GUJARAT TECHNOLOGICAL UNIVERSITY
Integrated Master of Science (Biotechnology)
Semester: 9
Subject Name: Animal and Plant Biotechnology
Subject Code: 1390401

Prerequisite: The prerequisites for Animal and Plant Biotechnology include a fundamental understanding of cell biology, genetics, microbiology, and biochemistry. Knowledge of molecular biology techniques, such as DNA extraction, PCR, and gene cloning, is essential. A grasp of tissue culture techniques for both plant and animal cells, along with familiarity with bioreactors and fermentation technology, is beneficial. Additionally, basic concepts in bioinformatics, genetic engineering, and regulatory guidelines related to biotechnology applications are important.

Rationale: Animal and Plant Biotechnology plays a crucial role in advancing agriculture, medicine, and environmental sustainability. It enables genetic modifications to enhance crop yield, pest resistance, and nutritional value in plants while improving disease resistance, productivity, and reproduction in animals. Biotechnology also supports the development of bio-based pharmaceuticals, sustainable food sources, and eco-friendly agricultural practices. By leveraging genetic engineering, tissue culture, and molecular breeding, this field contributes to food security, conservation, and the efficient use of natural resources, making it vital for global sustainability and human well-being.

Course Scheme:

Teaching Scheme			Total Credits	Assessment Pattern and Marks				Total Marks
				Theory		Practical		
L	T	PR	C	ESE (E)	PA(M)	ESE (V)	PA (I)	
4	0	8	8	70	30	30	20	150

Course Content:

Module No:	Module Content	No. of Sessions	Weightage (%)
1.	**Culture media for animal cell culture** Introduction and history; Media and supplements, serum, serum free media, natural media, feeder layer on substrate, Gas Phase for tissue culture, source of tissue, primary culture; Stages of commitment and differentiation, proliferation and malignancy.	6	10
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.	7	12

3	**Cloning and Hybridoma technology** Vectors and cloning, somatic cell fusion, hybridomas, HAT selection, Medium suspension fusion, selection of hybrid clones, organ culture, tumorigenesis.	6	10
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.	7	12
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	6	10
6	**Application of animal biotechnology and related problems** Artificial animal breeding, cloning and transgenic animals, medicines, vaccines, diagnosis of diseases and disorders, gene therapy, forensic application.	8	14
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.	7	12

	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	7	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 function of gene; Social, cultural, economic, legal problems; bioethics	6	10

Reference Books:

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

Course Outcome:

After Completion of the Course, Student will able to:

Sr. No	Course Outcome	RBT Level

1	• 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.	UN
2	• Plant improvement with PCR based detection diagnostic tools. • Describe the contribution 'functional genomics' is making in animal biotechnology.	AP
3	• Communicate concepts and ideas effectively.	AN
4	• Transparency, honesty and ethical reasoning in handling cells and biomolecules.	EV, AP

*RM: Remember, UN: Understand, AP: Apply, AN: Analyze, EL: Evaluate, CR: Create

List of Experiments:

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

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