GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Science (Industrial Biotechnology)

Level: PG Semester-3

Course / Subject Code: IB03001011

Course / Subject Name : Animal and Plant Biotechnology

1. Learning Outcomes

Learning Outcome Component	Learning Outcome (Learner will be able to)
Theoretical and practical understanding of Animal and Plant Biotechnology	• Understand sterile techniques, media preparation, DNA extraction methods, gene isolation and nucleotide sequence analysis. • Describe techniques and problems both technical and ethical in animal cloning.
Value applications of Animal and Plant Biotechnology in biological research as well as in biotech-industries	• Plant improvement with PCR based detection diagnostic tools. • Describe the contribution 'functional genomics' is making in animal biotechnology.
Effective Communication	• Communicate concepts and ideas effectively.
Professional & Ethical Behaviour	• Transparency, honesty and ethical reasoning in handling cells and biomolecules.

LO – PO Mapping: Correlation Levels:
1 = Slight (Low); 2 = Moderate (Medium); 3 = Substantial (High), "-"= no correlation

Sub Code: 1330101	PO1	PO2	PO3	PO4	PO5	PO6	PO7
LO1: Theoretical and practical understanding of Animal and Plant Biotechnology	3	2	3	3	2	2	2
LO2: Value applications of Animal and Plant Biotechnology in biological research as well as in biotech-industries	2	3	3	2	2	3	2
LO3: Effective communication	2	2	2	2	3	3	2
LO4: Professional & Ethical Behaviour	2	2	3	2	3	2	3

2. Course Duration: The course duration is 45 sessions of 60 minutes each.

3. Course Contents:

Module No:	Module Content	No. of Sessions	70 Marks (External Evaluation)
1	**Culture media for animal cell culture** Introduction and history; Media and supplements, serum, serum free media, natural media, feeder layer on substrate,	5	5

	Gas Phase for tissue culture, source of tissue, primary culture; Stages of commitment and differentiation, proliferation and malignancy.		
2	**Sub-culture and cell-lines** Cross contamination, terminology, naming and choosing cell line and its maintenance. Criteria for subculture, growth cycle and split ratio, propagation in suspension and attached culture.	5	10
3	**Cloning and Hybridoma technology** Vectors and cloning, somatic cell fusion, hybridomas, HAT selection, Medium suspension fusion, selection of hybrid clones, organ culture, tumorigenesis.	5	5
4	**Cell separation and quantitation** Separation techniques based on density, size, sedimentation velocity, antibody based techniques- immunopanning, magnetic sorting, fluroscence activated cell sorting; Quantitation-cell counting, cell weight, DNA content, protein, rate of synthesis, measurement of cell proliferation.	5	5
5	**Cell characterisation and differentiation** Authentication, record keeping, provenance, parameters of characterization, lineage and tissue markers, cell morphology, karyotyping, chromosome banding; Differentiation-commitment, terminal differentiation; Lineage selection, proliferation and differentiation, commitment and lineage, markers of differentiation, induction of differentiation, cell interaction-homotypic and heterotypic; Cell-matrix interaction	5	10
6	**Application of animal biotechnology and related problems**	4	5

	Artificial animal breeding, cloning and transgenic animals, medicines, vaccines, diagnosis of diseases and disorders, gene therapy, forensic application.		
7	**Cell and tissue culture in plants** Callus cultures; in vitro morphogenesis-organogenesis and embryogenesis; Artificial seeds, Micropropagation (clonal propagation); Haploidy; anther and ovule culture, Embryo culture; Protoplast isolation, culture protoplast fusion and somatic hybridization, cybrids, somaclonal variation; in-vitro mutation methods; virus elimination, pathogen indexing; cryopreservation; production of secondary metabolites; sources of plant secondary metabolites; criteria for cell selection, factors affecting culture of cells; different bioreactors and their use in secondary metabolite production; biochemical pathways for production of different secondary metabolites; biotransformation.	6	10
8	**Genetic engineering and applications** Principles and methods of genetic engineering and its applications in agriculture especially transgenic plants; Molecular markers-hybridization and PCR based markers, RFLC, RAPD, STS, SSR, AFLP, SNP markers; DNA fingerprinting- Principles and applications, introduction to mapping of genes/QTLS, marker assisted selection-Strategies for introducing genes of biotic and abiotic stress resistance in plants; Molecular diagnosis of pathogens in plants	5	10
9	**Plant and animal genomics** Overview of genomics- definition, complexity and classification, need for genomic level analysis, methods of analyzing genome at various levels- DNA, RNA, Protein, metabolites and phenotype, genome projects and bioinformatics- sources for genome research- database overview of forward and reverse genetics for assigning	5	10

	function of gene; Social, cultural, economic, legal problems; bioethics		
9	**Practicals** 1. Orientation to animal mammalian cell culture 2. Aseptic techniques for cell culture 3. Preparation of media and other reagents 4. Establishing primary cell culture 5. Preparation of monolayer and suspension cultures 6. Preparation and thawing cells 7. Checking viability and counting 8. Subculture, feed both adherent and suspension cultures 9. Growth curve analysis and use of fluorescent microscope for identification and analysis of cell cycle 10. Cell line cryopreservation 11. Preparation of cells for microscopy 12. Identification of apoptosis 13. Demonstration of mammalian cell culture in research and towards development of a variety of applications, such as large scale culture, production of monoclonal antibodies, production of viral vaccines and amniocentesis studies 14. Gene transfer experiments 15. Virus infection studies and virus quantification 16. Blood cell preparation such as macrophages, RBC etc.	-	(30 marks)

4. Pedagogy:

- ICT enabled Classroom teaching
- Practical / live assignment
- Interactive classroom discussions

5. Evaluation:
Students shall be evaluated on the following components:

	Internal Evaluation	**(Internal Assessment – 20 Marks)**
	• Assignments	10 marks

A	• Class Presence	5 marks
	• Record maintenance	5 marks
B	**Mid-Semester Examination**	**(Internal assessment-30 Marks)**
C	**End-Semester Examination**	**(External assessment-70 Marks)**

6. Reference Books:

No	Author	Name of the Book	Publisher	Year of Publication / Edition
1	Freshney, I	Cultures of Animal Cells	John Wiley and Sons Inc.	Latest Edition
2	Cibelli, J., Robert P., Keith L.H.S., Campbell H., and West M. D.	Principles of Cloning	Academic Press.	Latest Edition
3	J Hammond	Plant Biotechnology	Springer Verlag.	Latest Edition
4	R J Henry	Practical Application of Plant Molecular Biology	Champman and Hall	
5	Brun T.A.	Gene Gene Cloning and DNA Analysis. An Introduction Cloning and DNA Analysis. An Introduction	Blackwell Pub	Latest Edition
6	Primrose S.B and Twyman R.M.	Principles of Gene Manipulation and Genomics	Blackwell Pub.	Latest Edition
7	R. Ian Freshney	Culture of Animal Cells: a Manual of Basic Technique and Specialized Applications	John Wiley & Blackwell	6th Edition
8	J. M. Davis	Basic Cell Culture (Practical Approach Series)	OUP Oxford.	2nd Edition
9	S.J. Higgins and B.D. Hames	Protein Expression, A Practical Approach	OUP Oxford	Latest Edition

Note: Wherever the standard books are not available for the topic appropriate print and online resources, journals and books published by different authors may be prescribed.

Course Outcomes:
On completion of this course, students should be able to:

- Demonstrate knowledge of techniques related to basic cell culture, cloning and hybridoma production;
- Differentiate and describe establishment of primary cell culture and cell lines and enlist methods for quantitation and validation. Applications of various techniques of animal biotechnology in medical, farmland, industrial research and assessment of its social and ethical concerns;
- Recognize and assess the need for ethical standards and professional codes of conduct in animal and plant biotechnology research, Intellectual property rights.