University of Kerala

Discipline	**BOTANY**				
Course Code	**UK5DSEBOT304**				
Course Title	**PLANT BIOTECHNOLOGY**				
Type of Course	**DSE**				
Semester	**V**				
Academic Level	**300 - 399**				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	04	04 Hours	-	-	04 Hours
Pre-requisites	Basic knowledge about the various aspects of plants, concept of totipotency, genetic material				
Course Summary	This course provides a detailed account of the requirements of a tissue culture lab and covers the major procedures and events in plant tissue culture and recombinant DNA technology with speial ention its scope and application. An outlook on functional genomics and conservation biotechnology was also incorporated.				

Detailed Syllabus

Module	Unit	Content	Hrs
I		**Introduction and Techniques in tissue culture**	15
	1	Introduction to plant Biotechnology- Tissue culture- Basic principles, Totipotency of cells, differentiation and dedifferentiation. (brief account)	
	2	Requirements of tissue culture laboratory: culture vessels, instruments (pH meter, autoclave, weighing balance, refrigerator, distillation unit, microscope, Laminar air flow hood) (general account).	
	3	Medium composition and preparation: MS media- brief mentioning of different types of media- plant growth regulators; Procedures in tissue cultures- sterilization (dry, wet), aseptic techniques- explants in tissue culture.	
	4	Types of culture- Tissue and cell culture- callus culture- Cytodifferentiation, organogenesis- direct and indirect- *In vitro* techniques of micropropagation- axillary bud proliferation- meristem and shoot tip culture- production of virus-free plants and its applications; Somatic embryogenesis: Principle and concept- factors affecting embryo formation.	
	5	Cell Suspension Culture: Types- batch culture- continuous culture-open continuous-closed continuous, semi-continuous; Growth patterns in cell suspension culture- growth measurements- techniques for single cell culture. Root and hairy root culture. ***Learning Activity:-*** 1. Preparation of stock solution of MS media 2. Sterilization of tissue culture utensils 3. Preparation and sterilization of culture media	

		4. Techniques of culture- inoculation, sub culture etc.	
II		**Protoplast culture & Somatic hybridization**	**5**
	6	Protoplast culture and somatic hybridization- Significance, Problems and limitations; Protoplast isolation: methods- mechanical and enzymatic - production of protoplasts, osmoticum- protoplast viability and density- protoplast purification. Culture of Protoplast: Culture techniques- culture medium and environmental factors- cell wall formation, growth, division, and regeneration of plants.	
	7	Protoplast fusion and somatic hybridization- types- spontaneous fusion, induced fusion- types of fusogen- identification, and selection of hybrid cells-verification and characterization of somatic hybrids,-Cybrids.	
III		**Applications of Plant Tissue Culture**	**13**
	8	Clonal propagation, production of genetically variable plants. Crop improvement through tissue culture, scope, and application of tissue culture in forestry.	
	9	Production of secondary metabolites- method of production – factors affecting yield. Immobilized cell systems, bioreactors.	
	10	Application of somatic embryogenesis- Production of synthetic seed- encapsulation- Embryo rescue recovery of interspecific hybrids.	
	11	In vitro production of Haploids: Androgenic haploids and cyanogenic haploids- endosperm and embryo culture- Significance of haploids.	
	12	Application of plant biotechnology in agriculture horticulture and forestry: Improvement of cereals, vegetable crops, oil-yielding plants, ornamentals and forest trees. ***Learning Activity:-*** 1. Direct and indirect organogenesis 2. Preparation of artificial seeds	
IV		**Somaclones and Transgenics**	**15**
	13	Somaclonal variation- Origin and causes of somaclonal variants- applications, achievements, and limitations.	
	14	Recombinant DNA techniques- vectors, enzymes, PCR, Gene transfer mechanisms- Vector-mediated and vectorless gene transfer, Ti plasmid-mediated DNA delivery methods- Direct genetic transformation of DNA, particle bombardment, transformation of protoplast by electroporation, microinjection. ***Learning Activity:-*** 1. Isolation of DNA 2. Plasmid isolation 3. PCR amplification (demonstration only) 4. Agarose gel electrophoresis	
	15	Transgenic plants- GM crops-BT crops, Golden rice, Flavr -saver Tomato Current status and prospects of GM crops in India-New products - pharmaceuticals, bioremediation, edible vaccines, antiviral proteins.	
V		**Conservation Biotechnology & Functional Genomics**	**12**

	16	Germplasm Storage and Cryopreservation - Conservation Biotechnology –techniques of cryopreservation, choice of material, pre-culture, cryoprotection, freezing, thawing, reculture, vitrification, encapsulation applications of cryopreservation.	
	17	Analytical tools in Biotechnology: Molecular markers- RFLP, RAPD, microsatellites, NGS, Blotting techniques.	
	18	Innovations in plant biotechnology- Gene silencing, Antisense technology, Molecular pharming, Genome editing tools- CRISPR-Cas 9- Biosafety and bioethics in plant biotechnology.	

Suggested Readings

1. Brown, C.W., I. Campbell and F.G. Priest. 1987. Introduction to biotechnology Blackwell
2. scientific publications. Oxford.
3. Buchanan B.B, Gruissem W. and Jones R.L 2000. Biochemistry and Molecular Biology of
4. Plants. American Society of Plant Physiologistsm Maryland, USA.
5. Chawala, H. S. 2002. Introduction to Plant Biotechnology. Oxford & IBH Pubilishing Co.
6. Pvt.Ptd. New Delhi.
7. Dubey, R.C.1993. A Text book of Bio-Technology. S.Chand& Co. Ltd. New Delhi.

References

1. Turner, P.C. A.G. MC Lennan. A.D. Bates And M.R.H. White. 1998. Instant Notes in
2. Molecular. Biology. Viva Books Pvt. Ltd. Chennai.
3. Wolfe, S.L. 1993. Molecular and Cellular Biology. Wadsworth Publishing Co, Clifornia.
4. De Robertis, E.D.P & De Robertis, E.M.F (1980) Cell and molecular biology, Holt Saunders
5. International Editions, Philadelphia, Tokyo.
6. Ignacimuthu, S.J. 2012 Biotechnology –An introduction. Narosa Publishing House, New Delhi.

Web Link

1. https://www.intechopen.com/chapters/40180
2. https://www.apsnet.org/edcenter/disimpactmngmnt/labexercises/PlantBiotechnology/Documents/PlantTissueCulture.pdf
3. https://www.intechopen.com/chapters/63134
4. https://www.microscopemaster.com/transgenic-plants.htm

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Understand the core concepts and fundamentals of plant biotechnology	U	PSO-2
CO-2	students will be able to the function of cells in molecular – cellular totipotency	Ap	PSO-2

CO-3	Equip the students to carry out plant tissue culture. Analyse and evaluate secondary metabolite production from cultures	An, E	PSO-4
CO-4	The students will be able to understand the knowledge of the production of biologically important secondary metabolites through tissue culture.	AP	PSO-6,8
CO-5	Understand the current developments in the field of Biotechnology-strategy of conservation, artificial seeds, somaclonal variation	Ap	PSO-8

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: Plant Biotechnology
Credits: 4:0:0 (Lecture:Tutorial:Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/Tutorial (T)	Practical (P)
1	1	2	U	F, C	L	P
2	2	2	Ap	P	L	P
3	3	4	An, E	P	L	P
4	4	6,8	Ap	P	L	P
5	5	8	Ap	F, C,P	L	

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓			✓
CO 4		✓		✓
CO 5		✓		✓