M Sc biotechnology course of study

Title: Plant Biotechnology
Course code: BT523
Credits: 3

General objectives

- To acquaint with the principles, techniques, scientific and commercial applications of plant tissue and cell culture
- To expose to methodologies of plant tissue and cell culture, micropropagation techniques and applications of tissue and cell culture to plant improvement
- To make familiar with the molecular biology of plant development
- To acquaint with various methods of plant transformation and their uses.
- To acquaint with the process and genetic control of Plant development

Specific objective

- To introduce tissue culture techniques and demonstrate the principles of tissue culture
- To demonstrate how to initiate and perform tissue culture with a crop of choice.
- To provide knowledge on specialized cell culture techniques and their uses in plant science research and industry.
- To acquaint applications of biotechnology in creating fast- growing and healthy trees
- To acquaint the use of tissue culture in the production of phytochemicals
- To get informed to the potential of genetic engineering in the study of plants and its application in the improvement of plant varieties
- To explain various molecular biotechnology methods used in plants
- To know the basic process of embryo, seed, vegetative organs and reproductive organs development and their genetic control.

Plant Micro-Propagation Technique and Types of Culture 10 hrs

Scope of plant biotechnology and its application. Role of *in vitro* tissue culture in plant biotechnology. Types of in vitro culture, Techniques of Micropropagation: Axillary buds proliferation, Regeneration throughmeristem culture, callus cultures, organogenesis and somatic embryogenesis. Production, preservation and use of somatic embryos as propagules. Artificial synthetic seeds production, Suspension culture: Cell culture, Protoplast isolation and culture. Types of cell culture (continuous, discontinuous and semicontinuous culture), automation technology and its application in tissue culture. Cryopreservation and germ plasm storage. Indexing for plant pathogens-Culture indexing for bacterial and fungal contaminant. Micropropagation of woody plant.

Application of Tissue/Cell cultureTechniques 8 hrs

Techniques of Meristem culture and *in vitro* grafting for the production of virus free plants**.** Pollen/ microspore culture for haploid plant production, use of haploids in plant breeding and mutation research. Techniques of Embryo culture and embryo rescue in agricultural and horticultural corps**,**Application of embryo culture in wide hybridization. Endosperm culture.Suspension culture in bioreactor:Secondary metabolite (medicinal and other commercial products) production, Biotransformation, economic aspects of *in vitro* production of secondary metabolite of plants.Induction of somaclonal variation, screening and its applications, Somatic hybridization and production of hybrids. Plant tissue culture as industry, Automation of micropropagation and industrial production of plantlets

Mass scale production **5 hrs**

Molecular farming: novel proteins, carbohydrate and lipids production, enzyme production and Plant derived Vaccine. Culture in bioreactor: Principles and the technology, Carbohydrate and other economic chemicals production. Secondary metabolite production through cell cultures. Pharmaceutical & beverage production.

Single cell culture: media and techniques for algal culture, algae and cyanobacteria as source of nitrogen rich fertilizer, Single cell protein,

Genetic manipulation of plants **15 hrs**

*Techniques of introducing DNA into plant cells: (**10 hrs)***

Marker and reporter genes used for plant transformation, Model plants and their Role in genetic manipulation, Indirect transformation: Genetic transformation of plant tissues with the use of *Agrobacterium,* Ti-plasmid and mechanism of T-DNA transfer (different protein involved and their rolr, vir region and other genes involved), Ti plasmid derived plant vector systems; binary and cointrigative vectors transformation process, regeneration of the transformed lines, Plant Viruses as biological vectors. Direct gene transfer methods in plants (Microprojectile bombardment, Electroporation; polyethylene glycol (PEG)- mediated gene transformation, Silica carbomfibres whiskers). Transformation of protoplasts with naked DNA

Genetically modified plant and their Application (5hrs)

Genetic engineering for plant improvement: Development of Pest resistance, herbicide resistance, resistance against viruses, improving stress tolerance, Protoplast fusion and its implication, Importance of GM plants,

Plant developmental biology **10 hrs**

Life cycle of angiospermic plant, Introduction to developmental biology and morphogenesis in plants, Processes and molecular control mechanisms of different developmental stages: endosperm development, embryo development (radial and axil patterning), Seed and seedling development, dormancy, germination, vegetative growth (Pattern formation during Root and Shoot meristem development), Determination of leaf primordial and differentiation of leaf cells, Vegetative bud development, transition to reproductive growth, formation of floral organs and Floral development, senescence