Gyanmanjari Innovative University

Course Syllabus
Gyanmanjari Institute of Technology
Semester-7

Subject: Plant Biotechnology and Tissue Culture - BETBT17331

Type of course: Professional Core

Prerequisite:

Basic understanding of Cell Biology, Genetics, Molecular Biology, Plant Physiology, and fundamental concepts of Biotechnology. Familiarity with basic laboratory techniques will be beneficial for studying Plant Biotechnology and Tissue Culture.

Rationale:

Plant Biotechnology and Tissue Culture have emerged as important interdisciplinary fields with significant applications in agriculture, horticulture, forestry, pharmaceuticals, and crop improvement programs. The course is designed to provide students with fundamental and advanced knowledge of plant tissue culture techniques, genetic engineering, molecular markers, and modern biotechnological approaches used in plant science research and industry.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks					Total Marks
				Theory Marks		Practical Marks		CA	
CI	T	P	C	ESE	MSE	V	P	ALA	
4	0	2	5	60	30	10	20	30	150

Legends: CI-Class Room Instructions; T – Tutorial; P - Practical; C – Credit; ESE - End Semester Examination; MSE-Mid Semester Examination;V–Viva;CA Continuous Assessment; ALA-Active Learning Activities.

GYANMANJARI INNOVATIVE UNIVERSITY BHAVNAGAR

Course Content:

Unit No.	Course content	Hrs	% Weightage
1	**Fundamentals of Plant Biotechnology and Tissue Culture :** Scope, principle and applications of Plant Biotechnology, History and milestones of in vitro culture, Concept of totipotency, differentiation, competency and determinism, Types of in vitro cultures, Organization of tissue culture laboratory, Sterilization techniques and aseptic conditions, Culture media composition and preparation, Role of plant growth regulators, fundamental aspects of morphogenesis and somatic embryogenesis, callus and cell suspension cultures, growth measurements.	15	25%
2	**Micropropagation and Commercial Applications** Stages of micropropagation, Hardening and acclimatization, Somaclonal variation, Cryopreservation techniques, Secondary metabolite production, Bioreactors in plant tissue culture, Commercial applications in agriculture and horticulture	15	25%
3	**Plant Genetic Engineering and Molecular Markers** Gene transfer methods in plants, Agrobacterium-mediated transformation, Gene gun method, Electroporation, Ti plasmid and selectable markers, Transgenic plants and their applications, Molecular markers:RFLP, RAPD, AFLP, SSR, SNP, CAPS, Marker-assisted selection and genome mapping	15	25%
4	**Plant Breeding, Advanced Biotechnology and Biosafety** History and objectives of plant breeding, Genetic resources and centers of origin of crop plants, Law of homologous variation QTL mapping and genomics-assisted breeding, Plant genomics, proteomics and metabolomics, CRISPR/Cas genome editing, Bioinformatics in plant biotechnology, Biosafety, IPR and ethical issues in biotechnology	15	25%

Continuous Assessment:

Sr. No.	Active Learn	Marks
1.	**Case Study analysis:** Students analyze a recent biotechnology-based crop improvement technology such as genetic engineering, CRISPR-Cas9 gene editing, synthetic seeds, marker-assisted breeding, or transgenic crops, and discuss	10

	its methodology, benefits, limitations, and future prospects.	
2.	**Protocol Design:** Students prepare a detailed protocol for the micropropagation of a commercially important plant (e.g., banana, potato, sugarcane, orchid, or bamboo), including explant selection, sterilization methods, culture media composition, growth regulators, and hardening procedures. Upload the prepared protocol on the GMIU web portal.	10
3.	**Report and Presentation:** Students undertake a small project involving protocol design, analysis of tissue culture data, optimization of culture conditions, or a case study on the commercial production of tissue-cultured plants, followed by a report and presentation later uploaded to GMIU web portal	10
Total		30

Suggested Specification table with Marks (Theory):60

Distribution of Theory Marks (Revised Bloom's Taxonomy)						
Level	Remembrance (R)	Understanding (U)	Application (A)	Analyze (N)	Evaluate (E)	Create (C)
Weightage	20%	40%	30%	10%	-	-

List of Practical

Sr. No	Title	Hours
1	Preparation of MS medium	2
2	Sterilization and aseptic transfer	2
3	Callus induction	4
4	Micropropagation techniques	4
5	DNA isolation from plants	4
6	PCR and gel electrophoresis	4
7	Demonstration of molecular markers	4
8	Surface sterilization of plant explants	2
9	Estimation of chlorophyll content in regenerated plantlets.	2

10	Chromosome preparation from root tips	2
Total		30

Course Outcome:

After learning the course, the students should be able to:	
CO1	Remember and Develop proficiency in maintaining aseptic techniques, culture media preparation, and in vitro culture methods.
CO2	Apply plant tissue culture techniques for micropropagation, germplasm conservation, and production of disease-free plants.
CO3	Explain the principles of plant genetic engineering, molecular markers, and marker-assisted breeding.
CO4	Analyze the role of modern biotechnological tools such as genomics, CRISPR technology, and bioinformatics in crop improvement. Evaluate the commercial, agricultural, ethical, and biosafety aspects of plant biotechnology.

InstructionalMethod:

- The course delivery method will depend upon the requirement of content and the need of students.The teacher in addition to the conventional teaching method by blackboard, may also use any of Tool as demonstration, role play, Quiz, MOOCs etc.
- Students will use supplementary resources such as online videos, e-courses, Virtual Laboratory
- The internal evaluation will be done based on the Active Learning Assignment

REFRENCE BOOK:

1. Narayanaswamy, S. (2005) - Plant Cell & Tissue Culture, Tata McGraw-Hill.
2. Acquaah, G. Principles of Plant Genetics and Breeding, John Wiley sons, 2012.
3. Xu Y, Molecular Plant Breeding, CAB International, 2010.
4. Bhojwani SS, Razdan MK. Plant Tissue culture. Theory and Practice. Elsevier B. V. Publications, 2009. 4. Sambrook, J and Russell, D, Molecular Cloning: A Laboratory Manual, Third Edition, Cold Spring Harbor Laboratory Press, NY, 2001
5. Sleper, DA and Poehlman, JM. Breeding Field Crops, Wiley-Blackwell, NJ. 2006
6. Allard RW, Principles of Plant Breeding. 2nd Edition, John Wiley & Sons, NJ, 1999.