

3. Jordan E.L., Verma P.S., 2018. *Chordate Zoology*. S. Chand Publishers, New Delhi, India.
4. Rastogi S.C., 2019. *Essentials of Animal Physiology*, 4th Edition. New Age International Publishers.
5. Verma P.S., Agarwal V.K., 2006. *Cell Biology, Genetics, Molecular Biology, Evolution and Ecology*. S. Chand Publishers, New Delhi, India.
6. Sathyanarayana U., Chakrapani U., 2013. *Biochemistry*, 4th Edition. Elsevier Publishers.
7. Jain J.L., Jain S., Jain N., 2000. *Fundamentals of Biochemistry*. S. Chand Publishers, New Delhi, India.
8. Timberlake K., Timberlake W., 2019. *Basic Chemistry*, 5th Edition. Pearson Publishers.
9. Subrata Sen Gupta, 2014. *Organic Chemistry*, 1st Edition. Oxford Publishers.

ACTIVITIES

1. Prepare a display chart of the life cycle of non-flowering plants.
2. Prepare a display chart of the life cycle of flowering plants.
3. Study of stomata.
4. Activity to prove that chlorophyll is essential for photosynthesis.
5. Study of pollen grains.
6. Observation of pollen germination.
7. Ikebana (flower arrangement).
8. Differentiate between edible and poisonous mushrooms.
9. Visit a nearby mushroom cultivation unit and study its economics.
10. Draw the ultrastructure of prokaryotic and eukaryotic cells.
11. Visit a zoology lab and observe different methods of specimen preservation.
12. Hands-on experience with laboratory equipment – Microscopes, Centrifuge, pH Meter, Electronic Weighing Balance, Laminar Air Flow.
13. Visit a zoo, sericulture, apiculture, or aquaculture unit.
14. List different hormonal, genetic, and physiological disorders observed in society.

REFERENCES

1. Tortora G.J., Funke B.R., Case C.L., 2016. *Microbiology: An Introduction*, 11th Edition. Pearson Publications, London.
2. Pelczar M.J., Chan E.C.S., Krieg N.R., 2002. *Pelczar Microbiology*, 5th Edition. McGraw Education, New York, USA.
3. Sathyanarayana U., Chakrapani U., 2013. *Biochemistry*, 4th Edition. Elsevier Publishers.
4. Jain J.L., Jain S., Jain N., 2000. *Fundamentals of Biochemistry*. S. Chand Publishers, New Delhi, India.
5. Dubey R.C., 2014. *Advanced Biotechnology*. S. Chand Publishers, New Delhi, India.
6. Ratledge C., Kristiansen B., 2008. *Basic Biotechnology*, 3rd Edition. Cambridge Publishers.
7. Sathyanarayana U., 2005. *Biotechnology*, 1st Edition. Books and Allied Publishers Pvt. Ltd., Kolkata.
8. Upadhyay, Upadhyay, Nath, 2016. *Biophysical Chemistry: Principles and Techniques*. Himalaya Publishing House.
9. Lesk A.M., *Introduction to Bioinformatics*, 5th Edition. Oxford Publishers.
10. Kulkarni A.P., 2020. *Basics of Biostatistics*, 2nd Edition. CBS Publishers.

ACTIVITIES

1. Identify given organisms as harmful or beneficial.
2. Observe microorganisms from house dust under a microscope.
3. Identify microorganisms from pond water.
4. Visit a microbiology industry or biotech company.
5. Visit a wastewater treatment plant.
6. Retrieve a DNA or protein sequence of a gene.
7. Perform BLAST analysis for DNA and protein.
8. Solve problems on biostatistics.
9. Conduct field trips and awareness programs on environmental pollution caused by wastes and hazardous materials.
10. Demonstration of basic biotechnology laboratory equipment.
11. Prepare 3D models of genetic engineering techniques.
12. Prepare 3D models of transgenic plants and animals.

1. General characteristics of bryophytes; classification by Rothmaler (1951).
2. Occurrence, morphology, anatomy, reproduction, and life cycles of:
 - a) Hepaticopsida – *Marchantia*
 - b) Anthocerotopsida – *Anthoceros*
 - c) Bryopsida – *Funaria*
3. General account of evolution of sporophytes in bryophytes.

IV. TEXT BOOKS

1. Pandey B.P. (2013). *College Botany*, Volume I. S. Chand Publishing, New Delhi.
2. Hait G., Bhattacharya K., Ghosh A.K. (2011). *Textbook of Botany*, Volume I. New Central Book Agency Pvt. Ltd., Kolkata.

V. REFERENCE BOOKS

1. Fritsch F.E. (1945). *The Structure and Reproduction of Algae* (Vol. I & II). Cambridge University Press, UK.
2. Bold H.C., Wynne M.J. (1984). *Introduction to the Algae*. Prentice-Hall Inc., New Jersey.
3. Lee R.E. (2008). *Phycology*. Cambridge University Press, New York.
4. Van Den Hoek C., Mann D.G., Jahns H.M. (1996). *Algae: An Introduction to Phycology*. Cambridge University Press.
5. Alexopoulos C.J., Mims C.W., Blackwell M. (2007). *Introductory Mycology*. Wiley & Sons, New York.
6. Mehrotra R.S., Aneja K.R. (1990). *An Introduction to Mycology*. New Age International Publishers, New Delhi.
7. Kavanagh K. (2005). *Fungi: Biology and Applications*. John Wiley & Sons, England.
8. Webster J., Weber R.W.S. (2007). *Introduction to Fungi*. Cambridge University Press.
9. Shaw A.J., Goffinet B. (2000). *Bryophyte Biology*. Cambridge University Press.

VI. SUGGESTED ACTIVITIES AND EVALUATION METHODS

Unit 1:

Activity: Collection of algal specimens from local water bodies; recording characteristics, identification, and classification based on Fritsch system.

Evaluation Method: Assessment of report/presentation.

Unit 2:

Activity: Microscopic observation of six algal forms (excluding syllabus genera) and recording distinguishing features.

Evaluation Method: Quiz/exam or evaluation of charts/drawings/comparative data.

Unit 3:

Activity: Collection or laboratory culture of fungi and reporting key features.

Evaluation Method: Report evaluation, JAM/Quiz/Group discussion.

Unit 4:

Activity: Microscopic observation and summarization of features of fungal genera and lichens.

Evaluation Method: Quiz/exam or evaluation of charts/drawings.

Unit 5:

Activity: Collection, identification, and classification of four bryophytes from local areas.

Evaluation Method: Assessment based on accuracy, documentation, and presentation/report.

3. Microbial interactions – Mutualism, commensalism, competition, amensalism, parasitism, predation.
4. Microorganisms of rhizosphere, phyllosphere, and spermosphere; their effects on plant growth.

UNIT 5: Microbes in Agriculture (10 Hrs.)

1. Mass production, application, advantages, and limitations of bioinoculants (*Rhizobium*, *Azotobacter*, *Azospirillum*, cyanobacteria).
2. Role of *Frankia* and VAM in soil fertility.
3. Microbial biopesticides – Mode of action, influencing factors, and target pests; microbial herbicides.

IV. TEXT BOOKS

1. Bhattacharjee R.N. (2017). *Introduction to Microbiology and Microbial Diversity*. Kalyani Publishers, New Delhi.
2. Dubey R.C., Maheshwari D.K. (2013). *Textbook of Microbiology*. S. Chand & Company, New Delhi.
3. Toshniwal R.L. (2007). *Agricultural Microbiology*. Agrobios, Jodhpur.

V. REFERENCE BOOKS

1. Pelczar M.J., Chan E.C.N., Krieg N.R. (2001). *Microbiology*. Tata McGraw-Hill, New Delhi.
2. Prescott L., Harley J., Klein D. (2005). *Microbiology*. Tata McGraw-Hill, New Delhi.
3. Gyaneshwar A.D., Parekh G.J., Reddy V.S. (2004). *Agricultural Microbiology: Plant-Soil Interactions*. Research Signpost, India.
4. Shuler Z.A., Abid Z. (2014). *Agricultural Microbiology: Principles and Applications*. CRC Press, USA.

VI. SUGGESTED ACTIVITIES AND EVALUATION METHODS

Unit 1:

Activity: Collection of literature on historical developments in microbiology.

Evaluation: Assessment based on report quality.

Unit 2:

Activity: Group discussion on special groups of bacteria.

Evaluation: Assessment based on participation, communication, and teamwork.

Unit 3:

Activity: Poster/presentation on classification of eubacteria.

Evaluation: Based on accuracy and understanding.

Unit 4:

Activity: Microscopic observation of soil/phylloplane bacteria.

Evaluation: Report evaluation based on identification and classification.

Unit 5:

Activity: Culture and mass production of bioinoculants.

Evaluation: Assessment of practical skills.

III. TEXT BOOKS

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

IV. REFERENCE BOOKS

- Esau, K. (1971). *Anatomy of Seed Plants*. Wiley, USA.
- Fahn, A. (1990). *Plant Anatomy*. Pergamon Press, Oxford.
- Cutler, D.F. et al. (2008). *Plant Anatomy: An Applied Approach*. Wiley.
- Rudall, P. (1987). *Anatomy of Flowering Plants*. Cambridge University Press.
- Bhojwani, S.S., Bhatnagar, S.P. (2000). *Embryology of Angiosperms*. Vikas Publishing.
- Maheshwari, P. (1971). *Introduction to Embryology of Angiosperms*. McGraw Hill.
- Johri, B.M. (2011). *Embryology of Angiosperms*. Springer.
- Kormondy, E.J. (1996). *Concepts of Ecology*. PHI, New Delhi.
- Odum, E.P. (1996). *Fundamentals of Ecology*. Natraj Publishers.
- Sharma, P.D. (2012). *Ecology and Environment*. Rastogi Publications.
- Kumar, H.D. (2000). *Biodiversity & Sustainable Conservation*. Oxford & IBH.

ST. JOSEPH'S COLLEGE FOR WOMEN (AUTONOMOUS) VISAKHAPATNAM

II SEMESTER

BOTANY

TIME: 2Hrs/week

Anatomy and Embryology of Angiosperms, Plant Ecology and Biodiversity

BOTANY B 3152

Practical Syllabus

Max.Marks:50

W.e.f. "20AH"

I. COURSE OUTCOMES

On successful completion of this practical course, students will be able to:

1. Perform sectioning, staining, and microscopic study of plant tissues.
2. Identify and draw diagrams of plant anatomical and reproductive structures.
3. Apply ecological methods to study plant populations and biodiversity conservation.

II. LABORATORY / FIELD EXERCISES

1. Study of tissue organization in root and shoot apices using permanent slides.
2. Anomalous secondary growth in *Boerhaavia* and *Dracaena*.
3. Study of anther and ovule using slides/photographs.
4. Study of pollen germination and pollen viability.
5. Observation of embryo sac haustoria (*Santalum* or *Argemone*).
6. Study of endosperm types (nuclear and cellular).
7. Observation of endosperm haustoria (*Crotalaria* or *Coccinia*).
8. Developmental stages of dicot and monocot embryos.
9. Study of instruments for microclimatic variables: Soil thermometer, maximum–minimum thermometer, anemometer, rain gauge, lux meter (including field visit to meteorological station).
10. Study of hydrophytes and xerophytes (morphological and anatomical adaptations).
11. Quantitative analysis of herbaceous vegetation (frequency, density, abundance).
12. Identification of vegetation and comparison with Raunkiaer's frequency distribution law.
13. Estimation of alpha diversity of plants in a given area.
14. Mapping of biodiversity hotspots of the world and India.

3. Physiology of flowering: Photoperiodism, role of phytochrome in flowering.
4. Seed germination and senescence; physiological changes during seed germination.

IV. Text Books:

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

V. Reference Books:

1. Aravind Kumar & S.S. Purohit (1998) Plant Physiology – Fundamentals and Applications, Agro Botanica, 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.
7. Pandey, S.M. & B.K. Sinha (2006) Plant Physiology, Vikas Publishing House, New Delhi.
8. Salisbury, Frank B. & Cleon W. Ross (2007) Plant Physiology, Thomsen & Wadsworth, Australia & U.S.A.
9. Sinha, R.K. (2014) Modern Plant Physiology, Narosa Publishing House, New Delhi.
10. Taiz, L. & E. Zeiger (2003) Plant Physiology, Panima Publishers, New Delhi.
11. Verma, V. (2007) Text Book of Plant Physiology, Ane Books India, New Delhi.

VI. Suggested activities and evaluation method:

- **Unit-1: Activity:** Observe and tabulate the water content of different plant parts and justify the importance of the water based on the morphological nature.
 - **Evaluation method:** Assess the report and assign the grade points based on a rubric.
- **Unit-2 Activity:** Survey report on various inorganic and organic fertilizers available in the local markets.
 - **Evaluation method:** Assess the record and award the grades on a specified point scale.
- **Unit-3 Activity:** Identify the C4 plants from their locality and make a report.
 - **Evaluation method:** Assessing the clarity, organization, and effectiveness of the report's presentation and communication based on a rubric.

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.

ST. JOSEPH'S COLLEGE FOR WOMEN (AUTONOMOUS), VISAKHAPATNAM		
V SEMESTER	BOTANY	TIME: 3Hrs/Week
B 5153	PLANT TISSUE CULTURE	Max. Marks: 50
w.e.f. "20AH"	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. Manual, Springer-Verlag Berlin Heidelberg

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