



SECOND SEMESTER 2022-2023
(COURSE HANDOUT PART II)

Date: 17.01.2023

In addition to part I (General Handout for all courses appended to the time table) this portion gives further specific details regarding the course.

Course No: BIO G643

Course Title: Plant Biotechnology

Instructor-In charge: SRIDEV MOHAPATRA

Instructors: Gireesha Mohannath, Nikhil P.T., Abhirami T.S.

1. Scope and Objective of the Course:

Plant cell and tissue culture, media constituents, micro propagation and other culture techniques, their applications and limitations, germplasm storage, secondary metabolite production, therapeutic protein and antibody production through plants, promoter designing and inducible promoters, molecular markers and their applications, approaches to influence metabolite partitioning and quality and quantity of plant storage products.

This course will provide an insight to the theory and practice of plant biotechnology with emphasis on plant cell and tissue culture and genetic engineering of plants. Scope and objectives of this course encompass (a) plant cell and tissue culture (with emphasis on media constituents, micropropagation and other culture techniques, their applications and limitations, germplasm storage, secondary metabolite production etc.) and (b) techniques and applications of plant transformation (vectors for plant transformation, promoter designing and inducible promoters, molecular markers and their applications, genetic manipulation of herbicide tolerance, pest resistance, disease resistance, stress tolerance, improvement of crop yield and quality, therapeutic protein and antibody production through plants, approaches to influence metabolite partitioning and quality and quantity of plant storage products, public concerns of GM crops).

2. Text Books:

- (1). Narayanaswamy, S. Plant Cell and Tissue Culture, Tata McGraw Hill Publishing Company Limited, 1994 (Tenth Reprint 2011).
- (2). Adrian Slater, Nigel W. Scott, and Mark R. Fowler: Plant Biotechnology: The Genetic manipulation of plants (Second edition). Oxford University Press (Reprint 2010).

3. Reference Books:

- (1). Bhojwani, S.S. and Razdan, M.K. Plant Tissue Culture: Theory and Practices, A Revised Edition, Elsevier, Reprint 2004.
- (2). Hammond, J. Mc Garvey, P. and Yusibov, Plant Biotechnology. Springer Verlag, Berlin, NY (1999), 3rd Indian Reprint 2009.
- (3). Recent research articles and reviews will be recommended regularly.

4. Course Plan:

Lec. No.	Learning Objective	Topic	Reference to chapter
1	<i>Introduction</i>	Overview of plant tissue culture and plant biotechnology	Chap. 1, TB1 Chap 1, TB2
2	<i>Objective, scope and basic requirements of plant tissue culture</i>	Historical introduction to plant tissue culture, Lab organization (Lay out, requirements and general techniques)	Chap 1, 2-TB 1 Chap 1, 2-RB 1

3-4	<i>Requirements to grow plants in vitro (details)</i>	Culture media constituents, impact of hormones and other chemicals in culture media on the physiology of plant cells, media selection and preparation	Chap 3, TB 1 Chap 3, RB 1
5-6	<i>In vitro techniques of clonal propagation</i>	Micropropagation stages, factors affecting micropropagation, applications and limitations.	Chap 7, TB 1 Chap 16, RB 1
7-8	<i>Production of haploids</i>	Haploid production through anther culture and microspore culture, applications and limitations.	Chap 10, TB 1 Chap 7, RB 1
9	<i>Producing disease free plants</i>	Meristem culture and virus free plants.	Chap 6, TB 1 Chap 15, RB 1
10-11	<i>Producing secondary metabolites</i>	Cell culture and biosynthesis of secondary products	Chap 14, TB 1
12-14	<i>Creating variations in vitro</i>	Somaclonal variations.	Chap 9, RB 1
15-17	<i>Somatic hybridization</i>	Protoplast isolation and culture, somatic hybrids production.	Chap 11, TB 1 Chap 12 & 13, RB 1
18	<i>Germplasm storage</i>	Cryopreservation.	Chap 15, TB 1 Chap 18, RB 1
19	<i>Introduction to plant transformation</i>	Implications for plant transformation, protein targeting, heterologous promoters, molecular markers and their applications, <i>Arabidopsis</i> and new technologies	Chap 1, TB2 Chap 1, RB2
20-22	<i>Techniques for plant transformation</i>	Agrobacterium mediated transfer and the Ti plasmid technology, practical applications of Agrobacterium mediated plant transformation and case study, direct gene transfer methods.	Chap 3, TB2 Chap 2, 3, RB2
23-25	<i>Vectors for plant transformation</i>	Desirable features of a vector, development of plant transformation vectors and optimization	Chap 4, TB2 Chap 4, RB2
26-38	<i>Case studies</i>	Genetic manipulation of herbicide tolerance, pest resistance, plant disease resistance, strategies for engineering stress tolerance, strategies for improvement of crop yield and quality	Chap 5, 6, 7, 8, 9 and 10, TB2
39-40	<i>Approaches to influence metabolite partitioning and quality and quantity of plant storage products</i>	Molecular farming of Starch, polyfructans, bioplastics, the oleosin system, custom made antibodies, edible vaccines	Chap 11, TB2 Chap 5, 6, 8, RB2
Self Study	<i>Science and society</i>	Public concerns over GM crops and government regulations	Chap 12, TB2 Chap 1, RB2

List of Experiments:

1. Surface sterilization and germination of plant seeds in soil and nutrient media
2. Induction of callus from plant explants in nutrient media
3. Propagation of callus in suspension cultures
4. Tissue regeneration from callus
5. Protoplast isolation from dicot leaves
6. qRT-PCR of selected plant genes
7. Transformation of *Agrobacterium tumefaciens* with appropriate plant expression vector
8. Infiltration of *Nicotiana benthamiana* leaves with *Agrobacterium tumefaciens* and analysis of transformants

5. Evaluation Scheme:

Component	Duration	Weightage (%)	Date and time	Nature of Component
Mid-sem exam	90 min	20	16/03 9.30 - 11.00AM	Closed Book
Lecture assignments (Research related)	Variable	20	Variable	Open Book
Laboratory assignments	Variable	30	Variable	Open Book
Comprehensive Examination	180 min	30	15/05 FN	10% Closed Book + 20% Open Book

6. Chamber Consultation Hour: By prior appointment obtained in person or by email

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7. Notices: Notices, if any, regarding the course will be displayed on the **CMS**.

8. Make-up Policy: Only medical emergencies with evidence will be considered for make-up. For regulations about the make-up flexibility, students are advised to refer to Clause 4.07 of *BITS Academic Regulations*.

9. Academic Honesty and Integrity Policy: Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

Instructor-in-charge

BIO G643