroforest/silviculture sites, write their observations on nursery practices, various species grown in an agroforest, growth habit, cultivation practices, measurements, products etc., and submit to the teacher a hand-written Fieldwork/Project work Report not exceeding 10 pages in the given format.
3. Max marks for Fieldwork/Project work Report: 05
4. Suggested Format for Fieldwork/Project work Report: Title page, student details, index page, details of place visited, observations, findings and acknowledgements.
5. Unit tests (IE).

**a) Suggested Co-Curricular Activities:**

1. Training of students by related industrial experts.
2. Assignments (including technical assignments like criteria for selection of agroforestry tree species; silviculture practices in agroforests; measurements in agroforestry; economic, social, land use and cultural services of agroforestry)
3. Seminars, Group discussions, Quiz, Debates etc. (on related topics).
4. Preparation of videos on various agroforestry methods, silviculture practices, tree measurement techniques etc.,
5. Collection of material/figures/photos related to agroforestry, writing and organizing them in a systematic way in a file.
6. Visits to social forest nurseries, energy plantations and forest research centres; nearby agro-forest based industries in A.P.
7. Invited lectures and presentations on related topics by field/industrial experts

### Model Question Paper Pattern for Practical Examination

Semester – V/ Botany Skill Enhancement Course

#### Agroforestry

Max. Time: 3 Hrs.

Max. Marks: 50

- 
- |  |            |
|--|------------|
| 1. Demonstration pre-sowing seed treatments ‘A’                  | 8          |
| 2. Demonstration of hard wood cutting/air layering technique ‘B’ | 10         |
| 3. Demonstration of technique of diameter/height measurement ‘C’ | 12         |
| 4. Scientific observation and data analysis                      | 4 x 3 = 12 |
| D. Agroforest plant  |            |
| E. Agroforest product  |            |
| F. A tool used for measurement                                   |            |
| G. A herbarium specimen collected by him/her for identification  |            |
| 5. Record + Viva-voce  | 5+3 = 8    |

### Suggested pattern for Question Paper of Theory Examination(s) at Semester end

Max. Time: 3 Hrs.

Max. Marks: 75 M

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#### Section – A

Answer all the following questions.

5 x 2 = 10 M

- ✓ One question should be given from each Unit in the syllabus.

#### Section – B

Answer any Four of the following questions. Draw a labelled diagram wherever necessary

3 x 5 = 15 M

- ✓ One question should be given from each Unit in the syllabus.

#### Section – C

Answer any five of the following questions. Draw a labelled diagram wherever necessary

5 x 10 = 50 M

- ✓ Two questions (a & b) are to be given from each Unit in the syllabus (internal choice in each unit). Student has to answer 5 questions by choosing one from a set of questions given from a Unit.

**Note:** Questions should be framed in such a way to test the understanding, analytical and creative skills of the students. All the questions should be given within the frame work of the syllabus prescribed.