IV SEMESTER

BIOMEDICAL ENGINEERING (HARD CORE)

Hours: 52

Course outcomes:

After successful completion of the course, students will be able to:

CO 1. Understand basics and dynamics of animal cell culture, organ culture, stem cells and tissue engineering, techniques used in counting of cells, cell viability/toxicity assays

CO 2. Differentiate methods for gene transfer in animal cells, tissue-specific promoters, gene therapy

CO 3. Comprehend transgenic technology and use of animals as bioreactors

CO 4. Elucidate assisted reproductive techniques including cloning

Unit I (13 hrs)

Animal tissue culture, history, laboratory design, aseptic conditions, methodology and types of media. Role of carbon dioxide, serum and supplements. Equipments and materials for animal cell culture technology. Basic techniques of mammalian cell culture *in vitro*; desegregation of tissue and primary culture; maintenance of cell culture; Cell lines-characteristics and routine maintenance. Biology and characterization of the cultured cells, measuring parameters of growth. Measurement of viability and cytotoxicity.

Unit II (13 hrs)

Cell synchronization, Cell separation techniques. Somatic cell fusion, Cell cloning. Organ and histotypic cultures. Three-dimensional culture - Tissue engineering. Application of animal cell culture - Stem cell cultures, embryonic stem cells, mesenchymal stem cells, induced pluripotent stem cells and their applications. Culture of fish, molluscan and crustacean cells and their applications: Culture of secretory/ glandular cells to produce hormones, Pearl oyster mantle cells to produce pearls.

Unit III (13 hrs)

In vitro fertilization (IVF) and embryo transfer (ET), Sex determination or sex specific markers, sexing of sperm and embryos, Assisted reproductive technology (ART). *In vitro* gamete maturation, Intracytoplasmic sperm injection, Cryopreservation of gametes and embryo, Animal cloning-reproductive cloning, therapeutic cloning, xenotransplantation. Improvements of animals using transgenic approach with specific examples. Animals as bioreactors. Applications of biotechnology in sericulture. Production of Transgenic fishes. General steps to make and analyze transgenic fish and Genetically Improved Farmed Tilapia (GIFT). Guidelines for use of small laboratory animals in experimentation and pre-clinical research, maintenance and regulations.

Unit IV (13 hrs)

Animal genes and their regulation, some specific promoters for tissue specific expression. Gene manipulation in animals-cloning vectors and expression vectors for gene transfer to animal cells. Gene transfer methods in animal cells, Animal cells as cloning hosts. Gene expression in cell culture. Genetic engineering for production of regulatory proteins, blood products, vaccines and hormones. Applications of recombinant DNA in humans: mapping and cloning human disease genes, DNA based diagnosis of genetic diseases, gene therapy, types of gene therapy, somatic versus germline gene therapy, mechanism of gene therapy, Immunotherapy, gene knockout. Prenatal diagnosis (amniocentesis and chorionic villus sampling). Genetic counseling.