

# ANIMAL BIOTECHNOLOGY

## Course Structure

COURSE NO.	COURSE TITLE	CREDITS	SEM
ABT 601	BASIC & APPLIED BIOTECHNOLOGY	3+0	I
ABT 602*	FUNDAMENTALS OF CELL AND MOLECULAR BIOLOGY	3+0	I
ABT 603	APPLIED MOLECULAR BIOLOGY	2+1	I
ABT 604 *	ANIMAL CELL CULTURE: PRINCIPLES AND APPLICATIONS	1+2	I
ABT 605 *	MOLECULAR DIAGNOSTICS	1+2	II
ABT 606	VACCINE BIOTECHNOLOGY	2+1	II
ABT 607	IMMUNOLOGY APPLIED TO BIOTECHNOLOGY	1+1	II
ABT 608/ ❶ BIF 501/ MBB 555/ FSC 604	INTRODUCTION TO BIOINFORMATICS	2+1	I
ABT 609 *	ANIMAL GENOMICS	2+1	II
ABT 610 *	REPRODUCTIVE BIOTECHNOLOGY	2+1	II
ABT 611 *	TECHNIQUES IN MOLECULAR BIOLOGY AND GENETIC ENGINEERING	0+3	II
ABT 612	BIODIVERSITY, BIOSAFETY & BIOETHICS	2+0	I
ABT 613	MOLECULAR FORENSICS	2+1	II
ABT 614	INDUSTRIAL BIOTECHNOLOGY	2+1	II
ABT 615	PROBIOTICS & FEED BIOTECHNOLOGY	3+0	I
ABT 616 / ❷ MBB 511	ANIMAL BIOTECHNOLOGY	3+0	I
ABT 691	MASTER'S SEMINAR	1	I, II
ABT 699	MASTER'S RESEARCH	20	I, II
ABT 701 **	GENE CLONING AND EXPRESSION	1+1	II
ABT 702 **	FUNCTIONAL GENOMICS & PROTEOMICS	2+1	II
ABT 703 **	ADVANCES IN REPRODUCTIVE BIOTECHNOLOGY	2+1	II
ABT 704 **	TRENDS IN VACCINOLOGY	3+0	I
ABT 705 **	ADVANCES IN ANIMAL CELL CULTURE	2+1	I
ABT 706 **	TRANSGENIC ANIMAL TECHNOLOGY	2+0	II
ABT 707/ ❸ MBB 607	ADVANCES IN ANIMAL BIOTECHNOLOGY	2+0	II
ABT 791	DOCTORAL SEMINAR I	1	I, II
ABT 792	DOCTORAL SEMINAR II	1	I, II
ABT 799	DOCTORAL RESEARCH	45	I, II

\*Compulsory for Master's programme; \*\*Compulsory for Doctoral programme

To be taught by ❶ Animal Biotechnology, Bioinformatics, Molecular Biology & Biotechnology; ❷ Animal Biotechnology; ❸ Animal Biotechnology

# ANIMAL BIOTECHNOLOGY

## Course Contents

**ABT 601                      BASIC AND APPLIED BIOTECHNOLOGY                      3+0                      SEM - I**

**Objective**

Understanding the fundamental principles of biotechnology and its application in agriculture, veterinary sciences, medical sciences, industry and environment.

**Theory**

UNIT-I: History of biotechnology, scope of biotechnology, introduction of genetic engineering, plant and animal tissue culture.

UNIT-II: Fermentation technology, immobilized enzymes, vaccines, antibodies and hybridoma technology, diagnostics, embryo transfer technology, sexing of embryo, transgenics.

UNIT-III: Genome, genome mapping, physical maps, genetic maps, different types of DNA markers and their applications.

UNIT-IV: Application of biotechnology in agriculture, veterinary sciences, pharmaceutical industry, food industry, chemical industry and environment.

**Suggested Readings**

Becker JM, Cold Well GA & Zachgo EA. 2007. *Biotechnology a Laboratory Course*. Academic Press.

Brown CM, Campbell I & Priest FG. 2005. *Introduction to Biotechnology*. Panima.

Singh BD. 2006. *Biotechnology Expanding Horiozon*. Kalyani.

**ABT 602                      FUNDAMENTALS OF CELL AND                      3+0                      SEM - I**  
**MOLECULAR BIOLOGY**

**Objective**

Molecular structure and functions of cells and molecules such as DNA, RNA and proteins.

**Theory**

UNIT-I: Evolution of cells, Introduction to molecular interactions, thermodynamics, and equilibrium in molecular recognition and biological functions. Energy production: Structure of mitochondria, and chloroplasts, respiratory chain, ATP synthesis, photosynthesis, genomes of mitochondria and chloroplasts, cellular compartments and intercellular sorting of proteins: endoplasmic reticulum, lysosome, peroxisomes, synthesis and shorting of proteins (lysosomal proteins, membrane proteins, secretary proteins, lipoproteins, glycolipids. Lipid synthesis and transport.

UNIT-II: Cytoskeleton: Mechanism of muscle contraction, actin filaments and cell cortex, cilliary movements and cytoplasmic microtubules and intermediate filaments. Cell signaling: Endocrine, exocrine and synaptic signaling molecules, surface and intracellular receptors, G proteins and generation of econdary messengers, mode of action of cAMP and Ca<sup>++</sup> calmodulin, target cell adaptation. Cell growth and divisions: Cell cycle, cell division controls and transformation, growth factors, genes for social control of cell division, mechanism of cell division, cell adhesion, cell junctions and the extra cellular matrix, growth, development and differentiation.

UNIT-III: History of molecular biology, nucleic acid as hereditary material, structure of DNA, chromatin, rRNA, tRNA and mRNA, proteins. DNA replication, transcription, translation, genetic code, operon, positive and negative control of gene expression, important enzymes such as RNA replicase, reverse transcriptase, ligase, polymerase, ribozyme, etc.

UNIT-IV: Molecular mechanism of mutation. Molecular organization of cell, structure of genomes, synthetic chromosomes. RNA processing and alternative splicing, molecular biology of photosynthesis, nitrogen fixation and stress tolerance, development and differentiation and molecular evolution, RNAi and application.

**Suggested Readings**

Lewin B. 2008. *Gene IX*. Jones & Bartlett.

Primrose SB. 2001. *Molecular Biotechnology*. Panima.

Twyman RM. 2003. *Advanced Molecular Biology*. Bios Scientific.

**ABT 603                      APPLIED MOLECULAR BIOLOGY                      2+1                      SEM - I**

**Objective**

Understanding the principle and application of recombinant DNA in biotechnology.

**Theory**

UNIT-I: Enzymes used in molecular biology and recombinant DNA research, cloning and expression vectors, gene identification, construction of gene libraries, gene mapping and DNA structure analysis.

UNIT-II: Methods of DNA sequencing, synthesis of double stranded DNA and complementary DNA, cDNA library identification and enrichment of recombinant clones.

UNIT-III: Methods for transfer of cloned DNA, analysis and expression of recombinant DNA, site directed DNA alterations and gene manipulations, cloning in bacteria, yeast, plant and animal cells.

UNIT-IV: Genetics of tumorigenic region of agrobacteria and its applications in agriculture, veterinary and medical sciences, biotechnology applications for production of high value and industrial products, safety aspects of genetic manipulations.

**Practical**

- Extraction of DNA and RNA.
- Polyacrylamide gel electrophoresis (PAGE).
- Agarose gel electrophoresis.
- Restriction endonuclease analysis of DNA.
- Isolation and purification of plasmid.
- Polymerase chain reaction.
- Cloning of gene.
- Expression of cloned gene.
- Purification of recombinant protein.
- Blotting.
- RFLP.
- RAPD.

**Suggested Readings**

Kun LY. 2006. *Microbial Biotechnology*. World Scientific.

Sambrook J & Russel DW. 2001. *Molecular Cloning: a Laboratory Manual*. Cold Spring Harbour Lab. Press.

Twyman RM. 2003. *Advanced Molecular Biology*. Bios Scientific.

**ABT 604                      ANIMAL CELL CULTURE: PRINCIPLES                      1+2                      SEM - I**  
**AND APPLICATIONS**

**Objective**

Understanding the principles of animal cell culture and its application.

**Theory**

UNIT-I: Introduction, importance, history of cell culture development, different tissue culture techniques including primary and secondary culture, continuous cell lines, suspension culture, organ culture etc.

UNIT-II: Different type of cell culture media, growth supplements, serum free media, balanced salt solution, other cell culture reagents, culture of different tissues and its application.

UNIT-III: Behavior of cells in culture conditions, division, their growth pattern, metabolism of estimation of cell number.

UNIT-IV: Development of cell lines, characterization and maintenance of cell lines, stem cells, cryopreservation, common cell culture contaminants.

**Practical**

- Packing and sterilization of glass and plastic wares for cell culture.
- Preparation of reagents and media for cell culture.
- Primary culture technique chicken embryo fibroblast.
- Secondary culture of chicken embryo fibroblast.
- Cultivation of continuous cell lines.
- Quantification of cells by trypan blue exclusion dye.
- Isolation of lymphocytes and cultivation of lymphocytes
- Study of effect of toxic chemicals on cultured mammalian cells

- Study of effect of virus on mammalian cells.
- Suspension culture technique
- Cryopreservation of cell primary cultures and cell lines.
- Effect of viruses on cultured mammalian cells.

**Suggested Readings**

Freshney RI. 2005. *Culture of Animal Cells*. Wiley Liss.  
 Portner R. 2007. *Animal Cell Biotechnology*. Humana Press.

**ABT 605                      MOLECULAR DIAGNOSTICS                      1+2                      SEM - II**

**Objective**

Understanding the molecular techniques involved in diagnosis of diseases.

**Theory**

UNIT-I: Introduction, importance and historical perspective of development of molecular diagnostic technology, concept of development of group specific and strain specific nucleic acid based diagnostics, basis for selection of gene/nucleotide sequence of pathogenic organism to target for detection.

UNIT-II: Application of restriction endonuclease analysis for identification of pathogens, principle of development of pathogen specific DNA probes, Southern and Northern hybridization.

UNIT-III: Theoretical background of development of PCR and Real time PCR and its variations, application of PCR for diagnosis of infectious diseases of animals and poultry, nucleic acid sequence based diagnostics.

UNIT-IV: Advancements in diagnostic technology including DNA array technology, biosensors and nanotechnology. OIE guidelines in development of diagnostics.

**Practical**

- Preparations of buffers and reagents.
- Collection of clinical and environmental samples from animal and poultry farms for molecular detection of pathogens.
- Isolation of bacterial pathogens from the samples.
- Extraction of nucleic acids from bacteria and clinical specimens.
- Restriction endonuclease digestion and analysis in agarose electrophoresis.
- Development of animal pathogen specific nucleic acid probes.
- Southern blotting for detection of pathogens.
- Polymerase chain reaction for detection of pathogens in blood and other animal tissues.
- RT-PCR for detection of RNA viruses.
- Real time PCR for detection of pathogens in semen and other animal tissues.
- DNA fingerprinting for identification of animal species.
- PCR based detection of meat adulteration in processed and unprocessed meats.
- Detection of food borne pathogenic organisms in vegetables and fruits using PCR technology.
- PCR based detection of potential pathogens in milk, eggs and meat.

**Suggested Readings**

Elles R & Mountford R. 2004. *Molecular Diagnosis of Geneti Disease*. Humana Press.  
 Rao JR, Fleming CC & Moore JE. 2006. *Molecular Diagnostics* Horizon Bioscience.

**ABT 606                      VACCINE BIOTECHNOLOGY                      2+1                      SEM - II**

**Objective**

Understanding different approaches of vaccine development and production.

**Theory**

UNIT-I: History of vaccinology, conventional approaches to vaccine development, live attenuated and killed vaccines, adjuvants, quality control, preservation and monitoring of microorganisms in seed lot systems.

UNIT-II: Instruments related to monitoring of temperature, sterilization, environment, quality assurance and related areas. Production techniques, growing the microorganisms in maximum titre, preservation techniques to maintain good antigen quality, freeze drying.

UNIT-III: Introduction to newer vaccine approaches namely subunit-vaccines, synthetic vaccines, DNA vaccines, virus like particles, recombinant vaccines, edible vaccines, Nano particles in vaccine delivery systems, etc.

UNIT-IV: Introduction to pharmacopeal requirement, disease security and biosecurity principles and OIE guidelines such as seed management, method of manufacture, in-Process control, batch control, tests on final product.

**Practical**

- Inoculation of embryonated chicken eggs for cultivation of virus.
- Harvesting of virus from inoculated embryos.
- Inactivation of harvested viruses.
- Safety and sterility testing of inactivated vaccine.
- Inoculation of tissue culture for propagation of virus.
- Harvesting and production of inactivated virus vaccine.
- Isolation and cloning of genes encoding immunogenic proteins.
- Expression of cloned gene.
- Purification of recombinant immunogenic protein.
- Immunogenicity studies of recombinant protein.
- Immunization of laboratory animals.
- Titration of antibodies against the recombinant protein.

**Suggested Readings**

Barry R Bloom, Paul-Henri Lambert 2002. *The Vaccine Book*. Academic Press.  
Levine MM, Kaper JB, Rappuoli R, Liu MA, Good MF. 2004. *New Generation Vaccines*. 3<sup>rd</sup> Ed. Informa Healthcare.  
Lowrie DB & Whalen R. 2000. *DNA Vaccines*. Humana Press.  
Robinson A & Cranage MP. 2003. *Vaccine Protocols*. 2<sup>nd</sup> Ed. Humana Press.

**ABT 607**

**IMMUNOLOGY APPLIED TO  
BIOTECHNOLOGY**

**1+1**

**SEM - II**

**Objective**

Understanding the application of immunological techniques in biotechnology.

**Theory**

UNIT-I: Introduction, principles of immunology, immune system, immune response, major histocompatibility complex, various techniques used in biotechnology.

UNIT-II: Application of antibodies in purification, immunoblotting, expression of recombinant proteins and detection in different expression systems, industrial production of cytokines and interferon, expression of immunoglobulin genes in plants and production of antibodies.

UNIT-III: Application of antibodies in chemiluminescence and fluorescence assay used for actions for recombinant genes, antibody based nucleic acid probes and their applications, immunoinformatics.

UNIT-IV: Somatic cell hybridization, hybridoma technology, commercial production of antibodies using monoclonal antibodies.

**Practical**

- Immunodiffusion.
- Immuno-electrophoresis.
- Fluorescent antibody test.
- Enzyme immunoassays including ELISA.
- Immunoblotting.
- Affinity chromatography.
- Bioinformatics tools for immunological research.
- Cultivation of normal lymphocytes and myeloma cell line.
- Somatic cell hybridization and production of hybridoma.
- Screening of hybrids for production of monoclonal antibodies.

**Suggested Readings**

Kindt TJ, Goldsby RA & Osbrne BA. 2007. *Kuby Immunology*. WH Freeman.  
Male D, Brostoff J, Roth DB & Roitt I. 2006. *Immunology*. Elsevier.  
Spinger TA. 1985. *Hybridoma Technology in Biosciences and Medicine*. Plenum Press.

**ABT 608/**                    **INTRODUCTION TO BIOINFORMATICS**                    **2 +1**                    **SEM - I**  
**BIF 501/**                    (To be taught jointly by Animal Biotechnology, Bioinformatics and Molecular  
**MBB 555/**                    Biology & Biotechnology)  
**FSC 604**

**Objective**

To impart an introductory knowledge about the subject of Bioinformatics to the students studying any discipline of science.

**Theory**

UNIT-I: Introduction, biological databases – primary, secondary and structural, Protein and Gene Information Resources – PIR, SWISSPROT, PDB, genebank, DDBJ. Specialized genomic resources.

UNIT-II: DNA sequence analysis, cDNA libraries and EST, EST analysis, pairwise alignment techniques, database searching, multiple sequence alignment.

UNIT-III: Secondary database searching, building search protocol, computer aided drug design – basic principles, docking, QSAR.

UNIT-IV: Analysis packages – commercial databases and packages, GPL software for Bioinformatics, web-based analysis tools.

**Practical**

- Usage of NCBI resources
- Retrieval of sequence/structure from databases
- Visualization of structures
- Docking of ligand receptors
- BLAST exercises.

**Suggested Readings**

Attwood TK & Parry-Smith DJ. 2003. *Introduction to Bioinformatics*. Pearson Education.  
Rastogi SC, Mendiratta N & Rastogi P. 2004. *Bioinformatics: Concepts, Skills and Applications*. CBS.

**ABT 609**                    **ANIMAL GENOMICS**                    **2+1**                    **SEM - II**

**Objective**

Understanding structural, functional and comparative genomics of farm animals and its application for livestock improvement.

**Theory**

UNIT-I: Historical perspective, genome organization in eukaryotes, satellite DNA including mini and microsatellites and their various families, long and short interspersed nucleotide elements, DNA markers- RAPD, STR, SSCP, RFLP, DNA fingerprinting, SNP, EST etc.

UNIT-II: Importance of gene mapping in livestock, methods and techniques used for gene mapping, physical mapping, linkage analysis, cytogenetic techniques, FISH technique in gene mapping, somatic cell hybridization, radiation hybrid maps, *in-situ* hybridization, comparative gene mapping.

UNIT-III: Genetic distance analysis, breed characterization on the basis of DNA markers, genetic markers for quantitative traits loci, marker assisted selection for incorporation of desirable traits DNA markers with economic traits, restriction fragment length polymorphism (RFLP) of different structural genes.

UNIT-IV: Current status of gene maps of livestock, MHC and its relevance to disease resistance and immune response, genes influencing production traits, mitochondrial DNA of farm animals, evolutionary significance, applications of genome analysis of animals in breeding.

**Practical**

- Chromosome preparation (normal karyotyping, different types of banding) in farm animals.
- Isolation and purification of animal genomic DNA from blood lymphocytes.
- Analysis of DNA by agarose or polyacrylamide gel electrophoresis.
- Checking the quality and quantity of genomic DNA.
- Restriction digestion and analysis.
- Southern hybridization
- DNA fingerprinting.
- Techniques for revealing polymorphism-DNA fingerprinting, RFLP, SSCP, AFLP,

- STRP etc.
- Genomic DNA cloning or cDNA cloning.
- Differentiation of tissues of different species by mitochondrial genome analysis.

**Suggested Readings**

Gibson G & Muse SV. 2004. *A Primer of Genome Science*. Sinauer Associates.  
 Primrose SB & Twyman RM. 2007. *Principles of Genome Analysis and Genomics*. Blackwell.  
 Sensen CW. 2005. *Handbook of Genome Research*. Vols. I, II. Wiley-CVH.

**ABT 610                      REPRODUCTIVE BIOTECHNOLOGY                      2+1                      SEM - II**

**Objective**

Understanding *in-vitro* reproductive techniques for ovum and embryo manipulation.

**Theory**

UNIT-I: History, importance of assisted reproductive biotechnology in man and animal, introduction to embryo biotechnology, endocrine therapeutics.

UNIT-II: Biotechnological approaches to reproduction, methodology of super ovulation, *in vitro* fertilization, embryo culture and micromanipulation, preparation of sperm for IVF.

UNIT-III: Different method of gene transfer and their limitations, embryo splitting, embryo sexing by different methods, production of transgenic livestock by nuclear transfer and its application, regulatory issues.

UNIT-IV: Cloning of domestic animals. Conservation of endangered species. Characterization of embryonic stem cells. Different applications of embryonic stem cells.

**Practical**

- Synchronization and superovulation protocols.
- Collection of embryos using non-surgical procedures.
- Transferring embryos using non- surgical procedures.
- Embryo freezing protocols.
- Oocyte collection and evaluation from slaughterhouse ovaries.
- In vitro fertilization protocols.
- Micromanipulation of early embryos.

**Suggested Readings**

Ball PJH & Peter AR. 2004. *Reproduction in Cattle*. Blackwell.  
 Gordon I. 2003. *Laboratory Production of Cattle Embryos*. CABI.  
 Gordon I. 2005. *Reproductive Techniques in Farm Animals*. CABI.

**ABT 611                      TECHNIQUES IN MOLECULAR BIOLOGY                      0+3                      SEM - II**  
**AND GENETIC ENGINEERING**

**Objective**

To provide comprehensive hands-on training on techniques of molecular biology and genetic engineering.

**Practical**

UNIT-I: Isolation of bacterial plasmids and chromosomal DNA. Isolation of DNA from mammalian cells. Isolation of mRNA/RNA. Quantitation of nucleic acids.

UNIT-II: Plasmid minprep; Restriction endonuclease digestion of plasmid and chromosomal DNA. Agarose gel electrophoresis of RE digested DNA; Isolation of DNA; cDNA synthesis.

UNIT-III: Polymerase Chain Reaction using random primers as well as specific primers. Different types of PCR, Real time polymerase chain reaction.

UNIT-IV: Cloning of bacterial and viral genes in to plasmid vectors. DNA ligation and transformation; Confirmation of insert by RE digestion and touch PCR; Transformation of yeast; Synthesis of nucleic acid probes; Nucleic acid hybridization.

**Suggested Readings**

Kun LY. 2006. *Microbial Biotechnology*. World Scientific.  
 Sambrook J & Russel DW. 2001. *Molecular Cloning: a Laboratory Manual*. Cold Spring Harbour Lab. Press.  
 Twyman RM. 2003. *Advanced Molecular Biology*. Bios Scientific.

ABT 612

**BIODIVERSITY, BIOSAFETY AND  
BIOETHICS**

2+0

SEM - I

**Objective**

Understanding the basis of genetic diversity and its maintenance, biosafety procedures.

**Theory**

UNIT-I: Historical and geographical causes of diversity, genetic diversity, molecular taxonomy, species and population biodiversity. Quantifying biodiversity, maintenance of ecological biodiversity, biodiversity and centres of origin of animals, biodiversity hotspots in India.

UNIT-II: Collection and conservation of biodiversity, conservation of animal genetic resources, assessing, analyzing and documenting biodiversity. Morphological and molecular characterization of biodiversity, vulnerable and extinction of biodiversity, introduction to biodiversity database, global biodiversity information system, bioethics, CBD.

UNIT-III: Biosafety and Risk assessment issues; Health aspects; toxicology, allergenicity; Ecological aspects; Regulations; National biosafety policy and law. The Cartagena Protocol on biosafety. The WTO and other international agreements; Cross border movement of germplasm; Risk management issues; Monitoring strategies and methods for detecting transgenics; Risks, benefits and impacts of transgenics to human health, society and the environment.

UNIT-IV: Bio-safety and bio-hazards; general principles for the laboratory and environmental bio-safety; Environment Impact Assessment; Gene flow in natural and artificial ecologies; Sources of gene escape; Ecological risks of genetically modified plants. Implications of intellectual property rights, rights on the commercialization of biotechnology products.

**Suggested Readings**

Arya R. 2005. *Biodiversity*. Deep & Deep.

Gaston KJ. 2004. *Biodiversity: an Introduction*. Blackwell.

Kannaiyan S & Gopalam A. 2007. *Biodiversity in India: Issues and Concerns*. APC.

ABT 613

**MOLECULAR FORENSICS**

2+1

SEM - II

**Objective**

Understanding the application of DNA based techniques in animal forensics.

**Theory**

UNIT-I: General history of forensic science, introduction to DNA forensics, scope and application of DNA forensics in animal and human criminal investigations in variety of situations.

UNIT-II: Isolation methods and techniques such as DNA finger-printings, PCR, nucleic acid hybridization, restriction endo-nuclease analysis and sequencing, Individual Animal Identification using DNA fingerprinting.

UNIT-III: Animal species identification in religious disputes, adulteration of meat, theft of farm animals and pets etc., advantages, disadvantages and limitations of DNA forensics.

UNIT-IV: Mass spectroscopy, protein detections methods, immunological techniques including ELISA, immunoelectrophoresis and immunofluorescence.

**Practical**

- Collection of material for forensic analysis.
- Dispatch of material for forensic investigations.
- Storage and processing of forensics material.
- Preparation of different bio-reagents.
- Isolation and extraction of nucleic acid from samples.
- Isolation and extraction of nucleic acid from wild animal scat.
- Isolation of nucleic acid from blood, skin, meat, milk, hair and cooked and putrefied meat.
- Designing of primers.
- Polymerase chain reaction (PCR).
- Randomly amplified polymorphic DNA (RAPD).
- Restriction fragment length polymorphism (RFLP).
- Multiplex PCR for species identification.
- Detection of adulteration in meat by PCR and nucleic acid hybridization assay.



### Suggested Readings

- Lincoln PJ & Thomson J. 1998. *Forensic DNA Profiling Protocols*. Humana Press.  
Rudin N & Inman K. 2002. *An Introduction to Forensic DNA Analysis*. 2<sup>nd</sup> Ed. CRC Press.

## **ABT 614                      INDUSTRIAL BIOTECHNOLOGY                      2+1                      SEM - II**

### **Objective**

Understanding the concept of bioprocessing of products and their production at Commercial scale.

### **Theory**

UNIT-I: Introduction, scope and historical development; isolation, screening and genetic improvement of industrially important microorganisms, fermentation: introduction, historical perspective of development of bioprocessing technology.

UNIT-II: Emerging new technologies for processing and production of recombinant products, isolation, preservation. Media designs, sterilization, down stream processing, important fermentation process.

UNIT-III: Immobilization of enzymes and cells, and their application, growth rate analysis, estimation of biomass, batch and plug flow cultures, chemostate cultures. Production of vaccines and diagnostics.

UNIT-IV: Fermented beverages, production of single cell protein, steroid transformation, silage production, waste water treatment. Industrial application of Nanobiotechnology. Computer simulations, energy requirement and product formation in microbial culture, fed-batch and mixed cultures, scale-up principles.

### **Practical**

- Isolation of industrially important microorganisms.
- Maintenance and improvement.
- Production of industrial compounds such as alcohol, beer, citric acid, lactic acid.
- Recovery of alcohol, beer, citric acid, lactic acid.
- Study of bio-reactors and their operations.
- Production of biofertilizers.
- Experiments on microbial fermentation process.
- Harvesting purification and recovery of end products.
- Immobilization of cells and enzymes.
- Studies on enzyme kinetic behavior, growth analysis, biomass estimation, determination of mass transfer co-efficients.

### **Suggested Readings**

- Alberghina L. 2000. *Protein Engineering for Industrial Biotechnology*. Routledge.  
Kun L.Y. 2006. *Microbial Biotechnology*. World Scientific.  
Singh, R & Ghosh SK. 2004. *Industrial Biotechnology*. Global Vision Publ. House.  
Thomson J. 2006. *Your Guide to Industrial Biotechnology*. Abhishek Publ.

## **ABT 615                      PROBIOTICS AND FEED BIOTECHNOLOGY                      3+0                      SEM - I**

### **Objective**

Understanding the concept of probiotics and applications of new tools of biotechnology for quality feed/food production.

### **Theory**

UNIT-I: Introduction, history of probiotics, normal microflora of GI tract, methods for analysis of intestinal microflora, microorganisms and proteins used in probiotics, genetic modification of intestinal lactobacilli and bifidobacteria, recombinant probiotics. Mechanism of action of probiotics, immune response to probiotics, anti-mutagenic and anti-tumor activities of lactic acid bacteria, probiotics and immune system, lactic acid bacteria as live vaccines.

UNIT-II: Application of probiotics for humans, farm animals and poultry, probiotics and intestinal infections, lactose mal-digestion, probiotics regulatory issues. Symbiotics, traditional probiotic products, probiotics industrial perspectives, contradictions, precautions and adverse reactions.

UNIT-III: Introduction, feed processing and preservation, microbial bioconversion of lignin and cellulose rich feeds, factors affecting delignification. Diversity of organisms involved, fermentation techniques, large scale bioconversion of substrates, pre-treatment

of feeds, chemical vs. microbial treatment of feeds, anti-nutritional factors present in feeds, microbial detoxification of aflatoxins, mimosine and other anti-metabolites present. **UNIT-IV:** Genetic manipulation of organisms to enhance bioconversion ability, manipulation of rumen fermentation by selective removal of protozoa and fungi, effect of feed additives like antibiotics, methane inhibitors, genetic manipulation of rumen microflora to improve feed utilization, single cell protein as animal feed.

#### **Suggested Readings**

- Fuller R. 1997. *Probiotics 2: Applications and Practical Aspects*. Springer. Huffnagle GB & Wernick S. 2007. *The Probiotics Revolution: The Definitive Guide to Safe, Natural Health*. Bantam Books.
- Kalidas S, Paliyath G, Pometto A & Levin RE. 2004. *Functional Foods and Biotechnology*. CRC Press.
- Perdigón G & Fuller R. 2000. *Probiotics 3: Immunomodulation by the Gut Microflora and Probiotics*. Springer.
- Roger A. 1989. *Food Biotechnology*. Cambridge Univ. Press.
- Sambrook J & Russel DW. 2001. *Molecular Cloning: a Laboratory Manual*. Cold Spring Harbour Lab. Press.
- Trenv N. 1998. *Probiotics: Nature's Internal Healers*. Avery.

**ABT 616/  
MBB 511**

**ANIMAL BIOTECHNOLOGY**  
(To be taught by Animal Biotechnology)

**3+0**

**SEM - I**

#### **Objective**

Intended to provide an overview and current developments in different areas of animal biotechnology.

#### **Theory**

**UNIT-I:** Structure of animal cell, history of animal cell culture, cell culture media and reagents, culture of mammalian cells, tissues and organs, primary culture, secondary culture, continuous cell lines, suspension cultures, somatic cell cloning and hybridization, transfection and transformation of cells, commercial scale production of animal cells, application of animal cell culture for *in vitro* testing of drugs, testing of toxicity of environmental pollutants in cell culture, application of cell culture technology in production of human and animal viral vaccines and pharmaceutical proteins.

**UNIT-II:** Introduction to immune system, cellular and humoral immune response, history of development of vaccines, introduction to the concept of vaccines, conventional methods of animal vaccine production, recombinant approaches to vaccine production, hybridoma technology, phage display technology for production of antibodies, antigen-antibody based diagnostic assays including radioimmunoassays and enzyme immunoassays, immunoblotting, nucleic acid based diagnostic methods, commercial scale production of diagnostic antigens and antisera, animal disease diagnostic kits, probiotics.

**UNIT-III:** Structure of sperms and ovum, cryopreservation of sperms and ova of livestock, artificial insemination, super ovulation, *in vitro* fertilization, culture of embryos, cryopreservation of embryos, embryo transfer, embryo-splitting, embryo sexing, transgenic manipulation of animal embryos, different applications of transgenic animal technology, animal viral vectors, animal cloning basic concept, cloning from- embryonic cells and adult cells, cloning of different animals, cloning for conservation of endangered species, ethical, social and moral issues related to cloning, *in situ* and *ex situ* preservation of germplasm, *in utero* testing of foetus for genetic defects, pregnancy diagnostic kits, anti-fertility animal vaccines, gene knock out technology and animal models for human genetic disorders.

**UNIT-IV:** Introduction to different breeds of cattle, buffalo, sheep, goats, pigs, camels, horses, canines and poultry, genetic characterization of livestock breeds, marker assisted breeding of livestock, introduction to animal genomics, different methods for characterization of animal genomes, SNP, STR, QTL, RFLP, RAPD, genetic basis for disease resistance, Transgenic animal production and application in expression of therapeutic proteins. Immunological and nucleic acid based methods for identification of animal species, detection of meat adulteration using DNA based methods, detection food/feed adulteration with animal protein, identification of wild animal species using DNA based methods using different parts including bones, hair, blood, skin and other parts confiscated by anti-poaching agencies.

### Suggested Readings

- Gordon I. 2005. *Reproductive Techniques in Farm Animals*. CABI.  
Kindt TJ, Goldsby RA & Osbrne BA. 2007. *Kuby Immunology*. WH Freeman.  
Kun LY. 2006. *Microbial Biotechnology*. World Scientific.  
Levine MM, Kaper JB, Rappuoli R, Liu MA, Good MF. 2004. *New Generation Vaccines*. 3<sup>rd</sup> Ed. Informa Healthcare.  
Lincoln PJ & Thomson J. 1998. *Forensic DNA Profiling Protocols*. Humana Press.  
Portner R. 2007. *Animal Cell Biotechnology*. Humana Press.  
Spinger TA. 1985. *Hybridoma Technology in Biosciences and Medicine*. Plenum Press.  
Twyman RM. 2003. *Advanced Molecular Biology*. Bios Scientific.

## ABT 701                      GENE CLONING AND EXPRESSION                      1+1                      SEM - II

### Objective

Understanding the concept of gene cloning and expression.

### Theory

UNIT-I: Cloning vectors- plasmids, phages, cosmids, BAC, YAC, expression vectors-viral, baculo and yeast vectors, shuttle vectors.

UNIT-II: Restriction, ligation, transformation and recombinant selection methods, construction of genomic and cDNA library, construction of full length cDNA.

UNIT-III: Linkers, adapters and cassettes, screening the library.

UNIT-IV: Expression of genes, prokaryotic and eukaryotic expression, identity of protein, purification of expressed protein.

### Practical

- Preparation of vector.
- Restriction enzyme digestion of vector.
- Purification of DNA.
- DNA ligation.
- Transformation.
- Calculation of transformation efficiency.
- Preparation of electro competent cells.
- Screening by PCR.
- Cloning of PCR products in vectors.
- Induction of expressed protein.
- PAGE and western blotting.

### Suggested Readings

- Ausubel FM, Brent R, Kingston RE, Moore DD, Seidman JG, Smith JA & Struhl K. 2002. *Short Protocols in Molecular Biology*. Wiley.

## ABT 702                      FUNCTIONAL GENOMICS AND                      2+1                      SEM - II PROTEOMICS

### Objective

Understanding gene expression at different conditions/organs.

### Theory

UNIT-I: Transcriptome and different methods to study gene expression, single gene analysis, northern blots, quantitative PCR, SAGE, MPSS and Microarray.

UNIT-II: Introduction to basic microarray technology, Design of experiments, Types of microarray, nanoarray, Customised microarray design, Image processing and quantification, Normalization and filtering, Exploratory statistical analysis, gene expression databases.

UNIT-III: SAGE and Microbeads, massive parallel signature sequencing, Microbial transcriptome. Role of functional genomics to study cancer and various clinical applications, Development, physiology, and behavior, evolutionary and ecology.

UNIT-IV: Proteomics technology, identification and analysis of proteins by 2D analysis, mass spectrophotometry, NMR and X-ray crystallography, MALDI-TOF, Differential display proteomics, Protein -protein interaction, yeast two hybrid system and phage display.

### Practical

- Northern blotting.
- Quantitative PCR.



**ABT 705                      ADVANCES IN ANIMAL CELL CULTURE                      2+1                      SEM - I**

**Objective**

Understanding the latest developments in cell culture techniques.

**Theory**

UNIT-I: Development of cell lines, characterization of cell lines by morphology, chromosome analysis, DNA content, enzyme activity and antigenic markers, differentiation.

UNIT-II: Cultivation requirements of different types of cells, flow cytometry, DNA transfer by calcium phosphate co-precipitation, lipofection, electroporation.

UNIT-III: Expression of recombinant proteins in mammalian and avian cell lines.

UNIT-IV: Up-scaling of cells for production of vaccines, diagnostic antigens and other pharmaceutical agents, up-stream and downstream processing, cell culture fermentors.

**Practical**

- Primary and secondary mammalian cell culture.
- Development of transformed cell lines.
- Characterization of cell lines.
- Transfection of cells with recombinant DNA.
- Expression of recombinant proteins.
- Scaling-up of cultures.

**Suggested Readings**

Selected articles from journals.

**ABT 706                      TRANSGENIC ANIMAL TECHNOLOGY                      2+0                      SEM - II**

**Objective**

Understanding the latest developments in transgenic technology.

**Theory**

UNIT-I: Concept of transgenics, techniques of gene transfer, microinjection of recombinant DNA into fertilized eggs/stem cells, transfection of DNA totipotent keratocarcinoma cells, electroporation, gene transfer into cultured cells.

UNIT-II: Suitable promoters for expression of transgenes, eukaryotic expression vectors, detection of transgenes in the new born.

UNIT-III: Principles of animal cloning, application of transgenic and cloning technologies for improvement of livestock. Transgenic animals as bioreactors.

UNIT-IV: Social, ethical, religious, environmental and other regulatory issues related to transgenic animal technology.

**Suggested Readings**

Selected articles from journals

**ABT 707/                      ADVANCES IN ANIMAL BIOTECHNOLOGY                      2+0                      SEM - II**  
**MBB 607                      (To be taught by Animal Biotechnology)**

**Objective**

Intended to provide cutting edge knowledge on advances in different areas of animal biotechnology.

**Theory**

UNIT-I: Advances in animal cell culture technology, suspension culture technology, advances in commercial scale productions of mammalian cells.

UNIT-II: Advances in cell cloning and cell hybridization, advances in monoclonal antibody production technology, Advances in diagnostic technology, Computational vaccinology, reverse genetics based vaccines.

UNIT-III: Advances in embryo manipulation, knock out and knock in technology, advances in animal cloning technology, stem cell technology, Advances in development of animal models for human diseases using transgenic animal technology.

UNIT-IV: Advances in genetic basis for animal disease resistance, Molecular methods for animal forensics, Advances in animal genomics, proteomics.

**Suggested Readings**

Selected articles from journals.

# ANIMAL BIOTECHNOLOGY

## List of Journals

- Animal Biotechnology
- Animal Genetics
- Animal Reproduction
- Cellular and Molecular Probe
- Current Science
- Genome Research
- Indian journal of Microbiology
- Journal of Clinical Microbiology
- Journal of Dairy Science
- Journal of Reproduction and Fertility
- Methods in Virus Research
- Nature
- Nature Biotechnology
- Nature Genetics
- Nucleic Acid Research
- PNAS
- Reproduction in Domestic Animals
- Science
- Theriogenology
- Trends in Biotechnology
- Trends in Genetics
- Viral Research

## e-Resources

- [www.cls.casa.colostate.edu/TransgenicCrops/teacherlinks](http://www.cls.casa.colostate.edu/TransgenicCrops/teacherlinks)
- [www.hpc.unm.edu/~aroberts/main/top5%25.htm](http://www.hpc.unm.edu/~aroberts/main/top5%25.htm)
- [www.isaaa.org](http://www.isaaa.org)
- [www.ciat.cgiar.org/biotechnology/cbn/gines\\_mera\\_fund.htm](http://www.ciat.cgiar.org/biotechnology/cbn/gines_mera_fund.htm)
- [www.scidev.net/en/agriculture-and-environment/agri-biotech/links/publications-and-information-services](http://www.scidev.net/en/agriculture-and-environment/agri-biotech/links/publications-and-information-services)
- [www.biotechinstitute.org/programs/t\\_leader\\_program.html](http://www.biotechinstitute.org/programs/t_leader_program.html)
- [www.sci-ed-ga.org/modules/dna/analogies.html](http://www.sci-ed-ga.org/modules/dna/analogies.html)
- [www.accessexcellence.org/AE/AEPC/WWC/1993](http://www.accessexcellence.org/AE/AEPC/WWC/1993)
- [www.atschool.eduweb.co.uk/trinity/bio2.html](http://www.atschool.eduweb.co.uk/trinity/bio2.html)
- [www.pub.ac.za/resources/teach.html](http://www.pub.ac.za/resources/teach.html)
- [www.bio-link.org/biomaterial.htm](http://www.bio-link.org/biomaterial.htm)
- [www.biotechnology.gov.au/index.cfm?event=object.showContent&objectID=B35A914C-DE3D-1A59-79F89FAA26F54E44](http://www.biotechnology.gov.au/index.cfm?event=object.showContent&objectID=B35A914C-DE3D-1A59-79F89FAA26F54E44)
- [www.monsanto.com/products/techandsafety/technicalpubs/eduwebsites.asp](http://www.monsanto.com/products/techandsafety/technicalpubs/eduwebsites.asp)
- [www.ejbiotechnology.info/content/vol5/issue3/teaching/01/index.html](http://www.ejbiotechnology.info/content/vol5/issue3/teaching/01/index.html)
- [www.ncbiotech.org/resource\\_center/for\\_educators/online\\_teaching\\_resources.html](http://www.ncbiotech.org/resource_center/for_educators/online_teaching_resources.html)
- [www.ias.ac.in/currsci/dec252006/1594](http://www.ias.ac.in/currsci/dec252006/1594)
- [www.cco.k12.ca.us/stsvcs/newteacher/rop/curr\\_rop\\_links2.html](http://www.cco.k12.ca.us/stsvcs/newteacher/rop/curr_rop_links2.html)
- [www.scielo.cl/scielo.php?pid=S0717-34582003000100004&script=sci\\_arttext](http://www.scielo.cl/scielo.php?pid=S0717-34582003000100004&script=sci_arttext)
- [www.sunysb.edu/ligase/Forstudents/BiotechTeachingCenter/biotechcenter.html](http://www.sunysb.edu/ligase/Forstudents/BiotechTeachingCenter/biotechcenter.html)
- [www.ca.uky.edu/agc/pubs/brei/brei3tg/brei3tg.htm](http://www.ca.uky.edu/agc/pubs/brei/brei3tg/brei3tg.htm)
- [www.aggie-horticulture.tamu.edu/tisscult/biotech/biotechteach.html](http://www.aggie-horticulture.tamu.edu/tisscult/biotech/biotechteach.html)
- [www.ejbiotechnology.info/content/vol6/issue2/issues/2/index.html](http://www.ejbiotechnology.info/content/vol6/issue2/issues/2/index.html)
- <http://science.nhmccd.edu/biol/biolint.htm#dna>
- <http://nhscience.lonestar.edu/biol/biolint.htm>
- [www.ingentaconnect.com/content/tandf/tsed/2000/00000022/00000009/art00007](http://www.ingentaconnect.com/content/tandf/tsed/2000/00000022/00000009/art00007)

- [www.buildingbiotechnology.com/free.php](http://www.buildingbiotechnology.com/free.php)
- [www.biotechnologist2020.com/2008/04/teaching-jobs-in-bioinformatics.html](http://www.biotechnologist2020.com/2008/04/teaching-jobs-in-bioinformatics.html)
- [www.eric.ed.gov/ERICWebPortal/recordDetail?accno=EJ613711](http://www.eric.ed.gov/ERICWebPortal/recordDetail?accno=EJ613711)
- [www.uq.edu.au/teaching-learning/index.html?page=61920](http://www.uq.edu.au/teaching-learning/index.html?page=61920)
- [www.nature.com/nbt/journal/v18/n9/full/nbt0900\\_913b.html](http://www.nature.com/nbt/journal/v18/n9/full/nbt0900_913b.html)
- [www.fotodyne.com/literature/datasheets/E10700](http://www.fotodyne.com/literature/datasheets/E10700)
- [www.biotechics.org/conferences/maastricht/participants.html](http://www.biotechics.org/conferences/maastricht/participants.html)
- [www.brookes.ac.uk/studying/courses/postgraduate/2008/biotech](http://www.brookes.ac.uk/studying/courses/postgraduate/2008/biotech)
- [www.bioweb.usc.edu/courses/2003-spring/documents/bisc406-notes\\_011603](http://www.bioweb.usc.edu/courses/2003-spring/documents/bisc406-notes_011603)
- [www.agen.ufl.edu/~chyn/age2062/lect/lect\\_09/lect\\_09.htm](http://www.agen.ufl.edu/~chyn/age2062/lect/lect_09/lect_09.htm)
- [www.bioinformaticscourses.com/BIOL358/lectures.html](http://www.bioinformaticscourses.com/BIOL358/lectures.html)
- [www.isis.vt.edu/~nstone/LifeSci/lect5.html](http://www.isis.vt.edu/~nstone/LifeSci/lect5.html)
- [www.nwo.nl/nwohome.nsf/pages/NWOA\\_6Y2LGH\\_Eng](http://www.nwo.nl/nwohome.nsf/pages/NWOA_6Y2LGH_Eng)
- [www.soi.wide.ad.jp/class/20040016](http://www.soi.wide.ad.jp/class/20040016)
- [www.sciencetech.technomuses.ca/english/schoolzone/biotech.cfm](http://www.sciencetech.technomuses.ca/english/schoolzone/biotech.cfm)
- [www.freevidelectures.com/biotech.html](http://www.freevidelectures.com/biotech.html)
- [www.agen.ufl.edu/~chyn/age4660/lect/lect\\_07/lect\\_07.htm](http://www.agen.ufl.edu/~chyn/age4660/lect/lect_07/lect_07.htm)
- [www.web.mit.edu/cheme/news/frontiers\\_2005.html](http://www.web.mit.edu/cheme/news/frontiers_2005.html)

### **Suggested Broad Topics for Master's and Doctoral Research**

- Development of Vaccines against emerging pathogens
- Nucleic acid based diagnostics
- Molecular animal forensics
- Whole genome analysis of animal viruses
- Embryo manipulation
- Animal genomics
- Reproductive biotechnology
- Conservation of endangered animal species
- Animal breed characterization
- Genomic Diversity of animal viruses
- Mapping of disease resistance genes in livestock
- Proteomics