

**JYOTI NIVAS COLLEGE AUTONOMOUS
SYLLABUS FOR 2018 BATCH AND THEREAFTER**

Programme: B.Sc.

Semester: VI

BIOTECHNOLOGY PAPER VII

AGRICULTURAL AND INDUSTRIAL BIOTECHNOLOGY

Course Code: 18VIBT7

No. of Hours: 45

COURSE OBJECTIVES:

- This paper covers major areas related to commercial applications of biotechnology in agricultural sectors. This is aimed at students acquiring a practical knowledge on the techniques involved in the regeneration of plants through in vitro methods.
- Importance is also being given to current topics like plant transgenics and plant defence mechanisms.
- It also gives importance on methods of production of various industrially important chemicals through fermentation technology with an emphasis on the fermentation economics which is very much needed in current industrial sectors.

LEARNING OUTCOMES: On completion of the course, students will develop skills regarding

- Relationship between society and science
- Genetic manipulation of plants for the development of agricultural sector
- Environment friendly agricultural techniques for better production of plants
- Contribute to both economic and environmental sustainability
- Basic understanding of bioreactor designing
- knowledge into food processing industry and bioprocess technology.

UNIT I PLANT TISSUE CULTURES

07 HRS

Introduction and basic requirements of plant tissue culture. Totipotency and their role in *in-vitro* propagation. **Culture media**– Definition, chemical composition, role of phytohormones in plant tissue culture and types (*Murasighe and Skoog (MS), Nistch, and Whites Media*). **Micropropagation** – General account on Collection, Sterilization and Inoculation of explants (*Detailed account on micropropagation of virus free plants through meristem culture*). **Callus** – definition, formation and types (friable and compact), a brief account of organogenesis and embryogenesis. **Germplasm storage**–Introduction to germplasm, cryopreservation and its applications (*Brief account*).

UNIT II TYPES OF CULTURE

06 HRS

Endosperm, Embryo, Anther culture, Suspension culture and Hairy root culture, **Protoplast culture** - Protoplast isolation [Mechanical, Enzymatic method], Protoplast fusion [*Mechanical & Chemical Method*], Selection of hybrid protoplasts [*Visual, Auxotrophic mutants, staining technique, drug sensitivity method*], Applications of protoplast culture. A brief account

on Somatic Hybridization, Cybrids and its applications. Brief account of production and applications of secondary metabolites [*Betalin and Digoxin*]

UNIT III PLANT BIOTECHNOLOGY

10 HRS

Introduction to plant defence, biotic and abiotic stresses, A brief mention on plant diseases [Microbial], Plant immunity against various microbial infections, role of R – genes and PR proteins, Introduction to antibiosis and antagonisms. **Production of transgenic plants:** herbicide resistant (Round Up Ready[®]), insect resistant (Bt cotton), virus resistant, fungal resistant, bacterial resistant and drought resistant plants. Use of transgenic plants for the production of Vaccines, Vitamins (Golden Rice), Interferons and Biodegradable plastics. Antisense RNA technology and its applications.

UNIT IV FERMENTATION TECHNOLOGY

08 HRS

Introduction to industrial biotechnology and its applications. Introduction to upstream processing in fermentation. Isolation and Screening of Industrially useful microbes (Primary and Secondary screening), Strain improvement. Concept of biotransformation. Immobilization of whole cells. Fermentation Media – Carbon and Nitrogen sources, Minerals, Vitamins and Growth factors, Precursors, Inducers and Inhibitors. Newtonian and Non-Newtonian fluids and Viscoelastic fluids. Sterilization - Air sterilization, Media and Vessel sterilization

UNIT V FERMENTER AND FERMENTATION METHODS

07 HRS

Fermentation, Types of fermentation (Batch, Continuous, submerged and solid-state fermentation. **Fermenter** - Design and basic construction and functions of a fermenter for microbial and animal cell cultures. Heat and Mass transfer; Aeration – Oxygen Transfer Rate (OTR). Agitation - Pneumatic systems and Hydrodynamic mechanism. Foam detection and Antifoams; Control and Monitoring of foam. Types of Fermenters - Stirred tank, Airlift, Photo bioreactors and bioreactors for immobilized cells.

UNIT 6: DOWNSTREAM PROCESSING

07 HRS

Introduction to downstream processing - Removal of microbial cells and other solid matter, foam separation, precipitation, filtration & Centrifugation. **Cell disruption** (physical methods – *liquid shear, solid shear & Freezing- thawing*, chemical methods – *detergents, osmotic shock & alkali treatment*). Liquid – liquid extraction, solvent extraction, membrane processes, Drying, crystallization, whole broth processing. Industrial Production of Ethanol, Citric acid and Glutamic Acid. A Brief account on Fermentation economics and Effluent treatment

REFERENCES:

1. Introduction to Plant Biotechnology - Chawla H.S., Oxford and IBH Publication Co., Pvt. Ltd, New Delhi; 2nd edition (2005).
2. Plant Biotechnology - Genetic Manipulations of Plants - Slater, Adrian and Others, Oxford University Press, Oxford. (2003).
3. Environmental Biotechnology by Prof. Jogdand, Himalaya Publishing House. (2006).
4. Agricultural Biotechnology – Purohit S.S., Agrobios (India), 2nd edition (2005).
5. Applied Plant Biotechnology by Rev. Fr. Ignacimuthu., Revised Edition Tata McGraw-Hill Publishing Company, New Delhi. (2006).

6. An Introduction to Plant tissue culture - Razdan, M.K., Oxford and IBH Publishing Co. Pvt. Ltd. (Reprint 1996).
7. Applied and Fundamental Aspects of Plant Cell, Tissue and Organ Culture - Reinert J. and Bajaj Y.P.S., Narosa Publishing House (1997).
8. Bisen P. S. Frontiers in Microbial Technology, 1st edition, CBS Publishers, New Delhi. (1994).
9. Glazer A. N. & Nikaido H, Microbial Biotechnology, W. H Freeman and Company, New York. (1995).
10. Sullia S. B and Shanthram S, General Microbiology, Oxford and IBH Publishing Co Pvt., New Delhi. (1998).
11. Creueger W and Crueger A, A text book of Industrial Microbiology, 2nd edition, Panima Publishers Corp, Delhi. (2000).
12. Standbury P. F, Whitaker H. and Hall S. J. Principles of Fermentation Technology, Pergamone Press, Oxford. (1978).

PRACTICAL - PAPER VII: AGRICULTURAL AND INDUSTRIAL BIOTECHNOLOGY
15 UNITS

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| 1. Requirements for the plant tissue culture laboratory | 1 UNIT |
| 2. Preparation of Media. | 1 UNIT |
| 3. Preparation of plant Explants | 1 UNIT |
| 4. Callus, Nodal or anther culture | 2 UNITS |
| 5. Protoplast Isolation (demo experiment) | 1 UNIT |
| 6. Study of VAM and VAM infection | 2 UNITS |
| 7. Production of amylase enzyme | 1 UNIT |
| 8. Production and estimation of citric acid by <i>Aspergillus niger</i> | 2 UNITS |
| 9. Preparation of wine | 1 UNIT |
| 10. Estimation of alcohol by specific gravity method. | 1 UNIT |
| 11. Production of yeast from fruit juice / Molasses | 1 UNIT |

Tests and Repetition.