SILVER OAK UNIVERSITY
EDUCATION TO INNOVATION
(Established under Gujarat Private Universities Act, 2009)

SEMESTER – III

- Animal Biotechnology
- Plant Biotechnology
- Intellectual Property Rights, Bio safety and Bioethics
- Medical and Environmental Biotechnology
- Cell Culture Technology and Tissue Engineering

- Lab-V: Plant Tissue Culture Techniques
- Lab-IV: Animal Cell Culture and Environmental

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Subject: - Animal Biotechnology								
Program: M.Sc.				**Subject Code:**			**Semester: III**	
Teaching Scheme				**Examination Evaluation Scheme**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**
04	-	4	6	24/60	20/50	16/40	-	150

Course Objectives:

- The objectives of this course are to introduce students to the principles, practices and application of animal biotechnology, animal genomics, genetic transformation and molecular breeding of animals.
- The course is designed to give students a perspective on recent advances in Animal Biotechnology. Students will get familiarized with the different approaches to generate transgenic animals for various applications.
- To know the causes of infertility in humans and the process of in-vitro fertilization.
- To understand the importance of aquaculture and to learn the induced breading techniques in fishes.

UNIT-I

Structure and function of male and female reproductive system. Infertilities in humans- Types and causes of male and female infertility, sperm collection, Cryopreservation, artificial insemination, Oocyte recovery, superovulation.

Learning Outcomes:

- Understand the History, scope, principle, merits and demerits of animal Biotechnology and Infertilities in humans
- Understand the structure and function of male reproductive system.
- Understand the structure and function of female reproductive system.
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UNIT-II

In vitro fertilization in humans and cattle, Artificial insemination (AI) techniques and their development: Oocyte maturation in vitro, Embryo culture, embryo transfer in farm animals. Somatic cell nuclear transfer in humans – Legal aspects. Immunocontraception - hormonal methods.

Learning Outcomes:

- Understanding the concept of IVF in humans and cattle.
- Developing embryo - transfer technology.
- Understanding structural, functional and comparative genomics of farm animals and its application for livestock improvement.

UNIT-III

An overview of transgenic technology, Development of transgenic mice, sheep and fish. Molecular pharming and animal cloning. Potential applications of transgenic animals. Biotechnological approaches for the management of pests, mosquitoes and nematodes.

Learning Outcomes:

- Understanding transgenic animals.
- Understand the Generation of chimeric, transgenic and knockout mice and other animals and their characterization.

UNIT-IV

Transgenic poultry and transgenic insects as bioreactors. Animal models for various diseases/disorders, production of peptides and proteins of biopharmaceutical interest. Transgenic animals in live-stock improvement; transgenic in industry; Risks and ethical issues in animal biotechnology

Learning Outcomes:

- Understanding the principles of transgenic animal and its application.
- Understanding the Production of peptides and proteins of biopharmaceutical interest (molecular farming).
- Understanding the live-stock improvement; transgenics in industry; Ethical issues in animal biotechnology

UNIT-V

Aquaculture - Fresh water fish culture practices and types. Bioactive compounds from corals. Fish bio products. Pearl culture technology – principles and applications. Breeding: Hypophysation and induced breeding techniques. Eyestalk oblation. Post-harvest technology. Diagnosis of shrimp & fish diseases caused by bacterial, fungal and viral pathogens using molecular methods.

Learning Outcomes:

- Understand the fresh water fish culture practices and types.
- Understand the bioactive compounds from corals and Pearl culture technology – principles and applications.
- Understand the breeding: Hypophysation and induced breeding techniques.
- Understand the diagnosis of shrimp & fish diseases caused by bacterial, fungal and viral pathogens using molecular methods.

Course Outcomes: at the end of the course, students will be able to

- Describe the basics of Animal Biotechnology. Comprehend the fundamental concepts of animal cell culture, and its importance.
- Discuss the significance of transgenesis with reference to animal models. Explain the principles and applications of animal cloning and gene therapy along with ethical concerns.
- To identify and comprehend experimental knowhow of various techniques involved in cell separation and quantitation using latest technology.
- To relate and evaluate the applications of animal biotechnology, animal breeding, vaccine production and other biotechnological products of industrial and medical benefits.
- To relate to the social, cultural, economical, legal issues associated and comprehend the need Bioethics and patent rights in biotechnological research.

BOOKS RECOMMENDED:

1. Text Book of Animal Biotechnology, P R Yadav.

REFERENCE BOOKS:

1. Elements of Biotechnology by PK Gupta (Rastogi& Co).
2. Biotechnology by Kashav. T (Wiley Eastern Ltd).
3. Concepts in Biotechnology by Balasubrahmanianet. al., (University press)
4. Principles and practices of aquaculture by TVR Pillay.
5. Coastal aquaculture by Santhanam.
6. Fisheries of India by CBL Srivatsava.
7. Molecular Biotechnology by Glick.

SILVER OAK UNIVERSITY
EDUCATION TO INNOVATION
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Subject: - Plant Biotechnology								
Program: M.Sc.				Subject Code:			Semester: III	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE)- Theory	Continuous Internal Evaluation (CIE)- Practical	Total
04	-	4	6	24/60	20/50	16/40	-	150

Course Objectives:

- To understand basic and advanced Plant Biotechnology techniques & concepts.
- The students should able to know the applications of Plant Biotechnology.
- Learn how to present Plant molecular biology data and concepts to an audience.
- Understand current experimentation and research in the field of Plant Biotechnology.

UNIT-I

Plant Genetic engineering: Cloning Vectors, Screenable and Selectable markers. Gene cloning techniques. Agrobacterium and its importance in Plant transformation, The process of T-DNA transfer and integration, TI plasmid. Vectors for plant transformation: Features of Binary vectors. Techniques for gene transfer into plants: Agrobacterium mediated transformation, Direct Gene transfer by Particle bombardment. Identification of transgenic plants. Reporter genes. Transient gene assays. Clean gene technology.

Learning Outcomes:

- At the end of the unit the student should be able to understand how cloning is done.
- The student should understand different techniques used in Plant transformation.

UNIT-II

Molecular markers and their significance: Hybridization and PCR based markers - RFLP, SSR, SNP's, AFLP & RAPD. Biodiversity utilization and conservation. Introduction to molecular mapping in plants. Marker Assisted Selection (MAS). QTL mapping in plants.

Learning Outcomes:

- At the end of the unit the student should be able to conceptualize polymorphism and different molecular markers types.
- The student should able to understand how molecular markers are utilized in molecular breeding for crop improvement.

UNIT-III

Agricultural Biotechnology: Engineering of herbicide tolerance in plants (Case study: Glyphosate & Phosphinothricin tolerance), Environmental impact of herbicide tolerant crops: The development of super weeds. Development of insect resistant plants (Case study: Resistance of Bt Cotton). Biopesticides & Biofertilizers. Genetic engineering to improve plant disease resistance: PR proteins and antimicrobial proteins. Biotechnological strategies for engineering stress tolerance: Nature of abiotic stresses (Case studies: Glycine betaine production for water deficit stress, Na+/H+ antiporter for improving salt tolerance).

Learning Outcomes:

- At the end of the unit the student should learn the applications of Plant Biotechnology in generating tolerance/resistance to herbicides, pests, plant diseases and abiotic stesses.
- Should understand experimental procedure followed in Engineering tolerance/resistance to biotic and abiotic stresses.

UNIT-IV

Genetic modifications for reducing the effects of viral diseases: Antisense RNA, ribozymes and Post transcriptional gene silencing approaches. Genetic modifications for improving crop yield and quality: (Case studies: Manipulation of fruit ripening, Golden rice, Oil quality improvement). Chloroplast transformation – advantages in tobacco and potato. Molecular pharming. Edible vaccines and plantibodies.

Learning Outcome:

- At the end of the unit the student should plants are being used as a medium for production of Pharmaceutically important compounds.

UNIT-V

Plant tissue culture technology: Plasticity and totipotency, The culture environment, Plant cell culture media, Plant growth regulators. Culture types: Callus, Cell suspension cultures, Protoplasts, root cultures, shoot tip and meristem culture, embryo culture, microspore culture. Factors governing in vitro behaviour. Plant regeneration: Somatic embryogenesis, organogenesis and plant regeneration. Micro propagation. Somatic hybridization.

Learning Outcomes:

- At the end of the unit the students should be able to know the composition of different media used in tissue culture and importance of the components.
- Should understand invitro manipulation of tissues.

Course Outcomes: upon successful completion of this course, participants will be able to

- Understand how techniques of biotechnology are helping in unravelling the knowledge of complex plant processes.
- Analyze and understand the advantages of Molecular markers and QTLs provide over traditional breeding technologies.
- Explain how biotechnology is used for crop plant improvement with regards to Herbicide. tolerance, tolerance to pests and pathogens, yield improvement, stress tolerance and the ethical implications of that use.
- Familiarize with the processes involved in the planning, conduct and execution of plant biotechnology experiments.
- Cooperate and work effectively as a member of a team to solve complex problems.

BOOKS RECOMMENDED:

1. Plant Biotechnology by A. Slater, N.W.Scott and M.R. Fowler (Oxford University Press)
2. Plant Biotechnology by Chawla M.S. (Oxford)

REFERENCE BOOKS:

1. Biotechnology in Agriculture by Swaminathan, M.S. (Mc. Millan India Ltd).
2. Biotechnology and its applications to Agriculture by Copping LG and P. Rodgers (British Crop Projection).
3. Plant Biotechnology by Kung, S. And C.J. Arntzen (Butterworths).

SILVER OAK UNIVERSITY
EDUCATION TO INNOVATION
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Subject: - Intellectual Property Rights, Bio safety and Bioethics								
Program: M.Sc.				Subject Code:			Semester: III	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE)- Theory	Continuous Internal Evaluation (CIE)- Practical	Total
04	-	-	4	24/60	-	16/40	-	100

Course Objectives

- To provide basic knowledge on intellectual property rights and their implications in biological research and product development;
- To become familiar with India'sIPR Policy;
- To learn biosafety and risk assessment of products derived from biotechnology and regulation of such products;
- To become familiar with ethical issues in biological research.

UNIT I

Introduction to IPR: Introduction to intellectual property; types of IP: patents, trademarks, copyright & related rights, industrial design, traditional knowledge, geographical indications, protection of new GMOs; International framework for the protection of IP; IP as a factor in R&D; IPs of relevance to biotechnology and few case studies; introduction to history of GATT, WTO, WIPO and TRIPS; plant variety protection and farmers rights act; concept of 'prior art': invention in context of "prior art"; patent databases - country-wise patent searches (USPTO, EPO, India); analysis and report formation.
Learning Outcomes:

- The student will be introduced on the basics on Intellectual property
- To gain a considerable insights on international framework for IP protection

UNIT II

Patenting: Basics of patents: types of patents; Indian Patent Act 1970; recent amendments; WIPO Treaties; Budapest Treaty; Patent Cooperation Treaty (PCT) and implications; procedure for filing a PCT application; role of a Country Patent Office; filing of a patent application; precautions before patenting-disclosure/non-disclosure - patent application- forms and guidelines including those of National Bio-diversity Authority (NBA) and other regulatory bodies, fee structure, time frames

Learning Outcomes:

- Students should be able to understand the basics of patent types.
- Learn about the Indian patent acts and its role in patenting
- Will have knowledge on the process of filing a patent application

UNIT III

Types of patent applications: provisional and complete specifications; PCT and conventional patent applications; international patenting-requirement, procedures and costs; financial assistance for patenting- introduction to existing schemes; publication of patents-gazette of India, status in Europe and US; patent infringement- meaning, scope, litigation, case studies and examples; commercialization of patented innovations; licensing outright sale, licensing, royalty; patenting by research students and scientists- university/organizational rules in India and abroad, collaborative research - backward and forward IP; benefit/credit sharing among parties/community, commercial (financial) and non-commercial incentives.

Learning Outcomes:

- The student will understand the international patent procedures.
- The student will apply the patent knowledge in new discoveries.

UNIT IV

National and international regulations: International regulations – Cartagena protocol, OECD consensus documents and Codex Alimentarius; Indian regulations – EPA act and rules, guidance documents, regulatory framework – RCGM, GEAC, IBSC and other regulatory bodies; Draft bill of Biotechnology Regulatory authority of India - containments

– biosafety levels and category of rDNA experiments; field trails – biosafety research trials

– standard operating procedures - guidelines of state governments; GM labeling – Food Safety and Standards Authority of India (FSSAI).

Learning Outcomes:

- The student should have a detailed knowledge on regulatory framework of patenting
- They will focus on patent regulation frame works in rDNA experiments

UNIT V

Bioethics: Introduction, ethical conflicts in biological sciences - interference with nature, bioethics in health care - patient confidentiality, informed consent, euthanasia, artificial reproductive technologies, prenatal diagnosis, genetic screening, gene therapy, transplantation. Bioethics in research – cloning and stem cell research, Human and animal experimentation, animal rights/welfare, Agricultural biotechnology - Genetically engineered food, environmental risk, labeling and public opinion. Sharing benefits and protecting future generations - Protection of environment and biodiversity – biopiracy

Learning Outcomes:

- To have an insight on the bio ethical conflicts in biological sciences.
- Will focus on consequences of biomedical research technologies such as cloning of whole organisms, genetic modifications, DNA testing
- To focus on the various areas of research that require the concept of bioethics

Student Learning Outcomes

- Understand the rationale for and against IPR and especially patents
- Understand why India has adopted an IPR Policy and be familiar with broad outline of patent regulations;
- Understand different types of intellectual property rights in general and protection of products derived from biotechnology research and issues related to application and obtaining patents;
- Gain knowledge of biosafety and risk assessment of products derived from recombinant DNA research and environmental release of genetically modified organisms, national and international regulations;
- Understand ethical aspects related to biological, biomedical, health care and biotechnology research.

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Subject: - Medical and Environmental Biotechnology								
Program: M.Sc.				Subject Code:			Semester: III	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE)- Theory	Continuous Internal Evaluation (CIE)- Practical	Total
04	-	4	6	24/60	20/50	16/40	-	150

Course Objectives:

- to learn the types of enzyme and DNA probes& its importance in diagnosis
- to know the strategies for vaccine development and production methods of health care products through rDNA Technology
- to understand the importance of environment and its conservations
- to know the importance ofwaste management
- to know the importance of alternative resources to understand the process of bio hazards management.

UNIT – I

Revolution in diagnosis - Use of Enzymes in the diagnosis and treatment of diseases;Enzyme probes - glucose oxidase, lactate oxidase, monoamine oxidase;Enzyme based Biosensors;Nucleic acid probes – Use of nucleic acid probes in disease diagnosis; PCR amplification and disease diagnosis - Applications in forensic medicine.

Learning Outcomes

- Gain basic knowledge on the various application of enzymes in the field of medicine
- Will obtain an insight on the use of nucleic acid probes in the field of medicine

UNIT – II

Changing approaches of therapy - Genetic diseases and gene therapy; Current strategies for development of vaccines against HIV, Malaria, Tuberculosis and Hepatitis B. Clinical trails – norms and ICMR guidelines for design and conducting clinical trails.Health care products from recombinant DNA Technology - insulin, growth hormone, factor VIII, tissue plasminogen activator, interferons, lymphokines;

Learning Outcomes

- Will be introduced to the concept of gene therapy
- Will get indepth information on the current trends of vaccine development
- Will learn the application of rDNA products in the field of medicine

UNIT – III

Environmental pollution - types, sources and control of aerial and aquatic pollution. Environmental monitoring and biomonitoring. Bioremediation - solid and liquid waste treatment,Microbiology of waste water treatment,Industrial effluents and their management, oil spills, chemical herbicides;Bioleaching.

Learning Outcomes

- Will gain a comprehensive knowledge on different types of pollution and their remedial measures
- Will get an insight on the remedial measures of the environmental pollutants
- Will get a basic idea on bioleaching process

UNIT IV

Feacal Sludge and Septage Management (FSSM): Introduction, Government Initiatives, characteristics of feacal sludge, sampling and laboratory methods for waste characterization, health implication of unsafe practices, FSSM Value Chain and treatment options of feacal sludge for safe disposal, natural biological methods of waste treatment, reuse and recycling options of water and bio solids, safety, health and environmental protection measures.

Learning Outcomes

- Apprehend the process of FSSM
- Will gain an insight into the various methods of treatment for FSSM
- Will grasp the various resuse and recycling options of treated waste waters

UNIT-V

Environment and energy: Biomass, waste materials, energy crops, cellulose; Renewable sources of energy - Biogas, Biodiesel, Bioethanol, Biobutanolenergy and fuel using microorganisms. Global environmental problems: Ozone depletion, Green house effect, Climate Change. Biodiversity-benefit to mankind-conservation; Sustainable development; Environment Impact Assessment. Biosafety and environmental issues.

Learning Outcomes

- Will be aware of the various biofuels and their production methods
- Will apprehend the global environmental problems and their impact
- Will get an insight on the biosafety regulations of GMOs

Course Outcomes:

- Comprehensive information and insights in medical biotechnology and the development of biopharmaceuticals in pharmaceutical industry
- Address environmental issues including pollution, mineral resource, renewable energy
- Will have a specific focus on bioremediation and treatment of polluted effluent.
- Will also provide conceptual knowledge and significance of genetically modified microbes.
- Obtain knowledge on basic principles and technologies of decontamination of mainly by means of the biological approaches i.e. using bioremediation etc.
- Acquire the knowledge of biofuel production technologies, and their applications.

BOOKS RECOMMENDED:

1. Biotechnology by B.D.Singh (Kalyani).
2. Ecology and Environment by PD Sharma.
3. Environmental Biotechnology by Forster, C.F. and Wase D.A.J. (Ellis Horwood).
4. Biotechnology by U.Satyanarayana (Books & Allied (p) Ltd.

REFERENCE BOOKS:

1. Biotechnological innovations in environmental management by Leach, CK and Van Dam-Mieras, MCE (Butterworth-Herinemann, Oxford (Biotol Series).
2. Fundamentals of Ecology, by Odum, EP (Mc Graw Hill)
3. Molecular Biology and Biotechnology by Meyers, RA, A Comprehensive Desk Reference (VCH Publishers).

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Subject: - Cell Culture Technology and Tissue Engineering								
Program: M.Sc.				Subject Code:			Semester: III	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE)- Theory	Continuous Internal Evaluation (CIE)- Practical	Total
04	-	4	6	24/60	20/50	16/40	-	150

Course Objectives:

- To obtain deeper knowledge and understanding about the techniques of animal cell culture subject tissue engineering and tissue engineering.
- To obtain knowledge on fundamental concepts and different types of stem cells
- To learn about key technologies used in tissue engineering and transplantation
- To understand the concept of regenerative medicine and application of stem cells in regenerative medicine.
- To impart theoretical knowledge on various techniques of cell culture and tissue engineering and their applications

UNIT-I

Introduction to Animal cell culture: Background,Advantages, Limitations, Application; Culture environment, Cell adhesion, Cell proliferation, Differentiation; Essential equipments, Aseptic techniques, Sterile handling, Biohazards; Culture Media: Role of Physicochemical properties CO2 and bicarbonates; Buffering; Oxygen; Osmolality; Temperature; Surface tension and foaming, Balanced salt solutions and simple growth medium, Complete Media, Role of serum and supplements. Serum free media.

Learning Outcomes:

- At the end of the unit the student should have the basic knowledge on Animal cell culture
- The student should understand physical requirements of of cell culture

UNIT-II

Primary Culture: Isolation of tissue, Steps involved in primary cell culture, Subculture and propagation, Cell lines, Nomenclature, Cell line designations, Routine maintenance, Immortalization of cell lines, Cell transformation. Cell cloning and Cell separation, Cell synchronization, Measurement of viability and cytotoxicity: MTT assays, Trypan Blue, PI, FDA assays, Survival Assays, Applications of cytotoxicity assays

Learning Outcomes:

- At the end of the unit the student should have the basic knowledge on Animal cell culture
- The student should understand different types cell cultures and culture methods

UNIT-III

Fundamentals of Stem cells:Stem cells, Totipotency, Pluripotency, Embryonic stem cells, Germinal stem cells, Adult stem cells, Tumor stem cells,Properties and Potency of embryonic and adult stem cells. Differences and similarities in adult and embryonic stem cells. Stem cell markers. Stem-cell plasticity and differentiation.Mechanisms of self renewal.
Learning Outcomes:

- At the end of the unit the student should have insights into the basics of stem cells and their properties
- The student should understand different types of stem cells

UNIT-III

Isolation and characterization of stem cells:Isolation of stem cells;Epigenetics in stem cells development. Genetic programming in stem cells. Cell cycle regulation in stem cells. Tissue derivation from different germ layers. Differentiation of stem cells. Significance of pluripotency. Induced pluripotency of stem cells, Markers and factors involved in induced pluripotency. Production of induced pluripotent stem cells, Applications and challenges in the production of IPSCs.

Learning Outcomes:

- At the end of the unit the student should have an insight on stem cell differentiation and renewal
- The student should understand the Isolation of embryonic stem cells
- The student should know the basics Pluripotent stem cell production

UNIT – IV

Tissue engineering:: Introduction, structural and organization of tissues: Epithelial, connective; vascularity and angiogenesis, basic wound healing, cell migration, current scope of development and use in therapeutic and in-vitro testing, Scaffold and transplant ; Bone marrow Transplantation-Autologous and Allogenic Stem Cell Transplantation,HLA Typing.

Learning Outcomes:

- At the end of the unit the student will gain knowledge on structural and organization of tissue
- The student should have an insight stem cell transplantaion

UNIT – V

Stem cells in therapy: Stem Cells in gene therapy; Applications of stem cells in regenerative medicine-neurodegenerative diseases, stroke, diabetes, cancer and Anti-aging.Cryopreservation and maintenance of stem cells. Stem cell banking. Status of clinical trials in stem cell research. Challenges and promises of stem cell applications in medicine and research. Ethical and regulatory issues involving stem cell research.

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Learning Outcomes:

- At the end of the unit the student will gain knowledge on clinical applications of stem cell therapy
- The student should have an insight on ethical and regulatory issues in stem cell research

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Course Outcomes:

- Students will be able to Explain the fundamental scientific principles that underlie cell culture.
- Exhibit appropriate safety procedures in the cell culture laboratory including personal protective equipment, aseptic technique.
- Acquire comprehensive knowledge about transplantation techchnologies and its application.
- Learn the pathophysiologic basis for acute and chronic graft versus host disease.
- Develop an understanding of significance of stem cells role in the neurogenerative field.
- Student should gain strong understanding of animal based cell cultures system. This should help them to take up plant and animal biological research as well as placement in relevant biotech industry.

BOOKS RECOMMENDED& REFERENCES:

1. R. Ian Freshney Culture of Animal Cells: A Manual of Basic Technique, (2000).
2. Marshak L, Stem Cell Biology, Cold Spring Harbor Publication, (2001).
3. Masters, J. R.W., Animal Cell Culture, Oxford (2000). 2. Ranga, M.M., Animal Biotechnology, Agrobios (2007).
4. Essentials of Stem Cell Biology by Robert Lanza and Anthony Atala, 3rd ed, Academic Press.
5. Stem Cells: Basics and Applications by Koushik k Deb, Satish M Totey Tata McGraw- Hill Education, 2009.
6. Stem Cells: From Mechanisms to Technologies edited by Michal K. Stachowiak, Emmanuel Tzanakaki, Publishers: World Scientific.
7. Principles of Tissue Engineering by Robert Lanza, Robert Langer, Joseph P. Vacanti, Elsevier Academic Press.
8. Stem Cell Anthology: From Stem Cell Biology, Tissue Engineering, Cloning by Bruce M Carlson.
9. Stem Cells: From Basic Research to Therapy, Volume 1 by Federico Calegari, Claudia Waskow, CRC Press

LAB - V: PLANT TISSUE CULTURE TECHNIQUES

Course Objectives:

- To understand basic and advanced Plant Biotechnology techniques & concepts.
- Learn how to understand and present Plant molecular biology data and concepts to an audience.
- Understand current experimentation and research in the field of Plant Biotechnology.

Experiments

1. Preparation of media for plant tissue culture (MS and B5).
2. Establishment of callus cultures from carrot cambial tissue.
3. Establishment of cell cultures and plating.
4. Embryo culture of maize/ crotalaria.
5. Organogenesis and regeneration of plants from tobacco explants.
6. Anther culture and production of haploids.
7. Micropropagation using suitable system: Potato/solanum's
8. Enzymatic isolation of protoplast and culture.
9. Polyethylene glycol (PEG) mediated fusion of protoplasts.
10. Agrobacterium culture and transformation.
11. Reporter gene assay (GUS).

Learning Outcomes: upon successful completion of this course, participants will be able to

- Familiarize with the processes involved in the planning, conduct and execution of plant biotechnology experiments
- Do simple Plant Biotechnology experiments based on the knowledge gained in Molecular biology and Plant biotechnology practical experiments

- Analyze and understand the research papers in the field of Molecular markers and QTLs and appreciate the advantages of these techniques provide over traditional breeding techniques.
- Familiarize with advance techniques in the field of Plant Biotechnology
- Interpret the outcome of experiments that involve the use of recombinant DNA technology and other common gene analysis techniques.
- Present Plant Biotechnology experimental and Research date to a scientific audience
- Cooperate and work effectively as a member of a team to solve complex problems

BOOKS RECOMMENDED:

1. Plant cell culture – A practical approach by Dixion RA.
2. Plant tissue culture – theory and practice by Bhojwani, S.S.
3. Biotechnology: A laboratory Course by Becker, J.M.

LAB-IV: ANIMAL CELL CULTURE AND ENVIRONMENTAL BIOTECHNOLOGY

Course Objectives:

- Learn to grow animal cells in favourable environment
- To obtain a working knowledge of the principles, techniques and current applications of biotechnology to environmental quality evaluation, monitoring
- Focuses on the utilization of microbial processes in water treatment, and bioremediation.

1. Preparation of animal cell culture media and membrane filtration.
2. Preparation of single cell suspension from spleen and thymus.
3. MTT assay for cell viability and growth.
4. Demonstration of sections of human ovary, testis and aborted human embryos.
5. Estimation of dissolved oxygen and salinity in water samples.
6. Estimation of Chemical Oxygen Demand (COD).
7. Estimation of Biochemical Oxygen Demand (BOD).
8. Determination of suspended solids in industrial effluents.
9. Removal of color of the industrial effluents by biological methods.
10. Reduction of pollution load in effluents by biological methods (laboratory models).

Learning Outcomes:

- Learn the basics of handling animal cells
- Gain knowledge on utilization of microbial processes in water and waste water treatment
- Evaluate the potential for biodegradation of organic pollutants, taking microbial and physical/chemical environments,

BOOKS RECOMMENDED:

1. Animal cell culture – A practical approach Ed. By John R.W. Masters (IRL Press).

2. Animal cell culture techniques, Ed. Martin clyenes (Springer).
3. Comprehensive Biotechnology. Vol. 4. M.Moo-Young (Ed-in-chief), Pergamon Press, Oxford.
4. Environmental Chemistry. A.K.De, Wiley Eastern Ltd, New Delhi.
5. Introduction to Biodeterioration, D.Allsopp and K.J.Seal, ELBS/Edward Arnold.