

**Bachelor of Science (Hons.) in Applied Life Sciences with
Agrochemicals and Pest Management
SEMESTER-VI**

BOTANY COMPONENT - DSC

DISCIPLINE SPECIFIC CORE COURSE (DSC 06)

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Plant Biotechnology: Concepts and Applications ALS BOT DSC 06	4	2	0	2	Class 12th Pass with Science	NIL

Learning Objectives:

The learning objectives of this course are as follows:

- to give students knowledge of techniques used in plant biotechnology and its applications.
- to explore the use of biotechnology to generate genetic variation in plants and to understand how factors at the cellular level contribute to the expression of genotypes and hence to phenotypic variation.
- to understand the biotechnological processes such as recombinant DNA technology and its applicative value in pharmaceuticals, food industry, agriculture, horticultural and ecology. This knowledge is central to our ability to modify plant responses and properties for global food security and commercial gains in biotechnology and agriculture.
- to perform the techniques currently used to generate information and detect genetic variation.

Learning Outcomes:

By studying this course, students will be able to:

- comprehend the basic concepts, principles and processes of plant biotechnology.
- apply the acquired knowledge in biotechnological, pharmaceutical, medical, ecological and agricultural fields.
- use the basic biotechnological techniques to explore molecular biology of plants.
- explain the use of biotechnological techniques for plant improvement and biosafety concerns.

Unit 1: Introduction to Biotechnology

(2 Hours)

Historical timeline; Brief overview of techniques and methods in Biotechnology, sectors of Biotechnology.

Unit 2: Plant Tissue Culture

(8 Hours)

Historical perspective (Haberlandt, Laibach, White, Reinert and Steward, Murashige, Cocking, Guha and Maheshwari, Bhojwani, Morel and Martin); Composition of media; Nutrients (major and minor), vitamins and hormones; Plasticity and Totipotency; Regeneration: Organogenesis (Direct and Indirect) and Embryogenesis (somatic and zygotic); Protoplast isolation, culture and fusion; Tissue culture applications (micropropagation, androgenesis, haploids, triploids, cybrids, production of virus-free plants).

Unit 3: Recombinant DNA Technology and Genetic Transformation

(12 Hours)

Restriction Endonucleases (History, Types I - IV, biological role and applications); Modifying enzymes and their applications (nucleases, ligases, alkaline phosphatase, polynucleotide kinase) Introduction to prokaryotic and eukaryotic cloning vectors: pBR322, pUC 18, pUC19, BACs, Lambda phage, YACs. Gene Cloning: Restriction digestion of DNA, ligation, bacterial transformation and selection of recombinant clones; Methods of gene transfer to plants: *Agrobacterium*-mediated transformation (Ti plasmids), Direct gene transfer by Electroporation, Microinjection, Microprojectile bombardment; Selection of transgenic plants: selectable marker

genes (Positive selection markers – antibiotic- and herbicide-resistance conferring genes) and reporter genes (Luciferase, GUS, GFP).

Unit 3: Applications of Transgenic Technology

(8 Hours)

Pest resistant (Bt-cotton) and herbicide resistant plants (RoundUp Ready soybean); Transgenic crops with improved quality traits (Flavr Savr tomato. Golden rice); Improved horticultural varieties (Moondust carnations); Role of transgenics in bioremediation (Superbug); Edible vaccines; Introduction to genome editing; Biosafety of transgenic plants.

PRACTICALS

60 hours

1. Preparation of nutrient media for plant cell cultures- Murashige & Skoog's (MS) medium and B5 medium.
2. Initiation of axenic cultures (seed sterilisation and inoculation)
3. Micropropagation (shoot induction) using leaf and/or nodal explants of tobacco/*Datura/ Brassica* etc.
4. Study of anther culture, embryo and endosperm culture, somatic embryogenesis using digital resources/ photographs.
5. Preparation of artificial seeds.
6. Isolation of plasmid DNA.
7. Induction of callus and analysis of effects of growth regulators on *in vitro* regeneration using tobacco as a model plant
8. Preparation of competent cells and transformation of *E. coli* by heat shock method.
9. Restriction digestion and gel electrophoresis of plasmid DNA.
10. Construction of restriction map of circular and linear DNA from the data provided.
11. Visit to a Research laboratory.

Essential/recommended readings:

1. Bhojwani, S.S., Bhatnagar, S.P. (2011). The Embryology of Angiosperms, 5th edition. New Delhi, Delhi: Vikas Publication House Pvt. Ltd.
2. Bhojwani, S.S., Razdan, M.K., (1996). Plant Tissue Culture: Theory and Practice. Amsterdam, Netherlands: Elsevier Science.
3. Glick, B.R., & Patten C. (2022). Molecular Biotechnology: Principles and Applications. 6th edn. Washington, U.S.: ASM Press.
4. Brown, T. A. 2020. Gene Cloning & DNA Analysis: An Introduction. 8th edn. UK: Wiley Blackwell.
5. Slater, A., Scott, N. W. & Fowler, M. R. (2010) Plant Biotechnology: The Genetic Manipulation of Plants. 2nd edn. New York, USA: Oxford University Press Inc.
6. Primrose, S. B. and Twyman, R.M. (2013) Principles of Gene Manipulation and Genomics. 7th edn. Wiley-Blackwell Publishing.

Suggested Readings :

1. Stewart, C.N. Jr. (2008). Plant Biotechnology and Genetics: Principles, Techniques and Applications. New Jersey, U.S.: John Wiley & Sons Inc.
2. Snustad, D.P., Simmons, M.J. (2010). Principles of Genetics, 5th edition. Chichester, England: John Wiley and Sons.
3. Bhojwani, S.S. and Dantu, P.K. (2013). Plant Tissue Culture: An Introductory Text. Springer New Delhi Heidelberg New York Dordrecht London

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.