UNIVERSITY OF MADRAS

M.Sc. DEGREE PROGRAMME IN BOTANY

SYLLABUS WITH EFFECT FROM 2023-2024

Title of the Course		**APPLIED PLANT CELL AND TISSUE CULTURE**					
Paper Number		**Core X**					
Category	Core	**Year**	II	**Credits**	5	**Course Code**	523C3C
		Semester	III				
Instructional Hours per week		**Lecture**	**Lecture**	**Tutorial**	**Lab Practice**		
		4	1	-	5		
Pre-requisite		The course will equip students to either obtain employment in the field or start their own business there, depending on the needs of the industry.					

Learning Objectives:

C1	To comprehend the basic principles and methodologies of plant tissue culture.
C2	To acquire knowledge on *in vitro* cultivation techniques to develop protocols targeted towards commercialization.
C3	To gain understanding of the various techniques of tissue culture for secondary metabolites production. .
C4	To recognize the worth of traditional germplasm and receive training in preserving and enhancing crop varieties to meet consumer demand and global legal policies.
C5	To impart practical information on plant tissue culture in order to produce labour suitable for the demands of the industry and research facilities.

UNIT	**CONTENTS**
I	**BASIC PLANT TISSUE CULTURE:** Totipotency and concepts of plant tissue culture – Laboratory organization – Design of different laboratories and management - Aseptic techniques - Methods of sterilization – Explant preparation - Transfer and incubation of culture, culture media – Inorganic nutrients – Macronutrients – Micronutrients - Carbon and energy sources – Organic supplements – Growth regulators – Solidifying agent – MS medium.
II	**CALLUS CULTURE AND SOMACLONES** Callus culture – establishment - Organogenesis – Embryogenesis. Somaclonal and gametoclonal variation – synthetic seed technology. Production of pharmaceutically important drugs- alkaloids – food additives and insecticides under *in vitro* system.
III	**MICROPROPAGATION:** Micropropagation – Stages of micropropagation - Multiplication by axillary and apical shoots – Multiplication by adventitious shoots – Multiplication and Rooting - Hardening - Factors effecting micropropagation - Practical applications of micropropagation –- Shoot tip/Meristem culture for virus free plants.
IV	**PROTOPLAST CULTURES AND HAPLOID PRODUCTION:** Production of haploids - Anther culture and pollen culture –Role of haploids in Plant breeding - Protoplast culture: Protoplast isolation, purification – regeneration – culturing. Protoplast fusion techniques – somatic hybridization and cybridization - Applications of protoplast culture and somatic hybridization.

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V	**GERM PLASM AND CRYOPRESERVATION** Germplasm storage and conservation – Methods of *in vitro* conservation – Cryopreservation and steps involved in cryopreservation of plant materials - Types of bioreactors - Stirred tank and air lift - its uses in various fields - Applications of tissue culture in agriculture, horticulture and forestry.	
Course outcomes: CO	**On completion of this course, the students will be able to:**	**Programme outcomes**
CO1	Recall the principles and culture techniques of cells, callus, organs, pollen, anthers, embryos and protoplasts.	K1
CO2	Understand the techniques used in plant growth and regeneration under *in vitro* conditions.	K2
CO3	Apply the role plant tissue culture techniques in the production some secondary metabolites and planting stock in horticulture.	K3
CO4	Analyze the conditions that are suitable for direct and indirect plant regeneration.	K4
CO5	Evaluate the self-skills obtained during the course thorough internal and external assessment systems.	K5
CO6	Create idea to seek for suitable job in relevant industries/research centers or to become a potential entrepreneur based on knowledge achieved during the course.	K6
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)	
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill	

Recommended Text:

1. Narayanaswamy, S. 1999. Plant cell and tissue culture. 8th edn. Tata McGraw Hill Publ. ISBN 0074602772.
2. Bhojwani, S.S and Razdan, M.K. 2004. Plant Tissue Culture, Read Elsevier India Pvt. Ltd. ISBN 818147 3256.
3. Trigiano, R.N and D.J. Gray (eds.). 2000. Plant tissue culture concepts and laboratory exercises. CRC Press. (Textbook). 2nd Edition.
4. Kyte, M and Kleyn, J. 1996. Plant from test tubes. Timber Press. Auge, R. et al., 1995. In vitro culture and its applications in horticulture. Science Publishers, Inc.
5. Auge, R. 1995. In vitro culture and its applications in horticulture. Science Publishers, Inc.
6. Gamborg, O.L. and G.C. Phillips (eds). 1995. Plant cell, tissue and organ culture. Springer Lab Manual.
7. Khasim, S.M. 2002. Botanical Microtechnique: Principles and Practice, Capital Publishing Company, New Delhi.

8. Srivastava, P.S. 1998. Plant Tissue Culture and Molecular Biology. N.R. Book Distributors, New Delhi.
9. Vinay Sharma and Afroz Alam. 2019. Plant Tissue Culture. Wiley.
10. Pullaiah, E., Rao, T., M.V. Subba, Sreedev. 2017. Plant Tissue Culture: Theory and Practicals. Scientific Publishers.
11. Chawla, H.S. 2009. Introduction to plant biotechnology, 3rd edition, Oxford and IBH publishing, New Delhi.
12. Gupta, S.D and Ibaraki, Y. 2006. Plant tissue culture engineering (Vol. 6). Springer Science & Business Media, Germany.
13. Razdan, M.K. 2015. Introduction to Plant Tissue Culture, 3rd edition. Oxford and IBH publishing, New Delhi.
14. Rober, H. Smith. 2013. Plant Tissue Culture: Techniques and Experiments, Academic Press, Elsevier.
15. Robert, N. Trigiano and Dennis, J and Gray (Eds.). 2011. Plant Tissue Culture, Development, and Biotechnology, CRC Press, Taylor & Francis Group.

Reference Books

1. Bhojwani, S. S and Dantu, P.K. 2013. Plant tissue culture: an introductory text (Vol. 318). New Delhi, India: Springer.
2. Vasil, I.K. and Thorpe, T.A. 1994. Plant Cell and Tissue Culture, Kluwer Academic Press, The Netherlands.
3. Loyola-Vargas, V.M. Ochoa-Alejo, N. 2016. Somatic embryogenesis: Fundamental aspects and applications, Springer international publishing, Switzerland.
4. Elhiti, M., Stasolla, C and Wang, A. 2013. Molecular regulation of plant somatic embryogenesis. In Vitro Cellular & Developmental Biology-Plant, 49(6), 631-642
5. Collins, H.A. and Edwards, S. 1998. Plant Cell Culture, Bios Scientific Publishers, Oxford, UK.
6. Hall, R.D. (Ed.). 1999. Plant Tissue Culture: Techniques and Experiments, Academic Press, New York.
7. Kartha, K.K. 1985. Cyropreservation of plant cells and organs. CRC Press, Boca Raton, Florida.
8. Rihan, H.Z., Kareem, F., El-Mahrouk, M.E., and Fuller, M.P. 2017. Artificial seeds (principle, aspects and applications). Agronomy, 7(4), 7.
9. Pullaiah, T. 2009. Plant Tissue Culture: Theory and Practicals, Scientific Publishers Journals Dept.Timir Baran Jha and Biswajit Ghosh. 2016. Plant Tissue Culture: Basic and Applied, Platinum Publishers; 2nd Edn.
10. Anis Mohammad and Ahmad Naseem. 2016. Plant Tissue Culture: Propagation, Conservation and Crop Improvement, Springer. Singapore.
11. Mba, C., Afza, R., Bado, S., and Jain, S.M. 2010. Plant Cell Culture: Essential Methods, John Wiley & Sons, UK.
12. Abdin, M.Z., Kiran, U., Kamaluddin, M., Ali, A. (Eds.). 2017. Plant Biotechnology: Principles and Applications, Springer publishers.
13. Fett-Neto, Arthur Germano (Ed.). 2016. Biotechnology of Plant Secondary Metabolism: Methods and Protocols, Springer publishers.
14. Smith, R.H. 2012. Plant tissue culture: techniques and experiments. Academic Press, UK.

15. Trigiano, R. N., and Gray, D. J. 2011. Plant tissue culture, development, and biotechnology. CRC Press, US.

Web resources:

1. https://nptel.ac.in/courses/102/103/102103016/
2. http://ugcmoocs.inflibnet.ac.in/ugcmoocs/spoc.php?coordinator=574
3. https://www.youtube.com/watch?v=bi755vQVNx8
4. https://www.elsevier.com/books/plant-tissue-culture/park/978-0-12-821120-5
5. https://onlinelibrary.wiley.com/doi/book/10.1002/9780470686522

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	3	2	1	2	2	1	3
CO2	3	3	2	2	3	3	2	3	2	2
CO3	2	2	3	3	1	2	1	3	3	3
CO4	3	3	3	3	3	2	3	3	3	3
CO5	3	3	2	3	2	3	3	3	2	3

S-Strong (3) M-Medium (2) L-Low(1)