Course title: Plant and Animal Biotechnology			
Course code: BBP 123	**No. of credits:** 2	**L-T-P:** 30-0-0	**Learning hours:** 30
Pre-requisite course code and title (if any): Science graduate			
Department: Department of Biotechnology			
Course coordinator: Dr. Shashi Bhushan Tripathi		**Course instructor:** Dr. Shashi Bhushan Tripathi	
Contact details: shashi.tripathi@terisas.ac.in			
Course type: Core		**Course offered in:** Semester 1	

Course description:

The broad objective of the present core course is to provide an overview of plant and animal biotechnology. In this respect, students will be acquainted with principles and applications of different techniques of plant and animal cell/tissue culture and genetic transformation. In case of cell and tissue culture, the focus shall be on media composition and preparation, methods of *in vitro* regeneration, their applications and limitations. With respect to genetic transformation, the focus will be on detection and characterization of transformants. Further, the global status of GMOs, various case studies illustrating the application of biotechnology in developing crop varieties resistant to various biotic and abiotic stresses, enhancing nutritional quality and knock-out animal technology would be dealt in detail.

Course objectives:

1. To introduce the students to the principles and applications of plant tissue culture and animal cell culture
2. Development of plant transformation vectors specifically designed to facilitate transfer of improved/unique genetic traits to plants, and to provide knowledge on diverse genetic transformation technologies available for the production of transgenic plants in crop improvement programs.
3. Familiarization with knock-out and transgenic animals to model disease and study gene function.

Course contents

Module	Topic	L	T	P
1	**Principles of plant tissue culture**	8	0	0
	• History of plant tissue culture • Set up of a plant tissue culture laboratory • Media constituents and preparation • Micropropagation and clonal fidelity testing • Meristem culture for production of virus free plants • Somatic Embryogenesis • Organogenesis • Micrografting • Hardening and acclimatization			

2	**Applications of plant tissue culture**	6	0	0
	• Anther, pollen and ovary culture for production of doubled haploids • Production of Triploids • Embryo culture and embryo rescue • Protoplast isolation, culture and fusion • Cell culture and production of secondary metabolites • Cryopreservation • Synthetic seed technology			
3	**Animal cell culture and biotechnology**	8	0	0
	• Brief history of animal cell culture; cell culture media and reagents (buffer and pH; blood buffering system) • Basic techniques of mammalian cell culture • Organotypic and histotypic cultures • Primary culture, secondary culture, continuous cell lines (cancer cell line), suspension cultures • Cell synchronization and transformation • Clonal selection, cell fusion and monoclonal antibody production • Application of animal cell culture for virus isolation and production of human and animal viral vaccines • Application of animal cell culture for disease modelling and high throughput drug screening • Application of animal cell culture for isolation of pharmaceutical proteins and recombinant anti-bodies • Development of iPSC and human specific disease modelling • Multiple Ovulation and Embryo Transfer Technology			
4	**Applications of transgenic technology**	8	0	0
	• Introduction to Agrobacterium tumefaciens and Ti Plasmids • In-planta transformation methods • Chloroplast Transformation • Detection, characterization and expression of transformants (Genetic markers, reporter genes and transgene stability) • Conferring resistance to biotic stresses (pests, viruses, fungi) and abiotic stresses (salt, drought, heat) • Enhancing nutritional quality of crops • Transgenics for male sterility • Marker free transgenics • Knock-out/in animal development using embryonic stem cells technology • Transgenic animal development to model disease and study gene function.			
	Total	**30**	**0**	**0**

Evaluation criteria:

1. Test 1- (Module 1) 30%
2. Test 2- (Module 2) 30%
3. Test 3- (Modules 3 and 4) 40%

Learning outcomes:

1. An understanding of principles of various plant and animal cell/tissue culture techniques (Test 1-3)
2. An understanding of commercial applications of various cell and tissue culture-based technologies in plants and animals (Test 1-2)
3. Ability to rationalize and develop strategies for incorporating novel traits in plants and animals through genetic engineering (Test 3)

Pedagogical Approach:

1. Online/classroom lectures and discussions
2. Case studies and examples from original research articles

Skill Set:

1. Formulation of media preparation for plant and animal cell cultures
2. Initiation and maintenance of plant and animal cell cultures
3. Genetic transformation of plants

Employability:

1. Academic organisations
2. Tissue culture facilities and horticulture companies
3. Agri-biotechnology and seed companies
4. Pharmaceutical and drug research companies
5. IPR consultancy firms

Materials:

Suggested Readings

1. George E. F., Hall A H, and De Klerk G J (2008) Plant propagation by tissue culture. Springer.
2. Bhojwani SS and Razdan M K (1996) Plant Tissue Culture : Theory and Practice. Elsevier.
3. Herman, Edwin B., (Ed.) (2009) Genetic modification of plants: methods and applications 2005-2009, USA: Agritech Consultants.
4. Herman, Edwin B., (Ed.) (2007) Microbial contaminants in plant tissue culture, Vol. III : 2003 – 2007. Agritech Consultants, Inc. Shrub Oak.
5. Neumann, K H, Kumar, A, Imani, J (2009) Plant Cell and Tissue Culture – A tool in biotechnology : Basics and applications.
6. Halford,Nigel G. (Ed.) (2006) Plant Biotechnology: Current and Future Applications of genetically modified crops. John Wiley and Sons Ltd.
7. Chrispeels MJ; Sadava DE (2003) Plant, Genes and Crop Biotechnology. Jones and Bartlett Publishers, Inc.
8. Pörtner, R. (2007) Animal Cell Biotechnology: Methods and Protocols. Totowa, NJ: Humana Press.

9. Freshney R.I. (2010) Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications. Wiley, John & Sons, Inc; New Jersey

Additional information (if any):

Student responsibilities:

1. Class attendance.
2. Study of reading materials as specified by course instructor
3. Self-study

Course reviewers:

1. Prof. Ranjit Kumar Giri, National Brain Research Centre, Manesar, Haryana
2. Dr. Modhumita Ghosh, Scientist G, Institute of Forest Genetics and Tree Breeding, Coimbatore, Tamil Nadu