**UNIVERSITY OF GONDAR**

**INSTITUTE OF BIOTECHNOLOGY**

**DEPARTMENT OF AGRICULTURAL BIOTECHNOLOGY**

**COURSE SYLLABUS FOR PLANT BIOTECHNOLOGY**

**Course Title:** **Plant Biotechnology**

**Course Code: Biot.611**

**ECTS: 9**

**Lecture: 4 hours/wk**

**Laboratory: 4 hours/wk**

**Collaborative learning: 3 hours/wk**

**Independent learning: 6 hours/wk**

**Length of time: 16 weeks**

**Pre-requisite module:** Molecular Biology (Biot. 616)

**Co-requisite module: None**

**Barred combination module: None**

**Description**

This module covers three main parts, Plant Tissue Culture, Genetic Transformation and Plant Molecular Breeding. The Plant Tissue Culture Part covers laboratory organization, nutrition medium for plant tissue culture, sterilization techniques, different types of plant tissue cultures including micropropagation, cell suspension culture and secondary metabolites, *in vitro* production of haploids, protoplast isolation and fusion. It also discusses on somaclonal variation, germplasm storage and cryopreservation. The plant genetic transformation part covers different types of plant genetic transformation methods including *Agrobacterium*-mediated, virus-mediated, biolistics, electroporation, macroinjection, microinjection, liposome-mediated, silicon carbide fiber-mediated, ultrasound-mediated, DNA transfer via pollen, and using different chemicals that promote transformation. Different expression systems, analysis of transgenics, selectable marker free transformation systems will also be discussed. Application of genetic transformation in plants, regulations of transgenic plants and germplasm importation, public concerns and dealing with these concerns, and current status of transgenic plant production will be covered. In the Molecular Breeding part, first basic plant breeding principles such as different mating systems and factors controlling these mating systems, the genetic structures of plant populations, phenotypic variations in plants and their genetic bases, the basic schemes in plant breeding and genetic manipulations in plant breeding will be covered. Following this basic introduction of plant breeding, mutagenesis, genetic mapping, principles and methods of different molecular markers, marker assisted selection and genomics will be covered. The module has lecture component, student self and collaborative activities, assignments, oral presentations and laboratory activities.

**Learning outcomes**

Upon a successful completion of this module students will be able to:

* Discuss the designs and organization of plant tissue culture laboratory
* Explain the requirements and composition of nutrition medium for plant tissue culture
* Use different sterilization techniques in laboratory
* Discuss and perform micropropagation, cell suspension culture, in vitro production of haploids and protoplast isolation and fusion
* Explain somaclonal variation
* Discuss germplasm storage and cryopreservation
* Explain different methods of plant genetic transformation and carry out some of them
* Carry out transgenic analysis using different techniques
* Discuss different applications of genetic transformation
* Describe different regulations of transgenic plants and germplasm importation
* Aware of public concerns of transgenic plants and how to deal with these concerns
* Discuss current status of transgenic plants in the world
* Discuss different mating systems and methods controlling these mating systems in plants
* Explain genetic structures of plant populations on the basis of mating systems
* Become familiar with the basic schemes in plant breeding
* Discuss genetic manipulations in plant breeding
* Explain principles and methods of different molecular markers and perform some of them
* Describe how to select mapping populations and construct genetic map
* Discuss how marker assisted selection contributes to improving crop plants

**Module Content**

Plant tissue culture laboratory organization

Nutrition medium, composition and preparation

Sterilization techniques

Types of cultures

Micropropagation

Cell suspension and secondary metabolites

*In vitro* production of haploids

Protoplast isolation and fusion

Somaclonal variation

Germplasm storage and cryopreservation

*Agrobacterium*-mediated transformation

Virus-mediated transformation

Biolistcs method of transformation

Electroporation method of transformation

Macroinjection method of transformation

Microinjection method of transformation

Liposome-mediated transformation

Silicon carbide fiber-mediated transformation

Ultrasound-mediated transformation

DNA transfer via pollen

Chemical-methods to promote transformation

Expression systems

Analysis of transgenics

Selectable marker free transformation systems

Application of genetic transformation in plants

Regulations of transgenic plants and germplasm importation

Public concerns and dealing with these concerns

Current status of transgenic plant production

Objectives of plant breeding

Mating systems and genetic structures of plant populations

Phenotypic variations in plants and their genetic bases

Genetic manipulations in plant breeding

Principles and methods of molecular markers

Genetic mapping

Marker assisted selection

Genomics

**Module Delivery**

This module is based on lectures, group discussions, laboratory exercises, student collaborative learning and student self-learning.

**Assessment Criteria**

There will be regular student assessment of module assignments, oral presentations, laboratory reports and final written exam. Grades are computed based on the results of these module assignments, presentations, laboratory reports and the final exam.

**Role of Instructors and Students**

***Instructors***

Give lectures

Moderate and guide interactive learning

Supervise student self and collaborative learning

Instruct laboratory sessions

Assess the performance of students

***Students***

Attend lectures

Actively participate in interactive, self and collaborative learning

Work laboratory exercises

Read materials that enrich their knowledge of subject area such as books, journal articles, etc.

Prepare term papers in groups or individually and present orally

Prepare laboratory reports

**Teaching Support and Inputs**

***Class room teaching-learning***

White board; White board markers and other stationeries; Board erasers; LCD projector

Transparency projector; Laptop

***Practical***

All Plant tissue culture and molecular biology, and various types of chemicals including laminar air flow hood, autoclave, 4 °C refrigerator, PCR machines, -20 °C freezer, -80 °C deep freezer, pipettes (various volumes), double distiller, ovens, , incubator (37 °C), water bath with temperature control, hot plate, heat sterilizer with glass beads, centrifuge, vortex, dissecting microscope, shaker, heating blocks, magnetic stirrers, pH meter, sensitive balance, electronic balance, various glassware, disposable items, reagents, plasmid vectors.

**Module requirements**

Students are expected to:

Attend lectures regularly

Actively participate in student self and collaborative learning

Read books, journal articles, etc. of the subject area

Work on assignments and oral presentations seriously

Carry out laboratory exercises regularly

**Reading Materials:**

1. Chawla, H.S. (2002). Introduction to Plant Biotechnology. 2nd edition. Science Publishers, Inc. Enfield, New Hmapshire
2. George, E.F. (1993). Plant Propagation by Tissue Culture. Part 1. The Technology. 2nd edition. Exegetics Ltd. Edington, Eilts.
3. George, E.F. (1996). Plant Propagation by Tissue Culture. Part 2. In Practice. 2nd edition. Exegetics Ltd. Edington, Eilts.
4. Glick, B. R. and Pasternak, J., J. (1998). *Molecular Biotechnology: Principles and Applications of Recombinant DNA*. 2nd edition. ASM Press. Washington, D.C.
5. Gupta, P. K. (2004). Elements of Biotechnology. Rastogi Publications. Meerut.
6. Satyanarayana, U. (2005). Biotechnology. Books and Allied (P) Ltd. Kolkata.
7. Varshney, R.K. and Tuberosa, R. (2007). Genomics-Assisted Crop Improvement. Genomics Approaches and Plant forms. Vol. 1. Springer…
8. Weising, K., Nybom, H., Wolff, K., Kahl, G. (2005). DNA Fingerprinting in Plants. Principles, Methods, and Applications. 2nd edition. CRC Press. Taylor and Francis. Boca Raton, London, New York, Singapore