POST GRADUATE COURSE CATALOUGE

LALA LAJPAT RAI UNIVERSITY OF VETERINARY AND ANIMAL SCIENCES, HISAR-125004, HARYANA

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POST GRADUATE COURSE CATALOUGE
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ANIMAL BIOTECHNOLOGY

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*Compulsory for Master`s programme;**Compulsory for Doctoral programme

To be taught by Animal Biotechnology, Bioinformatics, Molecular Biology & Biotechnology; AnimalBiotechnology; 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 Horio*zon. Kalyani.

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

Objective

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

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^{++} 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 tumourogenic 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 AND APPLICATIONS 1+2 SEM -I

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.
- Primer 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.
- Immunogenecity 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*. 3rd Ed. Informa Healthcare.

Lowrie DB & Whalen R. 2000. *DNA Vaccines*. Humana Press.

Robinson A & Cranage MP. 2003. *Vaccine Protocols*. 2nd 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 florescence 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.
- Immunoelectrophoresis.
- 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/ BIF 501/ MBB 555/ FSC 604 **INTRODUCTION TO BIOINFORMATICS 2 +1 SEM - I**

(To be taught jointly by Animal Biotechnology, Bioinformatics and Molecular Biology & Biotechnology)

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
- Retrival 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 AND GENETIC ENGINEERING **0+3** **SEM - II**

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. Diiferent 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 immunofluorence.

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*. 2nd 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 LY. 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.

Trenev 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 assaysincluding 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-spliting, 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*. 3rd 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 bloting.

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 - IIPROTEOMICS

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 micrroarray 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 spectrophotometery, 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.
- Design of microarray experiments.
- Microarray image processing.
- Basic statistical methods.
- Clustering methods to study gene expression.
- Analytical software related to genomics and proteomics.

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 703 ADVANCES IN REPRODUCTIVE BIOTECHNOLOGY 2+1 SEM - II

Objective

Understanding the new developments in reproductive technology

Theory

UNIT-I: Reproductive cloning, somatic cell nuclear transfer and transgenic animal production, cryopreservation of gametes.

UNIT-II: Preimplantation genetic diagnosis (PGD), genomic imprinting and assisted reproduction, receptors of different hormones and their estimation.

UNIT-III: Introduction to stem cells, types, identification, characterization anddevelopment of stem cells,
transfection of gene in embryonic blastomeres.

UNIT-IV: Stem cell therapeutics, social, ethical religious and regulatory issues.

Practical

- Embryo micromanipulation.
- Microinjection.
- Intra-cytoplasmic sperm injection.
- ICSI Embryo biopsy for PGD and sexing.
- Culture of embryonic stem cell.
- Characterization of embryonic stem cells.

Suggested Readings

Selected articles from journals.

ABT 704 TRENDS IN VACCINOLOGY 3+0 SEM - I

Objective

Understanding the latest developments in vaccine production technologies.

Theory

UNIT-I: Molecular approaches to development of vaccines including: recombinant peptide vaccines, vectored vaccines, DNA vaccines, genetically manipulated live vaccines.

UNIT-II: Plant expression system based vaccines, idiotype and synthetic peptide based vaccines, reverse genetic approach and computational vaccinology.

UNIT-III: Immunomodulators including cytokines and new adjuvants, Immunomodulation, innovative methods of delivery of immunogens through liposomes, microspheres, ISCOMS, etc.

UNIT-IV: Large scale production technology and quality control, regulatory issues, environmental concerns with the use of recombinant vaccines.

Practical

- Preparation of gene construct for recombinant and nucleic acid vaccine.
- Expression of gene encoding immunogenic protein in prokaryotic/ yeast/ animal cell culture system.
- Study of immune response against recombinant vaccine.
- Protection and evaluation studies.
- Use of modern adjuvants in vaccines.
- Vaccine delivery systems including use of nanoparticles.

Suggested Readings

Selected articles from journals.

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 technologiesfor 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
- www.hpc.unm.edu/~aroberts/main/top5%25.htm
- www.isaaa.org
- www.ciat.cgiar.org/biotechnology/cbn/gines_mera_fund.htm
- www.scidev.net/en/agriculture-and-environment/agri-biotech/links/publications-and-information-services
- www.biotechinstitute.org/programs/t_leader_program.html
- www.sci-ed-ga.org/modules/dna/analogies.html
- www.accessexcellence.org/AE/AEPC/WWC/1993
- www.atschool.eduweb.co.uk/trinity/bio2.html
- www.pub.ac.za/resources/teach.html
- www.bio-link.org/biomaterial.htm
- www.biotechnology.gov.au/index.cfm?event=object.showContent&objectID=B35A914C-DE3D-1A59-79F89FAA26F54E44
- www.monsanto.com/products/techandsafety/technicalpubs/eduwebsites.asp
- www.ejbiotechnology.info/content/vol5/issue3/teaching/01/index.html
- www.ncbiotech.org/resource_center/for_educators/online_teaching_resources.html
- www.ias.ac.in/currsci/dec252006/1594
- www.cccoe.k12.ca.us/stsvcs/newteacher/rop/curr_rop_links2.html
- www.scielo.cl/scielo.php?pid=S0717-34582003000100004&script=sci_arttext
- www.sunysb.edu/ligase/Forstudents/BiotechTeachingCenter/biotechcenter.html
- www.ca.uky.edu/agc/pubs/brei/brei3tg/brei3tg.htm
- www.aggie-horticulture.tamu.edu/tisscult/biotech/biotechteach.html
- www.ejbiotechnology.info/content/vol6/issue2/issues/2/index.html
- http://science.nhmccd.edu/biol/bio1int.htm#dna
- http://nhscience.lonestar.edu/biol/bio1int.htm
- www.ingentaconnect.com/content/tandf/tsed/2000/00000022/00000009/art00007

- www.buildingbiotechnology.com/free.php
- www.biotechnologist2020.com/2008/04/teaching-jobs-in-bioinformatics.html
- www.eric.ed.gov/ERICWebPortal/recordDetail?accno=EJ613711
- www.uq.edu.au/teaching-learning/index.html?page=61920
- www.nature.com/nbt/journal/v18/n9/full/nbt0900_913b.html
- www.fotodyne.com/literature/datasheets/E10700
- www.biotethics.org/conferences/maastricht/partecipants.html
- www.brookes.ac.uk/studying/courses/postgraduate/2008/biotech
- www.bioweb.usc.edu/courses/2003-spring/documents/bisc406-notes_011603
- www.agen.ufl.edu/~chyn/age2062/lect/lect_09/lect_09.htm
- www.bioinformaticscourses.com/BIOL358/lectures.html
- www.isis.vt.edu/~nstone/LifeSci/lect5.html
- www.nwo.nl/nwohome.nsf/pages/NWOA_6Y2LGH_Eng
- www.soi.wide.ad.jp/class/20040016
- www.sciencetech.technomuses.ca/english/schoolzone/biotech.cfm
- www.freevideolectures.com/biotech.html
- www.agen.ufl.edu/~chyn/age4660/lect/lect_07/lect_07.htm
- 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

VETERINARY AND ANIMAL HUSBANDRY EXTENSION EDUCATION

Course Structure

COURSE NO.	COURSE TITLE	CREDITS	SEM
AHE 601	FUNDAMENTALS OF VETERINARY AND ANIMAL HUSBANDRY EXTENSION	2+1	I
AHE 602	COMMUNICATION FOR LIVESTOCK DEVELOPMENT	1+1	I
AHE 603	DIFFUSION AND ADOPTION OF ANIMAL	2+1	I
AHE 604	EXTENSION TECHNIQUES AND AUDIO VISUAL AIDS	2+1	I
AHE 605	ANIMAL HUSBANDRY PROGRAMME PLANNING AND EVALUATION	2+1	II
AHE 606	RESEARCH METHODOLOGY IN VETERINARY AND ANIMAL HUSBANDRY EXTENSION	2+1	II
AHE 607	SOCIAL PSYCHOLOGY AND GROUP DYNAMICS	2+1	I
AHE 608	ANIMAL HUSBANDRY DEVELOPMENTPROGRAMMES	1+0	II
AHE 609	DEVELOPMENTS IN THE CONCEPT OF EXTENSION	1+0	II
AHE 610	HUMAN RESOURCE MANAGEMENT IN ANIMAL HUSBANDRY SECTOR	2+1	II
AHE 611	GENDER AND LIVESTOCK DEVELOPMENT	1+0	II
AHE 612	INFORMATION AND COMMUNICATION TECHNOLOGY IN LIVESTOCK DEVELOPMENT	1+1	I
AHE 691	MASTER'S SEMINAR	1	I, II
AHE 699	MASTER'S RESEARCH	20	I, II
AHE 701	ORGANIZATIONAL MANAGEMENT	3+0	I
AHE 702	FARM JOURNALISM AND PUBLIC RELATIONS	2+1	II
AHE 703	ADVANCED RESEARCH TECHNIQUES IN SOCIAL	3+1	II
AHE 704	TRAINING FOR HUMAN RESOURCE DEVELOPMENT	2+1	I
AHE 705	POLICIES AND REGULATIONS IN LIVESTOCK	2+0	I
AHE 706	EDUCATIONAL TECHNOLOGY	2+1	II
AHE 707	DYNAMICS OF CHANGE	2+0	I
AHE 708	ORGANIZATIONAL COMMUNICATION	2+1	I
AHE 790	SPECIAL PROBLEM	0+2	I, II
AHE 791	DOCTORAL SEMINAR I	1	I, II
AHE 792	DOCTORAL SEMINAR II	1	I, II
AHE 799	DOCTORAL RESEARCH	45	I, II

VETERINARY AND ANIMAL HUSBANDRY EXTENSION EDUCATION

Course Contents

AHE-601 FUNDAMENTALS OF VETERINARY AND ANIMAL HUSBANDRY EXTENSION **2+1** **SEM-I**

Objective

To acquaint the students with the genesis, development and present status of animal husbandry extension and linkages among departments and various institutions.

Theory

UNIT-I: Concept, philosophy, principles, genesis, growth and scope of extension education.

UNIT-II: Earlier extension efforts and their implications. Emerging issues, problems and challenges of animal husbandry extension education.

UNIT-III: Extension approaches of State and Central Governments, ICAR, SVUs/ SAUs, NGOs and other organizations in delivery of animal husbandry and veterinary services.

UNIT-IV: Linkages between researcher-extension agent - livestock farmer-industry in the generation, dissemination and utilization of animal husbandry practices.

Practical

Study of the organizational set-up and functioning of State Animal Husbandry Department and dairy/rural development agencies. Study of indigenous technical know- how about animal husbandry practices in villages.

Suggested Readings

Adams ME. 1982. *Agricultural Extension in Developing Countries*. Longman, Singapore Publ.

Burton ES, Robert PB & Andrew JS. 1997. *Improving Agricultural Extension – A Reference Manual*. FAO.

Dahama OP & Bhatnagar OP. 1987. *Education and Communication for Development*. Oxford & IBH.

Mosher AT. 1966. *Getting Agriculture Moving- Essentials for Development and Modernization*. Praeger, New York.

Mosher AT. 1978. *An Introduction to Agricultural Extension*. ADC.

Owen E, Kitalyi A, Jayasuryia N & Smith T. (Ed). 2005. *Livestock and Wealth Creation – Improving of the Husbandry of Animals Kept by Resource Poor People in Developing Countries*. Nottingham Univ. Press.

Roling N. 1988. *Extension Science. Information Systems in Agricultural Development.* Cambridge Univ. Press.

Rivera WM & Schram SG. (Ed). 1987. *Agricultural Extension World wide – Issues, Practices and Emerging Priorities*. Croome Helm, London.

Rivera WM. & Gustafson DJ. (Ed). 1991. *Agricultural Extension: Worldwide: Institutional Evolution and Forces for Change,*. Elsevier.

Samanta RK. (Ed). 1990. *Development Communication for Agriculture*. BR Publ. Corp., Delhi.

Swanson BE. (Ed). 1984. *Agricultural Extension: A Reference Manual*. 2nd Ed. FAO.

Van den Ban AW & Hawkins HS. 1998. *Agricultural Extension*. Longman Scientific Tech.

AHE 602 COMMUNICATION FOR LIVESTOCK DEVELOPMENT **1+1** **SEM-I**

Objective

To acquaint the students with concept and models of communication and to improve their communication skills.

Theory

UNIT-I: Communication- meaning, concept, purpose and process.

UNIT-II: Models and theories of communication. Types of communication- intrapersonal, interpersonal, verbal and non-verbal. Criteria of effective communication, Determinants of communication- Empathy, credibility, fidelity, distortion, feed back and barriers to communication.

UNIT-III: Group and mass communication. Modern communication technologies. Key communicators and their role in animal husbandry development.

Practical

Exercises in oral communication and group discussion. Exercises in written communication. Writing for newspapers, magazines. Script writing for radio and TV. Client management in veterinary clinics. Identification of key communicators in a village.

Suggested Readings

Cragan FJ. & Wright WD. 1999. *Communication in Small Groups – Theory, Process, Skills*. Wadsworth Publ.

Mcquail D & Windahl S. 1993. *Communication Models for the Study of Mass Communications*. Longman Publ.

Ray GL. 1991. *Extension, Communication and Management*. Naya Prokash.

Rogers EM & Shoemaker FF. 1971. *Communication of Innovations: A Cross – Cultural Approach*. The Free Press.

Roloft Michael F. 1981. *Interpersonal Communication*. Sage Publ.

Servaes J, Thomas LJ. & Whitle AS. (Ed). 1997. *Participatory Communication for Social Change*. Sage Publ.

AHE 602 DIFFUSION AND ADOPTION OF ANIMAL 2+1 SEM-I

Objective

To sensitize the students towards technology generation, dissemination and its adoption through effective communication.

Theory

UNIT-I: Concept of diffusion. Elements in diffusion process, models and theories of diffusion. Decision-making, Stages in diffusion-adoption process.

UNIT-II: Concepts and stages of adoption. Adoption models. Adopter categories and their characteristics. Factors influencing adoption. Attributes of innovations, rate of adoption and sources of information. Consequences of adoption of innovations.

UNIT-III: Role of change agents in transfer of technology. Diffusion studies in veterinary extension. Role of communication in diffusion and adoption process

Practical

Study of selected animal husbandry innovations- the adoption and non- adoption of various practices. Reasons for adoption and non-adoption of innovations.

Suggested Readings

Brown Lawrence A. 1981. *Innovation Diffusion: A New Perspective*. Methuen.

Cragan FJ & Wright WD. 1999. *Communication in Small Groups – Theory, Process, Skills*. Wadsworth Publ.

Rogers EM. 2003. *Diffusion of Innovations*. Free Press.

Servaes J, Thomas LJ & Whitle AS. (Ed). 1997. *Participatory Communication for Social Change*. Sage Publ.

AHE 604 EXTENSION TECHNIQUES AND AUDIO VISUAL AIDS 2+1 SEM - I

Objective

To train the students about various techniques/methods for transfer of animal husbandry technologies through suitable audio-visual aids.

Theory

UNIT-I: Teaching learning process and its principles. Steps in extension teaching process, cone of experience. Learning situation. Criteria for effective teaching and learning.

UNIT-II: Extension approaches in livestock development– individual, group and mass approach (electronic and non electronic). Relative merits and demerits of different teaching methods in animal husbandry extension.

UNIT-III: Audio-visual aids– classification, use and evaluation. Selection criteria of audio-visual aids.

UNIT-IV: Multi-media projection and computer aided teaching aids for animal husbandry extension.

UNIT-V: Selection of different extension methods for dissemination of animal husbandry technologies and media-mix.

Practical

Preparation and presentation of various audio-visual aids. Use of different teaching methods in field situations. Review of research studies in teaching methods and A.V. aids.

Suggested Readings

Dahama OP & Bhatnagar OP. 1987. *Education and Communication for Development*. Oxford & IBH.

Hass KB & Packer HQ. 1962. *Preparation and Use of Audio-Visual Aids*. Prentice Hall.

Mathialagan P. 2005. *Text Book of Animal Husbandry and Livestock Extension*. International Book Distributing Co.

Mody Bella 1992. *Designing Messages for Development Communication. An Audience Participation based Approach*. Sage Publ.

Oakley P & Garforth C. 1985. *Guide to Extension Training*. FAO. Priyanjam Kartik 2005. *Audio Visual Aids and Education*. Dominant Publ. Ray GL. 1991. *Extension, Communication and Management*. Naya Prokash.

AHE 605 ANIMAL HUSBANDRY PROGRAMME PLANNING AND EVALUATION 2+1 SEM - II

Objective

To expose the students on planning, formulation, implementation and evaluation ofvarious animal husbandry development programmes.

Theory

UNIT-I: Importance of programme planning in veterinary and animal husbandry extension. Objectives, principles and steps in programme planning process. Role of animal husbandry extension agencies, local leaders, livestock owners and institutions in planning and implementation of need-based veterinary extension programmes.

UNIT-II: Genesis, nature and principles of planning. Planning Commission and its role. Five Year Plans with reference to animal husbandry development. Organizational structure for planning at different levels.

UNIT-III: Concept, principles, types and methods of evaluation. Importance of monitoring various livestock development programmes.

UNIT-IV: Needs assessment– meaning, importance, classification and steps. Concept of FSR, Participatory Approaches- Rapid Rural Appraisal (RRA) and Participatory Rural Appraisal (PRA).

UNIT-V: Project management techniques- Programme Evaluation and Review Technique (PERT). Critical Path Method (CPM). Project formulation. Project appraisal in terms of social benefit analysis, logical frame work.

Practical

Preparation of livestock development plan for a village. Developing instruemnts for monitoring and evaluation of on-going development programme at village level (Logical Frame Work). Exercises on Participatory approaches (RRA, PRA, Case study, Problem Based Learning).

Suggested Readings

Collinson M. 2000. *A History of Farming System Research*. CAB Publ.

Dantwala ML & Beroneda JN. 1990. *Rural Development, Approaches and Issues in Indian Agricultural Development since Independence*. Oxford & IBH.

Penders JMA. 1958. *Methods and Programme Planning in Rural Extension*. Veenman & Zonen.
Swanson BE. (Ed). 1997. *Agricultural Extension: A Reference Manual*. FAO.
Thyagrajan M. 1982. *Project Management through Network Techniques (PERTCPM)*. Indian Institute of Public Administration, New Delhi.
White Shirley (Ed). 1999. *The Art of Facilitating Participation – Releasing the Power of Grassroots Communication*. Sage Publ.

AHE 606 RESEARCH METHODOLOGY IN VETERINARY AND ANIMAL HUSBANDRY EXTENSION 2+1 SEM - II

Objective

To apprise the students about the selection criteria of research problem, variables, research design, sampling techniques, data collection procedure and report writing in the field of animal husbandry extension.

Theory

UNIT-I: Concept, nature and scope of research in social sciences. Types of research-fundamental, applied and action research, experimental and non- experimental research. Variables, types and their measurement. Selection and formulation of research problem. Hypothesis– importance, selection criteria (quality of workable hypothesis), formulation and testing of hypothesis.

UNIT-II: Measurement and levels of measurement; Research designs- exploratory, experimental, and ex-post-facto research design. Action research. Sampling methods-probability and non-probability sampling. Sources of errors.

UNIT-III: Methods of data collection–survey method, observation method, interview/ questionnaire method, case study, content analysis, sociometry and projective techniques. Action research. Reliability and validity of measurements.

UNIT-IV: Social statistics – Parametric and non-parametric. Data processing and analysis. Report writing. Review of studies in social research.

Practical

Selecting a research problem and working it out with all the steps; report writing andpresentation of the report.

Suggested Readings

Arlene Fink (Ed). 2003. *The Survey Kit* (10 booklets). Sage Publ.
Creswell John W. 1994. *Research Design – Qualitative and Quantitative Approaches*. University of Nebraska, Lincoln.
Edwards AL. 1969. *Techniques of Attitude Scale Construction*. Vakil, Feffer & Simons. Garrett HE. 1966. *Statistics in Psychology and Education*. International Book Bureau, Hyderabad.
Goode WJ & Hatt PK. 1952. *Methods in Social Research*. McGraw-Hill. Guilford JP. 1971. *Psychometric Methods*. Tata McGraw Hill.
Henerson EM, Morris LL. & Gibbon CT. 1987. *How to Measure Attitudes*. Sage Publ. Kerlinger FN. 1994. *Foundations of Behavioural Researches*. Holt, Rinehart & Winstons. Kumar, R. 1999. *Research Methodology – A Step by Step for Beginners*. Sage Publ.
Miller Delbert C. 1991. *Handbook of Research Design and Social Measurement*. Indiana University. Sage Publ.
Oppenheim AN. 1979. *Questionnaire Design and Attitude Measurement*. Heinemann Educational Books.

AHE 607 SOCIAL PSYCHOLOGY AND GROUP DYNAMICS 2+1 SEM - I

Objective

To acquaint the students with the structure and functioning of social groups and socio-psychological aspects in interacting with livestock farmers.

Theory

UNIT-I: Meaning, scope and importance of psychology in animal husbandry extension work. Orientation of psychology.

UNIT-II: Perception- nature, laws and selectivity in perception, factors in perception, importance of perception in extension work. Attitude- nature, theories, measurement and change of attitude towards livestock owners, formation of stereo types and prejudice, factors in attitude change.

UNIT-III: Motivation– nature, characteristics, theories, types and techniques of motivating farm people. Emotion- nature, types of emotional response, theories and role of emotion in regulating the human behaviour. Learning- principles, theories of learning and experiential learning.

UNIT-IV: Intelligence- nature, theories and measurement. Personality- nature, traits, types, biological and socio-cultural determinants of personality. Group and individual behaviour.

UNIT-V: Concept and types of groups; Typology and importance in rural development; Group structures - attraction, coalition, communication and power; Processes in group development and group identity; Factors affecting group performance; Conflicts in groups; Group belongingness.

Practical

Study of structure and functioning of selected Self Help Groups (SHGs), factors influencing the success/ failure of SHGs, Milk Cooperative Societies.

Suggested Readings

Baron RA. 1995. *Psychology*. Prentice Hall.

Cragan, FJ & Wright WD. 1999. *Communication in Small Groups – Theory, Process, Skills.* Wadsworth Publ.

Kagan J & Havemann E. 1980. *Psychology – An Introduction.* Harcourt Brace Javanovich Inc.

Morgan CT, King RA & Robinson NM. 1979. *Introduction to Psychology*. Tata McGraw- Hill.

Napier RW & Gershenfeld MK. 2006. *Groups – Theory and Experience*. AITBS Publ. Secord PF & Backman CW. 1964. *Social Psychology*. McGraw-Hill.

AHE 608 ANIMAL HUSBANDRY DEVELOPMENT PROGRAMMES 1+0 SEM - II

Objective

To make the students aware of livestock development programmes launched by various agencies.

Theory

UNIT-I: Concept of development, social and economic development; Historical overview on Rural Development in India.

UNIT-II: Ongoing Animal Husbandry Development Programmes - NPCBB, PM assistance livestock development programme, rural development programmes with special reference to livestock- SGSY, EGS.

UNIT-III: Transfer of Technology (TOT) programmes of ICAR–National Demonstration, Krishi Vigyan Kendra, Trainers' Training Centres, Lab to Land Programme, Operational Research Project, National Agricultural Research Project, Agricultural Technology Management Agency, National Agricultural Innovative Project.

UNIT-IV: Understanding the functioning of livestock development institutions - DRDA, NABARD, Insurance Companies, NGOs.

Suggested Readings

Candler W & Kumar N. 1998. *India. The Dairy Revolution – The Impact of Dairy Development in India and the World Bank Contribution*. The World Bank.

Dahama OP & Bhatnagar OP. 1987. *Education and Communication for Development*. Oxford & IBH.

Govt. of India 2005. *A Reference Manual*. Ministry of Information and Broadcasting, New Delhi. http:/www.dahd.nic.in

Mathialagan P. 2005. *Text Book of Animal Husbandry and Livestock Extension*. International Book Distributing Co.
Ray GL. 1991. *Extension, Communication and Management*. Naya Prokash.

AHE 609 DEVELOPMENTS IN THE CONCEPT OF EXTENSION 1+0 SEM - II

Objective

To acquaint the students with the recent development in extension.

Theory

UNIT-I: Important concepts in extension science; various schools of thought; Systems concept in extension.

UNIT-II: Changing approaches – Farmer participatory approaches; Global concepts of extension as applied to Indian Context.

UNIT-III: Recent trends in extension. Privatisation of extension. Public Private Partnership. Contract farming. Organic animal husbandry. Indicators of livestock sustainability. Animal welfare programmes.

UNIT-IV: Various stake holders in Livestock development; stakeholder analysis, problem tree.

Suggested Readings

Blackburn DJ. 1989. *Foundations and Changing Practices in Extension*. Univ. of Guelph, Canada.
Jones GE. (Ed). 1985. *Investing in Rural Extension: Strategies and Goals*. Elsevier.Roling N. 1988. *Extension Science*. Cambridge Univ. Press.

AHE 610 HUMAN RESOURCE MANAGEMENT IN ANIMAL HUSBANDRY SECTOR 2+1 SEM - II

Objective

To expose the students in human resource management techniques and dealing with the hierarchical and organizational problems.

Theory

UNIT-I: Concept, importance and functions of human resource management. Process of management- planning, organizing, staffing, directing, coordination, reporting and budgeting. Principles, levels and types of organization.

UNIT-II: Training– models, methods, identification of training needs, training evaluation and developing strategies for human resource development in animal husbandry sector.

UNIT-III: Supervision- meaning, process and techniques. Work motivation. job efficiency and job satisfaction.

UNIT-IV: Organizational communication. Organizational climate. Conflict management.

UNIT-V: Personnel management in animal husbandry organizations and disaster management.

Practical

Training needs assessment, development of training module, organization, evaluation of a training programme.

Suggested Readings

Buford JA, Bedeian AG & Lindner JR. 1995. *Management in Extension*. Ohio State Univ., USA.
Dwivedi RS. 1979. *Human Relations and Organizational Behaviour – A Global Perspective*. 5th Ed. McMillan India.
Keith D. 2004. *Human Behaviour*. 8th Ed. Mc Graw Hill.
Lynton R & Pareek U. 1990. *Training for Development*. Vistar Publ.
Lynton R & Pareek U. 2000. *Training for Organizational Transformation*. Sage Publ.
Mishra DC. 1990. *New Directions in Extension Training*. Directorate of Extension, Ministry of Agriculture, Govt. of India, New Delhi.

Stoner JAF & Freeman RF. 1994. *Management*. 5th Ed. Prentice Hall.
Turban E & Meredith J. 1991. *Fundamentals of Management Science*. 5th Ed. Home Wood I.L. Irwin.
Weirich H & Koontz H. 1993. *Management – A Global Perspective*. McGraw-Hill.

AHE 611 GENDER AND LIVESTOCK DEVELOPMENT 1+ 0 SEM - II

Objective

To acquaint the students with the concept of gender, its importance in livestock development, livestock development polices and programmes of the government to empower women.

Theory

UNIT-I: Basic concepts - gender, empowerment and livestock. Role of livestock sector in Indian economy and poverty alleviation. Enterprise integration- women in agriculture and livestock. Livestock and agrarian scenario – trends in numbers, growth, composition and exports and imports.

UNIT-II: Policies and programmes in livestock for empowering women, Composition of livestock sector- dairying and poultry sector, Women entrepreneurship in livestock, Institutional structure in livestock production, processing and marketing- co-operatives, contract farming and SHGs, Case studies- success and failures- from the state, country and other countries.

UNIT-III: Globalization and livestock development – opportunities and challenges, WTO-need for quality standards in livestock production- assurance and safety measures- SWOT analysis, Extension techniques for livestock development, Group project work-livestock feasibility report/live-in situation report.

Suggested Readings

Bura N, Deshmukh J, Ranadive & Murthy KR. (Ed). 2006. *Micro Credit, Poverty and Empowerment – Linking the Triad*. Sage Publ.
NABARD. 2005. *SHG Bank Linkage Programme*. http:/ www.nabard.org
Ramkumar S, Garforth C, Rao SVN & Waldie K. (Ed). 2001. *Landless LivestockFarming – Problems and Prospects*. RAGACOVAS, Pondicherry.
Seth Mira 2001. *Women and Development – Indian Experience*. Sage Publ.
Samanta RK. (Ed). *Women in Agriculture – Perspectives, Issues and Experiences*. MD Publ.
Waldie K & Ramkumar S. 2002. *Landless Women and Dairying – Opportunities for Development within a Poverty Perspective*. RAGACOVAS, Pondicherry.

AHE 612 INFORMATION AND COMMUNICATION TECHNOLOGY IN LIVESTOCK DEVELOPMENT 1+1 SEM - I

Objective

To apprise the students about information system, networking and use of various ICT tools.

Theory

UNIT-I: ICT – concept, importance and types of tools; Development and application of ICT tools including information kiosks, E-learning.

UNIT-II: Concept of information system and networking, component of information system, information resources, sharing and networking. Types of net work – PAN, LAN, WAN, Internet, AGRINET, AKIS, Indian National Agricultural Research database.

UNIT-III: ICT programmes in livestock development, Problems and prospects of ICTs in livestock development, Digitisation, Simulation models.

Practical

Study of various ICT tools in livestock development.

Suggested Readings

Anonymous 2002. *Handbook of Animal Husbandry*. ICAR.

Arnon I. 1989. *Agriculture Research and Technology Transfer*. Elsevier Science Publ. England.

Ramkumar S & Rao SVN. 2004. *Knowledge Dissemination on Cattle Health through Information Kiosks in Veterinary Centres*. RAGACOVAS, Pondicherry.

Singhal A & Rogers EM. 1989. *India's Information Revolution*. Sage Publ.

AHE 701 ORGANIZATIONAL MANAGEMENT 3+0 SEM - I

Objective

To acquaint the students with the general administration, management and motivational techniques for organizational change and development.

Theory

UNIT-I: Concept, approaches and functions of management. Principles and process of organization, hierarchy of organization, departmentalisation. Authority and responsibility. Components of individual behaviour in organization. Organizational climate, decision making by consensus and participation by subordinates.

UNIT-II: Motivation- nature and significance, motivational process, theories of motivation with respect to animal husbandry work. Importance of human needs, priority of needs, Managing work motivation.

UNIT-III: Conflict – types and management. Leadership and its role in conflict resolution. Morale in organizations, organizational factors affecting morale, attitude, and productivity, methods of improving morale and evaluation of morale. Performance appraisal process.

UNIT-IV: Supervision– principles, techniques and functions of supervision. Qualities of supervisor, supervisor-subordinate relationship and interaction process. Changing organizational structure and system, changing organizational climate and interpersonal style, issues and choice involved in making organizational climate.

UNIT-V: Organization development– history, nature, characteristics, assumptions and process. Organization development interventions.

Suggested Readings

Selected articles from journals.

AHE 702 FARM JOURNALISM AND PUBLIC RELATIONS 2+1 SEM - II

Objective

To sensitize students about the role of mass media, news papers, magazines, radio, T.V. and internet for promoting animal husbandry.

Theory

UNIT-I: Concept of farm journalism and communication. Journalism as a means of mass-communication and its role in livestock development. Opportunities, strength and limitations. Ethics and principles of journalism for effective writing.

UNIT-II: Art of writing, news items, news stories, feature articles, success stories, magazines, bulletins, folders etc. Fundamentals of lay-out in writing. Writing of research papers and popular articles in journals and farm magazines.

UNIT-III*:* Methods and techniques of broadcasting of farm programmes. Writing scripts for radio and televisions. Importance of public relations in veterinary and animal husbandry extension.

UNIT-IV: Rapport building with different categories of clients involved in veterinary and animal husbandry extension programmes. Art of speaking. Importance of listening and reading. Relations with press media.

UNIT-V: Event management, Organization of press meet. Qualities of a good public relation manager. Writing for press news.

Practical

Designing and preparation of news stories, feature articles, success stories related to animal husbandry. Designing and preparation of magazines, folders, popular research articles, radio and T.V. scripts. Visit to agricultural information and communication centre to record the activities of preparation, editing and publication of news articles and research publications. Exercise on the art of good speaking in class-room and field situations.

Suggested Readings

Selected articles from journals.

AHE 703 ADVANCED RESEARCH TECHNIQUES IN SOCIAL RESEARCH 3+1 SEM - III

Objective

To train the students about various research and management techniques/methods applicable to animal husbandry researches.

Theory

UNIT-I: Measurement– meaning and levels, tests, and scales. Different types of Variables.

UNIT-II: Techniques of attitude scale construction viz. paired comparison, equal appearing interval, successive interval, summated ratings, scalogram analysis.

UNIT-III: Measurement of reliability and validity of tests and scales. Sociometry. Critical incidence techniques. Q – sort technique, observation techniques, case studies.

UNIT-IV: Experimental and quasi experimental research designs. Content analysis and projective techniques.

UNIT-V: Multivariate analysis, systems analysis, principle component analysis, discriminant analysis and their application in extension education research.

Practical

Exercises on scaling techniques, attitude scale construction – Paired Comparison, Equal Appearing interval, Summated Rating Scale, Critical Incident Technique, Knowledge Test.

Suggested Readings

Selected articles from journals.

AHE 704 TRAINING FOR HUMAN RESOURCE DEVELOPMENT 2+1 SEM - I

Objective

To make the students aware of planning, implementation and evaluation of various training programmes.

Theory

UNIT-I: Concept of training and education. Training infrastructure for extension personnel and farmers in India. Role of institution, organization and participants in success of training programme.

UNIT-II: Assessment of training needs, curriculum design and development. Training strategies, models of training.

UNIT-III: Planning, development and execution of training programmes.

UNIT-IV: Training methods– Lecture, symposium, workshop, case studies, group discussion, conference, convention, panel discussion, buzz session, forum, debates, syndicate, simulation exercises, role playing, brain storming.

UNIT-V: Evaluation and follow-up of training programmes.

Practical

Preparation of training programmes for extension personnel, livestock and poultry farmers. Evaluation of on-going training programmes.

Suggested Readings

Selected articles from journals.

AHE 705 POLICIES AND REGULATIONS IN LIVESTOCK SECTOR 2+0 SEM - I

Objective

To sensitize the students about policies and regulations in animal husbandry sector.

Theory

UNIT-I: World Trade Organization in relation to livestock sector. Impact of WTO on Indian international trade of food products of animal origin, Intellectual Property Rights in relation to animal husbandry.

UNIT-II: HACCP, Sanitary and phyto-sanitary measures to protect the animals' life and health, food safety uses in relation to animal husbandry sector. Introduction to Agreement on Technical Barriers to Trade (ATBT).

UNIT-III: Animal welfare laws- legislations in veterinary and animal sciences.

UNIT-IV: Prevention of Cruelty to Animals Act-1960 and Rules. Animal Welfare Board, ABC Programme. Acts related to animals and animal diseases. Animal quarantine and certification.

Suggested Readings

Selected articles from journals.

AHE 706 EDUCATIONAL TECHNOLOGY 2+1 SEM - II

Objective

To acquaint students with different concepts of education technology and preparation of teaching aids.

Theory

UNIT-I: Educational Technology – Meaning, concepts and components. Curriculum development at macro and micro levels. Formulation of instructional objectives.

UNIT-II: Preparation of course outline for instructions, lesson planning. Designing instructions for theory and practical, Instructional methods and devices in class room instruction, computer aided learning. Understanding learners' behavior, learning styles, motivating learners.

UNIT-III: Student counselling and guidance, Student evaluation – meaning and methods, construction of measuring instrument – question banking.

UNIT-IV: Performance appraisal of teachers –meaning and methods, construction of assessment instruments. Use of library for effective learning.

Practical

Preparation of course outline, Preparation of lesson plans, Planning and preparation of instructional aids, Individual classroom instructional exercises, Development of student evaluation instrument, Development of performance appraisal instrument for teachers.

Suggested Readings

Selected articles from journals.

AHE 707 DYNAMICS OF CHANGE 2+0 SEM - I

Objective

To make the students aware of dynamics of change, group dynamics and social change.

Theory

UNIT-I: Definition of change, development, social and cultural change. Dimensions, characteristics, types, rate and directions of social change. General conditions of social change.

UNIT-II: Process of change. Concept, importance and problems of planned change. Role of change agents. Approaches of change agents towards planned change. Acceptance and rejection to planned change in animal husbandry. Techniques for accelerating change.

UNIT-III: Theories of change: Darwin, Kurt, Lewin, Ogburn & influence process of change, assessment of resources, fixation of change objective, evaluating change effect. Barrier to change-psychological, social & economical, stimulants to change: psychological, social & economical.

UNIT-IV: Agrarian changes with reference to livestock development.

Suggested Readings

Selected articles from journals.

AHE 708 ORGANIZATIONAL COMMUNICATION 2+1 SEM - I

Objective

To sensitize the students towards communication and networking to increase the efficiency of an organization.

Theory

UNIT-I: Organizational communication–its importance, function and characteristics. Understanding of organizational communication. Types of organizational communication–upward, downward, diagonal and grapevine. Communication network.

UNIT-II: Effectiveness and efficiency of organizational communication.

UNIT-III: Essentials of a sound organizational communication system. Social and Psychological barriers to effective organization communication. Causes of poor organization communication.

Practical

Studies on organizational communication patterns in animal husbandry.

Suggested Readings

Selected articles from journals.

AHE 790 SPECIAL PROBLEM 0+2 SEM - I, II

Objective

To provide expertise in handling practical research problem(s).

Practical

Short research problem(s) involving contemporary issues and research techniques.

EXTENSIONEDUCATION&COMMUNICATIONMANAGEMENT

List of Journals

- Communicator
- Development communication
- Economic and Political weekly
- Indian Dairyman
- Indian Farming
- Indian journal of Adult Education
- Indian Journal of Animal Research
- Indian Journal of Animal Sciences
- Indian Journal of Dairy Science
- Indian Journal of Extension Education
- Indian Journal of Gender Studies
- Indian Journal of Psychology
- Indian Journal of Public Administration
- Indian Veterinary Journal
- Journal of Agriculture Extension and Education
- Journal of Dairy Research
- Journal of Extension Systems
- Journal of Rural Development
- Journal of Training and Development
- Kurukshetra
- Yojana

e-Resources

- www.informaworld.com (Journal of Agricultural Education and Extension)
- www.blackwellpubllishing.co (International Journal of Training & Development)
- www.blackwellpubllishing.co (Educational Measurement: Issue and Practices)
- www.academicjournals.net (International Journal of Dairy Science)
- www. cipav.org.co (Livestock Research for Rural Development)
- www.joe.org (Journal of Extension)

Suggested Broad Topics for Master's and Doctoral Research

- Veterinary Education
- Training
- Communication and development
- Diffusion and adoption
- Management and entrepreneurship
- Livestock economics
- Evaluation of animal husbandry programmes

VETERINARY ANATOMY

Course Structure

COURSE NO.	COURSE TITLE	CREDITS	SEM
VAN 601	COMPARATIVE OSTEOLOGY AND ARTHROLOGY	1+2	I
VAN 602	COMPARATIVE SPLANCHNOLOGY	2+2	II
VAN 603	MYOLOGY, ANGIOLOGY, NEUROLOGY AND AESTHESIOLOGY OF OX	1+3	II
VAN 604	GROSS ANATOMICAL TECHNIQUES	0+2	I
VAN 605	THEORY AND PRACTICE OF HISTOLOGICAL AND HISTOCHEMICAL TECHNIQUES	1+2	II
VAN 606	GENERAL HISTOLOGY AND ULTRASTRUCTURE	3+1	I
VAN 607	SYSTEMIC HISTOLOGY AND ULTRASTRUCTURE	3+1	II
VAN 608	DEVELOPMENTAL ANATOMY	3+1	I
VAN 691	MASTER'S SEMINAR	1	I, II
VAN 699	MASTER'S RESEARCH	20	I, II
VAN 701	MYOLOGY, ANGIOLOGY, NEUROLOGY AND AESTHESIOLOGY OF EQUINE, CANINE AND PORCINE	0+3	II
VAN 702	PRINCIPLES AND APPLICATIONS OF BIOMECHANICS	2+0	I
VAN 703	AVIAN ANATOMY	1+2	I
VAN 704	NEUROANATOMY	3+1	I
VAN 705	ENDOCRINE ANATOMY	2+1	I
VAN 706	THEORY AND APPLICATIONS OF ELECTRON MICROSCOPE	2+1	II
VAN 707	HISTOENZYMOLOGY AND IMMUNOCYTOCHEMISTRY	2+1	II
VAN 708	APPLIED EMBRYOLOGY AND TERATOLOGY	1+2	II
VAN 709	FUNCTIONAL VETERINARY ANATOMY	2+0	I
VAN 710	GROSS ANATOMY OF LABORATORY ANIMALS	1+1	II
VAN 790	SPECIAL PROBLEM	0+2	I, II
VAN 791	DOCTORAL SEMINAR I	1	I, II
VAN 792	DOCTORAL SEMINAR II	1	I, II
VAN 799	DOCTORAL RESEARCH	45	I, II

VETERINARY ANATOMY

Course Contents

VAN 601 COMPARATIVE OSTEOLOGY AND ARTHROLOGY 1+2 SEM - I

Objective

To make a student well versed with the bones and joints of different domestic animals.

Theory

UNIT-I: Technical terms, structure, chemical composition and classification of bones. UNIT-II: Bones of appendicular skeleton of ox as a type and their comparison with those of horse, dog, pig and poultry.

UNIT-III: Bones of axial skeleton of ox as a type and their comparison with those of horse, dog, pig and poultry.

UNIT-IV: Classification and detailed study of different joints of the body.

UNIT-V: Study the various indices for estimating race, sex and age of different animals. Basics of biomechanics of the locomotor system. Radiography of normal and developing bones.

Practical

Demonstration of all bones and dissection of joints of buffalo/Cattle.

Suggested Readings

Dyce KM, Sack WO & Wensing CJG. 1996. *Text Book of Veterinary Anatomy*. WB Saunders.

Nickel R, Schumer A, Seiferle E, Freewin J & Wills KH. 1986. *The Locomotor System of Domestic Mammals.* Verlag Paul Parey.

Sisson S & Grossman JD. 1975. *The Anatomy of the Domestic Animals*. Vols. I, II. WB Saunders.

VAN 602 COMPARATIVE SPLANCHNOLOGY 2+2 SEM - II

Objective

To give a detailed overview of different systems constituting splanchnology.

Theory

UNIT-I: Descriptive anatomy of various organs of digestive system and associated glands of ox and their comparison with those of horse, dog, pig and poultry. Study of formation of thoracic, abdominal and pelvic cavities; reflection of these cavities.

UNIT-II: Study of various organs/structures and associated glands constituting the respiratory system of ox and their comparison with those of horse, dog, pig and poultry.

UNIT-III: Detailed study of organs and associated glands comprising the urinary system of ox as a type and their comparison with those of horse, dog, pig and poultry.

UNIT-IV: Complete study of various organs and associated glands of male and female genital systems.

UNIT-V: Surgical sites for various operations and clinically significant areas for performing auscultation, percussion and for carrying out surgical procedures such as laryngotomy, oesophagotomy, gastrotomy, rumenotomy, cystotomy, urethrotomy, caesarian section, exploratory laparotomy, mammectomy, thoracotomy, thoracocentesis etc.

Practical

Demonstration of structure and placement of organs in body cavities of all the animals.

Suggested Readings

Dyce KM, Sack WO & Wensing CJG. 1996. *Text Book of Veterinary Anatomy*. WB Saunders.

Schummer A, Nickel R & Sack WO. 1979. *The Viscera of the Domestic Mammals*. Verlag Paul Parey.

Sisson S & Grossman JD. 1975. *The Anatomy of the Domestic Animals*. Vols. I, II. WB Saunders.

VAN 603 MYOLOGY, ANGIOLOGY, NEUROLOGY AND AESTHESIOLOGY OF OX 1+3 SEM - II

Objective

To give a thorough knowledge about the muscles, course of blood vessels and nerves of the body in addition to various organs of circulatory, nervous and sensory systems of ox as a type animal.

Theory

UNIT-I: Classification of muscle fibres. Origin, insertion and relations of muscles of different body parts.

UNIT-II: Topographic anatomy of the vascular system comprising of heart, arteries, veins and lymphatics.

UNIT-III: Study of various components of central nervous system, peripheral nervous system and autonomic nervous system.

UNIT-IV: Complete study of the gross anatomy of various sense organs.

UNIT-V: Study of different nerve blocks, intravenous sites and enucleation of eye ball.

Practical

Dissection of heart, different vessels, brain, cranial nerves, brachial plexuses and lumbo- sacral plexus. Dissection of eye, ear, hoof and horn of buffalo/cattle.

Suggested Readings

Dyce KM, Sack WO & Wensing CJG. 1996. *Text Book of Veterinary Anatomy*. WB Saunders.

Nickel R, Schumer A, Seiferle E, Freewin J & Wills KH. 1986. *The Locomotor System of the Domestic Mammals*. Verlag Paul Parey.

Schummer A, Wickens H & Vollmerhaus B. 1981. *Circulatory System, Skin and Skin Organs of Domestic Mammals*. Verlag Paul Parey.

Seiferle E. 1975. *Nervous System, Sensory Organs, Endocrine Glands of Domestic Mammals*. Verlag Paul Parey.

Sisson S & Grossman JD. 1975. *The Anatomy of the Domestic Animals*. Vols. I, II. WB Saunders.

VAN 604 GROSS ANATOMICAL TECHNIQUES 0+2 SEM - I

Objective

Hands-on training for preparation of gross anatomical specimens**.**

Practical

Embalming fluids, embalming of animals, maceration and preparation of skeletons. Gross staining of brain sections. Demonstration of sites of ossifications. Preparation of transparent specimens, preparation of casts of various organs, blood vessels and ducts etc.

Suggested Readings

Luna LG. 1968. *Manual of Histologic Staining Methods of the Armed Forces Institute of Pathology*. McGraw-Hill.

Tompsett DH & Wakeley SC. 1956. *Anatomical Techniques*. E & W Living Stone.

VAN 605 THEORY AND PRACTICE OF HISTOLOGICAL AND HISTOCHEMICAL TECHNIQUES 1+2 SEM - II

Objective

To give exposure to methods of processing the tissues for research and teaching purposes.

Theory

UNIT-I: Preparation of tissues for light microscopy using different fixatives. UNIT-II: Different staining methods for routine light microscopy.

UNIT-III: Frozen sectioning techniques and staining methods for enzymes, carbohydrates, lipids, proteins, pigments etc.

UNIT-IV: Silver staining techniques for nervous tissue.

Practical

Study of different techniques for collection, fixation and processing of animal tissues preparation of paraffin and frozen sections; handling and care of microtomes. Demonstration of staining of carbohydrates, lipids, proteins, nucleic acids and enzymes.

Suggested Readings

Bancroft JD & Stevens A. 1977. *Theory and Practice of Histological Techniques*. Churchill Livingstone.

Durry RAB & Wallington EA. 1967. *Carleton's Histological Techniques*. Oxford Univ. Press.

Luna LG. 1968. *Manual of Histologic Staining Methods of the Armed Forces Institute of Pathology*. McGraw-Hill.

Thomson SW & Hunt RD. 1968. *Selected Histochemical and Histopathological Methods*. Charles C Thomas Publ.

VAN 606 GENERAL HISTOLOGY AND ULTRASTRUCTURE 3+1 SEM - I

Objective

To understand basic principles of light microscopy and light and ultrastructure of four basic tissues**.**

Theory

UNIT-I: Light and ultrastructural details of animal cell. UNIT-II: Light and ultrastructural details of epithelial tissue. UNIT-III: Light and ultrastructural details of muscular tissue.

UNIT-IV: Light and ultrastructural details of connective tissue. UNIT-V: Light and ultrastructural details of nervous tissue.

Practical

Demonstration of different components of cells and intercellular substances of the above referred tissues by special staining through the use of light, phase contrast, dark field, fluorescent and electron microscopes.

Suggested Readings

Banks WJ. 1993. *Applied Veterinary Histology*. Mosby Year Book. Dellmann HD. 1993. *Textbook of Histology*. Lea & Febiger.

DiFiore MS, Mancini R & Derbertis EDP. 2006. *New Atlas of Histology*. Williams & Wilkins, Lippincott.

Greep RO. 1977. *Histology*. McGraw-Hill.

Ham AW & Cormack DH. 1979. *Histology*. JB Lippin.

VAN 607 SYSTEMIC HISTOLOGY AND ULTRASTRUCTURE 3+1 SEM - II

Objective

To understand and identify arrangement of four basic tissues in organs of different body systems.

Theory

UNIT-I: Light and ultrastructure of different organs of digestive system of ruminants with differential features among domestic animals.

UNIT-II: Light and ultrastructure of different organs of respiratory, lymphoid and cardiovascular systems.

UNIT-III: Light and ultrastructure of different organs of urino-genital systems. UNIT-IV: Light and ultrastructure of different sense organs and nervous system.

Practical

Study of histological structure of organs of digestive, respiratory, urinary, genital and cardiovascular systems of buffalo, horse and dog/cat.

Suggested Readings

Banks WJ. 1983. *Applied Veterinary Histology*. Mosby Year Book. Dellmann HD. 1993. *Text Book of Histology*. Lea & Febiger.

DiFiore MS, Mancini R & Derbertis EDP. 2006. *New Atlas of Histology*. Williams & Wilkins, Lippincott.
Greep RO. 1977. *Histology*. McGraw-Hill.
Ham AW & Cormack DH. 1979. *Histology*. JB Lippin.

VAN 608 DEVELOPMENTAL ANATOMY 3+1 SEM - I

Objective

To understand the developmental processes of different body systems at various stages of pregnancy.

Theory

UNIT-I: Gametogenesis, fertilization, cleavage and gastrulation.

UNIT-II: Development of foetal membranes and placenta in domestic animals.

UNIT-III: Histogenesis of nervous system, sense organs, endocrine organs and cardiovascular system.

UNIT-IV: Embryonic development of digestive, respiratory, uro-genital and musculoskeletal system.

Practical

Study of serial sections of the chick and pig embryos at different stages of development.

Suggested Readings

Arey LB. 1965. *Developmental Anatomy*. WB Saunders.
Freeman WH & Brace Girdle B. 1967. *Atlas of Embryology*. Heilemann Edu. Books Ltd.
Langman J. 1976. *Medical Embryology*. William & Wilkin.
Latshaw WK. 1984. *Veterinary Developmental Anatomy; A Clinically Oriented Approach*. B.C. Decker Inc., Philadelphia.
Patten BM. 1985. *Foundation of Embryology*. Tata McGraw-Hill.
Tuchmann-Duplessis MH, David G & Haegel P. 1972. *Illustrated Human Embryology*.
Vol. I. Embryogenesis. Springer Verlag.
Tuchmann-Duplessis MH, David G & Haegel P. 1972. *Illustrated Human Embryology.*
Vol. II. *Organogenesis*. Springer Verlag.

VAN 701 MYOLOGY, ANGIOLOGY, NEUROLOGY AND AESTHESIOLOGY OF EQUINE, CANINE AND PORCINE 0+3 SEM - II

Objective

To teach students about anatomy of muscles, blood vessels, nervous tissue and sense organs in equine, canine and porcine.

Practical

Dissection of different body regions with respect to muscles, blood vessels and nerves; and see the topographic positioning of different organs in different body cavities in equine, canine and porcine.

Suggested Readings

Selected articles from journals.

VAN 702 PRINCIPLES AND APPLICATIONS OF BIOMECHANICS 2+0 SEM - I

Objective

To sensitize the student about the importance of biomechanics**.**

Theory

UNIT-I: Biomechanics, its definition and scope with reference to anatomy and physiology of domestic animals and musculo-skeletal dynamics.

UNIT-II: Locomotion and clinical applications. Biomechanics of cortical and trabecular bones.

UNIT-III: Biomechanics of fracture fixation. Instrumentation and techniques in locomotion and their applications in lameness.

Suggested Readings

Selected articles from journals.

VAN 703 AVIAN ANATOMY 1+2 SEM - I

Objective

To give detailed overview of poultry anatomy.

Theory

UNIT-I: The study of the gross features of different body systems of domestic fowl. UNIT-II: The study of microscopic features of different body systems of domestic fowl.

Practical

Dissection and demonstration of various body systems of fowl and turkey. Microscopic examination of slides of various organ systems of fowl.

Suggested Readings

Selected articles from journals.

VAN 704 NEUROANATOMY 3+1 SEM - I

Objective

To provide in-depth knowledge of nervous system.

Theory

UNIT-I: The gross and microscopic anatomy of the brain and spinal cord.

UNIT-II: Study of various cranial and spinal nerves along with their associated nuclei and ganglia.

UNIT-III: Motor and sensory pathways, different ascending and descending tracts of brain and spinal cord and autonomic nervous system.

Practical

Gross dissection and microscopic examination of the brain and spinal cord; demonstration of the nerves, nerve plexuses, ganglia of cranial importance, study of the serial sections of the brain and spinal cord in domestic animals.

Suggested Readings

Selected articles from journals.

VAN 705 ENDOCRINE ANATOMY 2+1 SEM - I

Objective

To project the importance and details of endocrine glands**.**

Theory

UNIT-I: Advanced gross and microscopic anatomy of the hypothalamus and pituitary gland.

UNIT-II: Advanced gross and microscopic anatomy of the thyroid, parathyroid and thymus.

UNIT-III: Advanced gross and microscopic anatomy of the adrenal glands, islets of Langerhans, pineal body and other tissues associated with endocrine secretions.

Practical

Demonstration of the topographic anatomy in the embalmed specimens and microscopic examination of the endocrine glands of ruminants.

Suggested Readings

Selected articles from journals.

VAN 706 THEORY AND APPLICATIONS OF ELECTRON MICROSCOPE 2+1 SEM - II

Objective

To give an overview of the electron microscope.

Theory

UNIT-I: Introduction and principles of electron microscopy. UNIT-II: Methods for transmission electron microscopy.

UNIT-III: Methods for scanning electron microscopy.

Practical

Preparation of blocks and demonstration of various techniques used for carrying out TEM and SEM.

Suggested Readings

Selected articles from journals.

VAN 707 HISTOENZYMOLOGY AND IMMUNOCYTOCHEMISTRY 2+1 SEM - II

Objective

To give a student hands-on practice for various advanced histoenzymic and histochemical techniques.

Theory

UNIT-I: Classification of enzymes – Principles of enzymes histochemistry methods. UNIT-II: Substrates –combination–coupling azo-dye methods –capture reagents.

UNIT-III: Localization of enzymes and controls in enzyme histochemistry.

UNIT-IV: Fluorescence microscopy in enzyme histochemistry. Immunohistochemistry-principles and techniques.

Practical

Preparation of fixatives and buffers used in histochemistry. Methods of preparations and microscopical examination of routine and special preparations showing different cell organelles and inclusions. Methods for tryptophan-SS, SH groups; Glycogen- glycoproteins; Mucopolysaccharides and lipids. Methods and identification of alkaline and acid phosphatases – succinic dehydrogenase, cytochrome-oxidase, choline-esterase, catecholamines by fluorescence microscopy. Immunohistochemistry – principles and techniques.

Suggested Readings

Selected articles from journals.

VAN 708 APPLIED EMBRYOLOGY AND TERATOLOGY 1+2 SEM - II

Objective

To apprise the students about the current trends in developmental processes.

Theory

UNIT-I: Principles of experimental embryology and teratology.

UNIT-II: Factors affecting the developmental mechanisms of embryo.

UNIT-III: Use of organizers implants, chemical and hormonal preparations in the developmental models and available literature on teratogenic experimentation.

Practical

Collection and study of various teratological specimens from domestic animals. Class discussions on experimental models and available literature on teratogenic experimentation.

Suggested Readings

Selected articles from journals.

VAN 709 FUNCTIONAL VETERINARY ANATOMY 2+0 SEM - I

Objective

To make the student understand the functional anatomy of various organs/systems in relation to structure.

Theory

UNIT-I: The relationship of structure to form and function.

UNIT-II: The relationship of structure for adaptation and behaviour.

UNIT-III: Relationship of structure in relation to clinical conditions/ applications.

Suggested Readings

Selected articles from journals.

VAN 710 GROSS ANATOMY OF LABORATORY ANIMALS 1+1 SEM - II

Objective

To give an overview of different body systems of laboratory animals.

Theory

UNIT-I: Study of different organs of digestive system of different laboratory animals. UNIT-II: Detailed study of urinary, male and female reproductive systems of different laboratory animals.

UNIT-III: Complete study of respiratory system of different laboratory animals

UNIT-IV: Study of organs of circulation and nervous system of different laboratory animals.

UNIT-V: Descriptive anatomy of endocrine glands of different laboratory animals.

Practical

Demonstration of placement and relations of different organs in the body cavities of different laboratory animals.

Suggested Readings

Papesko P, Rajtova V & Horak J. 2002. *A Colour Atlas of Anatomy of Small Laboratory Animals: Rabbit, Guinea Pig*. 2nd Ed. Wolfe Publ.

VETERINARY ANATOMY
List of Journals

- Acta Anatomica
- American Journal of Anatomy
- Anatomia Histologia and Embryologia
- Anatomical Record
- Anatomy and Embryology
- Indian Journal of Veterinary Anatomy
- Journal of Anatomy

e-Resources

- http://www.interscience.wiley.com/journal/117927935/grouphome/home. (American Journal of Anatomy)
- http://www.ovid.com/site/catalog/Journal/1057.jsp (Journal of Anatomy)
- http:http:www.interscience.wilety.com/jpages/0003-276X/ (Anatomical Record)
- http://www.blackwellpublishing.com/submit.asp (Anatomia Histologia and Embryologia)

Suggested Broad Topics for Master's and Doctoral Research

- Gross anatomical disposition of various organs of animals of local interest
- Light and ultra-structural studies of important organs and systems of animals of local importance
- Developmental studies of different body systems

VETERINARY BIOCHEMISTRY

Course Structure

COURSE NO.	COURSE TITLE	CREDITS	SEM
VBC 601	CHEMISTRY OF ANIMAL CELL	2+0	I
VBC 602	TECHNIQUES IN BIOCHEMISTRY	0+2	I, II
VBC 603	APPLICATIONS OF GENOMICS AND PROTEOMICS IN MOLECULAR BIOLOGY	2+0	II
VBC 604	BIOCHEMISTRY OF BIOMOLECULES: CARBOHYDRATES, LIPIDS AND MEMBRANE STRUCTURE	2+0	I
VBC 605	ENZYME CATALYSIS, KINETICS, INHIBITION AND REGULATION	2+0	II
VBC 606	METABOLISM-I: CARBOHYDRATES AND LIPIDS	2+0	I
VBC 607	METABOLISM-II: NUCLEIC ACIDS AND AMINO ACIDS	2+0	I
VBC 608	METABOLISM-III: INTEGRATION AND REGULATION	2+0	II
VBC 609	CENTRAL DOGMA AND PROTEIN FUNCTION	2+0	I
VBC 610	CLINICAL BIOCHEMISTRY OF ANIMALS	2+1	I
VBC 611	BIOCHEMICAL BASIS OF DISEASES OF DOMESTIC ANIMALS	2+0	II
VBC 612	ENDOCRINOLOGY AND REPRODUCTIVE BIOCHEMISTRY	2+0	II
VBC 613	BIOCHEMICAL BASIS OF ANIMAL PRODUCTION	2+1	II
VBC 691	MASTER'S SEMINAR	1	I, II
VBC 699	MASTER'S RESEARCH	20	I, II
VBC 701	ADVANCES IN BIOCHEMISTRY OF RUMINANT DISORDERS	2+0	II
VBC 702	ADVANCES IN ENZYMOLOGY	2+0	II
VBC 703	ADVANCES IN CLINICAL BIOCHEMISTRY	0+2	II
VBC 704	MEMBRANE DYNAMICS AND SIGNAL TRANSDUCTION IN ANIMAL CELL	2+0	I
VBC 705	METHODS IN PROTEIN ANALYSIS	2+1	I
VBC 706	NUTRITIONAL BIOCHEMISTRY	2+0	I
VBC 707	ADVANCES IN INTERMEDIARY METABOLISM	2+0	I
VBC 708	ENDOCRINE CONTROL OF FUEL METABOLISM	2+0	II
VBC 709	DIAGNOSTIC ENZYMOLOGY-I	2+0	I
VBC 710	DIAGNOSTIC ENZYMOLOGY-II	2+0	II
VBC 711	BIOCHEMISTRY OF DEVELOPMENT AND DIFFERENTIATION	2+0	I
VBC 712	ADVANCES IN TECHNIQUES IN BIOCHEMISTRY	0+2	I, II
VBC 713	ADVANCES IN MINERAL AND VITAMIN METABOLISM AND RELATED DISEASES	2+0	II
VBC 790	SPECIAL PROBLEM	0+2	I, II
VBC 791	DOCTORAL SEMINAR I	1	I, II
VBC 792	DOCTORAL SEMINAR II	1	I, II
VBC 799	DOCTORAL RESEARCH	45	I, II

VETERINARY BIOCHEMISTRY
Course Contents

VBC 601 CHEMISTRY OF ANIMAL CELL 2+0 SEM - I

Objective

Teaching of principles of physical chemistry as applicable to veterinary sciences.

Theory

UNIT-I: Pre-biotic world, chemical evolution. cellular architecture, molecular organization and metabolic function.

UNIT-II: Thermodynamics, chemical equilibrium, standard state, living cell as steady state, open system obeying laws of thermodynamics. Minimum energy conformation, quantum mechanical calculation. ΔG and ATP.

UNIT-III: Properties of water, homeostasis, pH, osmosis, viscosity, surface forces, adsorption, dialysis, diffusion rate and the sizes of organisms. The blood buffering system. Chemical basis of oral and parental fluid/electrolyte therapies, Bacterial toxigenic diarrhoeas.

Suggested Readings

Chang 2005. *Physical Chemistry for the Bioscience*. Univ. Science Books. Dvorak AM & Harris W. 1991. *Blood Cell Biochemistry*. 2nd Ed. Plenum. Garby L. 1995. *Bioenergetics*. Cambridge.

Voet D, Voet JG & Pratt CW. 2006. *Fundamentals of Biochemistry of Life at the Molecular Level*. 2nd Ed. John Wiley & Sons.

VBC 602 TECHNIQUES IN BIOCHEMISTRY 0+2 SEM - I, II

Objective

To make students well versed with methodologies used in biochemistry.

Practical

Solving problems using Henderson–Hasselbalch equation, pH, pKa and buffer concentration, normality. Application of colorimetry, spectrophotometry and NMR-X ray crystallography.

Paper, column and thin layer chromatography. Partition and adsorption co- efficient, quantitative and qualitative chromatography of amino acids, lipids and sugars including elution. Gas chromatography. Packing of column and choice of detectors and densitometry.

Application of electrophoresis. Electrophoresis of proteins and nucleic acids. Use of sodium dodecyl sulfate and molecular weight determination. Densitometry procedures and quantitative assays. Immunoelectrophoresis and its applications. Isoelectrofocussing and isotacophoresis. Molecular sieving and its application in Biochemistry. General properties of dextran, acrylamide, agar and other media used for gel filtration.

Ultracentrifugation– its principle and use, preparative analytical and density gradient ultracentrifugation. Fractionation of sub-cellular components and molecular weight determination using ultracentrifuge.

Suggested Readings

David L Nelson & Cox Michael M. 2007. *Lehninger's Principles of Biochemistry*. 4th Ed. Freeman.

Garrity S. 1999. *Experimental Biochemistry*. 3rd Ed. Academic Press. Gowenlock AH. 1996. *Varley's Practical Clinical Biochemistry*. 6th Ed. CBS. Holme DJ & Hazel P. 1983. *Analytical Biochemistry*. Longman.

VBC 603 APPLICATIONS OF GENOMICS AND PROTEOMICS IN MOLECULAR BIOLOGY 2+0 SEM - II

Objective

To acquaint students about molecular basis of structure and functional aspects of NA and AA.

Theory

UNIT-I: Nucleotides, nucleic acids, high order structures, cohesions and condensins in chromosome structure. SMC proteins, sequencing, mutation, evolution. DNA libraries. Bacterial RNA polymerase, RNA interference. DNA replication, RNA synthesis, control of gene expression. DNA microarrays/chips.

UNIT-II: PCR, Recombinant DNA technology in improving domestic animals. RFLP, Gene and gene products. Genetic changes in hereditary diseases, cancer and detection ion DNA probes. Gene Therapy DNA vaccines, anti-tumor antibodies. Telomerases and Topoisomerases in treatment of diseases. *Staphylococcus* resistance to erythromycin.

UNIT-III: Peptide bonds, acid-base properties, stereochemistry, side chain modifications, biological activities. Green fluorescent protein. Polypeptide diversity, protein purification and analysis, protein sequencing, reconstructing the sequence. Gene duplication and protein families, protein modules, combinatorial peptide libraries folding. Structural bio- informatics. Protein structure prediction and design. Proteomics. Drug molecules, myoglobin and haemoglobin. Mechanism and co-operativity in Hb. High altitude adaptation in ruminants and equines. Use of amino acid analysis in disease diagnosis.

Suggested Readings

David L Nelson & Cox Michael M. 2007. *Lehninger's Principles of Biochemistry.* 4th Ed. Freeman.

Murray RK, Granner DK, Mayes PA & Rodwell, VK. 2000. *Harper's Biochemistry*. Lange Medical Book.

Voet D, Voet JG & Pratt CW. 2006. *Fundamentals of Biochemistry of Life at the Molecular Level.* 2nd Ed. John Wiley & Sons.

VBC 604 BIOCHEMISTRY OF BIOMOLECULES: CARBOHYDRATES, LIPIDS AND MEMBRANE STRUCTURE 2+0 SEM - I

Objective

Teaching of molecular basis of structure and functional aspects of carbohydrates and lipids.

Theory

UNIT-I: Carbohydrates: Structure, glycoconjugates in cell surface, extra cellular matrix, sugar code functions, peptidoglycan-specific antibiotics. Cellular effects of Insulin, Glucose supply and removal, Ruminal fermentation, role of liver, glucose tolerance, indirect monitoring of blood glucose, ketone bodies.

UNIT-II: Lipid classification, metabolism of LCFA, TAG, PL, Sphingolipids, cholesterol, lipoproteins. Regulation of lipid metabolism in fed and fasted states. Regulation of FA oxidation. FAs as regulatory molecules. Glucose production and FAs in type II diabetes. Ketone bodies as fuel.

UNIT-III: Lipid bilayers, lipid motility, integral membrane proteins, lipid linked proteins, peripheral membrane proteins, fluid mosaic model, membrane skeleton, lipid asymmetry, vesicle trafficking, secretory pathway, membrane rafts, caveolae fusion, lung surfactant, structure of bacterial rhodopsin. thermodynamics of membrane transport, ionophores, porins, ion channels, aquaporins, transport proteins, P and F types (Na+ - K+) ATPases, Ca^{2+}, Ion–gradient, Gap Junction, Cl--HCO3 -exchanger, cardiac glycosides, abnormalities in cell membrane fluidity. Haemolytic anaemia.

Suggested Readings

Combs GF. 1992. *The Vitamins-Fundamental Aspects in Nutrition and Health*. Academic Press.

David L Nelson & Cox Michael M. 2007. *Lehninger's Principles of Biochemistry*. 4th Ed. Freeman.

Kaneko JJ, Harvey JH & Bruss ML. 1999. *Clinical Biochemistry of Domestic Animals*. 5th Ed. Academic Press.

VBC 605 ENZYME CATALYSIS, KINETICS, INHIBITION AND REGULATION 2+0 SEM - II

Objective

To givethorough knowledge of molecular basis of enzyme action in relation to diagnostic importance.

Theory

UNIT-I: Mechanisms: Enzyme activation energy and reaction co-ordination, acid- base, covalent, metal ion. Proximity and orientation effects. Preferential transitional state binding.

UNIT-II: Chemical kinetics, enzyme kinetics, kinetic data analysis, bisubstrate reactions. Competitive, Uncompetitive, Mixed inhibitors. Allosteric regulation. Drug design, drug discovery, bioavailability and toxicity, clinical trials. Cytochrome P450 and adverse drug reactions; synthesis of bacterial peptidoglycans, oxygenases, mixed function oxidases. Enzyme linked diagnostics.

UNIT-III: Lysozyme. Serine proteases, physiology and tumor cell metastasis. Nerve poisons, blood coagulation cascade, Equine immuno-deficiency enzyme inhibitors. Suicide activators (DFMO for inhibition of ornithine decarboxylases in trypanosomiasis).

Suggested Readings

David L Nelson & Cox Michael M. 2007. *Lehninger's Principles of Biochemistry*. 4th Ed. Freeman.

Hang C & Wang T. 1988. *Enzyme Dynamics and Regulation*. Springer- Verlag.

Voet D, Voet JG & Pratt CW. 2006. *Fundamentals of Biochemistry of Life at the Molecular Level*. 2nd Ed. John Wiley & Sons.

VBC 606 METABOLISM-I: CARBOHYDRATES AND LIPIDS 2+0 SEM - I

Objective

To teach regulatory mechanisms of carbohydrates and lipids metabolism in health and diseases.

Theory

UNIT-I: Metabolic control, analysis for enzymes limiting the flux through a pathway. Trophic strategies, universal mapping of metabolic pathways. Thermodynamic relationships. ΔG, ATP and phosphoryl group transfer, coupled reactions, thioesters, NAD+ and FAD.

UNIT-II: Overview of carbohydrate, and lipid cycles, control of glycolysis, glycolysis in cancer cells, control of pentose phosphate pathways, deficiency of glucose-6-phosphate dehydrogenase. Control of glycogen metabolism, control of gluconeogenesis. GSD. Regulation of citric acid cycle, pathways that use citric acid intermediates, Sugar interconversions and nucleotide– linked sugar formation. Disorders associated with impairment of metabolism.

UNIT-III: Electron transport and oxidative phosphorylation. Generation of heat by uncoupling in brown adipose tissue.

UNIT-IV: Regulation of fatty acid metabolism, inhibitors of fatty acids biosynthesis, sphingolipid degradation and lipid storage disease. Regulation of cholesterol synthesis. PGs in NSAID, leukotrienes, HETEs, hypersensitivity. Influence of glucose metabolism on lipid metabolism.

Suggested Readings

David L Nelson & Cox Michael M. 2007. *Lehninger's Principles of Biochemistry*. 4th Ed. Freeman.

Glasel JA & Deutscher MP. 1995. *Introduction to Biophysical Methods for Protein and Nucleic Acid Research*. Academic Press.

Russell TR, Brew K, Faber H & Schultz J. 2001. *From Gene to Protein: Information Transfer in Normal and Abnormal Cells*. Miami Winter Symposium-16. Academic Press.

Voet D, Voet JG & Pratt CW. 2006. *Fundamentals of Biochemistry of Life at the Molecular Level*. 2nd Ed. John Wiley & Sons.

VBC 607 METABOLISM - II: NUCLEIC ACIDS AND AMINO ACIDS 2+0 SEM - I

Objective

To understand regulatory mechanisms of amino acid and nucleic acid metabolism in health and diseases.

Theory

UNIT-I: Overview of pathways of amino acid and nucleic acid metabolism. Lysosomal degradation, ubiquitin, proteosome, breakdown of amino acids, heme biosynthesis and degradation, biosynthesis of physiologically active amines. Nitric oxide, homocystein as marker of disease. Diseases of amino acid metabolism, porphyrias.

UNIT-II: Nucleotide synthesis and degradation, inhibition of thymidylate synthesis in cancer therapy. Mutation in coenzyme binding sites and diseases forces stabilization.

structure, restriction endonucleases, small inhibitory RNAs. Chromatin organization. Inhibitors of topoisomerases as antibiotic and anti-cancer agents, interfering with purine and pyrimidine metabolism.

UNIT-III: Viral nucleic acids, DNA damage and repair, telomerase, ageing and cancer. Topoisomerases as drug targets. Chemotherapy can target precursors of DNA synthesis. Antibiotics and toxins that target RNA polymerase. Lysosomal enzymes, gout, diseases in purine and pyrimidine nucleotide metabolic impairment.

Suggested Readings

David L Nelson & Cox Michael M. 2007. *Lehninger's Principles of Biochemistry*. 4th Ed. Freeman.

Kaneko JJ, Harvey JH & Bruss ML. 1999. *Clinical Biochemistry of Domestic Animals*. 5th Ed. Academic Press.

Swenson MJ & Reece WO.1996. *Dukes' Physiology of Domestic Animals*. 11th Ed. Panima.

Voet D, Voet JG & Pratt CW. 2006. *Fundamentals of Biochemistry of Life at the Molecular Level*. 2nd Ed. John Wiley & Sons.

VBC 608 METABOLISM–III:INTEGRATIONAND REGULATION 2+0 SEM-II

Objective

To give exposure in inter-relationship of cellular metabolism of various macromolecules.

Theory

UNIT-I: Regulation and integration of all metabolic pathways.

UNIT-II: Organ specialization in fuel metabolism : Brain, muscle, adipose tissue, liver, kidney, inter organ metabolic pathways, hormonal control of fuel metabolism. Tracing metabolic fates, perturbing the system.

UNIT-III: Signal transduction, gated ion channels, G-proteins, adenylate cyclase, receptor tyrosine kinase, protein phosphatases, cGMP, Ca^{2+}, interaction with phosphoserine/tyrosine, integrations, drugs and toxins, cell cycle and CDKs that affect cell signaling.

UNIT-IV: Oncogenes and cancers. Mitochondrial genes and diseases. Reactive oxygen species. Cyanide and arsenic poisoning. Metabolic inter- relationships in obesity, diabetes, cancer, aerobic and anaerobic exercise in horses, pregnancy, lactation and stress injury. Mitochondria in apoptosis and oxidative stress. Cell suicide, liver diseases, renal diseases, acid-base balance. Metabolic/sensory transduction in nervous tissue. Vision. Blood coagulation.

Suggested Readings

Kaneko JJ, Harvey JH & Bruss ML. 1999. *Clinical Biochemistry of Domestic Animals*. 5th Ed. Academic Press.

Kurjan J & Taylor BL. 1993. *Signal Transduction*. Academic Press.

Voet D, Voet JG & Pratt CW. 2006. *Fundamentals of Biochemistry of Life at the Molecular Level*. 2nd Ed. John Wiley & Sons.

VBC 609 CENTRAL DOGMA AND PROTEIN FUNCTION 2+0 SEM - I

Objective

Teaching of applied aspects of replication, transcription and translation.

Theory

UNIT-I: Overview of transcription and translation in eukaryotes. Collision between DNA polymerase and RNA polymerase, inhibitors of transcription, introns, evolution and expansion of the genetic code. UNIT-II: The effects of antibiotics and toxins on protein synthesis. X chromosome inactivation. Eukaryotic gene expression, protein targeting.

UNIT-III: Actin structure, microfilament dynamics, actin-myosin reacting cycle, tubulin dimer, microtubules dynamics, kinesins, dyeins.

UNIT-IV: Antigen-antibody binding, cytokines, principles of immunochemical methods: agglutination, precipitation, typing of major histo-compatibility antigens. Blood group substances in farm animals.

UNIT-V: Proteins as infectious agents (prions – BSE). Protein misfolding and aggregation. Plasma proteins, synthesis, functions. Influences of physiological factors and inflammation on proteins. Dysproteinemias. Defects in collagen synthesis. Transmissible multiple drug resistance, transcription factors and cardiovascular diseases. Transferrin, Lactoferrin, Ferritin and Ceruloplasmin.

Suggested Readings

Creighton TE. 1993. *Protein Structures and Molecular Properties*. WH Freeman.

David L Nelson & Cox Michael M. 2007. *Lehninger's Principles of Biochemistry*. 4th Ed. Freeman.

Voet D, Voet JG & Pratt CW. 2006. *Fundamentals of Biochemistry of Life at the Molecular Level*. 2nd Ed. John Wiley & Sons.

VBC 610 CLINICAL BIOCHEMISTRY OF ANIMALS 2+1 SEM - I

Objective

To make a student well versed with biochemical basis for diagnosis and prognosis of diseases in animals and poultry.

Theory

UNIT-I: Disturbances of gastro-intestinal function, disturbances of rumen function. Lactic acidosis, Pickled pigs and malignant hyperthermia. Diagnosis of neuromuscular disorders.

UNIT-II: Myocardial infarction, respiratory distress syndrome. Primary renal dysfunctions and test, doping. Problems in game horses.

UNIT-III: Enzymes of diagnostic importance. Toxicity of ammonia in animals. Genetic defects in urea cycle. Lysosomal storage diseases. ATP synthase inhibitory protein during ischemia. Ischaemic – reperfusion injury.

UNIT-IV: Molecular oncology and tumor markers. CSF characteristics in diseases. Clinical biochemistry in toxicology. Glycosylated hemoglobin, HbA1c, fructosamine. Deranged glucose metabolism in cancerous tissue. Free Radical damage.

Practical

Estimation of constituents (enzymes, metabolites and electrolytes) of body fluids during normal and pathological conditions. Estimation of hormones. Liver and kidney function tests. Total volatile fatty acids and the fractions in ruminants.

Suggested Readings

Devlin 2005. *Textbook of Medical Biochemistry with Clinical Correlations*. Wiley Liss. Jurisica I & Wigle D. 2006. *Knowledge and Discovery in Proteomics*. CRC.

Kaneko JJ, Harvey JH & Bruss ML. 1999. *Clinical Biochemistry of Domestic Animals*. 5th Ed. Academic Press.

Liebler DL. 2002. *Introduction to Proteomics*. Humana Press. Pryor WA. 1996. *Free Radicals in Biology*. Academic Press. Searcy RL. 1969. *Diagnostic Biochemistry*. McGraw-Hill.

VBC 611 BIOCHEMICAL BASIS OF DISEASES OF DOMESTIC ANIMALS 2+0 SEM - II

Objective

To give a detailed overview of role of biomolecules in health and diseases in animals and poultry.

Theory

UNIT-I: Diabetes mellitus, hyperinsulemia, galactosemia, hypoglycaemia of baby pigs, Glycogen Storage Disease. Carbohydrate balance in ruminants. Biochemical alterations in body fluids of ruminants in hypoglycaemia, Ruminant ketosis.

UNIT-II: Hypercholesterolemia, atherosclerosis, hyperlipidemia in canine, feline, equine. Pathophysiology of ketonemia. Ketosis associated with fasting, diabetes, pregnancy, lactation and post exercise.

UNIT-III: Anemias of the newborn, cytosolic enzyme deficiencies and membrane abnormalities in erythrocytes. Porphyrins and porphyrias. Disorders of iron metabolism, neutrophil function defects and its testing. Equine immuno- deficiency.

UNIT-IV: Hepatic insufficiencies and its laboratory assessment. Pancreatitis and insuffiency. Metabolic diseases of Ca, P, Mg metabolism. Iron overload and injection, inorganic polyphosphate metabolism.

Suggested Readings

David L Nelson & Cox Michael M. 2007. *Lehninger's Principles of Biochemistry*. 4th Ed. Freeman.

Kaneko JJ, Harvey JH, Bruss ML. 1999. *Clinical Biochemistry of Domestic Animals*. 5th Ed. Academic Press.

Voet D, Voet JG & Pratt CW. 2006. *Fundamentals of Biochemistry of Life at the Molecular Level*. 2nd Ed. John Wiley & Sons.

VBC 612 ENDOCRINOLOGY AND REPRODUCTIVE BIOCHEMISTRY 2+0 SEM - II

Objective

To give a conceptual discussion on role of biomolecules in health and diseases in animals and poultry.

Theory

UNIT-I: Mechanism of hormone action, Receptor binding, biosynthetic and metabolic aspects in physio-pathology of hormones, factors, and minerals.

UNIT-II: Metabolic functions of the hormones of the hypothalamus, pituitary, thyroid, parathyroid, pancreas,adrenal, pineal, ovaries and testes. Biochemistry of prostaglandins and related agents. Clinical endocrine aspects in production and reproduction status in domestic animals and poultry.

Suggested Readings

Morgane PJ & Panksepp J. 2002. *Hand Book of Hypothalamus*. Dekker.

Nes WR & McKean ML. 1977. *Biochemistry of Steroids and other Isoprenoids*. University Park Press.

Voet D, Voet JG & Pratt CW. 2006. *Fundamentals of Biochemistry of Life at the Molecular Level*. 2nd Ed. John Wiley & Sons.

VBC 613 BIOCHEMICAL BASIS OF ANIMAL PRODUCTION 2+1 SEM - II

Objective

To teach about biochemistry of draft capacity, meat production and dairy chemistry.

Theory

UNIT-I: Chemistry of milk lipids, proteins, carbohydrates, minerals, vitamins, pigments, and enzymes. Structure of milk lipids, fat globular membranes, modification of milk fat. Milk proteins – casein, amino acid composition, whey proteins, immunoglobulins, genetic polymorphism. Carbohydrates: structure and sweetness.

UNIT-II: The biochemistry controlling postmortem energy metabolism mechanisms. Application of genomic technologies to the improvement of meat quality of farm animals. Identification of meat quality parameters by proteomics. Application of proteomics to understand the molecular mechanisms behind meat quality. Oxidative stability of post mortem muscles from sheep of various ages.

UNIT-III: Metabolic demands of draft animals, and biochemical aspects of work and kinesiology.

Practical

Biochemical tests for proteins of meat, milk and egg and analysis of wool structure.

Suggested Readings

Eston R & Reilly T. 1986. *Kinanthropometry and Exercise Physiology*. Laboratory Manual. E & FN SPON.

Hay JG. 2002. *Basic Mechanics of the Skeletal System*. Prentice Hall.

Hudson BJE. 1994. *New Developing Sources of Food Proteins*. Chapman & Hall. Jenness R & Patton S. 2001. *Principles of Dairy Chemistry*. Wiley Eastern.

Miller GD, Jarus JK & McBean LD. 2004. *Dairy Food and Nutrition*. CRC.

VBC 701 ADVANCES IN BIOCHEMISTRY OF RUMINANT DISORDERS 2+0 SEM - II

Objective

To give exposure about biochemical changes in diseases of ruminants.

Theory

UNIT-I: Comparative ruminant metabolism, metabolism of various nutrients by microflora. Postruminal digestion of dietary and microbial biomolecules.

UNIT-II: Metabolic disorders of rumen and recent development in disorders of ruminants associated with protein, carbohydrate and fat metabolism.

UNIT-III: Recent development in disorders of ruminants associated with mineral and electrolyte metabolism.

Suggested Readings

Selected articles from journals.

VBC 702 ADVANCES IN ENZYMOLOGY 2+0 SEM - II

Objective

To teach current developments in actions of enzymes.

Theory

UNIT-I: Current concept on how enzymes work.

UNIT-II: Recent innovations in enzymes kinetics to understand mechanism. UNIT-III: Current topics on regulatory enzymes.

UNIT-IV: Lysozymes, serine proteases, drug design.

Suggested Readings

Selected articles from journals.

VBC 703 ADVANCES IN CLINICAL BIOCHEMISTRY 0+2 SEM - II

Objective

To educate students about current developments in clinical biochemistry.

Theory

UNIT-I: Scope of clinical biochemistry and its application in disease diagnosis. UNIT-II: Molecular basis of cell injury and diseases.

UNIT-III: Molecular basis of autoimmunity, immunodeficiency, oncogenesis.

UNIT-IV: Functional tests : DNA finger printing, micro and mini satellites, PCR-RFLP in clinical biochemistry, DNA microarrays. Biomolecular prospecting and molecular designing.

Practical

Nucleic acid extraction, protein arrays, RT-PCR, hybridization, electrophoretogram ad chromatogram of macromolecules.

Suggested Readings

Selected articles from journals.

VBC 704 MEMBRANE DYNAMICS AND SIGNAL TRANSDUCTION IN ANIMAL CELL 2+0 SEM - I

Objective

Discussions on recent developments in membrane function.

Theory

UNIT-I: Developments in physical & chemical features of biological transport. UNIT-II: Developments in membrane dynamics.

UNIT-III: Developments in solute transport across membrane.

UNIT-IV: Developments in molecular mechanisms of signal transduction, regulation by steroid hormone, protein kinases.

UNIT-V: Developments in signaling in microorganisms, special senses

Suggested Readings

Selected articles from journals.

VBC 705 METHODS IN PROTEIN ANALYSIS 2+1 SEM - I

Objective

Discussions on contemporary information on techniques in protein research.

Theory

UNIT-I: Separation, purification and characterization of proteins in ECF and membrane. UNIT-II: Subcellular organization of proteins fused with green fluorescent protein. High throughput methodologies for determining protein structure. Investigating protein with mass spectrometry. Method of determining three dimensional structure of protein. Use of atomic force microscopy in visualizing protein complexes and membrane surfaces.

UNIT-III: Use of FRET (fluorescence resonance energy transfer) to measure transient changes in second messenger or protein kinase activity in living cell. Proteomics.

Practical

Proteomics, protein quantification.

Suggested Readings

Selected articles from journals.

VBC 706 NUTRITIONAL BIOCHEMISTRY 2+0 SEM - I

Objective

To give exposure about biochemical principle as applicable to nutrition in animals and poultry.

Theory

UNIT-I: Evolution of diet and nutritional status of animals, digestion, absorption in ruminants, equine and poultry.

UNIT-II: Calorimetry, BMR, SDA, PER, nutritional need for growth, work, production and disease. Parental nutrition.

UNIT-III: Obesity, food additives and naturally occurring toxic substances in food, dietary factors in carcinogenesis, free radical, antioxidant and pro-oxidant.

Suggested Readings

Selected articles from journals.

VBC 707 ADVANCES IN INTERMEDIARY METABOLISM 2+0 SEM - I

Objective

To teach methods and approaches in research on metabolism.

Theory

UNIT-I: Energy transformation in living cell, enzymes system, high energy compounds.

UNIT-II: Overview of cycles, role of TCA in producing biological precursor in evolution. Control of fatty acid metabolism, lipoprotein metabolism, pathways of amino acids, integration of cycles, metabolism of purines, pyrimidines. CoA, NAD^+, FAD^+ and ATP.

UNIT-III: Analytical approaches in studies on intermediary metabolism.

Suggested Readings

Selected articles from journals.

VBC 708 ENDOCRINE CONTROL OF FUEL METABOLISM 2+0 SEM - II

Objective

To study hormonal regulation and integration of mammalian metabolism.

Theory

UNIT-I: Hormone: Diverse structure for diverse functions. UNIT-II:Tissue specific metabolism.

UNIT-III: Hormonal regulation of fuel metabolism. ‘

UNIT-IV: Regulation of body mass, production of beef, egg, poultry and fish.

Suggested Readings

Selected articles from journals.

VBC 709 DIAGNOSTIC ENZYMOLOGY - I 2+0 SEM - I

Objective

To expose students about use of enzymes in diagnostics.

Theory

UNIT-I: History, development, validation of clinical enzyme assay.

UNIT-II: Assay of enzymes in clinical cases. Enzym uria. Enzymes in pathogenesis. UNIT-III: Enzyme histochemistry and cytochemistry, immobilized enzymes. Enzyme immuno diagnostics, molecular genetics

Suggested Readings

Selected articles from journals.

VBC 710 DIAGNOSTIC ENZYMOLOGY - II 2+0 SEM - II

Objective

To provide in-depth knowledge about enzymes in diagnosis of diseases of animals and poultry.

Theory

UNIT-I: Phosphatases, creatine kinase in diagnosis of diseases of animals and poultry.

UNIT-II: Amino transferases, trypsin in diagnosis of diseases of animals and poultry.

UNIT-III: Dehydrogenases in diagnosis of diseases of animals and poultry.

UNIT-IV: Cholinesterase, lipase, amylase, GGT, GTPx, arginase, AST, ALT & SDH in diagnosis of diseases of animals in poultry. Enzymes in pathogenesis.

Suggested Readings

Selected articles from journals.

VBC 711 BIOCHEMISTRY OF DEVELOPMENT AND DIFFERENTIATION 2+0 SEM - I

Objective

To develop understanding of biochemical basis of embryo development in mammals and aves.

Theory

UNIT-I: Molecular basis of reproductive events including gametogenesis, fertilization, embryo development and differentiation, gene knock out

UNIT-II: Homeotic gene maintenance and repair of body tissue. UNIT-III: Biochemical basis of chick and fetal development

Suggested Readings

Selected articles from journals.

VBC 712 ADVANCES IN TECHNIQUES IN BIOCHEMISTRY 0+2 SEM - I, II

Objective

To expose students about current developments in techniques used in animal biochemistry.

Practical

Tracer methodologies as applied to problems in biochemistry. Electrophoresis, HPLC, GLC & TLC, spectrometry as applied to problems in biochemistry. X-Ray- Crystallography, NMR Spectrometry. Atomic absorption spectrophotometry as applied to problems in biochemistry. Ultracentrifugation as applied to problems in biochemistry.

Suggested Readings

Selected articles from journals.

VBC 713 ADVANCES IN MINERAL AND VITAMIN METABOLISM AND RELATED DISEASES 2+0 SEM - II

Objective

To expose students to latest class material to be given on recent trends in research on cofactor and mineral metabolism disorders in animals.

Theory

UNIT-I: Biochemical basis of conditions related to nutrient deficiency and excess.

UNIT-II: Metabolism of Ca, P, Mg, Na, K and the related diseases in animals and poultry.

UNIT-III: Minerals and B Vitamins as cofactors and their metabolism in livestock and poultry.

UNIT-IV: Biochemical mechanisms of fat soluble and water soluble vitamins and their metabolism in livestock and poultry.

Suggested Readings

Selected articles from journals.

VBC 790 SPECIAL PROBLEM 0+2 SEM - I, II

Objective

To provide expertise in handling practical research problem(s).

Practical

Short research problem(s) involving contemporary issues and research techniques.

VETERINARY BIOCHEMISTRY
List of Journals

- Indian Journal of Chemical Technology
- Indian Journal of Biochemistry and Biophysics
- Indian Journal of Chemistry - Section B
- Indian Veterinary Journal
- Journal of Chemical Sciences
- Journal of Indian Chemical Society
- Meat Science - An International Journal
- The EMBO Journal
- Theriogenology
- Trends in Biochemical Sciences

e-Resources

- www.niscair.res.in/ScienceCommunication (Indian Journal of Biochemistry)
- www.medind.nic.in/iaf/iafm.shtml (Indian Journal of Clinical Biochemistry)
- www.ijcb.co.in (Indian Journal of Clinical Biochemistry)
- www.mcponline.org (Molecular & Cellular Proteomics)
- www.elsevier.com/vj/proteomics (Proteomics Virtual Journal)
- www.elsevier.com (Journal of Proteomics)
- www.elsevier.com (Clinical Biochemistry)
- www.sciencedirect.com/science/journal (Science Direct –Clinical Biochemistry)
- www.jbc.org (Journal of Biological Chemistry)

Suggested Broad Topics for M aster's and Doctoral Research

- Biochemical parameters in body fluids of patients in livestock and poultry
- Assay of enzymes for diagnosis of diseases in poultry and livestock.
- Endocrine studies on domestic and companion animals in relation to production and health status

VETERINARY GYNAECOLOGY & OBSTETRICS

Course Structure

COURSE NO.	COURSE TITLE	CREDITS	SEM
VOG 601	GENERAL GYNAECOLOGY	3+1	I
VOG 602	FEMALE INFERTILITY	3+1	II
VOG 603	VETERINARY OBSTETRICS	2+2	I
VOG 604	ANDROLOGY & MALE INFERTILITY	3+1	II
VOG 605	SEMEN PRESERVATION AND ARTIFICIAL INSEMINATION	2+1	I
VOG 606	REPRODUCTIVE BIOTECHNOLOGY	2+1	II
VOG 607	CLINICAL PRACTICE I	0+3	I
VOG 608	CLINICAL PRACTICE II	0+3	II
VOG 691	MASTER'S SEMINAR	1	I, II
VOG 699	MASTER'S RESEARCH	20	I, II
VOG 701	ADVANCES IN GYNAECOLOGY	2+1	I
VOG 702	ADVANCES IN OBSTETRICS	2+1	II
VOG 703	ADVANCES IN ANDROLOGY	2+1	I
VOG 704	ADVANCES IN REPRODUCTIVE BIOTECHNOLOGY	1+1	II
VOG 705	ADVANCES IN SEMEN PRESERVATION	1+1	I
VOG 706	CLINICAL PRACTICE I	0+3	I
VOG 707	CLINICAL PRACTICE II	0+3	II
VOG 790	SPECIAL PROBLEM	0+2	I, II
VOG 791	DOCTORAL SEMINAR I	1	I, II
VOG 792	DOCTORAL SEMINAR II	1	I, II
VOG 799	DOCTORAL RESEARCH	45	I, II

VETERINARY GYNAECOLOGY & OBSTETRICS
Course Contents

VOG 601 GENERAL GYNAECOLOGY 3+1 SEM - I

Objective

To understand hormonal regulation of female reproduction and therapeutic management of infertility.

Theory

UNIT-I: Puberty and sexual maturity, role of hypothalamic-pituitary-gonadal axis in attainment of puberty and sexual maturity, onset of postpartum ovarian activity, Endocrine regulation of estrous cycle.

UNIT-II: Folliculogenesis, oogenesis and ovulation and associated endocrine pattern, manipulation of follicular waves, synchronization of estrus and ovulation and induction of ovarian activity.

UNIT-III: Gamete transport, fertilization, implantation and maternal recognition of pregnancy.

UNIT-IV: Embryonic and fetal development, placentation, fetal circulation and gestation, position of fetus in the uterus, age characteristics of fetus.

UNIT-V: Pregnancy diagnosis: clinical, ultrasonographic, endocrinological and other diagnostic laboratory tests. Pseudo-pregnancy and its treatment.

UNIT-VI: Factors affecting reproduction – seasonality, nutrition, stress, environment, management, suckling and diseases.

UNIT-VII Lactation and artificial induction of lactation.

Practical

Clinical examination of female genitalia. Biometry of female genital organs. Rectal and vaginal examination to diagnose cyclic phases of estrous cycle. Fern pattern of cervical mucus and exfoliated vaginal cytology. Pregnancy diagnosis in large and small animals by various methods. Estimation of age of the fetus. Use of ultrasound / RIA / ELISA in gynaecology. Synchronization of estrus and ovulation in farm animals.

Suggested Readings

Cupps PT. 1991. *Reproduction in Domestic Animals*. Academic Press.

Hafez ESE. 2000. *Reproduction in Farm Animals*. Lippincott, Williams & Wilkins. Noakes DE, Parkinson DJ & England GCW. 2001. *Arthurs Veterinary Reproduction and Obstetrics*. Saunders Harcourt India.

Pubedam MH & Pubedam MH. 2003. *McDonald's Veterinary Endocrinology and Reproduction*. Iowa State Press.

Roberts SJ. 1976. *Veterinary Obstetrics and Genital Diseases*. Scientific Book Agency.

VOG 602 FEMALE INFERTILITY 3+1 SEM - II

Objective

To impart knowledge and training in diagnosis and treatment of infertility in female domestic animals.

Theory

UNIT-I: Introduction to infertility, classification, economic impact. Anatomical causes of infertility, congenital and hereditary causes and acquired defects.

UNIT-II: Nutritional causes of infertility. Importance of body condition score.

UNIT-III: Managemental and environmental causes of infertility. Out of season breeding. UNIT-IV: Infectious causes of female infertility, specific and non-specific infections.

UNIT-V: Ovarian dysfunction: anoestrus, cystic ovarian degeneration, anovulation, delayed ovulation and luteal insufficiency.

UNIT-VI: Repeat breeding: its causes, diagnosis and treatment.

UNIT-VII: Early embryonic death (EED): causes, diagnosis and therapeutic management. UNIT-VIII: Abortion: infectious and non-infectious causes, diagnosis and prevention of abortion.

UNIT-IX: Interactions in Immunological mechanisms and infertility.

Practical

Record keeping, herd fertility assessment and management, diagnosis and treatment of infertility in female animals, use of uterine swabs for bacterial and fungal culture, histo- pathological evaluation of uterine biopsy, exfoliated vaginal cytology and hormone assay. Use of ultrasonography in diagnosis of infertility. Immuno diagnostic techniques.

Suggested Readings

Laing JA. 1979. *Fertility and Infertility in Domestic Animals*. English Language Book Soc. & Bailliere Tindall.

Morrow DA. 1986. *Current Therapy in Theriogenology*. WB Saunders.

Noakes DE, Parkinson DJ & England GCW. 2001. *Arthurs Veterinary Reproduction and Obstetrics*. Saunders Harcourt India.

Roberts SJ. 1976. *Veterinary Obstetrics and Genital Diseases*. Scientific Book Agency.

VOG 603 VETERINARY OBSTETRICS 2+2 SEM - I

Objective

To impart knowledge and training on problems of pregnancy and parturition and their management in domestic animals.

Theory

UNIT-I: Parturition: stages of parturition, mechanism of initiation of parturition, hormonal profiles associated with parturition.

UNIT-II: Principles of handling of dystocia, obstetrical procedures: mutations, fetotomy, caesarean section. Obstetrical anesthesia and analgesia, epidural anesthesia.

UNIT-III: Fetal and maternal dystocia: causes, diagnosis and management. UNIT-IV: Uterine torsion: causes, diagnosis and its correction.

UNIT-V: Diseases and accidents during gestation and around parturition.

UNIT-VI: Etiology, diagnosis and treatment of ante-partum and post-partum uterine and vaginal prolapse.

UNIT-VII: Induction of parturition and elective termination of pregnancy. UNIT-VIII: Involution of uterus following normal and abnormal parturition. UNIT-IX: Care of dam and the newborn.

Practical

Pelvimetory of different species of farm animals. Diagnosis and correction of abnormal fetal presentation, position and posture in phantom box. Epidural anethesia, ovariohysterectomy and caesarean operation. Fetotomy exercises. Detorsion of uterus. Management of prolapse. Handling of clinical cases of dystocia.

Suggested Readings

Arthur GH, Pearson H & Noakes DE. 2000. *Veterinary Reproduction and Obstetrics*. English Languge Book Society & Bailliere Tindall.

Roberts SJ. 1976. *Veterinary Obstetrics and Genital Diseases*. Scientific Book Agency. Sloss V & Dufty JH. 1980. *Handbook of Bovine Obstetrics*. Williams & Wilkins.

VOG 604 ANDROLOGY AND MALE INFERTILITY 3+1 SEM - II

Objective

To impart knowledge and training about male reproduction and treatment of male infertility in domestic animals.

Theory

UNIT-I: Structure and function of reproductive tract of male.

UNIT-II: Sexual behavior and examination of bulls for breeding soundness.

UNIT-III: Spermatogenesis, (formation, migration, maturation and ejaculation of semen), fine structure of spermatozoa, semen and its composition.

UNIT-IV: Diseases transmitted through semen.

UNIT-V: Factors affecting semen quality, semen culture, tests for assessment of sperm motility,

sperm survival and fertilizing capacity of spermatozoa.

UNIT-VI: Causes of infertility: hereditary, congenital, infectious, nutritional and hormonal. Pathological and functional disturbances of epididymis, vas deferens and accessory sex glands.

UNIT-VII: Impotentia cocundi and impotentia generandi. Testicular hypoplasia and degeneration: causes and affect on semen and fertility.

UNIT-VIII: Coital injuries and vices of male animals.

Practical

General and rectal examination for biometrics of male genitalia and accessory sex glands. Breeding soundness evaluation of male animals. Semen evaluation for sperm abnormalities, fertility and determination of other biochemical constituents of seminal plasma. Computer assisted semen analysis (CASA), Microbiological load of semen.

Examination, diagnosis and treatment of infertile male animals.

Suggested Readings

Hafez ESE. 2000. *Reproduction in Farm Animals*. Lippincott, Williams & Wilkins. Mann T & Lutwak-Mann C. 1981. *Male Reproductive Function and Semen*. Springer-Verlag.

Morrow DA. 1986. *Current Therapy in Theriogenology*. WB Saunders.

Roberts SJ. 1976. *Veterinary Obstetrics and Genital Diseases*. Scientific Book Agency. Salisbury GW, VanDemark NL & Lodge JR. 1978. *Physiology of Reproduction and Artificial Insemination of Cattle*. WH Freeman & Co.

VOG 605 SEMEN PRESERVATION AND ARTIFICIAL INSEMINATION 2+1 SEM - I

Objective

To impart knowledge and training about collection, evaluation and preservation of semen and artificial insemination (AI) in domestic animals.

Theory

UNIT-I: History of artificial insemination. UNIT-II: Methods of semen collection.

UNIT-III: Semen evaluation: macroscopic, microscopic, biochemical and microbiological tests, Computer assisted semen analysis (CASA).

UNIT-IV: Semen preservation. Extenders for preservation of semen at different temperatures. Semen additives for enhancement of motility and fertilizing capacity of spermatozoa.

UNIT-V: Cryopreservation of semen. Effects of cryopreservation on spermatozoa, semen quality and fertility.

UNIT-VI: Thawing protocols of frozen semen. Factors affecting post-thaw semen quality.

UNIT-VII: Ideal protocol for AI in different species of animals. Factors affecting success of AI.

Practical

Computer assisted semen analysis (CASA), Collection and evaluation of semen. Preparation of extenders. Preservation of semen: room temperature, refrigeration and cryopreservation. Handling and evaluation of processed semen. Practice of AI techniques.

Suggested Readings

Hafez ESE. 2000. *Reproduction in Farm Animals*. Lippincott, Williams & Wilkins. Perry J. 1970. *Artificial Insemination of Farm Animals*. Oxford & IBH.

Salisbury GW, VanDemark NL & Lodge JR. 1978. *Physiology of Reproduction and Artificial Insemination of Cattle*. WH Freeman.

VOG 606 REPRODUCTIVE BIOTECHNOLOGY 2+1 SEM - II

Objective

To impart knowledge and training on biotechniques in animal reproduction.

Theory

UNIT-I: Embryo transfer technology: selection of donors and recipients.

UNIT-II: Synchronization, super-ovulation, surgical and non-surgical collection of embryos and evaluation of embryos.

UNIT-III: Cryopreservation of embryos, transfer of embryos to donors.

UNIT-IV: *In vitro* fertilization, *in vitro* maturation, micromanipulation of embryos. UNIT-V: Sexing of sperm and embryos.

UNIT-VI: Transgenic animals. Chimeras. UNIT-VII: Stem cell biotechnology

UNIT-VIII: Immuno-neutralization of hormones. Immunomodulation of fertility.

Practical

Synchronization of estrus in donors and recipients, superovulation, surgical and non- surgical collection and transfer of embryos. Collection of oocytes from slaughter house genitalia. *In vitro* fertilization, *in vitro* maturation and cryopreservation of embryos. Sexing of embryos.

Suggested Readings

Gordon I. 2004. *Reproductive Technologies in Farm Animals*. CABI.

Hafez ESE. 2000. *Reproduction in Farm Animals*. Lippincott, Williams & Wilkins.

VOG 607 CLINICAL PRACTICE – I 0+3 SEM - I

Objective

Hands-on training on diagnosis and treatment of reproductive disorders in animals in TVCC.

Practical

Clinical examination of animals affected with reproductive disorders, use of diagnostic techniques for diagnosis and institution of required therapy. Maintenance of case records. Presentation on selected /assigned cases.

Suggested Readings

Morrow DA. 1986. *Current Therapy in Theriogenology*. WB Saunders.

VOG 608 CLINICAL PRACTICE – II 0+3 SEM - II

Objective

Hands-on training on diagnosis and treatment of reproductive disorders in animals in TVCC.

Practical

Clinical examination of animals affected with reproductive disorders, use of diagnostic techniques for diagnosis and institution of required therapy. Maintenance of case records. Presentation on selected /assigned cases.

Suggested Readings

Morrow DA. 1986. *Current Therapy in Theriogenology*. WB Saunders.

VOG 701 ADVANCES IN GYNAECOLOGY 2+1 SEM - I

Objective

To learn about advances in endocrine, ovarian and uterine functions and effect of nutrition, season and immunological factors on female fertility.

Theory

UNIT-I: Neuro-endocrine control of reproduction, follicular development, ovulation fertilization and implantation. Embryonic and fetal development.

UNIT-II: Maternal recognition of pregnancy, Advances in early diagnosis of pregnancy. UNIT-III: Embryonic losses, abortion and their prevention.

UNIT-IV: Seasonal breeders, synchronization and induction of estrus and ovulation in seasonal breeders, Assisted reproductive technology (ART) to increase reproductive efficiency in farm animals..

UNIT-V: Effect of stress, nutrition and immunological factors on fertility. UNIT-VI: Onset of postpartum ovarian activity and factors affecting it.

UNIT-VII: Diagnostic & therapeutic approaches in infertility: Principles of hormone therapy in reproductive disorders, Laproscopy, ultrasonographic diagnosis of ovarian/uterine dysfunction,

RIA/ELISA techniques for hormones assay in reproductive disorders, vaginal and uterine cytology

Practical

Clinical examination of female animals. Use of ultrasonography in ovarian function (follicular image pattern, follicular dynamics) and in early pregnancy diagnosis and infertility. Utility of uterine culture, uterine cytology and uterine biopsy (histopathological examination) in infertility investigation. Laparoscopy in diagnosis of ovarian and uterine dysfunction. ELISA/RIA of hormones and interpretation of results. Use of Assisted reproductive technology (ART) to enhance reproductive efficiency in farm animals.

Suggested Readings

Selected articles from journals.

VOG 702 ADVANCES IN OBSTETRICS 2+1 SEM - II

Objective

To learn current developments in diagnosis and management of dystocia, accidents of gestation and peri-parturient disorders in domestic animals.

Theory

UNIT-I: Conceptus and its development. Factors influencing gestation period and birth weight.

UNIT-II: Anomalies of conceptus, teratogens and effect of stress on conceptus development.

UNIT-III: Mechanism of initiation of parturition. Use of tocolytic drugs in management of uterine inertia.

UNIT-IV: Induction of parturition and termination of abnormal pregnancies. Obstetrical analgesia and anaesthesia.

UNIT-V: Pre-treatment evaluation of the dam suffering from dystocia. Management of maternal and fetal dystocia, hydrallantois, hydramnion, fetal mummification, fetal maceration, uterine inertia and uterine torsion.

UNIT-VI: Fetotomy, caesarean section and ovairo-hysterectomy. UNIT-VII: Neo-natal physiology and post-natal adaptations.

UNIT-VIII: Involution of uterus, post-partum ovarian dysfunction and their manipulation.

Practical

Obstetrical operations in fetal dystocia: Mutations, fetotomy, caesarean section, ovario-hysterectomy; induction of parturition, use of tocolytic drugs in dystocia, obstetrical analgesia and anaesthesia.

Suggested Readings

Selected articles from journals.

VOG 703 ADVANCES IN ANDROLOGY 2+1 SEM - I

Objective

To learn advances in male reproduction and treatment of male infertility in domestic animals

Theory

UNIT-I: Spermatogenesis, spermatogenic waves, sperm passage in male genitalia, biochemical milieu of male genetalia. Correlation between motility and fertilizing capacity of spermatozoa.

UNIT-II: Separation of motile and immotile spermatozoa. Sexing and separation of male and female determining spermatozoa.

UNIT-III: Sperm plasma membrane and its permeability and binding properties: acrosome and lysosomal enzymes, sperm nucleus and nuclear proteins. Mitochondria and their role in sperm metabolism. Flagellum and the mechanochemical basis of motility and cyclic nucleotides.

UNIT-IV: Biochemistry of seminal plasma and accessory sex gland secretions. Electrolytes, proteins, enzymes and amino acids in seminal plasma. Fructose and other sugars, lipids, cholesterol, steroid hormones and prostaglandins in seminal plasma.

UNIT-V: Fructolysis index. Aerobic and anaerobic metabolism of spermatozoa.

UNIT-VI: Biochemical markers of fertility in males, sperm chromatin structure assay, Anti-sperm antibodies.

Practical

Breeding soundness evaluation of bulls, biochemical tests of semen for evaluation of fertility, semen culture for diagnosis of venereal diseases, diagnosis and treatment of genital pathological condition. Computer assisted semen analysis (CASA), Semen evaluation for assessment of fertilizing capacity of spermatozoa: cervical mucus penetration test, sperm capacitation test, hypo osmotic swelling test and zona free hamster egg penetration test. Anti-sperm antibody assay.

Suggested Readings

Selected articles from journals.

VOG 704 ADVANCES IN REPRODUCTIVE BIOTECHNOLOGY 1+1 SEM - II

Objective

To learn advances in recent developments in biotechnology in reproduction for the production of desired elite animals.

Theory

UNIT-I: Embryo transfer technology and its application in farm animals.

UNIT-II: Selection and management of donor and recipient animals. Superovulation, surgical and non-surgical collection, evaluation of embryos and transfer of embryos.

UNIT-III: *In vitro* fertilization and maturation of oocytes.

UNIT-IV: Micromanipulation, sexing and cryopreservation of embryos. UNIT-V: Sexing of sperm and embryos.

UNIT-VI: Transgenic animals. Chimeras. UNIT-VII: Stem cell biotechnology

UNIT-VIII: Immuno-neutralization of hormones. Immunomodulation of fertility.

Practical

Evaluation of superovulatory hormonal regimens in donors and synchronization of estrus in recipients. Surgical and non-surgical collection and transfer of embryos. Collection of oocytes from slaughter house genitalia. *In vitro* fertilization, *in vitro* maturation and cryopreservation of embryos. Sexing of embryos.

Suggested Readings

Selected articles from journals.

VOG 705 ADVANCES IN SEMEN PRESERVATION 1+1 SEM - I

Objective

To learn advances in processing and cryopreservation of semen and insemination techniques to obtain high fertility.

Theory

UNIT-I: Transmission of venereal diseases through semen and their prevention.

UNIT-II: Factors affecting motility and fertilizing capacity of spermatozoa. Semen collection, extension and cryopreservation of semen, damages to spermatozoa caused by cryopreservation.

UNIT-III: Use of semen additives for promotion of sperm motility and fertilizing capacity.

UNIT-IV: Thawing protocols for frozen semen. Post-thaw evaluation of motility and fertilizing capacity of spermatozoa.

Practical

Collection of preputial washings and semen for bacterial load and venereal pathogens. Preparation of semen extenders with different additives. Use of different freezing protocols for preservation of semen. Evaluation of fertility with frozen semen. Enzymatic changes in semen following cryopreservation.

Suggested Readings

Selected articles from journals.

VOG 706 CLINICAL PRACTICE – I 0+3 SEM - I

Objective

Hands-on training on diagnosis and treatment of reproductive disorders in animals.

Practical

Clinical examination of animals affected with reproductive disorders, use of diagnostic techniques for diagnosis and institution of required therapy, maintenance of case records, presentation on selected/ assigned cases.

Suggested Readings

Selected articles from journals.

VOG 707 CLINICAL PRACTICE – II 0+3 SEM - II

Objective

Hands-on training on diagnosis and treatment of reproductive disorders in animals.

Practical

Clinical examination of animals affected with reproductive disorders, use of diagnostic techniques for diagnosis and institution of required therapy.

Suggested Readings

Selected articles from journals.

VOG 790 SPECIAL PROBLEM 0+2 SEM - I, II

Objective

To expose students to research techniques related to sub discipline of the subject and submission of written project with references.

Practical

Student will carry out research on allotted project and submit the project along with research papers for publication in scientific journals.

VETERINARY GYNAECOLOGY & OBSTETRICS

List of Journals

- American Journal of Obstetrics and Gynaecology
- Animal Reproduction
- Animal Reproduction Science
- Animal Science Journal
- Bibliography of Reproduction
- Biology of Reproduction
- Equine practice
- Equine Veterinary Journal
- Fertility and Sterility
- Indian Journal of Animal Reproduction
- Indian Journal of Animal Sciences
- Indian Journal of Experimental Biology
- Indian Veterinary Journal
- Journal of American Veterinary Medical Association
- Journal of Animal Science
- Journal of Dairy Science
- Journal of Endocrinology
- Journal of Reproduction and Development
- Journal of Reproduction and fertility
- Reproduction in Domestic Animals
- Research in Veterinary Science
- Theriogenology
- Veterinary Record

e-Resources

- www.anirgyep.elsevier.com (Animal Reproduction Science)
- www.blackwellpublilshing.com (International Journal of Andrology)
- www.bioreprod.org (Biology of reproduction)
- www.domesticanimalendo.com (Domestic Animal Andocrinology)
- www.reproduction-onlline.org (Journal of Andrology)
- www.reproduction-online.org (Reproduction)
- www.interscience.wiley.com (Reproduction in domestic animals)
- www.theriojournal.com (Theriogenology)
- www.buffaloresearch.com (Buffalo Journal)
- www.eje-online.org (European journal of Endocrinology)
- www.sciencedirect.com (The Veterinary Journal)
- www.blackwellpublishing.com (Asian journal of Andrology)
- www.editorijar@yahoo.co.in (Indian Journal of Animal Reproduction)

Suggested Broad Topics for M aster's and Doctoral Research

- Anoestrus: Endocrinological investigations
- Reproductive biotechnology
- Investigations into andrological problems
- Management of obstetrical problems

VETERINARY MEDICINE

Course Structure

COURSE NO.	COURSE TITLE	CREDITS	SEM
VMD 601	RUMINANT MEDICINE - I	3+0	I
VMD 602	RUMINANT MEDICINE - II	3+0	II
VMD 603	EQUINE MEDICINE	2+0	I
VMD 604	CANINE AND FELINE MEDICINE	2+0	II
VMD 605	AVIAN MEDICINE	2+1	II
VMD 606	DISEASES OF ANIMAL SPECIES OF REGIONAL IMPORTANCE	1+0	I
VMD 607	SWINE MEDICINE	1+0	I
VMD 608	METABOLIC DISEASES	2+0	I
VMD 609	DISEASES OF ANIMALS CAUSED BY TOXICANTS	1+0	II
VMD 610	VETERINARY FORENSIC MEDICINE	1+1	II
VMD 611	CLINICAL DIAGNOSTIC TECHNIQUES	0+2	I
VMD 612	CLINICAL PRACTICE - I	0+3	I
VMD 613	CLINICAL PRACTICE - II	0+3	II
VMD 691	MASTER'S SEMINAR	1	I, II
VMD 699	MASTER'S RESEARCH	20	I, II
VMD 701	ADVANCES IN GASTROENTROLOGY	2+0	I
VMD 702	ADVANCES IN CARDIOPULMONARY MEDICINE	2+0	II
VMD 703	ADVANCES IN NEUROLOGICAL AND UROLOGICAL DISORDERS	2+0	II
VMD 704	ADVANCES IN ENDOCRINE AND DERMATOLOGICAL DISORDERS	2+0	II
VMD 705	ADVANCES IN METABOLIC DISEASES	1+2	I
VMD 706	ADVANCES IN INFECTIOUS DISEASES OF RUMINANTS	1+2	II
VMD 707	ADVANCES IN INFECTIOUS DISEASES OF EQUINES	1+2	I
VMD 708	ADVANCES IN INFECTIOUS DISEASES OF PET ANIMALS	1+2	II
VMD 709	ADVANCES IN DISEASES OF POULTRY	1+2	I
VMD 710	ADVANCES IN VETERINARY DIAGNOSTICS	1+2	II
VMD 711	ADVANCES IN VETERINARY THERAPEUTICS	1+2	I
VMD 712	ADVANCED CLINICAL PRACTICE I	0+2	I
VMD 713	ADVANCED CLINICAL PRACTICE II	0+2	II
VMD 714	ADVANCED CLINICAL PRACTICE III	0+2	I
VMD 790	SPECIAL PROBLEM	0+2	I, II
VMD 791	DOCTORAL SEMINAR I	1	I, II
VMD 792	DOCTORAL SEMINAR II	1	I, II
VMD 799	DOCTORAL RESEARCH	45	I, II

VETERINARY MEDICINE
Course Contents

VMD 601 RUMINANT MEDICINE - I 3+0 SEM - I

Objective

Study of diseases of various body systems, bacterial and viral diseases of bovine, sheep and goats.

Theory

UNIT-I: General systemic states.Diseases of alimentary system, liver and urinary system. UNIT-II: Diseases of respiratory, nervous .cardiovascular, blood and blood forming organs, musculoskeletal system and skin.

UNIT-III: Mastitis, joint ill, ulcerative lymphangitis, anthrax, clostridial infections, black quarter, bacillary haemoglobinuria, botulism, colibacillosis.pasteurellosis, listeriosis, tuberculosis, Johne's disease, braxy, entero-toxaemia, brucellosis, salmonellosis, leptospirosis. actinomycosis, actinobacillosis.

UNIT-IV: Foot and mouth disease, mucosal disease complex, PPR, malignant head catarrh, infectious bovine rhinotracheitis, rabies, scrapie, louping ill, blue tongue, pox diseases, rinderpest and ephemeral fever.

Suggested Readings

Chakrabarti A. 1998. *Text Book of Clinical Veterinary Medicine*. Kalyani.

Radostits OM, Gay CC, Blood DC & Hinchcliff KW. 2008. *Veterinary Medicine*.10th Ed. WB Saunders.

VMD 602 RUMINANT MEDICINE - II 3+0 SEM - II

Objective

Study of parasitic and fungal diseases of bovine, sheep and goats.

Theory

UNIT-I: Ringworm, cutaneous sporotrichosis, aspergillosis, coccidiodomycosis, rhinosporidiosis, mucormycosis, histoplasmosis, candidiasis, blastomycosis.

UNIT-II: Bovine tropical theileriosis, babesiosis, anaplasmosis, trypanosomiosis, toxoplasmosis, coccidiosis.

UNIT-III: Sarcocystosis, fascioliosis, amphistomiosis, gastro-intestinal nematodiosis, schistosomiosis, verminous bronchitis, echino-coccosis, coenurosis, tape worm infestations.

Suggested Readings

Chakrabarti A. 1998. *Text Book of Clinical Veterinary Medicine*. Kalyani Publ.

Radostits OM, Gay CC, Blood DC & Hinchcliff KW. 2008. *Veterinary Medicine*. 10th Ed. WB Saunders.

VMD 603 EQUINE MEDICINE 2+0 SEM - I

Objective

Study of etiology, epidemiology, pathogenesis, symptomatology, diagnosis , treatment and prevention of diseases of equines.

Theory

UNIT-I: General systemic states and diseases of various body systems (alimentary , urinary, respiratory, nervous .cardiovascular, blood and blood forming organs, musculoskeletal and integumentary).

UNIT-II: Anthrax, tetanus, botulism, strangles, glanders, malignant edema, actinomycosis, clostridial infections, African horse sickness, infectious equine anaemia, equine influenza, equine encephalomyelitis, equine viral rhinopneumonitis, equine viral arteritis, ulcerative lymphangitis.*Rhodococcus equi* pneumonia.

UNIT-III: Trypanosomiasis/ dourine, babesiosis, parasitic pneumonia.cutaneous eczema, cutaneous acne, cutaneous pustular dermatitis, candidiasis, histoplasmosis, coccidiodomycosis, dermatophytosis.

Suggested Readings

Wintzer H. 1986. *Equine Diseases*. Verlaug Paul Parey.

Radostits OM, Gay CC, Blood DC & Hinchcliff KW. 2008.*Veterinary Medicine*.10th Ed. WB Saunders.

VMD 604 CANINE AND FELINE MEDICINE 2+0 SEM - II

Objective

Study of etiology, epidemiology, pathogenesis, symptomatology, diagnosis and treatment of diseases of dogs and cats.

Theory

UNIT-I: General systemic states, hypothyroidism, diabetes mellitus, diabetes insipidus, rickets.

UNIT-II: Bacterial diseases: leptospirosis, , tetanus, botulism. Viral diseases: canine- distemper, infectious canine hepatitis, parvovirus infection, rabies, corona virus infection. UNIT-III: Parasitic diseases: toxoplasmosis, neosporosis, sarcoptic mange, demodectic mange, hookworm and toxocara canis infections, leishmaniasis, canine babesiosis, ehrlichiosis, hepatozoonosis.

UNIT-IV: Feline diseases: feline pan-leucopaenia, feline infectious peritonitis, feline herpesvirus, feline spongiform encephalopathy, feline calci and feline immuno-deficiency viral diseases.

Suggested Readings

Dunn JK. 1999. *Textbook of Small Animal Medicine*. WB Saunders.

Ettinger SJ & Feldman EC. 2000. *Text Book of Veterinary Internal Medicine*. Vols. I, II. Saunders.

Gorman NT. 1998. *Canine Medicine and Therapeutics*. Blackwell.

Tilley LP & Smith FWK Jr. 2004. *The 5-minute Veterinary Consult (Canine and Feline)*. 3rd Ed. Lippincot, Williams & Wilkins.

VMD 605 AVIAN MEDICINE 2+1 SEM - II

Objective

Study of etiology, epidemiology, pathogenesis, symptomatology, diagnosis and treatment of diseases of avian species.

Theory

UNIT-I: Diseases due to deficiency of vitamins (vitamins A, B complex, C, D,E and K); minerals (calcium, phosphorus, manganese, zinc) and sodium chloride; miscellaneous diseases/conditions/ vices.

UNIT-II: Bacterial diseases: *Escherichia coli* and salmonella infections, coryza, fowl cholera, gangrenous dermatitis, mycoplasmosis, CRD.

UNIT-III: Viral diseases: Newcastle disease, infectious bursal disease, Marek's disease, infectious bronchitis, inclusion body hepatitis, hydro-pericardium syndrome, avian pox, infectious laryngo-tracheitis, avian influenza, lymphoid leucosis, avian encephalomyelitis, infectious bronchitis.

UNIT-IV: Fungal and parasitic diseases: aspergillosis, candidiosis, favus, mycotoxicosis, coccidiosis, roundworm and tape worm infestations, vaccination schedule etc.

Practical

Post-mortem examination of poultry birds, collection of clinical material for laboratory diagnosis.

Suggested Readings

Calnek BW, Barnes HA, Beard CW, Reid WM & Yoder HW Jr. 1999. *Diseases of Poultry*. 10th Ed. Iowa State Univ. Press.

Jordan ETW and Pattison, M. 1996. *Poultry Diseases*. WB Saunders.

Leeson S, Diaz G & Summers JD. 2001. *Poultry Metabolic Disorders and Mycotoxins*. IBDC Publ.

VMD 606 DISEASES OF ANIMAL SPECIES OF REGIONAL IMPORTANCE (CAMEL) 1+0 SEM - I

Objective

Study of diseases of important regional animal species (camel).

Theory

The animal species, to be studied/ taught is to be decided by the individual institution. For Veterinary College at CCS HAU Hisar, camel diseases will be covered.

UNIT-I: General systemic states, nutritional deficiency disorders.

UNIT-II: Specific diseases (malli, kapali, jhooling, peritonitis, specific peritonitis, satyriasis, kumri, allotriophagia, tibersa and other common infectious diseases.

Suggested Readings

Gahlot TK. 2000. *Selected Topics on Camelids*. The Camelid Publishing House, Bikaner.

Kohler I, Rollfeson E & Evelyn M. 2001. *Field Manual of Camel Diseases*: Traditional and Modern Health Care of Dromedary. Germany.

Wernery U & Kaden M. 2002. *Infectious Diseases of Camelids*. Blackwell.

VMD 607 SWINE MEDICINE 1+0 SEM - I

Objective

Study of etiology, epidemiology, pathogenesis, symptomatology, diagnosis and treatment of diseases of swine.

Theory

UNIT-I: General systemic states, swine influenza, hog cholera, African swine fever, swine pox, vesicular exanthema, vesicular stomatitis, rabies.

UNIT-II: Porcine enteroviruses, pseudorabies, listeriosis, leptospirosis, brucellosis, anthrax, salmonellosis, swine erysipelas, pasteurellosis, tuberculosis mange etc.

Suggested Readings

Radostits OM, Gay CC, Blood DC & Hinchcliff KW. 2008. *Veterinary Medicine*: 10th Ed. WB Saunders.

Howard W Dunne & Allen D Leman (Eds.). 1978. *Diseases of Swine*. Iowa State Univ. Press.

VMD 608 METABOLIC DISEASES 2+0 SEM - I

Objective

Study of metabolic, production and deficiency diseases of domestic animals.

Theory

UNIT-I: General aspects, production diseases (parturient paresis, downer cow syndrome, ketosis, post-parturient haemoglobinuria, hypomagnesemic tetany, pregnancy toxaemia). UNIT-II: Lactation tetany of mares, eclampsia of bitches, osteodystrophia fibrosa, azoturia of equines, rheumatism-like syndrome in buffaloes, hypothyroidism, diabetes mellitus and diabetes insipidus in dogs.

UNIT-III: Deficiency diseases (calcium, phosphorus, vitamin-D3, vit-A, vit B-complex, vit-C and vit-K).

UNIT-IV: Deficiency diseases (iron, copper, cobalt, zinc, manganese, iodine, vitamin E and selenium).

Suggested Readings

Dunn JK. 1999. *Text Book of Small Animal Medicine*. WB Saunders.

Radostits OM, Gay CC, Blood DC & Hinchcliff KW. 2008. *Veterinary Medicine*.10th Ed. WB Saunders.

VMD 609 DISEASES OF ANIMALS CAUSED BY TOXICANTS 1+0 SEM - II

Objective

Study of diseases caused by various toxicants in domestic animals.

Theory

UNIT-I: Diseases caused by physical agents and poisoning of organic and inorganic compounds. farm chemicals and phytotoxins.

UNIT-II: Diseases caused by mycotoxins and zootoxins, poisonous plants, snake and insect bites.

Suggested Readings

Kahn Cynthia M. (Ed.). 2005. *The Merck Veterinary Manual*. Merck & Co.

Radostits OM, Gay CC, Blood DC & Hinchcliff KW. 2008. *Veterinary Medicine*. 10th Ed. WB Saunders.

VMD 610 VETERINARY FORENSIC MEDICINE 1+1 SEM - II

Objective

To familiarize students with various aspects of Veterinary Forensic Medicine.

Theory

UNIT-I: Veterolegal aspects of ante mortem and post mortem examination.

UNIT-II: Examination of wounds, blood, offenses, frauds in animals and their products, animal cruelty and welfare.

UNIT-III: Study of common laws related to veterolegal aspects.

Practical

Ante- mortem and post- mortem examination, examination of wounds, blood, offenses, frauds in animals and their products, collection, dispatch and examination of veterolegal samples.

Suggested Readings

Sharma SN, Gahlot AK, Tanwer RK. 2003. *Veterinary Jurisprudence*. NBS Publishers, Bikaner.

VMD 611 CLINICAL DIAGNOSTIC TECHNIQUES 0+2 SEM - I

Objective

Study the diagnostic protocols and procedures for various diseases of farm and companion animals.

Practical

UNIT-I: Clinical tests and their interpretation related to diseases of alimentary tract, liver, cardio vascular system, blood and blood-forming organs of various species of animals.

UNIT-II: Clinical tests and their interpretation related to respiratory, urinary, nervous, endocrine, musculoskeletal and integumentary systems of various species of animals.

Suggested Readings

Kelly WR. 1984. *Veterinary Clinical Diagnosis*. Balliere Tindall, London.

Kaneko JJ, Harvey JW & Bruss ML. 2008. *Clinical Biochemistry of Domestic Animals*. 6th Ed. Academic Press, Amsterdam.

VMD 612 CLINICAL PRACTICE - I 0+3 SEM - I

Objective

Application of the theoretical concepts in practice.

Practical

Diagnostic and therapeutic protocol application, specimen collection, examination and management of diseased farm and companion animals.

Note: This course will be conducted in TVCC (College Clinics), where students shall participate in diagnosis and treatment of diseased animals.

VMD 613 CLINICAL PRACTICE – II 0+3 SEM - II

Objective

Application of the theoretical concepts in practice.

Practical

Diagnostic and therapeutic protocol application, specimen collection, examination and management of diseased farm and companion animals.

Note: This course will be conducted in TVCC (College Clinics), where students shall participate in diagnosis and treatment of diseased animals.

VMD 701 ADVANCES IN GASTROENTEROLOGY 2+0 SEM - I

Objective

Study of contemporary advances in gastroenterology.

Theory

UNIT-I: Advances in diagnosis, therapy and control of diseases of gastrointestinal system and associated organs of farm animals.

UNIT-II: Advances in diagnosis, therapy and control of diseases of gastrointestinal system and associated organs of companion animals.

Suggested Readings

Selected articles from journals.

VMD 702 ADVANCES IN CARDIO-PULMONARY MEDICINE 2+0 SEM - II

Objective

Study of recent advances in the field of cardiopulmonary medicine.

Theory

UNIT-I: Advances in diagnosis and therapeutic management of diseases of circulatory system.

UNIT-II: Advances in diagnosis and therapeutic management of diseases of respiratory system.

UNIT-III: Advances in diagnosis and therapeutic management of diseases of blood and blood forming organs in animals.

Suggested Readings

Selected articles from journals.

VMD 703 ADVANCES IN NEUROLOGICAL AND UROLOGICAL DISORDERS 2+0 SEM - II

Objective

Study of recent advances in the field of neurological and urological disorders.

Theory

UNIT-I: Advances in diagnosis, therapy and prevention of diseases of nervous and locomotor systems.

UNIT-II: Advances in diagnosis, therapy and prevention of diseases of urinary system.

Suggested Readings

Selected articles from journals.

VMD 704 ADVANCES IN ENDOCRINE AND DERMATOLOGICAL DISORDERS 2+0 SEM - II

Objective

Study of recent advances in endocrine and dermatological disorders.

Theory

UNIT-I: Advances in diagnosis, therapy and prevention of diseases of integumentary system.

UNIT-II:

Advances in diagnosis, therapy and prevention of diseases of endocrine system. Suggested Readings

Selected articles from journals.

VMD 705 ADVANCES IN METABOLIC DISEASES 1+2 SEM - I

Objective

Study of recent advances and research methodology related to metabolic diseases of domestic/companion animals.

Theory

UNIT-I: Metabolic/production diseases of farm and companion animals. UNIT-II: Nutritional deficiency diseases of farm and companion animals.

Practical

Short term assignment with some research component pertainingto metabolic/ production/ nutritional deficiency diseases of domestic and companion animals.

Suggested Readings

Selected articles from journals.

VMD 706 ADVANCES IN INFECTIOUS DISEASES OF RUMINANTS 1+2 SEM II

Objective

Study of recent advances and research methodology related to infectious diseases of ruminants.

Theory

UNIT-I: Bacterial and viral diseases of bovines, sheep and goats.

UNIT-II: Fungal, parasitic and rickettsial diseases of bovines, sheep and goats. Practical

Short term assignment with some research component pertaining to ruminant infectious diseases.

Suggested Readings

Selected articles from journals.

VMD 707 ADVANCES IN INFECTIOUS DISEASES OF EQUINES 1+2 SEM - I

Objective

Study of recent advances and research methodology related to infectious diseases of equines and canines.

Theory

UNIT-I: Bacterial, viral and rickettsial diseases of equines. UNIT-II: Fungal and parasitic diseases of equines.

Practical

Short term assignment with some research component pertaining to infectious diseases of equines.

Suggested Readings

Selected articles from journals.

VMD 708 ADVANCES IN INFECTIOUS DISEASES OF PET ANIMALS 1+2 SEM - II

Objective

Study of recent advances and research methodology related to infectious diseases of pet animals.

Theory

UNIT-I: Bacterial, viral and rickettsial diseases of pet animals. UNIT-II: Fungal and parasitic diseases of pet animals.

Practical

Short term assignment with some research component pertaining to infectious diseases of pet animals.

Suggested Readings

Selected articles from journals.

VMD 709 ADVANCES IN DISEASES OF POULTRY 1+2 SEM - I

Objectives

Study of recent advances and research methodology related to diseases of poultry.

Theory

UNIT-I: Bacterial and viral diseases of poultry.

UNIT-II: Fungal, parasitic and miscellaneous diseases of poultry.

Practical

Short term assignment with some research component pertaining to diseases of poultry.

Suggested Readings

Selected articles from journals.

VMD 710 ADVANCES IN VETERINARY DIAGNOSTICS 1+2 SEM - II

Objective

Study of recent advances in diagnostics of animal diseases.

Theory

UNIT-I: Blood and serum biochemical and hematological analyses.

UNIT-II: Imaging techniques for the diagnosis of animal diseases (x-ray, contrast radiography, CAT scan, MRI, scintigraphy, echocardiography etc).

UNIT-III: Electrocardiography, ophthalmoscopy, ultrasonography, EEG, CVP, GFR assessment, pulse-oxymetry etc.

Practical

Assignments on advanced diagnostic techniques for various diseases of domestic animals. Use of above mentioned advanced diagnostic techniques where ever possible. Collection of CSF, Gastric / rumen /intestinal fluid, absorption and digestion tests, hematological interpretations, enzyme and other biochemical profiles.

Suggested Readings

Selected articles from journals.

VMD 711 ADVANCES IN VETERINARY THERAPEUTICS 1+2 SEM - I

Objective

Study of recent advances in Veterinary therapeutics.

Theory

UNIT-I: Fluid and electrolyte imbalance and therapy.

UNIT-II: Antimicrobial, antineoplastic and hormonal therapy.

UNIT-III: Blood transfusion and emergency critical care, peritoneal dialysis/ hemodialysis, gastric lavage, fluid therapy, parenteral total nutrition, nebulization, oxygen therapy, paracentesis, thoracocenetsis.

Practical

Assignments on advanced therapeutic approaches in various diseases of domestic animals.

Suggested Readings

Selected articles from journals.

VMD 712 ADVANCED CLINICAL PRACTICE - I 0+2 SEM - I

Objective

Application of the theoretical concepts in practice.

Practical

Diagnostic and therapeutic protocol application, specimen collection, examination and management of diseased farm and companion animals.

Note: This course will be conducted in TVCC (College Clinics), where students shall participate in diagnosis and treatment of diseased animals.

VMD 713 ADVANCED CLINICAL PRACTICE - II 0+2 SEM - II

Objective

Application of the theoretical concepts in practice.

Practical

Diagnostic and therapeutic protocol application, specimen collection, examination and management of diseased farm and companion animals.

Note: This course will be conducted in TVCC (College Clinics), where students shall participate in diagnosis and treatment of diseased animals.

VMD 714 ADVANCED CLINICAL PRACTICE - III 0+2 SEM - I

Objective

Application of the theoretical concepts in practice.

Practical

Diagnostic and therapeutic protocol application, specimen collection, examination and management of diseased farm and companion animals.

Note: This courses will be conducted in TVCC (College Clinics), where students shall participate in diagnosis and treatment of diseased animals.

VMD 790 SPECIAL PROBLEM 0+2 SEM - I, II

Objective

A short-term project work on some aspect of etio-pathogensis, diagnosis and therapy of diseases of domestic animals.

VETERINARY MEDICINE
List of Journals

- Indian Journal of Poultry Science
- Indian Journal of Veterinary Medicine
- Indian Journal of Veterinary Research
- Indian Veterinary Journal
- Journal of American Veterinary Medical Association
- Research in Veterinary Science
- Veterinary Medicine
- Veterinary Medicine and Small Animal Clinician
- Veterinary Record
- Veterinary Research Communications

e-Resources

- www.uni-sz.bg/bjvm/bjvm.htm (Bulgarian Journal of Veterinary Medicine)
- www.jarm.com (International Journal of Applied Research in Vety. Medicine)
- www.ispub.com/ostia/index..php?xmlFilePath=journals/ijvm/front.xml (Internet Journal of Veterinary Medicine)
- Isrvma.org/journal.htm. (Israel Journal of Veterinary Medicine)
- www.medwellonline.net/java/fp.html (Journal of Animal & Veterinary Advances)
- www.jstage.jst.go.ijp/browse/jes/-char/en (Journal of Equine Science)
- www.stage.jst.go.jp/browse/jpsa (Journal of Poultry science)
- www.vesci.org (Journal of Veterinary Science)
- www.sasas.co.za (South African Journal of Animal Science)
- journals.tubitak.gov.tr/veterinary/index.php (Turkish Journal of Veterinary and Animal Sciences)
- vetmed.vri.cz (Veterinary Medicine)

Suggested Broad Topics for Master's and Doctoral Research

- Clinico-therapeutic aspects of bovine mastitis
- Hepatic, respiratory and skin disorders in animals
- Metabolic/nutritional deficiency disorders in animals with emphasis on hypophosphatemia, hypocupremia and hypomagnesemia
- Clinico-therapeutic studies on various infectious diseases of domestic and pet animals

VETERINARY MICROBIOLOGY

Course Structure

COURSE NO.	COURSE TITLE	CREDITS	SEM
VMC 601	BACTERIOLOGY - I	3+1	I
VMC 602	BACTERIOLOGY - II	3+1	II
VMC 603	VETERINARY MYCOLOGY	1+1	II
VMC 604	GENERAL VIROLOGY	2+1	I
VMC 605	SYSTEMATIC ANIMAL VIROLOGY	3+1	II
VMC 606	PRINCIPLES OF IMMUNOLOGY	2+1	I
VMC 607	VACCINOLOGY	2+0	II
VMC 608	DIAGNOSTICS OF INFECTIOUS DISEASES	1+2	I
VMC 609	TECHNIQUES IN MICROBIOLOGY AND IMMUNOLOGY	0+3	II
VMC 691	MASTER'S SEMINAR	1	I, II
VMC 699	MASTER'S RESEARCH	20	I, II
VMC 701	ADVANCES IN BACTERIOLOGY	2+1	I
VMC 702	ADVANCES IN MYCOLOGY	2+1	I
VMC 703	BACTERIAL GENETICS	2+1	II
VMC 704	MICROBIAL TOXINS	2+1	II
VMC 705	MOLECULAR DETERMINANTS OF BACTERIAL PATHOGENESIS	2+1	II
VMC 706	ADVANCES IN VIROLOGY	2+1	I
VMC 707	MOLECULAR AND GENETIC ASPECTS OF VIRAL PATHOGENESIS	2+1	II
VMC 708	STRUCTURE FUNCTION RELATIONSHIP OF DNA AND RNA VIRUSES	3+0	I
VMC 709	ONCOGENIC VIRUSES	2+0	I
VMC 710	SLOW VIRAL INFECTIONS AND PRIONS	2+0	I
VMC 711*	MOLECULAR IMMUNOLOGY	2+1	I
VMC 712*	ADVANCES IN CELLULAR IMMUNOLOGY	2+1	I
VMC 713*	CYTOKINES AND IMMUNOMODULATORS	2+0	II
VMC 714*	ADVANCES IN VACCINOLOGY	2+0	I
VMC 715*	ADVANCES IN IMMUNODIAGNOSTICS	1+1	I
VMC 716*	MODERN IMMUNOTECHNOLOGY	1+2	II
VMC 717	CURRENT TOPICS IN INFECTION AND IMMUNITY	3+0	I
VMC 718	VETERINARY MICROBIAL BIOTECHNOLOGY	2+1	II
VMC 790	SPECIAL PROBLEM	0+2	II
VMC 791	DOCTORAL SEMINAR I	1	I, II
VMC 792	DOCTORAL SEMINAR II	1	I, II
VMC 799	DOCTORAL RESEARCH	45	I, II

SERVICE COURSE			
BIF 510/ MBB 512/ BIOCHEM 506	IMMUNOLOGY AND MOLECULAR DIAGNOSTICS	2+1	II

* Compulsory for Doctoral progamme in Veterinary Immunology

VETERINARY MICROBIOLOGY
Course Contents

VMC 601 BACTERIOLOGY – I 3+1 SEM - I

Objective

To impart knowledge on general microbiology and important aerobic bacteria.

Theory

UNIT-I: Introduction to historical development of cellular organization, genetic and chemical characteristics of eukaryotic and prokaryotic cells. Classification, nomenclature and identification; genetic characterization and numerical taxonomy. Bacterial cell structure, physiology and antigenic structure.

UNIT-II: Determinants of pathogenicity and its molecular basis. Bacteriophages: temperate and virulent phages; lysogeny and lysogenic conversion. Bacterial genetics: bacterial variation, genetic transfer mechanisms (transformation, transduction and conjugation); plasmids, transposons and drug resistance; recombinant DNA technology. UNIT-III: Systemic study of following bacteria: Gram negative- aerobic rods and cocci, family *Pseudomonadaceae*, *Legionellaceae*, *Neisseriaceae*, and genus *Brucella*. Facultative anaerobic Gram negative rods, family- *Vibrionaceae*, *Pasteurellaceae*, *Enterobacteriaceae* and other genera.

Practical

Morphological characterization, cell fractionation, enrichment & isolation technology, various methods used in growth measurement and bacterial preservation, gene transfer experiment. Detailed characterization (biochemical, serological, pathogenicity) of bacteria.

Suggested Readings

Glen Sonder J & Karen W Post 2005. *Veterinary Microbiology: Bacterial & Fungal Agents of Animal Diseases*. Cold Spring Harbor Lab. Press.

Prescot LM, Harley JP & Klen DA. 2005. *Microbiology*. W. C. Brown Publ.

Tortora GJ, Funke BR & Case CL. 2004. *Microbiology: An Introduction*. Benjamin/Cummins Publ.

VMC 602 BACTERIOLOGY – II 3+1 SEM - II

Objective

To learn about spore forming bacteria and some important aerobes and anaerobes.

Theory

UNIT-I: Systematic study of following pathogenic bacteria: Gram positive cocci, family *Micrococaceae*, endospore forming Gram positive rods and cocci, family *Bacillaceae* genus *Bacillus*, *Sporolactobacillus* and *Clostridium*. Spirochetes. Family *Spirochetaceae* and other families like *Spirillaceae*, coryneform bacteria, *Dermatophillaceae*, *Streptomycetaceae.*

UNIT-II: *Mycobacteria* and *Nocardia*, family *Actinomycetaceae*. Atypical prokaryotes such as *Chlamydia*, *Rickettsiae*, *Mycoplasma*, *Acholeplasma*, *Spiroplasma*, *Anaeroplasma* and *Thermoplasma*.

UNIT-III: Regular non-sporing Gram positive rods such as *Listeria* and *Erysipelas*. Anaerobic Gram negative straight, curved and helical rods, family *Bacteriodaceae* and genus *Bacteroides* and *Fusobacterium*.

Practical

Detailed and comparative study of morphology, biochemical reactions, physiology, serology and pathogenicity of various bacteria studied in theory, isolation of bacteria from field materials leading to their characterization and identification.

Suggested Readings

Glen Sonder J & Karen W Post 2005. *Veterinary Microbiology: Bacterial and Fungal Agents of Animal Diseases.* Cold Spring Harbor Lab. Press.

Prescot LM, Harley JP & Klen DA. 2005. *Microbiology*. W. C. Brown Publ.

Tortora GJ, Funke BR & Case CL. 2004. *Microbiology: An Introduction*. Benjamin/Cummins Publ.

VMC 603 VETERINARY MYCOLOGY 1+1 SEM - II

Objective

To learn general and pathogenic mycology.

Theory

UNIT-I: Morphology, physiology, reproduction, cultural characters, classification of fungi, immunology of pathogenic fungi.

UNIT-II: Systematic study of animal mycoses such as aspergillosis, candidiasis, cryptococcosis, epizootic lymphangitis, mycetomas, sporotrichosis, histoplasmosis, blastomycosis, coccidioidomycosis, haplomycosis, rhinosporidiosis, zygomycosis, mycotic abortion, mycotic mastitis, mycotic dermatitis, dermatophytoses, mycotoxicosis, etc.

Practical

Collection and processing of clinical material for isolation of fungi. Study of gross and microscopic characters of pathogenic fungi.

Suggested Readings

Glen Sonder J & Karen W Post 2005. *Veterinary Microbiology: Bacterial and Fungal Agents of Animal Diseases*. Cold Spring Harbor Lab. Press.

VMC 604 GENERAL VIROLOGY 2+1 SEM - I

Objective

To study general aspects of viral structure, classification, replication, interactions and immunity to viruses.

Theory

UNIT-I: History of virology; origin and nature of viruses; biochemical and morphological structure of viruses; nomenclature and classification of viruses.

UNIT-II: Replication of DNA and RNA viruses, viral genetics and evolution.

UNIT-III: Genetic and non-genetic interactions between viruses, virus-cell interactions, viral pathogenesis, viral persistence, oncogenic viruses, epidemiology of viral infections. UNIT-IV: Immune response to viruses, viral vaccines, viral chemotherapy.

Practical

Orientation to a virology laboratory, preparation of equipment for sterilization, collection, preservation, transportation of samples and their processing, isolation and cultivation of viruses in animals/ birds, embryonated chicken eggs; media and reagents for cell culture, trypsinization and maintenance of monolayer cell cultures, isolation of virus in cell cultures, titration of viruses by 50% end-point cytopathogenicity, and haemagglutination; detection of viral antibodies by serum neutralization test, agar gel precipitation test, haemagglutination inhibition and ELISA.

Suggested Readings

Acheson NH. 2006. *Fundamentals of Molecular Virology*. Wiley.

Carter J & Saunders V. 2007. *Virology: Principles and Applications*. 1st Ed. Wiley.

Knipe DM, Howley PM, Griffin DE. 2006. *Fields Virology*. 5th Ed. Vols. I, II. Lippincott, Williams & Wilkins.

Mahy BWJ & Kangaroo HO. 1996. *Virology Methods Manual*. Academic Press.

Murphy FA, Gibbs, EPJ, Holzmek MK & Studdert MJ. 1999. *Veterinary Virology*. 3rd Ed. Academic Press.

VMC 605 SYSTEMATIC ANIMAL VIROLOGY 3+1 SEM - II

Objectives

To study viral properties, epidemiology, pathogenesis, diagnosis and control of diseases caused by animal viruses.

Theory

UNIT-I: Studies on animal viruses belonging to various families, and prion agents given below with reference to antigens, cultivation, pathogenesis, epidemiology, disease status in India, diagnosis, immunity and control. Capripoxvirus, avipoxvirus, cowpoxvirus; bovine herpes

viruses, equine herpes viruses, infectious laryngotracheitis virus, Marek's disease virus, pseudorabies virus, malignant cattarrh fever virus; infectious canine hepatitis virus, egg drop syndrome virus, inclusion body hepatitis, hydropericardium virus, papillomatosis, canine parvoviruses, feline panleucopenia virus.

UNIT-II: Newcastle disease virus, canine distemper virus, rinderpest virus, PPR virus; infectious bursal disease virus; rotavirus, blue tongue virus, African horse sickness virus; rabies virus, ephemeral fever virus, borna virus.

UNIT-III: Infectious bronchitis virus, transmissible gastroenteritis virus; equine arteritis virus, equine encephalomyelitis viruses; swine fever virus, BVDVmucosal disease virus; foot and mouth disease virus, duck hepatitis virus; visna/maedi virus, equine infectious anemia virus, avian leucosis complex virus, bovine leukemia virus, chicken anemia virus; prions: scrapie, bovine spongiform encephalopathy.

Practical

Isolation of viruses in embryonated eggs and cell cultures; cytopathogenicity of representative animal viruses viz., cell death, syncytia formation, inclusion body, etc.; diagnosis of animal viruses employing various serological tests, viz., haemagglutination and haemagglutination inhibition for Newcastle disease virus, agar gel diffusion and virus neutralization test for infectious bursal disease viruses; diagnosis of IBD virus and rotavirus by latex agglutination test, serotyping of FMD virus by ELISA, electropherotyping of rotavirus, PCR for diagnosis of viral infections.

Suggested Readings

Acheson NH. 2006. *Fundamentals of Molecular Virology*. Wiley.

Carter J & Saunders V. 2007. *Virology: Principles and Applications*. 1st Ed. Wiley.

Knipe DM, Howley PM, Griffin DE. 2006. *Fields Virology*. 5th Ed. Vols. I, II. Lippincott, Williams & Wilkins.

Mahy, BWJ & Kangaroo HO. 1996. *Virology Methods Manual*. Academic Press.

Murphy FA, Gibbs, EPJ, Holzmek MK & Studdert MJ. 1999. *Veterinary Virology*. 3rd Ed. Academic Press.

VMC 606 PRINCIPLES OF IMMUNOLOGY 2+1 SEM - I

Objective

To impart knowledge about fundamental principles of immunology and its applications in the field of infectious diseases.

Theory

UNIT-I: History of immunology, immunity types, cardinal features, phylogeny. Vertebrate immune system: lymphoid organs and tissues; development of B and T lymphocyte repertoires and other leukocytes, differentiation markers and other distinguishing characters of leukocytes; lymphoid cells trafficking.

UNIT-II: Antigens: fundamental features, types, factors affecting immuno-genicity, adjuvants. Antibodies: structure, functions and classification; theories of antibody production; immunoglobulin genes and genetic basis of antibody diversity. Complement system: activation pathways and biological activities.

UNIT-III: Major histocompatibility complex: structure, functions and gene organization. T lymphocyte subsets. Antigen-specific T cell receptors: structure, gene organization and genetic basis of diversity. Immune response development: phases of humoral and cell- mediated immune response development, cellular interactions, properties and classification of various cytokines, immunoregulation.

UNIT-IV: Immunity against veterinary infectious agents, immunological surveillance and cancer immunity, immunological tolerance, its breakdown and autoimmunity, immuno- deficiencies: types and examples, hypersensitivity: classification, mechanisms of induction and examples.

Practical

Preparation of antigens for laboratory animals immunization; production, collection and

preservation of antisera; quantitation of immunoglobulins in antisera by zinc sulphate turbidity and single radial immunodiffusion; examination of lymphoid organs of animals; tests for *in vivo* and *in vitro* phagocytosis; separation and counting of peripheral blood lymphocytes; separation and concentration of immunoglobulin by ammonium sulphate precipitation and dialysis; demonstration of antigen- antibody interactions in serological tests such as agar gel precipitation, immunoelectrophoresis, bacterial agglutination, direct and passive hemagglutination, latex agglutination, complement fixation, enzyme-linked immunosorbent assay, immunoblotting.

Suggested Readings

Kindt TJ, Goldsby RA & Osborne BA. 2007. *Kuby Immunology*. 6th Ed. WH Freeman. Male D, Brostoff J, Roth DB & Roitts I. 2007. *Immunology*. 7th Ed. Mosby-Elsevier.

Tizard IR. 2004. *Veterinary Immunology: An Introduction*. 7th Ed. Saunders/Elsevier.

VMC 607 VACCINOLOGY 2+0 SEM - II

Objective

To understand science and practice of vaccines for prevention of bacterial and viral diseases.

Theory

UNIT-I: History of veterinary vaccinology. Vaccines: classification, comparison of major types. Components of various types of vaccines: immunogens, adjuvants, stabilizers, preservatives, vehicles. Vaccine qualities: definitions and methods of testing. Vaccine development: cost-effectiveness of preventive immunization programmes, stages of development, clinical trials and regulatory requirements**.**

UNIT-II: Traditional vaccines: inactivated, attenuated and toxoid vaccines. Methods of construction of traditional vaccines: microbial cultures, embryonated eggs, cell culture. Seed-lots of vaccine organisms. Methods of inactivation and attenuation of pathogens.

UNIT-III: Modern vaccines: nucleic acids, vectored vaccines, recombinant expressed immunogens, synthetic peptides, marker vaccines, etc. Combination/multivalent vaccines. Novel immunomodulators and delivery systems. Modern methods of vaccine construction: methods based on synthetic chemistry and rDNA technology.

UNIT-IV: Vaccine formulation: pharmacopeal requirements. Vaccine stability and preservation: cold chain. Immunization schedules of veterinary vaccines, logistic problems and vaccination failure. Strategies of disease control and eradication by vaccination.

Suggested Readings

Dodds WJ & Schulz R. (Eds). 1999. *Veterinary Vaccines and Diagnostics*. Vol. 41 (*Advances in Veterinary Medicine*) Ist Ed. Academic Press.

Levine MM, Kaper JB, Rappuoli R, Liu MA & Good MF. 2004. *New Generation Vaccines*. 3rd Ed. Marcel-Dekker.

Pastoret PP, Blancou J, Vannier C & Verschueren C. 1997. *Veterinary Vaccinology*. Elsevier.

VMC 608 DIAGNOSTICS OF INFECTIOUS DISEASES 1+2 SEM - I

Objective

To provide training in essential immunological and molecular diagnostic techniques.

Theory

UNIT-I: Diagnosis of infectious diseases: an overview. Principles of serodiagnostic: agglutination-reaction based tests, precipitation-reaction based tests, complement fixation test and enzyme immunoassays.

UNIT-II: Principles of molecular diagnostic tests: PCR, RT-PCR, Southern blotting, northern blotting, western blotting, dot-blot. DNA diagnostics versus serodiagnostics. Development and validation of diagnostic tests.

Practical

Serodiagnostic tests for infectious diseases: bacterial slide and microtitre plate agglutination, agar gel immunodiffusion test, passive hemagglutination, hemagglutination inhibition and latex

agglutination tests, complement fixation test, enzyme linked immunosorbent immunoassays, dot-ELISA, fluorescent antibody technique, immuno- electron microscopy, virus neutralization test, etc. Molecular diagnostic techniques: protein profiling of infectious agents by SDS-polyacrylamide gel electrophoresis, antigen profiling of infectious agents by immunoblotting, nucleic acids isolation from infectious agents, detection of infectious agent nucleic acids by various formats of polymerase chain reaction and reverse transcription-PCR, dot-blot technique, etc.

Suggested Readings

Detrick B & Hamilton RG. (Eds). 2006. *Manual of Molecular and Clinical Laboratory Immunology*. 7th Ed. American Society for Microbiology.

Rose NR, Friedman H & Fahey JL. (Eds). 1986. *Manual of Clinical Laboratory Immunology*. American Society for Microbiology.

Weir DM. 1986. *Handbook of Experimental Immunology*. Vol. IV. Blackwell.

VMC 609 TECHNIQUES IN MICROBIOLOGY AND IMMUNOLOGY 0+3 SEM - II

Objective

To learn various important techniques of bacteriology, virology and immunology.

Practical

Preparation of different media used in bacteriology and mycology; isolation and identification of bacteria and fungi; antibiotic sensitivity of microorganisms from clinical specimens. Plasmid profiling, pathogenicity test in cell culture or laboratory animals, maintenance and preservation of bacteria and fungi. Cryopreservation and reconstitution of preserved cell lines; Concentration and purification of animal viruses by chemical agents, differential centrifugation, density gradient centrifugation, and ultra filtration, etc. Storage of animal viruses by freeze drying and ultra freezing. Biophysical and biochemical characterization of animal viruses; Molecular characterization of viral protein and nucleic acid. Immunoglobulin purification by salt precipitation and chromatographic techniques, anti-species antibody production, enzyme-linked immunosorbent assays for antigen and antibody detection, neutrophils and peritoneal macrophage isolation and demonstration of phagocytic activity, lymphocyte separation, lymphocyte proliferation assay, tuberculin-type delayed type hypersensitivity reaction.

Suggested Readings

Coligan JE, Kruisbeek AM, Margulies DH, Shevach EM & Strober W. 2003. *Current Protocols in Immunology*. 3rd Ed. John Wiley & Sons.

Detrick B & Hamilton RG. (Eds). 2006. *Manual of Molecular and Clinical Laboratory Immunology*. 7th Ed. American Society for Microbiology.

Hay FC & Westwood OMR. 2002. *Practical Immunology*. 4th Ed. Blackwell. Mahy BWJ & Kangaro HO. 1996. *Virology Methods Manual*. Academic Press.

Quinn PJ, Carter ME, Markey B & Carter GR. 1994. *Clinical Veterinary Microbiology*. Wolfe Publ.

VMC 701 ADVANCES IN BACTERIOLOGY 2+1 SEM - I

Objective

To learn about the latest development in the field of bacteriology.

Theory

UNIT-I: Advanced studies on cytology, biochemical activities, antigenic structure and molecular biology of bacteria.

UNIT-II: Advanced studies on pathogenicity, immunology and serology of bacteria.

Practical

Biochemical, physiological and pathogenesis studies of various bacterial diseases**.**

Suggested Readings

Selected articles from journals.

VMC 702 ADVANCES IN MYCOLOGY 2+1 SEM - I

Objective

To learn about the latest development in the field of mycology.

Theory

UNIT-I: Advanced studies on taxonomic genetics, physiology and antigenic characterization of pathogenic fungi.

UNIT-II: Advanced studies on molecular approaches for identification of fungi and immunology and serology of mycoses.

Practical

Biochemical, physiological and pathogenesis studies of various fungal diseases**.**

Suggested Readings

Selected articles from journals.

VMC 703 BACTERIAL GENETICS 2+1 SEM - II

Objective

To learn the basic aspects of bacterial genetics.

Theory

UNIT-I: Prokaryotic and eukaryotic genome. Replication of eukaryotic and prokaryotic DNA. Structure, classification and replication of plasmids. Molecular basis of mutations.

UNIT-II: Biochemical genetic and gene mapping by recombination, fine gene structure analysis. Gene transfer in bacteria through transduction, transformation and conjugation and gene mapping by these processes.

UNIT-III: Transposable elements. Gene cloning and gene sequencing. Regulation of gene expression.

Practical

Mutagenesis of microorganisms by different methods. Production, isolation and characterization of mutants. Determination of mutation rate. Isolation, characterization and curing of plasmids. Transfer of plasmid by conjugation, electroporation. Tetrad and random spore analysis.

Suggested Readings

Selected articles from journals.

VMC 704 MICROBIAL TOXINS 2+1 SEM - II

Objective

To learn about the bacterial and fungal toxins.

Theory

UNIT-I: The role of microbial toxins in the pathogenesis of diseases; biochemical and biological characteristics of toxins produced by various bacteria. Toxin producing Gram positive and negative bacteria. Properties and clinical conditions produced by different bacterial toxins.

UNIT-II: Production, characterization, and study of pathogenicity of various fungal toxins.

Practical

Isolation of toxigenic strains of bacteria from suspected material, production of toxins in suitable media, purification and characterization of toxins; biological characterization in animal and in tissue culture; immunobiological studies of toxins.

Suggested Readings

Selected articles from journals.

VMC 705 MOLECULAR DETERMINANTS OF BACTERIAL PATHOGENESIS 2+1 SEM - II

Objective

To learn the molecular mechanisms of bacterial pathogenesis.

Theory

UNIT-I: Molecular structure, production and mode of action of bacterial adhesins, invasions, impedins, aggressins, modulins, capsule, flagella, enzymes, components of cell wall and siderophores.

UNIT-II: The production, structure and molecular mechanism of actions of various exotoxins and endotoxins, siderophores and cytotoxins, and plasmids in causation of disease.

Practical

To study the production and effects of exotoxins and endotoxins, LPS and various enzymes produced by the bacteria on various cell culture and live animals.

Suggested Readings

Selected articles from journals.

VMC 706 ADVANCES IN VIROLOGY 2+1 SEM - I

Objective

Advanced study of virus structure, their nucleic acids and proteins; latest trends in animal virus research.

Theory

UNIT-I: Biology of RNA and DNA virus replication.

UNIT-II: Current concepts in animal virus research with respect to viral structure and architecture, viral virulence, viral pathogenesis, persistence and oncogenesis.

UNIT-III: Latest trends in the development of antivirals. UNIT-IV: Cloning and expression in viral vectors.

Practical

Separation and characterization of viral proteins, and nucleic acid by polyacrylamide gel electrophoresis, column chromatography, blotting techniques. Problem oriented practical assignments aimed at development of bioreagents and relevant diagnostic tests. Screening and evaluation of antiviral agents for efficacy and toxicity.

Suggested Readings

Selected articles from journals.

VMC 707 MOLECULAR AND GENETIC ASPECTS OF VIRAL PATHOGENESIS 2+1 SEM - II

Objective

To study molecular and genetic determinants of viral virulence and pathogenesis; animal models for studying viral pathogenesis.

Theory

UNIT-I: Mechanisms of viral infection and spread through the body; detailed study of virus host interactions.

UNIT-II: Host immune responses to viral infections; viral strategies to evade host immune responses.

UNIT-III: Pathogenesis of viral diseases of various systems; animal models for studying viral pathogenesis; molecular and genetic determinants of viral virulence; mechanisms of viral virulence.

UNIT-IV: Molecular and genetic determinants of viral persistence, viral oncogenesis, viral immunosuppression, and immunopathology. Animal models for studying viral pathogenesis.

Practical

Pathotyping of animal viruses using Newcastle disease virus as model; Determination of immunosuppressive potential of animal viruses using infectious bursal disease virus/ Marek's

disease virus/ chicken anemia virus; characterization of molecular determinants of viral virulence using variants, recombinants and reassortants; isolation and molecular characterization of viruses with varying virulence.

Suggested Readings

Selected articles from journals.

VMC 708 STRUCTURE FUNCTION RELATIONSHIP OF DNA AND RNA VIRUSES 3+0 SEM - I

Objective

To understand the relationship between structure and function of DNA and RNA viruses of animals for the development of next generation viral vaccine and antivirals.

Theory

UNIT-I: Methods of studying virus structure and architecture; methods of amplification of viral nucleic acids; molecular characterization of viral protein and nucleic acid, nucleotide sequencing, and its analysis by software programmes.

UNIT-II: Detailed study of virus replication in various groups of animal viruses.

UNIT-III: Understanding the relationship between structure and function of animal DNA and RNA viruses, development of modern vaccines and antivirals using the relationship between structure and function of animal DNA and RNA viruses.

Suggested Readings

Selected articles from journals.

VMC 709 ONCOGENIC VIRUSES 2+0 SEM - I

Objective

To study mechanisms of viral oncogenesis.

Theory

UNIT-I: General features of cell transformation and characterization of transformed cells; Oncogenic RNA and DNA viruses; expression of viral and cellular oncogenes.

UNIT-II: Mechanisms of viral oncogenesis; Diagnosis of viral oncogenesis.

Suggested Readings

Selected articles from journals.

VMC 710 SLOW VIRAL INFECTIONS AND PRIONS 2+0 SEM - I

Objective

To study slow viral infections; properties and replication of prions, and diseases caused by them.

Theory

UNIT-I: Epidemiology, pathogenesis, diagnosis and control of slow viral infections. UNIT-II: Properties, replication and epidemiology of prions. Pathogenesis, immunity, diagnosis and control of various diseases caused by prions; recent trends in prion research.

Suggested Readings

Selected articles from journals.

VMC 711 MOLECULAR IMMUNOLOGY 2+1 SEM - I

Objective

To familiarize with advances in research on immune system molecules such as antigens, antibodies, complement, cytokines, surface molecules, etc.

Theory

UNIT-I: Pathogen associated molecular patterns and pattern recognition receptors in immunity. Advances in characterization of antigens and superantigens, epitope mapping. Novel functions of immunoglobulins and their fragments produced by rDNA technology. UNIT-II: Cytokines and cytokine receptors: structure and function. Complement components genes and polymorphism. MHC genes. Evolutionary aspects of recombination activating genes-mediated immunity in vertebrates.

UNIT-III: Immunoinformatics as applied to MHC molecules-peptide complexes and other molecules. Immunomics.

Practical

Purification of immunoglobulin classes and IgG subclasses, IgG fragments production by pepsin and papain digestion, cytokine quantitation and detection by ELISPOT assay, IgV gene amplification and sequencing, use of immunoinformatic tools to Ig genes.

Suggested Readings

Selected articles from journals.

VMC 712 ADVANCES IN CELLULAR IMMUNOLOGY 2+1 SEM - I

Objective

To learn advances in research on immune cell biology and cellular interactions in immune responses.

Theory

UNIT-I: Hematopoietic stem cells and differentiation pathways of various leukocytes. B and T lymphocyte repertoires. Lymphocyte- endothelial cell interactions during lymphocyte emigration and recirculation. Antigen presenting cells, T cell subsets, regulatory T cells, memory B and T cells. NK cell biology.

UNIT-II: Cellular interactions during immune response development: microenvironments, antigen processing and presentation, activation of B and T cells, co-stimulatory molecules, cytokines in intercellular communication. Signal transduction pathways in B and T cell activation.

UNIT-III: Immunoregulation of B and T cell response. Mucosal immune system. Oral tolerance and its breakdown. Advances in transplantation immunology. SCID, gene- knockout and transgenic animals in immunobiology research.

Practical

Fluorescence activated and magnetic cell sorting of lymphocyte subsets, Lymphocyte proliferation assays using non-radioisotope methods, adoptive transfer of lymphocyte subsets, cytotoxic T cell assays, ELISPOT assays for enumeration of lymphocyte subsets secreting cytokines.

Suggested Readings

Selected articles from journals.

VMC 713 CYTOKINES AND IMMUNOMODULATORS 2+0 SEM - II

Objective

To learn about structure and function of various cytokines and other immunomodulators.

Theory

UNIT-I: Cytokines and immunomodulators: definitions and classification. Cytokines structure and functions. Cytokine receptors: structural types and presence on different cells. Roles in activation, division and differentiation of immune cells, and immunoregulation.

UNIT-II: Cytokine networks. Cytokines in reproductive processes and neuroendocrino-immunological interactions. Immunomodulators in control of diseases. Cytokines as adjuvants and imunomodulators. Colony stimulating factors and other cytokines in stem cell research.

Suggested Readings

Selected articles from journals.

VMC 714 ADVANCES IN VACCINOLOGY 2+0 SEM - I

Objective

To learn about advances in vaccine research and modern approaches to vaccine development.

Theory

UNIT-I: Advances in vaccine development research. Antigen identification and characterization employing newer molecular technologies such as microarrays, *in vivo* expression technology, signature-tagged mutagenesis and phage display technology, etc. UNIT-II: Immunoinformatics

as applied to epitope mapping, T cell epitopes, identification of pathogenic epitopes, etc. Novel vaccines: nucleic acids, marker vaccines, mucosal vaccines, bacterial ghosts as vaccines, virus-like particles. Futuristic vaccines: anti-allergic, anti-autoimmune diseases, de-addiction vaccines, transplant survival/ prolonging vaccines etc.

Suggested Readings

Selected articles from journals.

VMC 715 ADVANCES IN IMMUNODIAGNOSTICS 1+1 SEM - I

Objective

To learn and employ modern approaches to immunodiagnosis.

Theory

Newer methods of immunodiagnosis: simple, rapid, penside immunodiagnostic tests such as immunochromatofocussing, immunofiltration tests, etc. Development of highly sensitive enzyme immunoassays such as immuno-PCR, use of luminescent substrates, etc. Disciminant immunoassays for differentiating cross-reactive antigens. Antibodies in biosensors.

Practical

Development of immunofiltration test using monoclonal antibody for diagnosis of any veterinary infectious disease. Blocking ELISA to differentiate cross-reactive antigens.

Suggested Readings

Selected articles from journals.

VMC 716 MODERN IMMUNOTECHNOLOGY 1+2 SEM - II

Objective

To provide training on production of monoclonal antibody and other immunobiologicals by various modern methods.

Theory

UNIT-I: Historical developments in modern immunotechnology. Hybridoma technology: advances in monoclonal antibody production. Chimeric and humanized monoclonal antibodies.

UNIT-II: Recombinant DNA technology for expression of antibody fragments: Fab, scFv, bispecific antibody, nanobody and various other antibody formats**.** Modern uses of antibody fragments: biosensors, catalysis, therapeutics, *in vivo* imaging, microarrays, proteomics, etc.

Practical

Production of murine monoclonal antibody against antigens of infectious agents by hydridoma technique. Production of phage display library of scFv or camel nanobody. Selection of antigen-specific phage displayed antibody fragment by panning or other techniques.

Suggested Readings

Selected articles from journals.

VMC 717 CURRENT TOPICS IN INFECTION AND IMMUNITY 3+0 SEM - I

Objective

Discussions on recent developments in the immunobiology of major viral, bacterial and fungal diseases of animals.

Theory

UNIT-I: Introduction and historical developments. Host-pathogen relationship.

UNIT-II: Effector mechanisms of specific and non specific immunity to different groups of microbes.

UNIT-III: Immunobiology of major viral, bacterial and fungal diseases of animals. Types of vaccines in infectious diseases and current trends in vaccine development.

Suggested Readings

Selected articles from journals.

VMC 718 VETERINARY MICROBIAL BIOTECHNOLOGY 2+1 SEM - II

Objective

To understand as to how microbial processes and activities can be used for development of medically and industrially important products and processes.

Theory

UNIT-I: History of microbial biotechnology. Microbes in nature. Microbes as infectious agents of human and animals. Host-microbe relationships. Microbial metabolism and growth characteristics. Microbial genetics.

UNIT-II: Introduction to molecular biology of microorganisms: DNA, RNA and proteins structure and functions. DNA replication, RNA transcription, reverse transcription, protein translation, regulatory mechanisms. Bacterial extrachromosomal DNA elements**.** UNIT-III: Genetic engineering: restriction enzymes, DNA ligases, DNA polymerases, RNases and DNases, other enzymes. DNA sequencing. Plasmids and phage-derived vectors, bacterial hosts for cloning and expression of transgenes. Genomic libraries and sequencing. Blotting of DNA, RNA and proteins. Polymerase chain reaction. Microarrays. Metagenomics.

UNIT-IV: Expression of antigens and antibody fragments useful as diagnostic reagents and vaccines. PCR and blotting techniques in infectious disease diagnosis. Nucleic acid vaccines. Vectored viral and bacterial vaccines. Construction of defined mutants and marker vaccines using genetic manipulation techniques. Display technologies for production of immunobiologicals. Manipulation of microbial processes for production of industrially useful substances.

Practical

Extraction of nucleic acids from viruses and bacteria. Restriction endonuclease digestion of DNA and resolution in agarose gel electrophoresis. PCR amplification of DNA. RT- PCR of RNA. Insertion of DNA fragments into plasmid/phagemid/phage vectors. Construction of competent *E. coli* host cells. Transformation and transfection of competent *E. coli* cells. Screening of transformants and isolation of clones. DNA sequencing of clones/PCR amplicons. Expression of genes of bacterial/viral antigens. Use of PCR for infectious disease diagnosis.

Suggested Readings

Selected articles from journals.

VMC 790 SPECIAL PROBLEM 0+2 SEM - II

Objective

To provide expertise in handling practical research problem(s).

Practical

Short research problem(s) involving contemporary issues and research techniques.

VETERINARY MICROBIOLOGY

List of Journals

- Advances in Immunology
- Advances in Virus Research
- Annual Review of Immunology
- Current Topics in Microbiology and Immunology
- Immunology
- Indian Journal of Virology
- Infection and Immunity
- Journal of Bacteriology
- Journal of General Virology
- Journal of Immunology
- Journal of Virology
- Nature
- Nature Immunology
- Nature Reviews Immunology
- Science
- Trends in Biotechnology
- Trends in Immunology
- Vaccine
- Veterinary Immunology and Immunopathology
- Veterinary Microbiology
- Virology

e-Resources

- www.virology.com (Virology Journal)
- www.elsevier.com/locate/vetmic (Veterinary Microbiology)
- www.jb.asm.org (Journal of Bacteriology)
- www.jac.oxford.journals.org (Clinical Bacteriology)
- www.benthem.org/open/tomycj (The Open Mycology Journal)
- www.nature.com/nrmicro (Nature Review of Microbiology)
- www.trends.com/tim (Trends in Microbiology)
- www.arjournals.annualreviews.org/loi/micro (Annual Reviews of Microbiology)
- www.jcm.asm.org (Journal of Clinical Microbiology)
- www.trends.com/it (Trends in Immunology)
- www.arjournals.annualreviews.org/loi/immunol (Annual Reviews of Immunology)
- www.elsevier.com/locate/vaccine (Vaccine)
- www.nature.com/immunol (Nature Review of Immunology)
- www.iac.asm.org (Infection and Immunity)
- www.jaconline.com (Journal of Allergy and Clinical Immunology)
- www.elsevier.com/locate/molimm (Molecular Immunology)
- www.blackwellpublishing.com/journals/pim (Parasite Immunology)
- www.jleukbio.org (Journal of Leucocyte Biology)
- www.ocw.mit.edu (MIT Open Course Ware/Health Sciences and Technology)

Suggested Broad Topics for Master's and Doctoral Research

- Isolation, identification and characterization of pathogenic bacteria for developing diagnostics and vaccines
- Development of genetically modified bacteria for improved vaccine and genetically modified signatured bacteria for developing vaccine candidate that can differentiate vaccinated from infected animals

- Development of molecular tools for studying evolution, quick diagnosis and molecular epidemiology of microbes
- Molecular characterization and antigenic relationship of field isolates of important viruses of animals and poultry.
- Isolation and characterization of field isolates of important viruses of livestock and poultry with the aim of development of diagnostics and candidate vaccines
- Studies on immune responses and immunity to animal and poultry viruses
- Investigation of the roles of proinflammatory cytokines in ovarian activity of buffaloes
- Production of phage display libraries of bovine scFv for diagnostic and therapeutic uses
- Development of novel delivery systems for developing mucosal veterinary vaccines

VETERINARY PARASITOLOGY

Course Structure

COURSE NO.	COURSE TITLE	CREDITS	SEM
VPA 601	VETERINARY HELMINTHOLOGY - I	2+1	I
VPA 602	VETERINARY HELMINTHOLOGY - II	2+1	II
VPA 603	VETERINARY ENTOMOLOGY AND ACAROLOGY	2+1	I
VPA 604	VETERINARY PROTOZOOLOGY	2+1	II
VPA 605	PARASITOLOGICAL TECHNIQUES	0+2	I
VPA 606	CLINICAL PARASITOLOGY	1+1	I
VPA 607	TRENDS IN CONTROL OF LIVESTOCK AND POULTRY PARASITES	1+1	II
VPA 608	IMMUNOPARASITOLOGY	2+1	I
VPA 609	PARASITIC ZOONOSES	2+0	II
VPA 610	PARASITES OF ZOO AND WILD ANIMALS	2+1	II
VPA 611	MALACOLOGY	1+1	I
VPA 691	MASTER'S SEMINAR	1	I, II
VPA 699	MASTER'S RESEARCH	20	I, II
VPA 701	APPLICATIONS OF REMOTE SENSING AND GEOGRAPHIC INFORMATION SYSTEM IN PARASITOLOGY	1+2	I
VPA 702	MOLECULAR DIAGNOSTICS AND VACCINE DEVELOPMENT IN PARASITOLOGY	2+1	II
VPA 703	HOST PARASITE INTERACTIONS	2+0	I
VPA 704	ADVANCES IN PROTOZOOLOGY	2+1	II
VPA 705	ADVANCES IN HELMINTHOLOGY - I	2+1	I
VPA 706	ADVANCES IN HELMINTHOLOGY - II	2+1	II
VPA 707	ADVANCES IN ENTOMOLOGY AND ACAROLOGY	2+1	I
VPA 708	*IN VITRO* CULTIVATION OF PARASITES	1+2	II
VPA 709	EMERGING AND RE-EMERGING PARASITIC DISEASES	2+0	II
VPA 710	BIONOMICS OF PARASITES	3+0	I
VPA 711	ENVIRONMENTAL PARASITOLOGY	1+1	I
VPA 790	SPECIAL PROBLEM	0+2	I, II
VPA 791	DOCTORAL SEMINAR I	1	I, II
VPA 792	DOCTORAL SEMINAR II	1	I, II
VPA 799	DOCTORAL RESEARCH	45	I, II

VETERINARY PARASITOLOGY
Course Contents

VPA 601 VETERINARY HELMINTHOLOGY – I 2+1 SEM - I

Objective

To learn about various aspects of trematode and cestode parasites of veterinary importance.

Theory

UNIT-I: Introduction, history, classification, general account and economic importance of platyhelminths.

UNIT-II: Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of trematodes belonging to families: Dicrocoeliidae, Opisthorchiidae, Strigeidae and Fasciolidae.

UNIT-III: Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of trematodes belonging to families: Echinostomatidae, Heterophyidae, Plagiorchiidae, Troglotrematidae, Prosthogonimidae, Nanophyetidae and Paragonimidae.

UNIT-IV: Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of trematodes belonging to families: Notocotylidae, Brachylemidae, Cyclocoelidae, Paramphistomatidae and Schistosomatidae.

UNIT-V: Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of cestodes belonging to families: Mesocestoididae, Anoplocephalidae, Thysanosomidae, Dipylidiidae and Dilepididae.

UNIT-VI: Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of cestodes belonging to families: Davaineidae, Hymenolepididae, Taeniidae and Diphyllobothriidae.

Practical

Identification of trematode and cestode parasites; their eggs and intermediate hosts. Observation on parasitic stages in host tissues and associated pathological lesions.

Suggested Readings

Chowdhury N. and Toda I. 1994. *Helminthology*. Spinger Verlag, Narosa Publishing House.

Dalton JP. 1999. *Fasciolosis*. CABI.

Gibson DI. 2002. *Keys to the Trematoda*, Vol.I. CABI.

Khalil LF, Jones A & Bray RA. 1994. *Keys to the Cestode Parasites of Vertebrates*. CABI.

Kumar V. 1998. *Trematode Infections and Diseases of Man and Animals*. Kluwer Academic Publishers.

Lapage G. 2000. *Monning's Veterinary Helminthology and Entomology*. Greenworld Publ.

Mehlhorn H. 1988. *Parasitology in Focus: Facts and Trends*. Springer Verlag. Singh G & Prabhakar S. 2002. *Taenia solium Cysticercosis*.CABI

Sood ML. 2003. *Helminthology in India*. International Book Distributors.

Soulsby EJL. 1982. *Helminths, Arthropods and Protozoa of Domesticated Animals*. Bailliere Tindal.

VPA 602 VETERINARY HELMINTHOLOGY – II 2+1 SEM - II

Objective

To learn about various aspects of nematodes, thorny-headed worms and leeches of veterinary importance.

Theory

UNIT-I: Introduction, history, classification, general account and economic importance of nematodes and thorny-headed worms.

UNIT-II*:* Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of nematodes belonging to families: Ascarididae, Anisakidae, Oxyuridae, Heterakidae and Subuluridae.

UNIT-III: Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of nematodes belonging to families: Rhabditidae, Strongyloididae and Strongylidae.

UNIT-IV: Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of nematodes belonging to families: Trichonematidae, Amidostomidae, Stephanuridae, Syngamidae and Ancylostomatidae.

UNIT-V: Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of nematodes belonging to families: Metastrongylidae, Protostrongylidae, Filaroididae, Trichostrongylidae, Ollulanidae, Crenosomatidae and Dictyocaulidae.

UNIT-VI: Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of nematodes belonging to families: Spiruridae, Thelaziidae, Acuariidae, Tetrameridae, Physalopteridae, Gnathostomatidae, Filariidae, Setariidae, Onchocercidae and Dracunculidae.

UNIT-VII: Morphology,epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of nematodes belonging to families: Trichinellidae, Trichuridae, Capillariidae, Dioctophymatidae, Polymorphidae, Oligacanthorhynchidae and Gnathobdellidae.

Practical

Identification of nematode parasites; their eggs and intermediate hosts, differentiation, study of their stages in the tissues and associated pathological lesions.

Suggested Readings

Andersen RC. 2000. *Nematode Parasites of Vertebrates, their Development and Transmission*. CABI.

Kennedy MW & Harnett W. 2001. *Parasitic Nematodes: Molecular Biology, Biochemistry and Immunology*. CABI.

Lapage G. 2000. *Monning's Veterinary Helminthology and Entomology*. Greenworld Publ.

Lee DL. 2002. *The Biology of Nematodes*. Taylor & Francis.

Soulsby EJL. 1982. *Helminths, Arthropods and Protozoa of Domesticated Animals*. Bailliere Tindal.

VPA 603 VETERINARY ENTOMOLOGY AND ACAROLOGY 2+1 SEM - I

Objective

To learn various aspects of arthropods of veterinary importance.

Theory

UNIT-I: Introduction, history, classification and economic importance.

UNIT-II: Distribution, life cycle, seasonal pattern, pathogenesis, economic significance and control of arthropods belonging to the families: Culicidae, Ceratopogonidae, Simuliidae and Psychodidae.

UNIT-III: Distribution, life cycle, seasonal pattern, pathogenesis, diagnosis, economic significance and control of arthropods belonging to the families: Tabanidae, Gasterophilidae, Muscidae, and Glossinidae.

UNIT-IV: Distribution, life cycle, seasonal pattern, pathogenesis, diagnosis, economic significance and control of arthropods belonging to the families: Oestridae, Sarcophagidae, Calliphoridae and Hippoboscidae.

UNIT-V: Distribution, life cycle, seasonal pattern, pathogenesis, diagnosis, economic significance and control of arthropods belonging to the families: Pediculidae, Haematopinidae, Linognathidae, Menoponidae, Philopteridae and Trichodectidae.

UNIT-VI: Distribution, life cycle, seasonal pattern, pathogenesis, diagnosis, economic significance and control of arthropods belonging to the families: Siphonapteridae, Cimicidae and Reduviidae.

UNIT-VII: Distribution, life cycle, seasonal pattern, pathogenesis, diagnosis, economic significance and control of arthropods belonging to the families: Dermanyssidae. Argasidae and Ixodidae.

UNIT-VIII: Distribution, life cycle, seasonal pattern, pathogenesis, diagnosis, economic significance and control of arthropods belonging to the families: Sarcoptidae, Psoroptidae, Demodicidae, Trombiculidae, Cytoditidae and Linguatulidae.

UNIT-IX: Strategic control measures of arthropods with special emphasis on improved versions of chemical, biological and immunological control and integrated pest management.

Practical

Collection, preservation, identification and differentiation of various arthropods and their developmental stages; associated pathological changes and lesions; skin scraping examination.

Suggested Readings

Gupta SK & Kumar R. 2003. *Manual of Veterinary Entomology and Acarology*. International Book Distr. Co.

Harwood RF & James MT. 1979. *Entomology in Human and Animal Health*. MacMillan. Kettle DS. 1995. *Medical and Veterinary Entomology*. CABI.

Lehane M. 2005. *The Biology of Blood Sucking Insects*. 2nd Ed. Cambridge University Press.

Marquardt WC. 2000. *Parasitology and Vector Biology*. Academic Press.

Mullen G & Durben L. 2002 *Medical and Veterinary Entomology*. Academic Press. Wall R & Shearer D. 1997. *Veterinary Entomology*. Chapman & Hall.

VPA 604 VETERINARY PROTOZOOLOGY 2+1 SEM - II

Objective

To project the importance and to impart detailed knowledge on various aspects of protozoan parasites.

Theory

UNIT-I: Introduction, history, classification, general account, economic importance of protozoan parasites.

UNIT-II: Morphology, epidemiology, pathogenesis, clinical signs, diagnosis and control measures of protozoan parasites belonging to the families: Trypanosomatidae, Monocercomonadidae, Trichomonadidae, Hexamitidae and Endamoebidae.

UNIT-III: Morphology, epidemiology, pathogenesis, clinical signs, diagnosis and control measures of protozoan parasites belonging to the families: Eimeriidae, Cryptosporidiidae and Sarcocystidae.

UNIT-IV: Morphology, epidemiology, pathogenesis, clinical signs, diagnosis and control measures of protozoan parasites belonging to the families: Plasmodiidae, Babesiidae, Theileriidae, Haemogregarinidae and Balantidiidae.

UNIT-V: Morphology, epidemiology, pathogenesis, clinical signs, diagnosis and control measures of Rickettsiales like *Anaplasma, Ehrlichia* and *Haemobartonella*.

Practical

Identification of protozoan parasites and observation on parasite stages in host tissues and the attendant pathological lesions. Diagnosis of protozoan parasites of veterinary importance.

Suggested Readings

Bhatia BB & Shah HL. 2000. *Protozoa and Protozoan Diseases of Domestic Livestock*. ICAR.

Bhatia BB. 2000. *Textbook of Veterinary Protozoology*. ICAR. Dobbelaere DAE & McKeever D. 2002. *Theileria*. Springer Verlag.

Dubey JP & Beattie CP.1988. *Toxoplasmosis of Animals and Man*. CRC Press.

Dubey JP, Speer CA & Fayer R. 1989. *Sarcocystosis of Animals and Man*. CRC Press. Dubey JP, Speer CA & Fayer R. 1990. *Cryptosporidiosis in Man and Animals*. CRC Press.

Kreier JP. 1991-95. *Parasitic Protozoa*. Ed. JR Baker. Academic Press. Levine ND. 1985. *Veterinary Protozoology*. Iowa State Univ. Press.

Lindsay DS & Weiss LM. 2004. *Opportunistic Infections* :*Toxoplasma, Sarcocystis and Microsporidia*. Kluwer Academic Press.

Maudlin I. 2004. *The Trypanosomiases*. Oxford Univ. Press.
Sterling CR. and Adam RD. 2004. *The Pathogenic Enteric Protozoa*. Kluwer Academic Press.
Thompson A. 2003. *Cryptosporidium*. Elsevier.

VPA 605 PARASITOLOGICAL TECHNIQUES 0+2 SEM - I

Objective

To impart practical knowledge on various techniques used in veterinary parasitology.

Practical

Microscopy, micrometry, camera lucida drawings, micro- and digital photography.
Collection, processing and examination of faecal and blood samples; lymph node biopsies, skin scrapings and nasal washings from animals for parasitological findings. Quantitative faecal examination. Evaluation of the efficacy and resistance of drugs against parasites. Maintenance of tick and fly colonies in laboratory for experimental purposes and testing of drugs; tick dissection for vector potential. Collection of aquatic snails from field and their examination for the presence of different parasitic stages. Collection, fixation, staining, whole mounts and identification of parasites. Cryopreservation of parasites, culturing techniques for important parasites and pasture larval count, worm count and assessment of worm burden. Remote sensing (RS) and geographic information system (GIS) as tools for mapping parasitic diseases.

Suggested Readings

Chaudhri SS & Gupta SK. 2003. *Manual of General Veterinary Parasitology*. International Book Distr. Co.
Durr P & Gatrell A. 2004. *GIS and Spatial Analysis in Veterinary Science*. CABI. Ministry of Aghriculture, Fisheries and Food (MAFF). 1986. *Manual of Veterinary Parasitological Laboratory Techniques*. 3rd Ed. Tech. Bull. 18, HMSO. Rathore VS & Sengar YS. 2005. *Diagnostic Parasitology*. Pointer Publ.

VPA 606 CLINICAL PARASITOLOGY 1+1 SEM - I

Objective

Collection and examination of clinical material for parasitological investigations and study of clinical cases.

Theory

UNIT-I: History, clinical signs, gross and microscopic examination of secretions and excretions of clinical cases.
UNIT-II: Collection and dispatch of material to laboratory for diagnosis.
UNIT-III: Animal sub-inoculation tests; blood and biopsy smear examination; histopathology of affected organs.

Practical

Identification, observation of parasitic stages in host tissues, excretions, secretions and associated pathological lesions.

Suggested Readings

Faust EC, Russell PF & Jung RC. 1971. *Craig and Faust's Clinical Parasitology*. Lea & Febiger.
Sloss MW, Kemp RL & Zajac AM. 1994. *Veterinary Clinical Parasitology*. Indian Ed. International Book Distr. Co.
Soulsby EJL. 1965. *Textbook of Veterinary Clinical Parasitology*. Blackwell.

VPA 607 TRENDS IN CONTROL OF LIVESTOCK AND POULTRY PARASITES 1+1 SEM - II

Objective

To learn about integrated approach for the control of helminths, arthropods and protozoan parasites of veterinary importance.

Theory

UNIT-I: Conventional and novel methods of control of helminth – anthelmintics, their mode of action, characteristic of an ideal anthelmintic, anthelmintic resistance, spectrum of activity, delivery devices, integrated control method and immunological control Formulation of deworming schedule. Snail and other intermediate host control.

UNIT-II: Conventional and novel methods of control of protozoan parasites – antiprotozoan drugs, their mode of action, integrated control method and immunological control.

UNIT-III: Conventional and novel methods of control of insects – Insecticides / acaricides - methods of application, their mode of action, insecticide resistance , integrated control method and immunological control.

Practical

In vivo and *in vitro* detection of efficacy of and resistance to parasiticidal agents.

Suggested Readings

Kaufmann J. 1996. *Parasitic Infections of Domestic Animals*. Birkhauser Verlag. Mehlhorn H (Ed). 2001. *Encyclopedic Reference of Parasitology: Diseases, Treatment, Therapy*. Springer Verlag.

VPA 608 IMMUNOPARASITOLOGY 2+1 SEM - I

Objective

To impart knowledge about the immunology, immunodiagnosis and immunoprophylaxis of ecto- and endoparasites of veterinary importance.

Theory

UNIT-I: Introduction, types of parasitic antigens and their characterization.

UNIT-II: Types of immunity in parasitic infections. Cellular and humoral immunity to parasites, hypersensitivity, regulation of the immune response.

UNIT-III: Evasion of immunity, immumomodulations and their uses.

UNIT-IV: Immune responses in helminths, arthropods and protozoa of veterinary importance.

UNIT-V: Immunodiagnostic tests and their techniques; application of biotechnological tools in the diagnosis and control of parasitic diseases.

UNIT-VI: Vaccines and vaccination against parasitic infections. UNIT-VII: Genetic control of parasites.

Practical

Preparation of various antigens (somatic, secretory and excretory) and their fractionation and characterization; raising of antisera and demonstration of various immunodiagnostic methods for the diagnosis of parasitic infections.

Suggested Readings

Behnkey JM. 1990. *Parasites, Immunity and Pathology*. Taylor & Francis.

Boothroyd JC & Komuniecki R. 1995. *Molecular Approaches to Parasitology*. Wileyliss Publication, New York.

Cohen S & Sadun EH. 1976. *Immunology of Parasitic Infections*. Blackwell. Cox FEG. 1993. *Modern Parasitology*. Blackwell.

Marr JJ, Nilsen TW & Komuniecki RW. 2003. *Molecular Medical Parasitology*. Elsevier. Waklin D. 1996. *Immunity to Parasites*. Cambridge University Press.

VPA 609 PARASITIC ZOONOSES 2+0 SEM - II

Objective

To provide the students with an in-depth knowledge of occurrence and importance of parasitic zoonoses and how these parasites are diagnosed and controlled.

Theory

UNIT-I: Introduction to the concept of zoonotic infections, definitions, various classifications of zoonoses, host-parasite relationships, modes of infections, factors influencing prevalence of zoonoses.

UNIT-II: A detailed study of transmission, epidemiology, diagnosis and control of major protozoa of zoonotic importance.

UNIT-III: A detailed study of transmission, epidemiology, diagnosis and control of major helminths of zoonotic importance.

UNIT-IV: A detailed study of transmission, epidemiology, diagnosis and control of major arthropods of zoonotic importance.

Suggested Readings

Miyazaki 1991. *Helminthic Zoonoses*. International Medical Foundation of Japan. Palmer SR, Soulsby EJL & Simpson DIH. 1998. *Zoonoses*. Oxford.

Parija SC. 1990. *Review of Parasitic Zoonoses*. AITBS Publ. Rathore VS.2005. *Parasitic Zoonoses*. Pointer Publishers.

Shakespeare M. 2002. *Zoonoses*. Pharmaceutical Press. University Press.

VPA 610 PARASITESOFZOO AND WILD ANIMALS 2+1 SEM - II

Objective

To learn about biological and control aspects of parasitic diseases of zoo and wild animals.

Theory

UNIT-I: A detailed study of major protozoa of zoo and wild animals with particular emphasis on morphological features, geographical distribution, epidemiology, diagnosis and management.

UNIT-II: A detailed study of major arthropod parasites of zoo and wild animals with particular emphasis on morphological features, geographical distribution, epidemiology, diagnosis and management.

UNIT-III: A detailed study of major helminth parasites of zoo and wild animals with particular emphasis on morphological features, geographical distribution, epidemiology, diagnosis and management.

Practical

Methods for investigating parasitic diseases in wild animals. Collection of parasites at post-mortem. Identification and quantification of parasites. Visit to Zoo and Wild Life Parks/ Sanctuaries.

Suggested Readings

Chowdhury N & Alonso Aquirre A. 2001. *Helminths of Wild Life*. Oxford & IBH Publishing Co. Pvt. Ltd.

Friend M & Franson JC. 1999. *Field Manual of Wildlife Diseases: General Field Proceduresand Diseases of Birds.* Free of charge at: www.nwhc.usgs.gov/publications/ field_manual/ field_manual_of_wildlife_ diseases.pdf

NBII Wildlife Diseases Information Node can be reached at: http://wildlifediseases.nbii.gov

Samual W, Pybus M & Kocan A. (Eds). 2001. *Parasitic Diseases of Wild Mammals*. Iowa State Univ. Press.

VPA 611 MALACOLOGY 1+1 SEM - I

Objective

To learn about the details of various snails involved in diseases transmission.

Theory

UNIT-I: Characters and classification of Mollusca.

UNIT-II: Occurrence, distribution, ecology, life history, morphology and control of vector snails belonging to families, Planorbidae, Lymnaeiidae, Thiridae, Amnicolidae, Helicidae, Succineidae and Zonitidae.

UNIT-III: Examination of vector molluscs for parasitic infections.

UNIT-IV: Haematology, internal defense mechanisms, parasite-induced pathology and molluscan tissue culture.

Practical

Collection and identification of vector molluscs, study of their shells and internal organs. Breeding, rearing and maintenance of vector molluscs in the laboratory. Examination of molluscs for various developmental stages of parasites.

Suggested Readings

Malek EA & Cheng TC. 1974. *Medical and Economic Malacology*. Academic Press. Sturm CF, Pearce TA & Valdés A. 2006. *The Mollusks: A Guide to Their Study, Collection and Preservation*. American Malacological Society, Pittsburgh and Universal Publishers, Boca Raton.

VPA 701 APPLICATIONS OF REMOTE SENSING AND GEOGRAPHIC INFORMATION SYSTEM IN PARASITOLOGY **1+2** **SEM - I**

Objective

To study the emerging applications of Remote Sensing and Geographic Information System in parasitology.

Theory

UNIT-I: Basic principles of Remote Sensing, satellite and imagery sensor systems, spectral signatures, interpretation of satellite imagery, digital image processing.

UNIT-II: Fundamentals of GIS, raster data representation, vector data representation, GIS data management, data input, editing, analysis and modeling. GIS output as maps.

UNIT-III: Integration of RS and GIS. Applications of RS and GIS in parasitology, case studies related to vector and vector-borne parasitic diseases, soil transmitted helminths.

Practical

Understanding maps and map projections, maps as models. IRS data products, visual interpretation of image, Digital image processing, contrast enhancements, spatial filtering techniques, image transformations, image classification. Applications of Remote Sensing in parasitology. Components of GIS, creation of digital database in a GIS, GIS operations, data analysis and modeling. Case studies of applications of GIS in parasitology. Application of GIS in modeling the spatial and temporal spread of parasites. Global

Positioning System (GPS), its applications and hands-on practice. Hands-on practice on RS and GIS software's like ERDAS Imagine, ArcGIS, ILWIS etc. Internet as resource for RS data products.

Suggested Readings

Selected articles from journals

VPA 702 MOLECULAR DIAGNOSTICS AND VACCINE DEVELOPMENT IN PARASITOLOGY **2+1** **SEM - II**

Objective

To understand the molecular analysis of parasites for diagnosis, disease control, drug development and vaccine production.

Theory

UNIT-I: Introduction and parasite genomics.

UNIT-II: DNA and RNA technology, Gene expression and regulation. UNIT-III: Recombinant protein production.

UNIT-IV: Hybridoma technology and its application in parasitology.

UNIT-V: Molecular diagnosis and Phylogeny. Expression of antigens and antibody fragments useful as diagnostic reagents and vaccines. Restriction Fragment Length Polymorphism (RFLP), Polymerase Chain Reaction, modified PCR and related techniques, Random Amplified Polymorphic DNA (RAPD), Nucleic acid probe and Cleavage Length Fragment Polymorphism (CFLP).

UNIT-VI: Types of immune responses produced by various parasites, novel and other antigens, proteases and cytokines in vaccine production.

UNIT-VII: Nucleic acid vaccines. Vectored parasitic vaccines.

Practical

Identification, characterization, and purification of antigens, analysis of parasite protein antigens, preparation of polyclonal antibodies. RAPD, RFLP, PCR, modified PCR and related techniques. DNA and RNA isolation protocols from blood, tissues and parasites and immuno- assays for studying the vaccine response.

Suggested Readings

Selected articles from journals.

VPA 703 HOST PARASITE INTERACTIONS 2+0 SEM - I

Objective

To understand the importance of host-parasite interactions.

Theory

UNIT-I: Introduction, distribution of parasites on/in the host, morphological specializations for life on the host.

UNIT-II: Behavioural defenses, host immune responses and genetic resistance to parasites.

UNIT-III: Establishment of parasites in immuno-competent, susceptible, intermediate and abnormal hosts, chronicity of parasitic infections, immuno-evasive strategies of the parasites, host-parasite equilibrium.

UNIT-IV: Pathology of host parasite interactions, host parasite interactions in relation to malnutrition and micronutrient metabolism.

Suggested Readings

Selected articles from journals.

VPA 704 ADVANCES IN PROTOZOOLOGY 2+1 SEM - II

Objective

To discuss the latest scientific developments on various aspects of protozoan parasites.

Theory

UNIT-I: Advanced studies on taxonomy, molecular biology, pathogenesis, immunology and serology of intestinal protozoa.

UNIT-II: Advanced studies on taxonomy, molecular biology, pathogenesis, immunology and serology of haemoprotozoans.

UNIT-III: Advanced studies on taxonomy, molecular biology, pathogenesis, immunology and serology of tissue and other protozoa

Practical

Morphological, pathological and immunodiagnostic studies on various protozoan parasites.

Suggested Readings

Selected articles from journals.

VPA 705 ADVANCES IN HELMINTHOLOGY – I 2+1 SEM - I

Objective

To discuss the latest scientific developments on various aspects of trematodes and cestodes.

Theory

UNIT-I: Advanced studies on taxonomy, molecular biology, pathogenesis, immunology and serology of trematodes and their larval stages.

UNIT-II: Advanced studies on taxonomy, molecular biology, pathogenesis, immunology and serology of cestodes and metacestodes.

Practical

Morphological, pathological and immunodiagnostic studies on various trematodes and cestodes.

Suggested Readings

Selected articles from journals.

VPA 706 ADVANCES IN HELMINTHOLOGY – II 2+1 SEM - II

Objective

To discuss the latest scientific developments on various aspects of nematodes and thorny- headed worms.

Theory

UNIT-I: Advanced studies on taxonomy, molecular biology, pathogenesis, immunology and serology of nematodes and their larval stages.

UNIT-II: Advanced studies on taxonomy, molecular biology, pathogenesis, immunology and serology of thorny-headed worms.

Practical

Morphological, pathological and immunodiagnostic studies on various nematodes and thorny-headed worms.

Suggested Readings

Selected articles from journals.

VPA 707 ADVANCES IN ENTOMOLOGY AND ACAROLOGY 2+1 SEM - I

Objective

To discuss latest scientific developments on various aspects of arthropods.

Theory

UNIT-I: Origin, evolution, regional and seasonal distribution, forecasting insect and acarine population through biological modelling.

UNIT-II: Population dynamics of insects and acarines in relation to biotic and abiotic factors.

UNIT-III: Recent developments pertaining to insects of veterinary importance. UNIT-IV: Recent developments pertaining to arachnids of veterinary importance.

UNIT-V: Chemical, biological, immunological control measures and in-depth study of integrated pest management. Modulation of vector competence to transmit parasitic infections using molecular genetics by developing transgenic vectors.

Practical

Identification of arthropods of veterinary importance in the region. Dissection of arthropods for recovery of infective stages of parasites. Immunopathological changes in the host tissues due to haemato-phagous arthropods.

Suggested Readings

Selected articles from journals.

VPA 708 *IN VITRO* CULTIVATION OF PARASITES 1+2 SEM - II

Objective

Development of skills for cultivation of various parasites in the laboratory for research and practical control.

Theory

UNIT-I: Introduction, problems and goals.

UNIT-II: *In vitro* cultivation of genital flagellates, intestinal flagellates and intestinal ciliates.

UNIT-III: *In vitro* cultivation of intestinal and tissue protozoa. UNIT-IV: *In vitro* cultivation of haemoprotozoans.

UNIT-V: *In vitro* techniques, media and tissue culture for cultivation of helminths and their larval stages.

UNIT-VI: *In vitro* mass rearing and colonization of ticks, flies and other insects**.**

Practical

Preparation of media and cultivation of important parasites, raising and maintenance of cell-lines of important parasites.

Suggested Readings

Selected articles from journals.

VPA 709 EMERGING AND RE-EMERGING PARASITIC DISEASES 2+0 SEM - II

Objective

To study the emerging and re-emerging parasitic diseases.

Theory

UNIT-I: Emerging and re-emerging helminthic diseases. UNIT-II: Emerging and re-emerging protozoan diseases. UNIT-III: Emerging and re-emerging vector-borne diseases.

Suggested Readings

Selected articles from journals.

VPA 710 BIONOMICS OF PARASITES 3+0 SEM - I

Objective

To study ultrastructure, physiology, biochemistry and bionomics of important parasites.

Theory

UNIT-I: Ultrastructure, physiology, biochemistry and bionomics of trematodes and cestodes of veterinary importance.

UNIT-II: Ultrastructure, physiology, biochemistry and bionomics of nematodes of veterinary importance.

UNIT-III: Ultrastructure, physiology, biochemistry and bionomics of important arthropod parasites.

UNIT-IV: Ultrastructure, physiology, biochemistry and bionomics of important protozoan parasites.

Suggested Readings

Selected articles from journals.

VPA 711 ENVIRONMENTAL PARASITOLOGY 1+1 SEM - I

Objective

To study the effect of environmental changes and ecological disturbances on the emergence, proliferation and transmission of parasitic diseases.

Theory

UNIT-I: Environmental changes and ecological disturbances due to natural phenomenon and human interventions (demographic, societal and agricultural changes, global warming, floods, hurricanes and pollution etc.).

UNIT-II: Effect of environmental changes and ecological disturbances on the proliferation and transmission of helminthic diseases.

UNIT-III: Effect of environmental changes and ecological disturbances on the proliferation and transmission of protozoan diseases.

UNIT-IV: Effect of environmental changes and ecological disturbances on the proliferation of intermediate hosts and vectors and their role in transmission of diseases.

Practical

Examination of water, soil, meat and vegetables etc. to record the contamination with parasites due to environmental changes. Assessment of effect of temperature and humidity on the development of parasites. Use of Process-based (mathematical) models to express the scientifically documented relationship between climatic variables and

biological parameters e.g., vector breeding, survival and biting rates; parasite incubation rates.

Suggested Readings

Selected articles from journals.

VPA 790 SPECIAL PROBLEM 0+2 SEM - I, II

Objective

To provide expertise in handling practical research problem(s).

Practical

Short research problem(s) involving contemporary issues and research techniques.

VETERINARY PARASITOLOGY
List of Journals

- Advances in Parasitology
- Experimental Parasitology
- International Journal for Parasitology
- Journal of Helminthology
- Journal of Parasitic Diseases
- Journal of Protozoology
- Journal of Protozoology Research
- Journal of Veterinary Parasitology
- Medical and Veterinary Entomology
- Parasitology
- Parasitology International
- Trends in Parasitology
- Veterinary Parasitology

e-Resources

- http://www.sciencedirect.com/science/journal/03044017 (Veterinary. Parasitology)
- http://www.sciencedirect.com/science/journal/14714922 (Trends in Parasitology)
- http://www.sciencedirect.com/science/journal/00207519 (International Journal for Parasitology)
- http://www.sciencedirect.com/science/journal/13835769 (Parasitology International)
- http://www.sciencedirect.com/science/journal/00144894(Experimental Parasitology)
- http://journals. Cambridge.org (Parasitology)
- http://asp.unl.edu (Journal of Parasitology)
- http://www.bentham.org/open/toparaj (The open Parasitology Journal)
- http://www.springer.com/biomed/medical+microbiology)Journal/436 (Parasitology Research)
- http://parasitologyindia.org (Journal of Parasitic Diseases)
- http://www.waap.org (World Assoc. for Advancement of Vety. Parasitology)

Suggested Broad Topics for Master's and Doctoral Research

- Detection and management of antiparasitic drug resistance.
- Studies on the efficacy of medicinal plants/herbal preparations against various parasites affecting domestic animals and poultry and the effect of these plants on pathogenicity and immunology of parasites
- Development of immunoprophylactic measures and immunodiagnostic techniques using modern molecular and biotechnological based tools for important parasitic diseases prevalent in the state
- Application of remote sensing and GIS for the management of parasitic diseases.
- Studies on application of host's resistance as a part of integrated parasite management programme.

VETERINARY PATHOLOGY

Course Structure

COURSE NO.	COURSE TITLE	CREDITS	SEM
VPP 601	GENERAL PATHOLOGY	2+1	I
VPP 602	TECHNIQUES IN PATHOLOGY	1+1	I
VPP 603	ANIMAL ONCOLOGY	1+1	I
VPP 604	CLINICAL PATHOLOGY	1+2	I
VPP 605	NECROPSY PROCEDURES AND INTERPRETATIONS - I	0+1	I
VPP 606	NECROPSY PROCEDURES AND INTERPRETATIONS - II	0+1	II
VPP 607	SYSTEMIC PATHOLOGY	2+1	II
VPP 608	PATHOLOGY OF INFECTIOUS DISEASES OF DOMESTIC ANIMALS	2+1	II
VPP 609	TOXICOPATHOLOGY	2+1	II
VPP 610	AVIAN PATHOLOGY	2+1	I
VPP 611	PATHOLOGY OF LABORATORY ANIMALS, FISH AND WILD ANIMALS	2+1	II
VPP 612	VETEROLEGAL PATHOLOGY	1+0	II
VPP 691	MASTER'S SEMINAR	1	I, II
VPP 699	MASTER'S RESEARCH	20	I, II
VPP 701	PATHOLOGY OF NUTRITIONAL AND METABOLIC DISTURBANCES	2+1	I
VPP 702	ADVANCES IN TOXICOPATHOLOGY	2+1	I
VPP 703	ADVANCES IN DIAGNOSTIC PATHOLOGY	1+2	I
VPP 704	ULTRASTRUCTURAL PATHOLOGY	1+1	II
VPP 705	IMMUNOPATHOLOGY	2+1	II
VPP 706	PATHOLOGY OF IMPORTANT AND EMERGING DISEASES OF PETS AND LIVESTOCK	1+1	II
VPP 707	ADVANCES IN AVIAN PATHOLOGY	2+1	I
VPP 708	PATHOLOGY OF FUNGAL DISEASES	2+1	II
VPP 709	MOLECULAR PATHOLOGY OF CELL INJURY	2+1	II
VPP 710	EXPERIMENTAL PATHOLOGY	1+1	I
VPP 790	SPECIAL PROBLEM	0+2	I, II
VPP 791	DOCTORAL SEMINAR I	1	I, II
VPP 792	DOCTORAL SEMINAR II	1	I, II
VPP 799	DOCTORAL RESEARCH	45	I, II

VETERINARY PATHOLOGY
Course Contents

VPP 601 GENERAL PATHOLOGY 2+1 SEM - I

Objective

To acquaint students with different types of degenerations, cell injuries caused by different types of irritants and inflammation.

Theory

UNIT-I: Introduction and history of pathology, principles of pathology including etiology, course and termination of disease.

UNIT-II: Advanced study of various degenerations, infiltrations, necrosis, endogenous and exogenous pigmentations.

UNIT-III: Circulatory and growth disturbances. Reversible and irreversible cell injury. UNIT-IV: Inflammation including vascular and cellular alterations with emphasis on chemical mediators. Hypersentivity and immune mediated mechanisms, Mechanism of healing and fever.

Practical

To study the gross and microscopic changes in degenerations, infiltrations, pigmentations, circulatory and growth disturbances and different types of necrosis in different tissues of domestic animals. Study of gross and histopathological features of different types of inflammation.

Suggested Readings

McGavin MD & Zachary JF. 2006. *Pathologic Basis of Veterinary Diseases*. 4th Ed. Elsevier.

Vegad JL. 2007. *Text Book of Veterinary General Pathology*. 2nd Ed. International Book Distr.

VPP 602 TECHNIQUES IN PATHOLOGY 1+1 SEM - I

Objective

To acquaint students with different techniques used frequently in Veterinary Pathology.

Theory

UNIT-I: Basic histopathological techniques, collection of tissues, fixation, processing and section cutting, staining by routine and special methods.

UNIT-II: Principles of dark ground, phase contrast and fluorescent microscopy and micrometry.

UNIT-III: Histochemical techniques for demonstration of fat, glycogen and fibrous connective tissue, mucopolysaccharides and common enzymes.

Practical

Collection of tissues for histopathological, histochemical, toxic, bacterial and viral examination. Use of different fixatives for preservation of museum specimens. Application of different techniques- histopathological, cryosectioning, micrometry, routine and special staining. Demonstration of different inclusions, bacteria and fungi in tissues. Histochemical techniques to demonstrate different tissue constituents.

Suggested Readings

Culling CFA. 1969. *Handbook of Histological Techniques*. Butterworths.

Lillie RD. 1965. *Histopathologic Techniques and Practical Histo-chemistry*. 3rd Ed. McGraw-Hill.

VPP 603 ANIMAL ONCOLOGY 1+1 SEM - I

Objective

To acquaint students with different types of neoplasms of domestic animals, their nature, cause, pathology and diagnosis.

Theory

UNIT-I: Study of different neoplasms of animals including their identification, and epidemiology.

UNIT-II: Etiology, histogenesis and experimental production.

UNIT-III: Tumour immunology, cell cultures, transplantation and biological behaviour.

Practical

To study the gross and microscopic changes in different types of neoplasms.

Suggested Readings

Meuten DJ. 2002. *Tumors in Domestic Animals*. 4th Ed. Blackwell.

VPP 604 CLINICAL PATHOLOGY 1+2 SEM - I

Objective

To acquaint students with clinical alterations in blood, urine, CSF and other body fluids due to different diseases.

Theory

UNIT-I: Study of changes in blood, urine, faeces, cerebrospinal fluid and biopsy specimens and their interpretation.

UNIT-II: Exfoliative cytology, organ function tests and their interpretation.

UNIT-III: Biochemical profile of blood/plasma/serum and its correlation with disease conditions in domestic animals.

Practical

Evaluation of laboratory investigations on blood, urine, faeces and biopsy specimens from natural and experimentally produced disease conditions.

Suggested Readings

Benzamin MM. 1978. *Outline of Veterinary Clinical Pathology*. 3rd Ed. Iowa State Univ. Press.

Coles EH. 1967. *Veterinary Clinical Pathology*. WB Saunders.

VPP 605 NECROPSY PROCEDURES AND INTERPRETATIONS - I 0+1 SEM - I

Objective

To acquaint students with different Post-mortem procedures in large animals and study of PM lesions in different diseases.

Practical

Detailed necropsy examination of various species of farm animals, laboratory animals and wildlife. Necropsy case presentation and report writing/protocol preparation. Collection of specimens for diagnosis of viral, bacterial, protozoan, parasitic diseases, toxic/ poisoning and for histochemistry/histopathology. Systemic examination of brain, lungs, heart, endocrine glands, lymph nodes, liver, Gastro Intestinal tract, urinary and genital systems for gross pathological and histopathological studies and correlation of the observations to diagnose the disease conditions.

Suggested Readings

Jones TC & Gleiser CA. 1954. *Veterinary Necropsy Procedures*. JB Lippincott.

VPP 606 NECROPSY PROCEDURES AND INTERPRETATIONS - II 0+1 SEM - II

Objective

To acquaint students with different Post-mortem procedures in small animals and poultry and study of PM lesions in different diseases.

Practical

Detailed necropsy examination of various species of small animals, poultry, laboratory animals and wildlife. Necropsy case presentation and report writing/protocol preparation. Collection of specimens for diagnosis of viral, bacterial, protozoan, parasitic diseases, toxic/poisoning and for histochemistry/histopathology. Systemic examination of brain, lungs, heart, endocrine glands, lymph nodes, liver, Gastro Intestinal tract, urinary and genital systems for gross pathological and histopathological studies and correlation of the observations to diagnose the disease conditions.

Suggested Readings

Jones TC & Gleiser CA. 1954. *Veterinary Necropsy Procedures*. JB Lippincott.

VPP 607 SYSTEMIC PATHOLOGY 2+1 SEM - II

Objective

To teach the students about the different disease conditions of haemopoietic, circulatory, respiratory, digestive, urinary and genital systems, nervous, musculoskeletal, endocrine, glands and special senses.

Theory

UNIT-I: Advanced study of pathological conditions affecting different organs of haemopoietic (bone marrow, blood, spleen, lymph node), circulatory (heart, blood vessels and lymph vessels). Respiratory (nasal cavity, larynx, trachea, bronchi, lung and pleura) systems. Study of etiology, pathology and pathogenesis of specific infectious and non-infectious diseases of domestic animals related to the above mentioned systems.

UNIT-II: Advanced study of pathological conditions affecting different organs of digestive (buccal cavity, pharynx, oesophagus, stomach and intestines) urinary (kidneys, ureter, urinary bladder and urethra) and genital (male and female organs including mammary gland) systems. Study of etiology, pathology and pathogenesis of specific infectious and non-infectious diseases of domestic animals related to the above mentioned systems.

UNIT-III: Advanced study of pathological conditions affecting different organs of nervous (brain and spinal cord), endocrine (pituitary, thyroid, parathyroid, pancreas), musculo-skeletal systems (muscles and bones), and organs of special senses (eye, ear), skin and its appendages (hoof, tail). Study of etiology, pathology and pathogenesis of specific infectious and non- infectious diseases of domestic animals related to the above mentioned systems/organs

Practical

To study the gross and histopathological changes in important conditions affecting various systems. Study of gross and microscopic lesions in specific diseases pertaining to above said systems.

Suggested Readings

Jubb KVF & Kennedy PC. 2005. *Pathology of Domestic Animals*. Academic Press.

VPP 608 PATHOLOGY OF INFECTIOUS DISEASES OF DOMESTIC ANIMALS 2+1 SEM - II

Objective

To teach the students about the important infectious disease conditions of domestic animals.

Theory

UNIT-I: Pathology of various viral diseases of domestic animals.

UNIT-II: Pathology of various bacterial and fungal diseases of domestic animals. UNIT-III: Pathology of various rickettsial and parasitic diseases of domestic animals.

Practical

To study the slides, museum specimens including autopsy specimens concerned with specific diseases.

Suggested Readings

Jones TC, Hunt RD & King NW 1997. *Veterinary Pathology*. Blackwell Publishing. Jubb KVF & Kennedy PC 2005. *Pathology of Domestic Animals*. Academic Press.

VPP 609 TOXICOPATHOLOGY 2+1 SEM - II

Objective

To teach students about toxicity in livestock due to plants and extraneous poisons.

Theory

UNIT-I: Introduction, mode of action, diagnosis and treatment of different poisons and their classification.

UNIT-II: Pathogenesis, gross and microscopic pathology of diseases caused by toxic plants, organic and inorganic poisons commonly taken or administered maliciously to different species of domestic animals.

Practical

To study gross and histopathological alterations as a result of ingestion of toxic plants and extraneous poisons in domestic animals.

Suggested Readings

Jones TC, Hunt RD & King NW 1997. *Veterinary Pathology*. Blackwell Publishing.

VPP 610 AVIAN PATHOLOGY 2+1 SEM - I

Objective

To teach the students about the different disease conditions of poultry including pathology and diagnosis.

Theory

UNIT-I: Pathology of infectious diseases of chickens, turkeys, ducks and other birds. UNIT-II: Pathology of non-infectious diseases of chickens, turkeys, ducks and other birds.

Practical

Necropsy examination of the different species of poultry; study of gross and histopathological lesions in naturally occurring and artificially produced diseases of birds.

Suggested Readings

Calnek BW. 1991. *Diseases of Poultry*. 9th Ed. Iowa State Univ. Press.

Saif YM, Barnes FJ, Glisson JR, Fadly AM, Mc Dougald LR & Swayne D. 2008. *Diseases of Poultry*. 11th Ed. Blackwell Publishing.

VPP 611 PATHOLOGY OF LABORATORY ANIMALS, FISH AND WILD ANIMALS 2+1 SEM - II

Objective

To teach the pathology and diagnosis of different disease conditions of laboratory animals, fish and wild animals.

Theory

UNIT-I: Introduction, disease transmission and inter-phase.

UNIT-II: Pathology of important infectious diseases (viz. bacterial, viral, fungal and parasitic) of fish, laboratory and wild/zoo animals.

UNIT-III: Pathology of non-infectious diseases of fish, lab/ wild/zoo animals.

Practical

Post-mortem examination of wild animals including wild birds. Study of gross and microscopic lesions of important infectious and non - infectious diseases of fish and laboratory animals.

Suggested Readings

Arora BM. 1984. *Wildlife Diseases in India*. Periodical Expert Book Agency.

Beninchka K, Garner FM & Jones TC. 1978. *Pathology of Laboratory Animals.* Vols. I, II. Springer Verlag.

Fowler ME. 1978. *Zoo and Wild Animal Medicine*. WB Saunders. Roberts RJ. 1979. *Fish Pathology*. Bailliere Tindall, London.

VPP 612 VETEROLEGAL PATHOLOGY 1+0 SEM - II

Objective

To educate the students about common veterolegal problems and legal writing of PM report.

Theory

UNIT-I: General knowledge about the laws relating to veterinary practice, professional discipline and professional etiquettes.

UNIT-II: Regulations dealing with diseases of animals in India regarding epidemiology, quarantine certificate, issue of soundness certificate etc.

UNIT-III: Common causes of violent death, criminal assault, cruelty to animals, malicious poisoning, snake bite, electrocution, gun shot wounds, automobile accidents, doping etc.

Suggested Readings

Gahlot AK, Sharma SN & Tanwar RA. 2003. *Veterinary Jurisprudence*. 5th Ed. NBS Publishers, Bikaner.

Jones TC & Gleiser CA. 1954. *Veterinary Necropsy Procedures*. JB Lippincott. Lincoln PJ & Thomson J. 1998. *Forensic DNA Profiling Protocols*. Humana Press. Rudin N & Inman K. 2002. *An Introduction to Forensic DNA Analysis*. CRC Press.

VPP 701 PATHOLOGY OF NUTRITIONAL AND METABOLIC DISTURBANCES 2+1 SEM - I

Objective

To teach students about nutritional and metabolic disorders of livestock.

Theory

UNIT-I: Pathogenesis, gross and microscopic pathology of nutritional deficiencies viz. carbohydrate, protein, fats, vitamins and macro and microelements and their imbalances. UNIT-II: Different metabolic diseases namely milk fever, ketosis, tetany, azoturia. Downer's cow syndrome and post parturient hemoglobinuria in domestic animals.

Practical

Estimation of certain minerals in sera of natural and experimentally induced deficiencies in domestic animals. To study the haematological, gross and microscopic pathological alterations caused by nutritional and metabolic disorders.

Suggested Readings

Selected articles from journals.

VPP 702 ADVANCES IN TOXICOPATHOLOGY 2+1 SEM - I

Objective

To teach students about toxicity in livestock due to plants and extraneous poisons.

Theory

UNIT-I: Introduction, mode of action, diagnosis and treatment of different poisons and their classification. Experimental animal models for toxicity studies and evaluation of parameters.

UNIT-II: Pathogenesis, gross and microscopic pathology of diseases caused by toxic plants, organic and inorganic poisons commonly taken or administered maliciously to different species of domestic animals.

Practical

Clinico-pathological studies on natural or experimentally induced toxicity /poisoning in domestic animals. To study gross and histopathological alterations as a result of ingestion of toxic plants and extraneous poisons in domestic animals.

Suggested Readings

Selected articles from journals.

VPP 703 ADVANCESINDIAGNOSTICPATHOLOGY 1+2 SEM - I

Objective

To teach current diagnostic techniques for diagnosis of different diseases.

Theory

UNIT-I: Study of the principles of biopsy techniques and electron microscopy. UNIT-II: Current techniques for diagnosis of diseases.

Practical

Principles and practice of fluorescent and phase contrast microscopy, chromatography, spectrophotometery and immunodiffusion technique, use of laboratory animals, chick embryos etc. for the diagnosis of animal diseases.

Suggested Readings

Selected articles from journals.

VPP 704 ULTRASTRUCTURAL PATHOLOGY 1+1 SEM - II

Objective

To study the significance of ultra-structural changes in organelles.

Theory

UNIT-I: Study of cells- cell morphology, interpretation of normal and abnormal cells. UNIT-II: Study of cell organelles, degenerations, infiltrations, viral inclusions.

Practical

Study of EM photographs, collection and preparation of specimens for EM studies.

Suggested Readings

Selected articles from journals.

VPP 705 IMMUNOPATHOLOGY 2+1 SEM - II

Objective

To teach students immunologically mediated and autoimmune diseases of livestock.

Theory

UNIT-I: Principles of immunopathology, hypersensitivity status, pathology of immune complex diseases.

UNIT-II: Immunoproliferative disorders, autoimmune diseases and immune deficiencies in man and domestic animals.

Practical

Immune complexes, quantification and determination by various techniques, enumeration of various populations of lymphocytes by different techniques, determination of C3 levels, autoimmune reaction by demonstrating autoantibodies, hypersensitivity reactions (class IV and others).

Suggested Readings

Selected articles from journals.

VPP 706 PATHOLOGY OF IMPORTANT AND EMERGING DISEASES OF PETS AND LIVESTOCK 1+1 SEM - II

Objective

To teach students important and emerging diseases of pets and livestock.

Theory

UNIT-I: Introduction to emerging diseases, foot and mouth disease, vesicular stomatitis, vesicular exanthema, rinderpest/Peste des petits ruminants, para influenza -3, infectious bovine rhinotracheitis/infectious pustular vulvovaginitis, bovine spongiform encephalopathy, scrapie, blue tongue, malignant catarrhal fever, mucosal disease/bovine viral diarrhoea, bovine leucosis.

UNIT-II: Tuberculosis/Johne's disease, brucellosis, listeriosis, caprine arthritis, campytobacteriosis, encephalitis, parvovirus infection, emerging diseases of pets.

Practical

Study of clinical and gross alterations and histopathology of some important emerging and enzootic diseases.

Suggested Readings

Selected articles from journals.

VPP 707 ADVANCES IN AVIAN PATHOLOGY 2+1 SEM - I

Objective

To teach different diagnostic techniques for diagnosis of different avian diseases.

Theory

UNIT-I: Advances in pathogenesis and pathology including molecular basis of important infections (bacterial, viral, fungal and parasitic).

UNIT-II: Non-infectious diseases with particular emphasis on emerging diseases of chickens, turkeys, ducks and other birds.

Practical

Necropsy examination of different species of poultry. Study of gross and microscopic lesions in natural and experimentally produced diseases in different species of birds. Diagnosis of different diseases of poultry.

Suggested Readings

Selected articles from journals.

VPP 708 PATHOLOGY OF FUNGAL DISEASES 2+1 SEM - II

Objective

To teach the diseases caused by different fungi and mycotoxins in animals.

Theory

UNIT-I: Pathology of diseases associated with pathogenic fungi like aspergillosis, candidiasis, epizootic lymphangitis, histoplasmosis, coccidioidomycosis, cryptococcosis, bovine abortions, dermatophytomycosis etc.

UNIT-II: Diseases associated with mycotoxins like aflatoxins, rubratoxin, T2 toxin, ochratoxin etc. Metabolism of toxins and their effect in man, domestic and laboratory animals, poultry and aquatic species.

Practical

Demonstration of pathogenic mycotoxic fungi, chemistry of toxic compounds, physical and chemical properties, methods of extraction, isolation and identification of mycotoxins.

Suggested Readings

Selected articles from journals.

VPP 709 MOLECULAR PATHOLOGY OF CELLINJURY 2+1 SEM - II

Objective

To acquaint the students about the molecular basis of cell injury and inflammation.

Theory

UNIT-I: Causes of cell injury - Ischemic, Hypoxic, Free radicals, virus and chemical cell injury - Chemical Mediators - Cytoskeletal and biochemical changes in cell injury.

UNIT-II: Ultrastructural changes and biochemical mechanisms of reversible injury, necrosis, apoptosis. Molecular basis of disease. Cellular adaptation- hyperplasia, hypertrophy, atrophy, metaplasia and dysplasia. Intracellular accumulations.

UNIT-III: Inflammation- mechanism and types. Tissue repair and healing.

Practical

Gross and histopathological studies pertaining to above conditions.

Suggested Readings

Selected articles from journals.

VPP 710 EXPERIMENTAL PATHOLOGY 1+1 SEM - I

Objective

To provide expertise in designing the experiments and handling of animals.

Theory

UNIT-I: Need for experimentation in research, animal experimentation techniques, preparation of experimental protocols, biochemical studies, pathological examination of clinical samples.

UNIT-II: Transplantation techniques, immune regulation, tissue culture, blood cell separation protocols, electrophoresis and chromatography, study of animal model and designing of experiment.

Practical

Short research problems involving contemporary issues and research techniques.

Suggested Readings

Selected articles from journals.

VPP 790 SPECIAL PROBLEM 0+2 SEM - I, II

Objective

To provide expertise in handling practical research problem(s).

Practical

Short research problem(s) involving contemporary issues and research techniques.

VETERINARY PATHOLOGY
List of Journals

- Advances in Veterinary Sciences
- American Journal of Veterinary Medical Association
- Avian Diseases
- Current Contents
- Indian Journal of Animal Sciences
- Indian Journal of Poultry Science
- Indian Journal of Veterinary Pathology
- Journal of Immunology and Immunopathology
- Veterinary Bulletin
- Veterinary Pathology

e-Resources

- www.iavp.org (Indian Journal of Veterinary Pathology)
- www.vetpathology.org (Veterinary Pathology)
- www.tandf.co.uk (Avian Pathology)
- www.avdi.allenpress.com (Avian Diseases)
- www.elsevier.com/locate/vetimm (Veterinary Immunology and Immuno- pathology)

Suggested Broad Topics for M aster's and Doctoral Research

- Effect of probiotics on pathogenesis and pathology of bacterial diseases
- Effect of antioxidants on pathogenesis and pathology of bacterial diseases
- Pathology of mixed infections in domestic animals
- Role of stress in pathogenesis and pathology of animal diseases

VETERINARY PHARMACOLOGY AND TOXICOLOGY

Course Structure

COURSE NO.	COURSE ITLE	CREDITS	SEM
VPT 601	GENERAL PHARMACOLOGY	2+0	I
VPT 602	AUTONOMIC AND AUTACOID PHARMACOLOGY	2+1	I
VPT 603	CNS PHARMACOLOGY	2+1	II
VPT 604	DIGESTIVE AND RESPIRATORY PHARMACOLOGY	2+0	I
VPT 605	CARDIOVASCULAR AND RENAL PHARMACOLOGY	2+0	I
VPT 606	ENDOCRINE AND REPRODUCTIVE PHARMACOLOGY	2+0	II
VPT 607	CHEMOTHERAPY	2+1	I
VPT 608	TOXICOLOGY OF XENOBIOTICS	2+1	I
VPT 609	TOXICOLOGY OF PLANTS AND TOXINS	2+0	II
VPT 610	PHARMACOLOGICAL TECHNIQUES	1+1	I
VPT 611	TECHNIQUES IN TOXICOLOGY	1+1	II
VPT 612	ETHNOPHARMACOLOGY	2+0	II
VPT 691	MASTER'S SEMINAR	1	I, II
VPT 699	MASTER'S RESEARCH	20	I, II
VPT 701	ADVANCES IN NEUROPHARMACOLOGY	2+0	I
VPT 702	AUTACOID PHARMACOLOGY	1+0	II
VPT 703	PHARMACOLOGY OF HERBAL DRUGS	2+1	I
VPT 704	DRUG METABOLISM	2+0	II
VPT 705	MOLECULAR PHARMACOLOGY	2+0	I
VPT 706	PHARMACOKINETICS	2+1	I
VPT 707	PHARMACOGENOMICS	2+0	II
VPT 708	IMMUNOPHARMACOLOGY	1+0	I
VPT 709	MOLECULAR TOXICOLOGY	2+0	II
VPT 710	CLINICAL PHARMACOLOGY	1+1	I
VPT 711	CLINICAL TOXICOLOGY	2+1	II
VPT 712	ECOTOXICOLOGY	2+0	I
VPT 713	REGULATORY TOXICOLOGY	2+1	II
VPT 790	SPECIAL PROBLEM	0+2	I, II
VPT 791	DOCTORAL SEMINAR I	I	I, II
VPT 792	DOCTORAL SEMINAR II	I	I, II
VPT 799	DOCTORAL RESEARCH	45	I, II

VETERINARY PHARMACOLOGY AND TOXICOLOGY
Course Contents

VPT 601 GENERAL PHARMACOLOGY 2+0 SEM - I

Objective

To study the scope of pharmacology and to understand the basic mechanisms of drug actions and its effects.

Theory

UNIT-I: History and scope of pharmacology, Principles of drug absorption, distribution, metabolism and elimination. Drug bioavailability and routes of administration.

UNIT-II: Important pharmacokinetic parameters and their clinical significance.

UNIT-III: Pharmacodynamics: mechanism of action and the relationship between drug concentration and effect; signal transduction mechanism and drug receptors for physiological regulatory molecules.

UNIT-IV: Quantitation of drug-receptor interactions and elicited effects. Competitive and non-competitive antagonism. Factors affecting drug response. Adverse drug reactions.

Suggested Readings

Brunton LL. (Ed). 2005. *Goodman and Gilman's The Pharmacological Basis of Therapeutics*.11th Ed. McGraw-Hill.

Richard AH. (Ed). 2001. *Veterinary Pharmacology and Therapeutics*. 8th Ed. Iowa State Univ. Press.

Sandhu HS & Rampal S. 2006. *Essentials of Veterinary Pharmacology and Therapeutics*. 1st Ed. Kalyani Publishers.

VPT 602 AUTONOMIC AND AUTACOID PHARMACOLOGY 2+1 SEM - I

Objective

To study the pharmacodynamics of autonomic drugs.

Theory

UNIT-I: Anatomical and physiological considerations of autonomic nervous system (ANS).

UNIT-II: Neurohumoral transmission in ANS.

UNIT-III: Pharmacology of cholinergic agonists and antagonists. UNIT-IV: Pharmacology of adrenergic agonists and antagonists. UNIT-V: Ganglionic stimulants and blockers.

UNIT-VI: Autacoids: Histamine, serotonin, kinins, eicosanoids and platelet activating factor.

Practical

Pharmacological experiments on intact and isolated preparations for studying the effects of various prototype drugs on vascular, intestinal, respiratory, urinary and reproductive smooth muscles, autonomic ganglia, skeletal muscles; blood pressure, ECG, heart etc.

Suggested Readings

Brunton LL. (Ed). 2005. *Goodman and Gilman's The Pharmacological Basis of Therapeutics*.11th Ed. McGraw-Hill.

Richard AH. (Ed). 2001. *Veterinary Pharmacology and Therapeutics*. 8th Ed. Iowa State Univ. Press.

Sandhu HS & Rampal S. 2006. *Essentials of Veterinary Pharmacology and Therapeutics*. 1st Ed. Kalyani Publishers.

VPT 603 CNS PHARMACOLOGY 2+1 SEM - II

Objective

To study the pharmacodynamics of drugs acting on CNS.

Theory

UNIT-I: Anatomical and physiological considerations of central nervous system (CNS); neurohumoral transmission in CNS.

UNIT-II: Historical development, theories, principles and stages of general anaesthesia. UNIT-

III: Pharmacology of anaesthetics, sedatives, hypnotics, neuroleptics, antiepileptics. UNIT-IV: CNS stimulants, analeptics, opioid agonists and antagonists; non-steroidal anti-inflammatory agents, central and peripheral muscle relaxants, local anaesthetics, therapeutic gases. euthanizing agents. Doping.

Practical

Study of pharmacodynamics of prototype drugs of each group in experimental animals.

Suggested Readings

Brunton LL. (Ed). 2005. *Goodman and Gilman's The Pharmacological Basis of Therapeutics*.11th Ed. McGraw-Hill.

Richard AH. (Ed). 2001. *Veterinary Pharmacology and Therapeutics*. 8th Ed. Iowa State Univ. Press.

Sandhu HS & Rampal S. 2006. *Essentials of Veterinary Pharmacology and Therapeutics*. 1st Ed. Kalyani Publishers.

VPT 604 DIGESTIVE AND RESPIRATORY PHARMACOLOGY 2+0 SEM - I

Objective

To study the pharmacological aspects of drugs acting on digestive and respiratory systems.

Theory

UNIT-I: Pharmacology of drugs acting on gastrointestinal tract. Appetite stimulants, emetics and anti-emetics.

UNIT-II: Anti-ulcer drugs, modulators of gastric and intestinal motility and secretions. UNIT-III: Gastrointestinal protectants and adsorbents, laxatives and cathartics.

UNIT-IV: Agents promoting digestive functions; bile acids and pancreatic enzymes, drugs affecting liver; rumen pharmacology.

UNIT-V: Pharmacology of drugs acting on respiratory system: pathogenesis of inflammatory respiratory diseases.

UNIT-VI: Bronchodilators, antitussives, mucolytics, expectorants, decongestants. UNIT-VII: Drugs used in treatment of asthma.

Suggested Readings

Brunton LL. (Ed). 2005. *Goodman and Gilman's The Pharmacological Basis of Therapeutics*.11th Ed. McGraw-Hill.

Richard AH. (Ed). 2001. *Veterinary Pharmacology and Therapeutics*. 8th Ed. Iowa State Univ. Press.

Sandhu HS and Rampal S. 2006. *Essentials of Veterinary Pharmacology and Therapeutics*. 1st Ed. Kalyani Publishers.

VPT 605 CARDIOVASCULAR AND RENAL PHARMACOLOGY 2+0 SEM - I

Objective

To study the pharmacological aspects of drugs acting on CVS and kidneys.

Theory

UNIT-I: Pharmacology of cardiac glycosides.

UNIT-II: Antiarrhythmic, antihypertensive and antihyperlipidaemic drugs.

UNIT-III: Drugs affecting vasomotor and cardiorespiratory reflex mechanisms and haemopoietic system.

UNIT-IV: Coagulants and anticoagulants, thrombolytic agents.

UNIT-V: Pharmacology of drugs affecting renal functions and fluid-electrolyte balance. UNIT-VI: Fluid and electrolyte therapy, diuretics, antidiuretics, uricosuric drugs.

Suggested Readings

Brunton LL. (Ed). 2005. *Goodman and Gilman's The Pharmacological Basis of Therapeutics*.11th Ed. McGraw-Hill.

Richard AH. (Ed). 2001. *Veterinary Pharmacology and Therapeutics*. 8th Ed. Iowa State Univ. Press.

Sandhu HS & Rampal S. 2006. *Essentials of Veterinary Pharmacology and Therapeutics*. 1st Ed. Kalyani Publishers.

VPT 606 ENDOCRINE AND REPRODUCTIVE PHARMACOLOGY 2+0 SEM - II

Objective

To study the pharmacology of drugs affecting endocrine functions.

Theory

UNIT-I: Pharmacology of drugs affecting endocrine functions of pituitary, thyroid, adrenals and pancreas.

UNIT-II: Hormonal regulation of calcium and phosphorus homeostasis.

UNIT-III: Pharmacology of drugs affecting male reproductive organs, spermatogenesis. UNIT-IV: Pharmacology of drugs affecting female reproductive organs, ovulation, oestrus, conception, gestation and lactation.

UNIT-V: Oxytocic and tocolytic drugs.

Suggested Readings

Brunton LL. (Ed). 2005. *Goodman and Gilman's The Pharmacological Basis of Therapeutics*. 11th Ed. McGraw-Hill.

Richard AH. (Ed). 2001. *Veterinary Pharmacology and Therapeutics*. 8th Ed. Iowa State Univ. Press.

Sandhu HS & Rampal S. 2006. *Essentials of Veterinary Pharmacology and Therapeutics*. 1st Ed. Kalyani Publishers.

VPT 607 CHEMOTHERAPY 2+1 SEM - I

Objective

To study the recent advances of chemotherapeutic agents with relevance to pharmacological and therapeutic aspects.

Theory

UNIT-I: General consideration and principles of chemotherapy, classification of chemotherapeutic agents; development of microbial resistance to antimicrobials, combination therapy.

UNIT-II: Systemic and gut acting sulfonamides, diaminopyrimidines, quinolones sulfones, nitrofurans.

UNIT-III: Penicillins, cephalosporins, beta-lactam antibiotics.

UNIT-IV: Chloramphenicol, tetracyclines, macrolides, polymixins, polypeptides. UNIT-V: Aminoglycosides and other antibiotics.

UNIT-VI: Anti-protozoans, anthelmintics, ectoparasiticides.

UNIT-VII: Antituberculosis, antifungal, antiviral and antineoplastic drugs.

Practical

General methods for assay of chemotherapeutic agents, antibiotic sensitivity tests, estimation of sulfonamides, penicillins, oxytetracyclines, trimethoprim and nitrofurans in biological fluids to study their kinetics and bioavailability.

Suggested Readings

Brunton LL. (Ed). 2005. *Goodman and Gilman's The Pharmacological Basis of Therapeutics*.11th Ed. McGraw-Hill.

Richard AH. (Ed). 2001. *Veterinary Pharmacology and Therapeutics*. 8th Ed. Iowa State Univ. Press.

Sandhu HS & Rampal S. 2006. *Essentials of Veterinary Pharmacology and Therapeutics*. 1st Ed. Kalyani Publishers.

VPT 608 TOXICOLOGY OF XENOBIOTICS 2+1 SEM - I

Objective

To study the poisonings and their antidotal therapy in animals.

Theory

UNIT-I: Principles and scope of toxicology, sources of poisoning.

UNIT-II: General modes of action of poisons, detoxification, factors affecting toxicity, general principles of diagnosis and treatment of poisonings.

UNIT-III: Toxicology of metals, agrochemicals, solvents and vapors, feed additives. UNIT-IV: Toxic effects of radiations and radioactive chemicals, genetic and developmental toxicology; forensic and regulatory aspects of toxicology.

Practical

Extraction, separation and detection of common poisons in toxicological specimens, study of toxicity and antidotal treatment in animals, designing of animal toxicity experiments and general toxicity tests.

Suggested Readings

Klassen CD, Amdure MO & Doull J. (Eds). 1996. *Casarett & Doull's Toxicology: The Basic Sciences of Poisons*. 5th Ed. McGraw Hill.

Sandhu HS & Brar RS. 2000. *Text Book of Veterinary Toxicology*. 1st Ed. Kalyani. Stive KE & Brown TM. 2006. *Principles of Toxicology*. 2nd Ed. CRC Press.

VPT 609 TOXICOLOGY OF PLANTS AND TOXINS 2+0 SEM - II

Objective

To impart knowledge of toxicity of poisonous plants and natural toxins.

Theory

UNIT-I: Classification, identification and chemical constituents of poisonous plants. Plants containing cyanide, nitrate/nitrite, oxalate, lectins and cardiotoxic glycosides.

UNIT-II: Plants producing lathyrism, thiamine deficiency and photosensitization.

UNIT-III: Toxicology of mycotoxins: aflatoxins, rubratoxins, ochratoxins, trichothecenes, tremorgens and ergot.

UNIT-IV: Animal bites and stings: snake venom, scorpion, spider and insect stings and toad poisoning. Bacterial toxins: botulism.

Suggested Readings

Chopra SR, Badhwar RL & Ghosh S. 1984. *Poisonous Plants of India*. 1st Ed., Academic Publishers, Jaipur.

Klassen CD, Amdure MO & Doull J. (Eds). 1996. *Casarett & Doull's Toxicology: Basic Sciences of Poisons*. 5th Ed., McGraw Hill.

Sandhu HS and Brar RS. 2000. *Text Book of Veterinary Toxicology*. 1st Ed., Kalyani Publishers.

VPT 610 PHARMACOLOGICAL TECHNIQUES 1+1 SEM - I

Objective

To impart the knowledge of various basic pharmacological techniques and screening methods of drugs.

Theory

UNIT-I: Principles of drug action and bioassay. Dose response curves and their analysis. UNIT-II: Techniques for setting up isolated and intact preparations.

UNIT-III: Organization of screening programme of drugs; multidimensional screening procedures and gross observational methods.

Practical

Setting up of isolated and intact preparations, recording of BP in dog/rat, recording of ECG in rat, experiments on drug potentiation, antagonism and tachyphylaxis. Construction of dose-response plots, calculation of EC_{50}, dissociation rate constants, potency ratio, pAx , pDx and pD'x values. Specific tests for evaluation of tranquillizing, hypnotic, analgesic, anticonvulsant,

general and local anesthetic, muscle relaxant anti- inflammatory, antipyretic, antiarrhythmic, antihypertensive, antihyperglycemic and anticholesterimic activities. Determinationof potency ratio, median effective, toxic or lethal doses. Bioassay techniques.

Suggested Readings

Ghosh MN. (Ed). 2005. *Fundamentals of Experimental Pharmacology*. 3rd Ed. Hilton & Co.

Kulkarni SK (Ed). 2004. *Handbook of Experimental Pharmacology*. 3rd Ed. Vallabh Prakashan.

Laurance DR & Bacharach AL. (Ed). 1964. *Evaluation of Drug Activities: Pharmacometrics*. Vols. I, II. Academic Press.

Parmar NS & Shiv Prakash 2006. *Screening Methods in Pharmacology*. 1st Ed. Narosa. Seth UK, Dadkar NK & Usha G Kamat (Eds). 1972. *Selected Topics in Experimental Pharmacology*. 1st Ed. Kothari Book Depot.

Tallarida RJ & Murray RB. 1987. *Manual of Pharmacologic Calculations*. 2nd Ed. Springer Verlag.

VPT 611 TECHNIQUES IN TOXICOLOGY 1+1 SEM - II

Objective

To understand the animal toxicity tests and assessment of various toxicants using specific tests.

Theory

UNIT-I: Animal models in toxicological studies.

UNIT-II: Animal toxicity tests for acute, sub-acute and chronic toxicity.

UNIT-III: Specific toxicity tests for neurotoxicity, immunotoxicity, developmental, behavioural, reproductive and inhalation toxicity, mutagencity, carcinogenicity.

UNIT-IV: Animal toxicological tests for the study of metabolism, synergism and antagonism.

Practical

Tests for acute, sub-acute and chronic toxicity, protocols and various specific toxicity tests. Assay for marker enzymes, analysis of toxicant residues in biological materials.

Suggested Readings

Derelanko MJ. 1995. *CRC Hand Book of Toxicology*. Mannfred A. Holinger.

Gad SC & Chengelis CP. 1998. *Acute Toxicology Testing*. 2nd Ed. Academic Press. Hayes AW. 1994. *Principles and Methods of Toxicology*. 3rd Ed. Raven Press.

VPT 612 ETHNOPHARMACOLOGY 2+0 SEM - II

Objective

To impart the knowledge and importance of traditional Indian medicine.

Theory

UNIT-I: Historical aspects: Traditional Indian remedies and regional folklore in disease cure.

UNIT-II: Classification, identification and chemical constituents of medicinal plants. Extraction, distillation, evaporation and other processes used in purification and preparation of active constituents from medicinal plants.

UNIT-III: Standardization and clinical validation of bioactive molecules from vegetable sources. Therapeutic and adverse effects of potential herbal drugs. Indigenous drugs used as carminatives, antiseptics, antimicrobials, analgesics, and anti-inflammatory agents.

UNIT-IV: Alternate systems of medicine in animals.

Suggested Readings

Agrawal VS. (Ed). 1997. *Drug Plants of India*. Kalyani Publishers.

Anjaria J. 2002. *Inventory of Traditional Veterinary Medicinal Practices in India*. GOI Publ., Pathik Enterprises, Ahmedabad.

Bisset NG. (Ed). 1994. *Herbal Drugs and Phytopharmaceuticals*. CRC Press.

Chopra RN, Nayar SL & Chopra IC. (Eds.). 2002. *Glossary of Indian Medicinal Plants*. NISCAIR, CSIR, New Delhi.

Pushpangadan P, Nyman U & George V. (Eds). 1995. *Glimpses of Indian Ethnopharmacology*. TBGRI Publication.

Rastogi RP & Mehrotra BN (Eds). 1993-95. *Compendium of Indian Medicinal Plants*. Vols. I-IV. Publication and Information Directorate, New Delhi.

VPT 701 ADVANCES IN NEUROPHARMACOLOGY 2+0 SEM - I

Objective

To understand the underlying mechanisms of drug receptor interactions and its effects.

Theory

UNIT-I: Definition, classification of receptors, molecular structure of receptors.

UNIT-II: G-protein coupled, ligand gated-ion channel and tyrosine kinase-linked receptors.

UNIT-III: Ligand binding study of receptors. Signal transduction system: introduction to signal transduction, receptor linked to ion channels.

UNIT-IV: G-proteins, second messengers: phospholipases, phosphokinases, intracellular calcium, protein kinase-C, IP3 , diacylglycerol and cyclic nucleotides.

UNIT-V: Signal transduction through protein tyrosine kinases. Receptors as pharmaceutical targets.

Suggested Readings

Selected articles from journals.

VPT 702 AUTACOID PHARMACOLOGY 1+0 SEM - II

Objective

To study the pharmacodynamics of autacoids.

Theory

UNIT-I: Pharmacodynamics of histamine and antihistamines.

UNIT-II: Pharmacodynamics of serotonin and its antagonists; eicosanoids, bradykinin, angiotensin, kallikrein and other kinins.

UNIT-III: Platelet-activating factors, slow reacting substances.

UNIT-IV: Putative neurohumoral transmission – purine nucleotides, peptides, amino acids and nitric oxide.

Suggested Readings

Selected articles from journals.

VPT 703 PHARMACOLOGY OF HERBAL DRUGS 2+1 SEM - I

Objective

To study the pharmacological, therapeutic and toxicological aspects of potential medicinal plants and herbal drugs.

Theory

UNIT-I: Historical aspect, chemical constituents of medicinal plants and their classification.

UNIT-II: Identification, collection, preservation, purification, isolation, standardization and clinical validation of bioactive molecules from vegetable sources.

UNIT-III: Characterization of pharmacological, therapeutic and toxic effects of potential herbal drugs.

UNIT-IV: Strategies for development of herbal drugs.

Practical

Extraction, detection, isolation and purifications of active chemical constituents from plant sources. Pharmacological effects of herbal drugs on intact and isolated preparations.

Suggested Readings

Selected articles from journals.

VPT 704 DRUG METABOLISM 2+0 SEM - II

Objective

To study the mechanisms and processes of drug biotransformation.

Theory

UNIT-I: Mechanisms and processes of drug biotransformation. UNIT-II: Synthetic and non-synthetic pathways of drug metabolism.

UNIT-III: Chemical, biological, genetic and environmental factors. Species variations affecting drug biotransformation mechanisms.

UNIT-IV: Hepatic microsomal and non-microsomal enzyme systems. UNIT-V: Enzyme induction and inhibition.

Suggested Readings

Selected articles from journals.

VPT 705 MOLECULAR PHARMACOLOGY 2+0 SEM - I

Objective

To study the identification and characterization of receptors and drug receptors interactions.

Theory

UNIT-I: Physicochemical properties of drugs, forces involved in binding of drugs to receptors.

UNIT-II: Receptor conformation and configuration and structure activity relationship. UNIT-III: Theories of drug receptor interactions; analysis of dose response relationship and molecular mechanisms of drug actions.

UNIT-IV: Methods of identification, isolation and characterization of receptors.

Suggested Readings

Selected articles from journals.

VPT 706 PHARMACOKINETICS 2+1 SEM - I

Objective

To study the absorption, distribution, biotransformation and excretion of drugs.

Theory

UNIT-I: Routes of drug administration, factors modifying drug delivery; absorption, distribution, biotransformation and elimination.

UNIT-II: Kinetics following single and multiple dosage; compartmental models of drug distribution, bioavailability, volume of distribution and protein binding of drugs.

UNIT-III: Rates of absorption, distribution and elimination; absorption and elimination half-lives and rate of transfer of drugs between compartments.

UNIT-IV: Renal clearance, dosage regimen; non-compartmental pharmacokinetic modeling.

UNIT-V: Application of pharmacokinetic principles in therapeutics.

Practical

Analysis of pharmacokinetic data and determination of different pharmacokinetic parameters and bioavailability of drugs in normal and diseased animal models.

Suggested Readings

Selected articles from journals.

VPT 707 PHARMACOGENOMICS 2+0 SEM - II

Objective

To study the responses to drugs with respect to various aspects of genomics.

Theory

UNIT-I: Introduction, species variations affecting drug responses, increased and decreased responsiveness to drug effects/toxicities and novel drug effects.

UNIT-II: Genetic polymorphism.

UNIT-III: Gene therapy: gene transfer technology, viral vectors, natural delivery strategies.

UNIT-IV: Drugs and gene therapy of inherited diseases, genetic repair and inactivation strategies; synthesis of therapeutic proteins and cancer gene therapy.

UNIT-V: Role of bioinformatics in pharmacogenomics.

Suggested Readings

Selected articles from journals.

VPT 708 IMMUNOPHARMACOLOGY 1+0 SEM - I

Objective

To study the pharmacological control of immune system.

Theory

UNIT-I: General aspect of immune system, chemical mediators of immune system.

UNIT-II: Pharmacological control of immune responses. Immunomodulators; immunostimulants, immunosuppressant and tolerogens; immunological basis of drug allergy and drug tolerance.

UNIT-III: Interaction of nervous system, endocrine system and immune system, immunotoxic effects of environmental and other pollutants.

UNIT-IV: Xenobiotic-induced immune dysfunctions and immune deficiencies; autoimmune reactions to xenobiotics, immunoregulants and their therapeutic applications in asthma, arthritis, cancer, dermatology and organ transplant etc.

Suggested Readings

Selected articles from journals.

VPT 709 MOLECULAR TOXICOLOGY 2+0 SEM - II

Objective

To understand the mechanisms & targets of cellular/ molecular toxicity.

Theory

UNIT-I: Cellular, subcellular and molecular targets of toxicity; mechanisms of toxicities. UNIT-II: Factors affecting toxicity, interactions of toxicants with target molecules.

UNIT-III: Cellular dysfunctions, repair and dysrepair.

UNIT-IV: Target organ directed toxicological effects of xenobiotics, detoxification, risk assessment.

UNIT-V: Mechanism of chemical mutagenesis, carcinogenesis, teratogenesis and radiation toxicity.

Suggested Readings

Selected articles from journals.

VPT 710 CLINICAL PHARMACOLOGY 1+1 SEM - I

Objective

To study the clinical pharmacological aspects of drugs.

Theory

UNIT-I: Scope of clinical pharmacology.

UNIT-II: Drug discovery and clinical trials. Pharmacovigilance. Pharmacoepidemiology and pharmacoeconomics.

UNIT-III: PK-PD relationship and its applications. Drug interactions and adverse drug reactions.

UNIT-IV: Therapeutic drug monitoring. Rationale of drug use, drug regulations and acts.

Practical

Study on drug interactions and drug levels in diseased conditions. Study on plasma drug concentration-time profile and establishment of various pharmacokinetic parameters. Dosage adjustment in diseased conditions. Clinical trials of various drugs.

Suggested Readings

Selected articles from journals.

VPT 711 CLINICAL TOXICOLOGY 2+1 SEM - II

Objective

To study the scope of clinical toxicology and management of poisonings including regulatory and forensic toxicology.

Theory

UNIT-I: Scope of clinical toxicology. Toxicological investigation and management of poisonings.

UNIT-II: Target organ directed toxicity, Antidotal therapy.

UNIT-III: Clinical aspect of poisoning due to specific toxicants viz. metals, pesticides, mycotoxins, animal and bacterial toxins, solvents and vapours, drugs and other food/feed contaminants.

UNIT-IV: Forensic and analytical toxicology.

Practical

Demonstration of poisonings and their antidotal treatment; use of biomarkers in the assessment of toxicity. GLP evaluation, analysis of poisons in biological samples.

Suggested Readings

Selected articles from journals.

VPT 712 ECOTOXICOLOGY 2+0 SEM - I

Objectives

To impart knowledge regarding ecotoxicology for conservation of healthy eco-system.

Theory

UNIT-I: Basic principles of ecotoxicology. Sources of contamination and effects of pollutants on eco-health.

UNIT-II: Chemical contamination of air, water, soil and food by major agricultural and industrial chemicals – pesticides, hydrocarbons and metals. Fate of chemicals in the environment and target species.

UNIT-III: Marine and wildlife as monitors of environmental quality.

UNIT-IV: Contamination control and approaches to rehabilitating damaged ecosystems.

Suggested Readings

Selected articles from journals.

VPT 713 REGULATORY TOXICOLOGY 2+1 SEM - II

Objectives

Introduction to general principles in toxicological risk assessment.

Theory

UNIT-I: Principles of risk assessment. Test protocols for toxicity studies.

UNIT-II: Interaction between toxicology and industry. Compounds under regulatory legislation demands. Regulatory essential dose levels in chemical risk assessment (NOEL, NOAEL, LOEL, LOAEL & AOEL).

UNIT-III: Risk assessment in practice. Classification and marking/branding of chemicals. Monitoring/surveillance of chemicals. Exposure assessment and modeling.

UNIT-IV: Quality control in safety research (GLP). Operation of product register.

Practical

Good laboratory practice in toxicological research. Screening procedures in regulatory toxicology. Mandatory toxicity testing protocols. Determination of ADI, NOEL, NOAEL, LOEL, LOAEL and AOEL.

Suggested Readings

Selected articles from journals.

VPT 790 SPECIAL PROBLEM 0+2 SEM - I, II

Objective

To provide expertise in handling practical research problem(s).

Practical

Short research problem(s) involving contemporary issues and research techniques.

VETERINARY PHARMACOLOGY AND TOXICOLOGY
List of Journals

- American Journal of Veterinary Research
- Annual Review of Pharmacology
- Annual Review of Pharmacology and Toxicology
- Drugs
- Environmental Toxicology and Pharmacology
- European Journal of Pharmacology
- Indian Journal of Pharmacology
- Journal of American Medical Association
- Journal of Ethnopharmacology
- Journal of Pharmacology and Experimental Therapeutics
- Journal of Veterinary Pharmacology and Therapeutics
- Pharmacological Reviews
- Pharmacology, Biochemistry and Behaviour
- Toxicology
- Toxicology and Applied Pharmacology
- Toxicology International
- Trends in Pharmacological Sciences
- Veterinary and Human Toxicology

e-Resources

- www.elsevier.com (Environmental Toxicology and Pharmacology)
- www.blackwellpublishing.com (Journal of Vet. Pharmacology & Therapeutics)
- www.elsevier.com (Comparative Biochem. & Physiol.-Part C: Toxicol. & Pharma.)
- www.clinicalneuropharm.com (Clinical Neuropharmacology)
- www.arjournals.annualreviews.org (Annual Review of Pharma. & Toxicology)
- www.aac.aron.org (Antimicrobial agents and chemotherapy)
- www.nature.com/big/in dex.html (British Journal of Pharmacology)
- www. dmd.aspetijournals.org. (Drug metabolismand disposition)
- http://jpet.aspetijournals.org (The Journal of Pharmacology & Experimental Therapeutics)
- http://modpharm (Molecular Pharmacology)
- http://Pharmet.org (Pharmacological Reviews)
- www.nature.com/tpj/index.html (The Pharmacogenomics Journal)
- www. informaworld.org (International Journal of Toxicology)
- www.toxici.oxfordjournals.org (Toxicological Science)

Suggested Broad Topics for M aster's and Doctoral Research

- Neuro- and Behavioural Toxicology of Agrochemicals
- Pharmacokinetics and Pharmacodynamics of Newer Drugs
- Ethnopharmacology
- Autonomic Pharmacology of Ruminants
- Autonomic Pharmacology of Poultry
- Clinical Pharmacology
- Clinical Toxicology

VETERINARY PHYSIOLOGY

Course Structure

COURSE NO.	COURSE TITLE	CREDITS	SEM
VPY 601	PHYSIOLOGY OF DIGESTION	2+1	I
VPY 602	CARDIOVASCULAR AND RESPIRATORY PHYSIOLOGY	2+1	I
VPY 603	RENAL PHYSIOLOGY AND BODY FLUID DYNAMICS	2+1	I
VPY 604	HAEMATOLOGY	2+1	I
VPY 605	VITAMINS AND MINERALS IN ANIMAL PHYSIOLOGY	2+0	I
VPY 606	PHYSIOLOGY OF ANIMAL REPRODUCTION	2+1	II
VPY 607	CLINICAL PHYSIOLOGY	2+1	II
VPY 608	NEUROMUSCULAR PHYSIOLOGY	2+1	II
VPY 609	CHEMICAL BIOREGULATION IN PHYSIOLOGICAL FUNCTIONS	3+0	II
VPY 610	RESEARCH TECHNIQUES IN VETERINARY PHYSIOLOGY	0+2	II
VPY 691	MASTER'S SEMINAR	1	I, II
VPY 699	MASTER'S RESEARCH	20	I, II
VPY 701	APPLIED PHYSIOLOGY OF BODY FLUIDS AND ELECTROLYTES	2+1	I
VPY 702	PHYSIOLOGY OF ANIMAL BEHAVIOUR	2+0	I
VPY 703	COMPARATIVE PHYSIOLOGY OF RUMINANT DIGESTION	2+1	I
VPY 704	ADVANCES IN NEURO-ENDOCRINOLOGY	2+1	I
VPY 705	MYOPHYSIOLOGY AND KINESIOLOGY	2+1	I
VPY 706	AVIAN PHYSIOLOGY	2+1	I
VPY 707	PHYSIOLOGY OF LACTATION	2+1	II
VPY 708	ADVANCES IN ENVIRONMENTAL PHYSIOLOGY AND GROWTH	2+1	II
VPY 709	ADVANCES IN RUMEN MICROBIOLOGY AND METABOLISM	2+1	II
VPY 710	ADVANCES IN IMMUNOPHYSIOLOGY	2+1	II
VPY 711	PHYSIOLOGY OF STRESS	2+1	II
VPY 790	SPECIAL PROBLEM	0+2	I, II
VPY 791	DOCTORAL SEMINAR I	I	I, II
VPY 792	DOCTORAL SEMINAR II	I	I, II
VPY 799	DOCTORAL RESEARCH	45	I, II
SERVICE COURSE			
FN 511	ADVANCED HUMAN PHYSIOLOGY	2+1	I

VETERINARY PHYSIOLOGY
Course Contents

VPY 601 PHYSIOLOGY OF DIGESTION 2+1 SEM - I

Objective

To teach comparative physiology of digestive system of monogastric animals, ruminants and birds, and basic techniques.

Theory

UNIT-I: Basic characteristics and comparative physiology of digestive system of domestic animals.

UNIT-II: Gastro-intestinal motility, secretory functions of gastro-intestinal tract, their regulation and gastro-intestinal hormones.

UNIT-III: Absorption, metabolism and excretion of various nutrients, appetite and control of feed intake.

UNIT-IV: Development of ruminant system and rumen environment. Ruminant microbial digestion, its advantages and disadvantages. Rumino-reticular motility, its significance and control.

UNIT-V: Rumen microbiology. Digestion in birds.

Practical

Collection of saliva and its enzymatic studies. Activity of pepsin and trypsin enzymes. Gastric and intestinal motility. Estimation of digestive metabolites such as glucose, ketone bodies, triglycerides, cholesterol, urea- nitrogen and total proteins. Liver function tests. Method of collection of rumen liquor, merits and demerits. Determination of pH, total volatile fatty acids, ammonia-nitrogen and total-nitrogen in strained rumen liquor. Rate of passage of digesta and its estimation. Rumino-reticular movements. Artificial rumen, counting of protozoa and bacteria.

Suggested Readings

Church DC. 1988. *Digestive Physiology & Nutrition of Ruminants*. Prentice Hall. Cunningham JG. 1992. *Text book of Veterinary Physiology*. WB Saunders.

Forbes JM. & France J. 1993. *Quantitative aspects of Ruminant Digestion & Metabolism*. CABI.

Hungate RE. 1966. *Rumen and its Microbes*. Academic Press.

Swenson MJ & Reece WO. 2005. *Duke's Physiology of Domestic Animals*. Panima.

VPY 602 CARDIOVASCULAR AND RESPIRATORY PHYSIOLOGY 2+1 SEM - I

Objective

To teach function and regulation of heart, recording of ECG and respiration in different animals and basic techniques.

Theory

UNIT-I: Heart muscle, heart as pump, origin and propagation of heart beat. Electrophysiology of heart, rhythmic excitation of heart, cardiac cycle, heart sound and dynamics of valvular and congenital heart defect.

UNIT-II: Cardiac output and its measurements, factors affecting cardiac output. Venous return and its regulation. Control of the heart.

UNIT-III: Normal electro-cardiogram, electrocardiographic interpretation in cardiac myopathies and cardiac arrhythmias.

UNIT-IV: Circulation and hemodynamics, coronary, systemic and pulmonary circulation, their regulation, energetics of circulation, pathophysiology of circulation.

UNIT-V: Respiration, mechanism of ventilation, hemoglobin, oxygen and carbon- dioxide transport. Respiratory gas exchange. Respiratory adjustment at high altitude and deep swimming. Neural and chemical control of respiration, artificial respiration. Respiration in birds.

Practical

Determination and recording of cardiac output, blood pressure and electrocardiogram, blood volume. Estimation of lung volumes and capacities by spirometery, effect of various levels of exercise on lung functional capacities. Estimation of blood gases.

Suggested Readings

Cunningham JG. 1992. *Text book of Veterinary Physiology*. WB Saunders. Ganong FW. 2003. *Review of Medical Physiology*. Prentice-Hall.

Patton 1989. *Howell's Text book of Physiology*. WB. Saunders.

Swenson MJ & Reece WO. 2005. *Duke's Physiology of Domestic Animals*. Panima.

VPY 603 RENAL PHYSIOLOGY AND BODY FLUID DYNAMICS 2+1 SEM - I

Objective

To impart knowledge regarding excretory system of mammals and birds, maintenance of body fluid homeostasis.

Theory

UNIT-I: An overview of nephron structure and function. Renal homeostatic function and renal excretory function.

UNIT-II: Quantitative analysis of renal function, renal haemodynamics. Glomerular filtration- its mechanism and measurement. Permselectivity of the glomerular capillary wall, structural basis of GFR, tubular reabsorption and transport.

UNIT-III: Role of kidney in acid-base balance. Physiology of micturition, endocrine control of renal function. Non excretory functions of kidney.

UNIT-IV: Skin- general anatomy of epidermis, dermis, hypodermis, mechanical protection, permeability, actinic irradiation, sweat glands, sebaceous glands. Skin grafting. Immune properties of skin.

UNIT-V: Composition of body fluids and their regulation. Excretory system in birds.

Practical

Collection and preservation of urine. Physical and chemical analysis of urine and its interpretation in health and disease condition. Demonstration of various kidney function tests, glomerular filtration rate, creatinine clearance rate, urea clearance rate and glucose tolerance test.

Suggested Readings

Klahar S. 1983. *The Kidney and Body Fluids in Health and Diseases*. Plenum Press. Swenson MJ & Reece WO. 2005. *Duke's Physiology of Domestic Animals*. Panima.

VPY 604 HAEMATOLOGY 2+1 SEM - I

Objective

To acquaint the students about haematology of different animals including hands-on training.

Theory

UNIT-I: Red blood cells, anaemia, different types of anaemia, polycythemia and their effect on circulation in mammals and birds.

UNIT-II: Resistance of the body to infection, leukocytes, tissue macrophage system and inflammation.

UNIT-III: Immunity, immunoglobulins, immunogenetics, polymorphism in hemoglobin, transferrin etc. Changes in blood during diseases. Iatrogenic blood diseases, hemorrhagic diathesis, hemophilias.

UNIT-IV: Hemostasis and coagulation factors, role of platelets, fibrinolysis. Blood groups, transfusion of blood. Tissue and organ transplantation. Conditions causing bleeding disorders.

Practical

Haemograms, platelet count, erythrocyte fragility. Estimation of serum iron and iron binding capacities of plasma. Separation of variants of hemoglobin and transferrin by electrophoresis. Examination of bone marrow. Isolation of different types of blood cells by sedimentation and column chromatography.

Suggested Readings

Dacie JV & Lewis SM.1991. *Practical Hematology*. Churchill Livingstone. Jain NC. 1993. *Essentials of Veterinary Hematology*. Lea & Febiger.

Rapaport SI. 1987. *Introduction to Hematology*. JB Lippincott.

VPY 605 VITAMINS AND MINERALS IN ANIMAL PHYSIOLOGY 2+0 SEM - I

Objective

To teach the importance of these nutrients in normal body functions and in disease conditions.

Theory

UNIT-I: Introduction and brief history, definition, general properties and overview of functions.

UNIT-II: Fat soluble vitamins, their functions and deficiency diseases.

UNIT-III: Water soluble vitamins and vitamin-like compounds, their functions and deficiency diseases.

UNIT-IV: Physiological functions of trace elements, their role in metabolism, toxicity, deficiency diseases.

Suggested Readings

McDowell LR. 1989. *Vitamins in Animal Nutrition*. Academic Press.

Underwood EJ. 1977. *Trace Elements in Human and Animal Nutrition*. Academic Press.

VPY 606 PHYSIOLOGY OF ANIMAL REPRODUCTION 2+1 SEM - II

Objective

To impart knowledge of male and female reproductive system of different species of animals including birds.

Theory

UNIT-I: Functional histomorphology of male and female reproductive system, development of male and female sex organs. Endocrine and neuroendocrine relation in male and female reproductive function in different domestic animals.

UNIT-II: Sexual cycles and mating behaviours in females, oogenesis, folliculogenesis and ovulation. Secretions of female reproductive tract in different species of animals.

UNIT-III: Male mating behaviour, spermatogenesis, spermiogenesis, Seminiferous, epithelial cycles. Spermatozoa- structure and composition, maturation and transportation. Secretions of male reproductive tract.

UNIT-IV: Transport of male and female gametes, fertilization, implantation. Pregnancy and parturition. Post-partum recovery in different species of domestic animals.

Practical

Heat detection in different animals, palpation of reproductive organs. Physical and biochemical evaluation of semen, determination of sperm enzyme, leakage during freezing. Preservation of semen, RIA of steroid hormones.

Suggested Readings

Hafeez ESE. 2000. *Reproduction in Farm Animals*. Lippincott, Williams & Wilkins. Pineda & Doley 2003. *McDonald's Veterinary Endocrionology*. Iowa State University

Press, Ames.

Salisbury GW & Demark NL. 1978. *Physiology of Reproduction and Artificial Insemination*. WB Saunders.

Swenson MJ & Reece WO. 2005. *Duke's Physiology of Domestic Animals*. Panima.

VPY 607 CLINICAL PHYSIOLOGY 2+1 SEM - II

Objective

To teach physiological basis of clinical abnormalities in body functions.

Theory

UNIT-I: Cardiovascular, respiratory, hepatic and renal evaluation of body functions in relation to clinical conditions.

UNIT-II: Carbohydrate, fat, protein and mineral metabolism in health and disease of various species.

UNIT-III: Functions and dysfunctions of liver, kidney and gastro-intestinal tract.

UNIT-IV: Clinico-immunological evaluation of immune responses and clinical enzymology.

Practical

Qualitative tests for glucose, ketone bodies, protein and calcium in urine. Quantitative determination of glucose in blood and urine. Electrophoresis of plasma proteins. Determination of sodium and potassium in serum. Determination of serum chloride.

Separation of amino acids. Thin-layer chromatography of serum lipids.

Suggested Readings

Henry RJ. 1974. *Clinical Chemistry. Principles and Techniques*. Harper & Row.

Kaneko JJ, Harvey JW & Bruss ML. 1997. *Clinical Biochemistry of Domestic Animals*. Academic Press.

King EJ & Wooton IDP. 1956. *Microanalysis in Medical Biochemistry*. Churchill Livingstone.

Oser BL. 1976. *Hawk's Physiological Chemistry*. Tata McGraw-Hill.

Rose BD. 1989. *Clinical Physiology of Acid Base and Electrolyte Disorders*. McGraw- Hill.

Tietz NW. 1970. *Fundamentals of Clinical Chemistry*. WB Saunders.

VPY 608 NEUROMUSCULAR PHYSIOLOGY 2+1 SEM - II

Objective

To impart knowledge of coordination of body functions and regulation of brain functions and sense organs.

Theory

UNIT-I: Types and classification of muscles, comparative histopathology of muscles. Skeletal muscle fibers, membrane and action potential at myoneuronal junction. Molecular characteristics of contractile filaments, molecular mechanism of muscle contraction, relationship between actin and myosin filaments, overlap and tension developed by the contracting muscles. Contractile process of smooth muscles.

UNIT-II: Length and tension relationship, force and velocity relationship. Skeletal muscle energetics, metabolism and lactate shuttle. Exercise, adaptation to training and performance. Neuromuscular disorders of domestic animals.

UNIT-III: Nervous system, synapse, transmission and processing of information, receptors, brain and spinal reflexes, motor functions of brain stem, limbic system, memory, sleep, learning, autonomic nervous system.

UNIT-IV: Special senses and somatic senses.

Practical

Recording of electro-myogram, fatigue, tetanus in muscles. Effect of temperature on different types of muscles, demonstration of intestinal movements, effect of drugs on all types of muscles, estimation of muscles specific enzymes.

Suggested Readings

Basmajian JV. 1978. *Muscle Alive: their Functions Revealed by Electromyography*. Williams & Wilkins.

Cooper R. 1980. *EEG Technology*. Butterworths.

Klemm. WR. 1969. *Animal Electroencephalography*. Academic Press. Smith R.F. 1978. *Fundamentals of Neurophysiology*. Springer Verlag.

Swenson MJ & Reece WO. 2005. *Duke's Physiology of Domestic Animals*. Panima.

VPY 609 CHEMICAL BIOREGULATION IN PHYSIOLOGICAL FUNCTIONS 3+0 SEM - II

Objective

To acquaint the students about different endocrine glands of the body and their relationship with production.

Theory

UNIT-I: Methods to study bioregulation including methods of endocrine analysis. Manipulation and disruption of biorhythms in homeostatic and natural ecosystem.

UNIT-II: Hormonal relationship in animal production. Concepts in hormone function, classification and methods of study. Hormonal assay, mechanism of hormone synthesis, release and transport. Mechanisms of hormone action, target cell interactions.

UNIT-III: Genetic and genomic approaches in endocrinology. Animal models and alternate uses of animal model. Regulation and metabolism of hypothalamic, hypophyseal, thyroid and adrenal hormones.

UNIT-IV: Gonadal and placental hormones, their regulation and mechanism of action. Hormonal principles of pineal gland and its role in production.

UNIT-V: Endocrine control of carbohydrate and calcium homeostasis. Hormones and adaptation to environment. Hormonal regulation of gastro-intestinal activity. Prostaglandins. Hormones in fertility regulation and production augmentation. Avian endocrinology.

Suggested Readings

Pineda MH & Doley MP. 2003. *McDonald's Veterinary Endocrinology*. Blackwell Publ. Turner CD & Bagnara JT. 1976. *General Endocrinology*. WB Saunders.

Williams RH. 1982. *Text Book of Endocrinology*. WB Saunders.

VPY 610 RESEARCH TECHNIQUES IN VETERINARY PHYSIOLOGY 0+2 SEM - II

Objective

Training in various techniques for application in research in Animal Physiology.

Practical

Recording of ECG, EMG, blood pressure, pulse rate, movement of GI tract by Physiograph. Gas Liquid Chromatography. Electrophoresis. Estimation of various electrolytes. Estimation of bacterial production rate and VFA production rate, solid and liquid digesta flow rates and body composition using radio-isotopes, *in vitro* and *in sacco* rumen studies, ELISA. R.I. A. techniques of various hormones.

Suggested Readings

Abraham GE. 1977. *Handbook of Radioimmunoassay*. Marcel Dekker.

Armstrong ML. 1978. *Electrocardiograms: A Systematic Method of Reading Them*. KM Verghese.

Oser BL. 1976. *Hawk's Physiological Chemistry*. Tata McGraw-Hill.

Smorto MP & Basmajian JV. 1979. *Clinical Electroneurography – An Introduction to Nerve Conduction Tests*. Williams & Wilkins.

VPY 701 APPLIED PHYSIOLOGY OF BODY FLUIDS AND ELECTROLYTES 2+1 SEM - I

Objective

To teach physiological and clinical implication of changes in electrolytes and body fluids.

Theory

UNIT-I: Volume and composition of body fluids, exchange of water and electrolytes between body compartments, blood and external environment. Osmolarity of fluid.

UNIT-II: Regulation of volume and osmolarity of extra cellular fluid. Regulation of pH and acid base balance. Formation and composition of cerebrospinal fluid and lymph.

UNIT-III: Clinical implications of change in electrolytes and body fluids. Structural and functional consideration of plasma and its composition. Diuresis and endocrine control of renal functions.

UNIT-IV: Clinical feature in fluid and electrolyte imbalance, clinicopathological indictors of fluid and electrolytes imbalance.

Practical

Determination of electrolytes viz. sodium, potassium and chloride in plasma, determination of total body water and plasma volume by various techniques i.e. dye dilution and radioisotope technique, Estimation of osmolarity and osmolality of body fluids.

Suggested Readings

Selected articles from journals.

VPY 702 PHYSIOLOGY OF ANIMAL BEHAVIOUR 2+0 SEM - I

Objective

To impart knowledge on various aspects of animal behaviour viz. communication in animals, sexual behaviour, feeding behaviour etc.

Theory

UNIT-I: Introduction to animal ethology. Neurophysiological basis of animal behaviour. UNIT-II: Behaviour in relation to changes in the environment. Feeding behaviour, grazing, stall feeding and rumination.

UNIT-III: Sexual behaviour in the female and male. Maternal behaviour. Milk let down. UNIT-IV: Social behaviour, communication in animals, animal temperament. Response of dogs and horses to training.

Suggested Readings

Selected articles from journals.

VPY 703 COMPARATIVE PHYSIOLOGY OF RUMINANT DIGESTION 2+1 SEM - I

Objective

To teach functional development of rumen and comparative digestive functions in different ruminant species.

Theory

UNIT-I: Functional development of ruminant stomach. Rumen motility and its control. UNIT-II: Salivary secretion and its regulation. Intraruminal environment, rumen metabolites and their assimilation, NPN feeding, nitrogen recycling.

UNIT-III: Synthesis of microbial proteins and vitamins. Rumen dysfunctions. Comparative efficiency of rumen function in different species. Stoichiometry of carbohydrate fermentation.

UNIT-IV: Manipulation of rumen fermentation, protected nutrients feeding, probiotics supplementation etc. Rumen flow rate and rumen volume.

Practical

Reticulo-ruminal motility, artificial rumen techniques, total volatile fatty acids and their fractions, bacteria, protozoa and fungi in rumen. Flow rates of ruminal contents.

Suggested Readings

Selected articles from journals.

VPY 704 ADVANCESINNEURO-ENDOCRINOLOGY 2+1 SEM - I

Objective

To acquaint the students about neuro-endocrine integrating mechanism in animals and birds.

Theory

UNIT-I: Neuroendocrine integrating mechanism. Structure of hypothalamus, pituitary gland, limbic and other neural pathways and endocrine functions.

UNIT-II: Neural control of oxytocin, adrenocorticotropic hormone, aldosterone, thyrotropic hormone, growth hormone, gonadotrophins etc. Hypothalamic releasing factors and the neuro-vascular link between brain and anterior pituitary.

UNIT-III: Role of afferent impulses from genitals and other regions in reproductive system. Influence of hormones on brain activity.

UNIT-IV: Effects of drugs on neuro-endocrine system. Neuro-endocrine mechanisms in birds. Interaction of nervous, endocrine and immune system in animal production and reproduction.

Practical

Radio-immuno assay of progesterone, effects of ovariectomy, effects of testosterone treatment. Bioassay of estrogens. Estimation of T3 and T4 in blood.

Suggested Readings

Selected articles from journals.

VPY 705 MYOPHYSIOLOGY AND KINESIOLOGY 2+1 SEM - I

Objective

To impart the knowledge regarding exercise and work physiology, molecular basis of muscle contraction.

Theory

UNIT-I: Structure of muscle, chemical composition, muscle contraction and irritability. Mechanical properties of skeletal muscle.

UNIT-II: Thermal properties of muscles. Chemical correlates of contraction.

UNIT-III: Molecular basis of muscular contraction of skeletal muscle. Pathophysiology of muscles and myocardium.

UNIT-IV: Lever systems of body joints, Synovial fluid formation and its physiology. Principles of Kinesiology and its application in work physiology.

Practical

Electromyogram, Tetany. Electro-cardiogram. Intestinal movements. Effects of various drugs on all types of muscles.

Suggested Readings

Selected articles from journals.

VPY 706 AVIAN PHYSIOLOGY 2+1 SEM - I

Objective

To impart complete knowledge about physiology of domestic fowl and comparative physiology of other birds.

Theory

UNIT-I: Digestive and urinary system.

UNIT-II: Blood, cardiovascular and respiratory system. UNIT-III: Reproductive and endocrine system.

UNIT-IV: Nervous system and musculo-skeletal system.

Practical

Study of blood cells, haemoglobin, packed cell volume (haematocrit) and erythrocyte sedimentation rate. Determination of glucose, calcium, uric acid and urea in blood. Electrophoretic separation of plasma proteins and egg proteins.

Suggested Readings

Selected articles from journals.

VPY 707 PHYSIOLOGY OF LACTATION 2+1 SEM - II

Objective

To acquaint students with physiology and mechanism of lactation.

Theory

UNIT-I: Functional anatomy, histology and cytology of mammary gland in domestic animals.

UNIT-II: Development of mammary gland, hormonal control of mammary gland growth. UNIT-III: Process of lactation, initiation of milk secretion, hormonal control of lactation. Biochemical and histological changes in mammary gland during lactation. Mechanism of galactopoiesis.

UNIT-IV: Neural control of lactation, milk let down, milk ejection and inhibition of milk ejection. Induced lactation. Composition of milk in different species of animals.

Practical

Examination of normal udder of cow and buffalo. Composition of colostrum and milk during different phases of lactation. Effect of adrenalin and oxytocin on milk let down, artificial induction of lactation. Estimation of lactogenic hormones.

Suggested Readings

Selected articles from journals.

VPY 708 ADVANCES IN ENVIRONMENTAL PHYSIOLOGY AND GROWTH 2+1 SEM - II

Objective

To acquaint the students about co-relation of various environmental factors on growth and performance of animals.

Theory

UNIT-I: Ecology of farm animals, biological rhythms, mammalian circadian rhythms, their regulation. Components of physical environment, biometeorology and principles of thermoregulation in mammals and birds.

UNIT-II: Physiological response of farm animals to heat and cold. Effect of various climatic components on health and production (growth and egg production), reproduction and climatic adaptation.

UNIT-III: Concept and definitions of cellular, prenatal and postnatal growth- patterns in different species of domestic animals.

UNIT-IV: Factors affecting live weight growth viz. nutrition, hormones, vitamins, antibiotics, environment. Ageing and senescence. Growth anomalies.

Practical

Growth measurement and growth curves, recording of various climatic variables, effect of climatic variables on growth and production.

Suggested Readings

Selected articles from journals.

VPY 709 ADVANCES IN RUMEN MICROBIOLOGY AND METABOLISM 2+1 SEM - II

Objective

Students will learn about rumen ecosystem and symbiotic relationship of flora and fauna, their structure and functions. Rumen manipulation techniques.

Theory

UNIT-I: Introduction to rumen bacteria, protozoa and fungi. Development and natural fluctuation in rumen microbial population.

UNIT-II: Microbial ecology and physiology of feed degradation within the rumen. Metabolism of nitrogen containing compounds.

UNIT-III: Degradation of carbohydrate, fat and protein by rumen microbes, NPN utilization, Microbe-microbe interaction. Protected nutrients and other feed additives.

UNIT-IV: Genetics and biotechnology of rumen microbes, rumen anaerobic fungi, their role and interaction with other rumen microbes.

Practical

Counting of total and differential protozoa, total and viable bacteria and fungi in rumen liquor. Individual VFA by GLC. Defaunation and manipulation of rumen fermentation. Culture of bacteria and fungi.

Suggested Readings

Selected articles from journals.

VPY 710 ADVANCES IN IMMUNOPHYSIOLOGY 2+1 SEM - II

Objective

To study cells and organs of immune system, its development and role in physiological functions and immunomodulation.

Theory

UNIT-I: Introduction, history, body defense, organs of immune system, ontogeny and phylogeny of immune system, vertical transmission of immunity and difference between vertebrates and invertebrates.

UNIT-II: Immunoglobulins-basic structure and functions, hematopoiesis, T-cell and B- cell-evolution, development and their functions, species-specific immunity, cytokines- sources and actions, MHC, genetic organization of immunoglobulin, MHC and complement system.

UNIT-III: Immune-endocrine interactions, immune system in reproduction, ageing, stress and other physiological functions, immunomodulation.

UNIT-IV: Hypersensitivity, diseases related to immune system, dysfunction, autoimmune disorders and their genesis, immunodeficiency.

Practical

Qualitative & quantitative analysis of immunoglobulins in body fluids, RIA, ELISA, Electrophoresis techniques in immunophysiology, raising hyperimmune sera and blood group immunophysiology.

Suggested Readings

Abbas AK, Lichtman AH & Pillai S. (Eds). 2007. *Cellular and Molecular Immunology*. 6th Ed. Elsevier.

Goldsby RA, Kindt TJ, Osborne PA & Kuby J. 2007. *Immunology.* 6th Ed. WH. Freeman. Roitt IM. 1997. *Essential Immunology*. 9th Ed. Blackwell, Oxford.

Tizzard IR. 2004. *Veterinary Immunology*. 5th Ed. WB. Saunders.

VPY 711 PHYSIOLOGY OF STRESS 2+1 SEM - II

Objective

To teach the mechanism and effect of stress on production and reproduction in domestic animals.

Theory

UNIT-I: Definition of stress, various types of stresses, their effect on animal production and reproduction.

UNIT-II: Physico-chemical changes of blood composition due to exercise and work. Energy utilization and requirement of muscles during work and exercise.

UNIT-III: Capacity of work under field and controlled laboratory conditions, factors that regulate it.

UNIT-IV: Effect of various stresses on endocrine status of animals, endurances in animals.

Practical

Measurement of various biochemical parameters during stress and /or exercise in animals, measurement of various hormones during different stresses in animals, measurement of cardio-respiratory reactions during stresses.

Suggested Readings

Selected articles from journals.

VPY 790 SPECIAL PROBLEM 0+2 SEM- I, II

Objective

To provide expertise in handling practical research problem(s).

Practical

Short research problem(s) involving contemporary issues and research techniques.

VETERINARY PHYSIOLOGY

List of Journals

- Acta Endocrinologica
- Advances in Clinical Chemistry
- Advances in Reproductive Physiology
- Advances in Veterinary Sciences
- American Journal of Clinical Nutrition
- American Journal of Physiology
- American Journal of Veterinary Research
- Animal Nutrition and Feed Technology
- Animal Reproduction Science
- Animal Sciences
- Annual Review of Physiology
- Buffalo Journal
- Domestic Animal Endocrinology
- Indian Journal of Animal Reproduction
- Indian Journal of Animal Nutrition
- Indian Journal of Animal Physiology
- Indian Journal of Animal Research
- Indian Journal of Animal Science
- Indian Veterinary Journal
- Journal of Endocrinology
- Journal of Physiology
- Journal of Reproduction and Fertility
- Neuroendocrinology

e-Resources

- http://intl-joe, endocrinology-journals.org (Journal of Endocrinology)
- http://intl-ajpcon.physiology.org (American Journal of Physiology)
- http://arjournals.annualreviewes.org (Annual Review of Physiology)
- www.jneurosci.org (Journal of Neuroscience)
- www3.interscience.wiley.com (Journal of Physiology & Animal Nutrition)
- http://jp.physioc.org. (Journal of Physiology)

Suggested Broad Topics for Master's and Doctoral Research

- Manipulation of rumen fermentation to enhance growth and productivity in ruminants.
- Normal renal functions of domestic animals.
- To study the mechanism of regulation of various hormones involved in production and reproduction in domestic animals.
- Dietary effects on growth and production in poultry.

VETERINARY PUBLIC HEALTH AND EPIDEMIOLOGY
Course Structure

COURSE NO.	COURSE TITLE	CREDITS	SEM
VPE 601	ELEMENTS OF VETERINARY PUBLIC HEALTH	2+0	I
VPE 602	MICROORGANISMS OF PUBLIC HEALTH SIGNIFICANCE	3+1	I
VPE 603	ZOONOSES AND PUBLIC HEALTH	2+1	II
VPE 604	PRINCIPLES OF FOOD HYGIENE AND SAFETY	3+1	I
VPE 605	MEAT AND MILK HYGIENE	2+1	II
VPE 606	ENVIRONMENTAL POLLUTION AND SAFETY	2+1	I
VPE 607	PRINCIPLES OF EPIDEMIOLOGY	2+0	I
VPE 608	APPLIED EPIDEMIOLOGY	2+1	II
VPE 609	LIVESTOCK AND POULTRY DISEASE INVESTIGATION	0+2	I
VPE 610	VETERINARY CLINICAL EPIDEMIOLOGY	1+1	II
VPE 691	MASTER'S SEMINAR	1	I, II
VPE 699	MASTER'S RESEARCH	20	I, II
VPE 701	CURRENT TOPICS IN VETERINARY PUBLIC HEALTH	2+0	I
VPE 702	EMERGING AND REEMERGING ZOONOSES	2+1	I
VPE 703	QUALITY CONTROL OF FOODS OF ANIMAL ORIGIN	2+1	I
VPE 704	ADVANCES IN ENVIRONMENTAL POLLUTION CONTROL	1+1	II
VPE 705	RECENT CONCEPTS IN EPIDEMIOLOGY AND DISEASE FORECASTING	2+1	I
VPE 706	HERD HEALTH MANAGEMENT	2+1	I
VPE 707	SURVEY, SURVEILLANCE AND DATA MANAGEMENT	2+1	II
VPE 708	MOLECULAR APPROACHES IN EPIDEMIOLOGY	2+1	II
VPE 790	SPECIAL PROBLEM	0+2	II
VPE 791	DOCTORAL SEMINAR I	1	I, II
VPE 792	DOCTORAL SEMINAR II	1	I, II
VPE 799	DOCTORAL RESEARCH	45	I, II

VETERINARY PUBLIC HEALTH AND EPIDEMIOLOGY
Course Contents

VPE 601 ELEMENTS OF VETERINARY PUBLIC HEALTH 2+0 SEM - I

Objective

To acquaint students with basics of veterinary public health and to update knowledge of disaster, biological weapons, biological hazards and remedial measures, bioterrorism and biomedical hazards and their prevention.

Theory

UNIT-I: The purpose and scope of veterinary public health; veterinary interests in public health, principal functions and fields of activity of public health veterinarians.

UNIT-II: Definition of veterinary public health administration; organization, administration and implementation of veterinary public health services and programmes. Public health team, administration and functions; place of veterinarian in the public health team; veterinary public health agencies and institutions in India and abroad.

UNIT-III: Natural and man made disaster, impact analysis and classification of disaster, scale, essential preparations to manage disaster, role and sequence of emergency medical services by veterinarians, effect of natural disasters like floods, prolonged draughts, forest fires, earthquakes, tsunami and tidal damages, storms etc. on animal population both domestic and wild, post-disaster disease susceptibility, emergency control and remedial measures.

UNIT-IV: Biomedical hazards and biosafety, occupational health risk management, biological weapons, major agents and their characteristics which have been used in the past and those which can be used in future as biological weapons, hazard analysis and combating bioterrorism, bioethics and social ethics, advisory role of veterinarians.

Suggested Readings

Schwabe CW. 1969. *Veterinary Medicine and Human Health*. Williams & Wilkins. Sherikar AT, Bachchil VN & Thapliyal DC. 2004. *Textbook of Elements of Veterinary Public Health*. ICAR.

Singh SK. 1998. *Disaster Management*. Mittal Publications, New Delhi.

VPE 602 MICROORGANISMS OF PUBLIC HEALTH SIGNIFICANCE 3+1 SEM - I

Objective

To impart knowledge about importance and characteristic features of bacterial, viral, fungal, parasitic, chlamydial and rickettsial pathogens of public health significance.

Theory

UNIT-I: Importance of microbes in relation to veterinary public health; cultural, biochemical and other identification characters; ecology, transmission and survivability of bacteria in nature.

UNIT-II: Description of bacterial and viral pathogens of public health significance like *Bacillus, Listeria, Mycobacterium, Clostridium, Staphylococcus, Brucella, Leptospira, Vibrio, Salmonella, Escherichia, Campylobacter, Yersinia, Lactobacillus, Pseudomonas* and *Micrococcus*., Japanese encephalitis, encephalomyelitis, rabies, influenza, KFD, Rift valley fever, enteroviruses etc.

UNIT-III: Description of rickettsial, chlamydial and parasitic agents of public health significance belonging to genera *Coxiella, Rickettsia, Chlamydia. Taenia, Echinococcus, Trichinella, Toxoplasma, Diphyllobothrium, Fasciola, Cryptosporidium, Leishmaniasis,* etc.

UNIT-IV: Description of fungal agents of public health importance belonging to genera: *Aspergillus, Penicillium, Fusarium, Mucor, Histoplasma, Microsporum, Trichophyton* and *Sporotrichum*.

Practical

Isolation and identification methods for important bacterial, fungal, viral, parasitic and rickettsial agents of public health significance from host, vehicle and environment.

Suggested Readings

Ananthanarayan R & Panikar J. 1997. *Textbook of Microbiology*. Orient Longman.

Holt JG, Krieg NR, Sneath PHA, Staley JT & Williams ST. 1994. *Bergey's Manual of Determinative Bacteriology*. Williams & Wilkins.

Pathak KML. 1991. *Fundamentals of Parasitic Zoonoses*. Kalyani.

VPE 603 ZOONOSES AND PUBLIC HEALTH 2+1 SEM - II

Objective

To impart knowledge of epidemiology, prevention and control of important zoonotic diseases.

Theory

UNIT-I: Concept and classification of zoonoses; comprehensive description of etiology, host range, epidemiology, diagnosis and management of zoonotic diseases.

UNIT-II: Bacterial diseases: anthrax, brucellosis, tuberculosis, salmonellosis, yersiniosis, leptospirosis, listeriosis, plague, tularaemia, glanders, malidiosis, staphylococcosis, streptococcosis, tetanus, botulism, infections due to *Clostridium perfringens*, *E. coli*, *Aeromonas hydrophilla*, *Bacillus cereus* and *Vibrio parahaemolyticus*, cat scratch disease, chlamydiosis, Lyme disease, borreliosis (relapsing fever).

UNIT-III: Detailed description of viral zoonoses: influenza, rabies, tickborne encephalitis, FMD, hepatitis A & E, Norwalk, entero, parvo, adeno,76cytomegalo, astro, calci and corona viruses, vector borneviruses viz. Japanese encephalitis, Kyasanur forest disease, chickengunya,Crimean-Congo haemorrhagic fever, dengue fever, West-Nile viruses,yellow fever, rift-valley fever, equine encephalitis, louping ill, and some rare and potential zoonotic viruses such as Newcastle and pox viruses, food-borne viruses viz. rota virus.

UNIT-IV: Q fever and other rickettsiosis, fungal infections viz. dermatophytosis, blastomycosis, coccidioidomycosis, cryptococcosis, histoplasmosis, aspergillosis, candidiasis, rhinosporidiosis and sporotrichosis. Attributes and impact of parasitic zoonoses; description, etiology, host range, epidemiology, diagnosis and disease management of echinococcosis, taeniasis and cysticercosis, toxoplasmosis, trichinellosis, cryptosporidiosis, dracunculosis, fasciolopsiosis, sarcocystosis, liver fluke diseases, cutaneous and visceral larva migrans, schistosomiasis, leishmaniasis, trypanosomosis.

Practical

Isolation and identification of zoonotic agents, diagnostic procedures of zoonotic diseases.

Suggested Readings

Thapliyal DC. 1999. *Diseases of Animals Transmissible to Man*. International Book Distr. Co.

VPE 604 PRINCIPLES OF FOOD HYGIENE AND SAFETY 3+1 SEM - I

Objective

To acquaint the students about principles of food hygiene and quality improvement practices and to impart knowledge about major illnesses due to foods.

Theory

UNIT-I: Relation between veterinary public health and food hygiene; concept of food hygiene, impact of environmental sanitation and other factors on food quality.

UNIT-II: Food-borne bacterial and viral infections and intoxications due to *Salmonella*, *Campylobacter*, *Clostridium*, *Staphylococcus*, *Listeria*, *Vibrio*, *E. coli*, *Bacillus cereus*, bacterial toxins, infectious hepatitis, poliomyelitis, gastroenteritis etc, natural toxic substances in foods.

UNIT-III: Health problems due to food additives, biocides, bacterial toxins, heavy metals, antibiotics, hormones etc. in food. Food spoilage, safety and preservation methods.

UNIT-IV: General principles of prevention of food-borne illnesses, GMP, HACCP, risk analysis, Microbiological standards and quality control (biological and other indicators of hygienic quality and spoilage) of foods to prevent food borne infections.

Practical

Procedures for evaluation of hygienic/microbiological quality of raw and processed foods of animal origin by detection of biological and other indicators, detection and quantitation of food-borne pathogens, toxins, antibiotics, pesticides and additives in foods.

Suggested Readings

Jay JM. 1996. *Modern Food Microbiology*. CBS.

VPE 605 MEAT AND MILK HYGIENE 2+1 SEM - II

Objective

To educate regarding general methods of food hygiene.

Theory

UNIT-I: Principles of food hygiene with special reference to foods of animal origin, human health and economics, nature and problems of food supply in India.

UNIT-II: Meat hygiene and public health, abattoir hygiene. UNIT-III: Milk hygiene and public health, in-place cleaning.

UNIT-IV: Fish hygiene, egg hygiene, meat and milk adulteration, food legislation.

Practical

Milk and meat inspection, quality control tests of meat, milk and fish.

Suggested Readings

Gracey JF, Collins DS & Huey RJ. 1999. *Meat Hygiene*. WB Saunders. Jay JM. 1996. *Modern Food Microbiology*. CBS.

WHO. 1962. *Milk Hygiene*. WHO.

VPE 606 ENVIRONMENTAL POLLUTION AND SAFETY 2+1 SEM - I

Objective

To impart education about pollutants in the environment and their control.

Theory

UNIT-I: Introduction to environmental hygiene, environment and health, microbial aspects of pollution. Soil pollution, air pollution, water pollution and health.

UNIT-II: Genetic risk from environmental agents, health problems from nuclear energy and radiation pollution, environmental estrogens and pesticides pollution.

UNIT-III: Dissemination of excreted pathogens, animal-waste and human risk, principles of safe disposal of waste.

UNIT-IV: Heavy metals, pesticides, veterinary drug residues and human health.

Practical

Determination of potability of drinking water, estimation and detection of pathogenic microbes in water, air, soil, animal products, sewage, animal waste, inspection of sewage and waste disposal plants/sites.

Suggested Readings

Trieff NM. 1980. *Environment and Health*. Ann Arbor Science Publ.

VPE 607 PRINCIPLES OF EPIDEMIOLOGY 2+0 SEM - I

Objective

To familiarize students with epidemiological concepts.

Theory

UNIT-I: Definitions, scope, concepts, types, application and common terms used in epidemiology.

UNIT-II: Host-Agent-Environmental factors in causation of diseases, disease patterns, routes and means of transmission of diseases, their interruption.

UNIT-III: Epidemiological data: its nature, sources, collection/sampling, designing of a questionnaire, storage, retrieval and presentation of data.

UNIT-IV: Disease monitoring and surveillance, epidemiological studies: experimental and

observational, international organizations and laws regulating animal diseases.

Suggested Readings

Martin SW, Meek AH & Willeberg P. 1993. *Veterinary Epidemiology:Principles and Methods*. IBH.

Narayan KG. 2004. *Epidemiology, Diagnosis and Management of Zoonoses*. ICAR. Schwabe CW, Riemann HP & Franti CE. 1984. *Epidemiology in Veterinary Practice*. 3rd Ed. Lea & Fabiger.

Thrusfield M. 2004. *Veterinary Epidemiology*. 8th Ed. Blackwell.

VPE 608 APPLIED EPIDEMIOLOGY 2+1 SEM - II

Objective

To acquaint students with the application of epidemiology in disease diagnosis, prevention and control.

Theory

UNIT-I: Priciples of biosecurity, vaccines and vaccination, disinfection.

UNIT-II: Epidemiological investigations of disease outbreak, modeling, disease forecasting, serological and molecular epidemiology.

UNIT-III: Economics of diseases and different strategies for prevention and control of diseases and syndromes. Disease free zones and zero disease concept.

UNIT-IV: Molecular basis of a disease, application of nucleic acid based assays for genomic characterization of field isolates vis-à-vis vaccine strains, emerging of new strains and vaccination failure.

Practical

Design proforma questionnaires for collection of information on health and diseases in populations, sero-surveys for important diseases of livestock and poultry, investigation of outbreaks, use of computer software in epidemiology. Extraction and isolation of nucleic acid of field isolates and vaccine strains, and their characterization by PCR and other molecular techniques.

Suggested Readings

Martin SW, Meek AH & Willeberg P. 1993. *Veterinary Epidemiology:Principles and Methods*. IBH.

Thomas B. (Ed.). *Applied Veterinary Epidemiology*. Elsevier. Thrusfield M. 2004. *Veterinary Epidemiology*. 8th Ed. Blackwell.

VPE 609 LIVESTOCK AND POULTRY DISEASE INVESTIGATION 0+2 SEM - I

Objective

To expose students to actual field based investigations of diseases in livestock and poultry.

Practical

To attend outbreaks of infectious diseases and toxicological conditions in livestock and poultry in the field and at farms. Recording and analysis of data. Investigation and diagnosis on dead and live diseased animal(s) and poultry. Collection, preservation and transport of material in the face of disease outbreak, and processing of material in the laboratory for diagnosis, isolation of pathogens, antibiotic sensitivity test; screening of animal herds and poultry flocks for certain important diseases. Formulating and advising prevention and control measures. Estimation of Aflatoxins in feed samples and other poisons in suspected outbreaks.

Suggested Readings

Vihan VS. 2002. *Modern Veterinary Laboratory Techniques in Clinical Diagnosis*. CBS. Swayne *et al.* 2006. *A Laboratory Manual for the Isolation and Identification of Avian Pathogens*. IBD.

VPE 610 VETERINARY CLINICAL EPIDEMIOLOGY 1+1 SEM - II

Objective

To familiarize students with various epidemiological approaches for solving field problems.

Theory

UNIT-I: Definitions and epidemiological approaches, measuring frequency of clinical events, incidence, prevalence, occurrence etc., principles of accuracy, precision, linearity, diagnostic sensitivity and specificity.

UNIT-II: Uses of diagnostic tests, evaluation of diagnostic tests, cohort and case control studies.

UNIT-III: Design and evaluation of clinical trials, cost of disease, cost benefit analysis.

Practical

Diseases of multiple etiology: mastitis, diarrhea, abortions, their diagnosis and prevention. Sampling, isolations and antibiotic/ culture sensitivity etc. statistical evaluation of diagnostic assays, sensitivity and specificity of diagnostic tests.

Suggested Readings

Smith RD. 2005. *Veterinary Clinical Epidemiology - a Problem Oriented Approach*. 3rd Ed. Taylor & Francis, CRC.

VPE 701 CURRENT TOPICS IN VETERINARY PUBLIC HEALTH 2+0 SEM - I

Objective

To acquaint with contemporary issues concerning VPH.

Theory

UNIT-I: Contemporary status of Veterinary Public Health administration, organization and functions of veterinary public health agencies in India and abroad.

UNIT-II: Advanced studies on principles, diagnostic methods of emerging public health problems, advances in zoonotic diseases. Role of biotechnology in food hygiene, Hazard Analysis Critical Control Point System (HACCP).

UNIT-III: Health/diseases associated with various occupations: Transportation, spread, maintenance and control of diseases affecting various occupational groups in contact with animals and their public health significance

UNIT-IV: Biohazards and bioterrorism: Case studies, innovative biosecurity approaches, regulations for safety in laboratories, hospitals, biological plants, case studies of natural and man made disasters, approaches for management of disasters, formation of teams/ groups, equipments required for managing such disasters.

Suggested Readings

Goel SL. 2007. *Disaster Administration and Management: Text and Case Studies*. Deep & Deep Publ., New Delhi.

Pinnkowski J. (Ed.). 2008. *Disaster Management Handbook*. CRC Press, Boca Raton. Selected articles from journals.

VPE 702 EMERGING AND RE-EMERGING ZOONOSES 2+1 SEM - I

Objective

To acquaint with emerging and re-emerging zoonotic diseases.

Theory

UNIT-I: Concept of emerging and re-emerging zoonotic infections, international interests in zoonoses, measurement and economics of zoonoses, latest diagnostic and management planning for zoonoses.

UNIT-II: Current challenges and strategies, euzoonoses, xenozoonoses, nosocomial zoonoses, newer zoonotic agents viz. cat-scratch disease, rat bite fever, Creutzfeld-Jacob disease, Ebola, Marburg, Lassa, Nipah, Menangle, Herpes B, SARS.

UNIT-III: Simian and human immunodeficiency, bovine spongiform encephalopathy, hepatitis A & E, toro, influenza viruses; re-emerging zoonoses with new pathology viz. neurocysticercosis, campylobacteriosis, rabies, Guillan-Barre Syndrome, tuberculosis.

Practical

Special problems related to emerging/re-emerging prevalent zoonotic diseases in India.

Suggested Readings

Selected articles from journals.

VPE 703 QUALITY CONTROL OF FOODS OF ANIMAL ORIGIN 2+1 SEM - I

Objective

To provide expertise to student in food quality control.

Theory

UNIT-I: Microorganisms influencing food quality and food safety, principles of microbiological quality control of foods.

UNIT-II: Major food-borne pathogens and spoilage organisms; their significance in consumer safety.

UNIT-III: Detection of microorganisms in foods of animal origin.

UNIT-IV: Importance and maintenance of abattoir and meat plant sanitation, dairy plant sanitation, food plant waste disposal.

Practical

Special problems on microbiological quality of foods of animal origin; detection, enumeration and identification of important food-borne pathogens. Evaluation of sanitation and disinfection procedures in food plants, evaluation of efficacy of disinfectants.

Suggested Readings

Selected articles from journals.

VPE 704 ADVANCES IN ENVIRONMENTAL POLLUTION CONTROL 1+1 SEM - II

Objective

To update knowledge on modern environmental pollution problem and control.

Theory

UNIT-I: Advanced studies on problems pertaining to environmental hygiene, air, soil and water pollution, disinfection procedures, impact of global environmental problems on human/animal health; ecophilosophy, environmental ethics and environmental economics, environmental conflicts and cooperation.

UNIT-II: Environmental risks and management, environmental risk assessment and reporting, modern global information, surveillance and monitoring systems, decision making and public awareness.

UNIT-III: International environmental management efforts, participatory international organizations and their selected programmes and selected legislations.

Practical

Detection and estimation of air, soil and water pollution; detection of pathogens in environmental sources.

Suggested Readings

Selected articles from journals.

VPE 705 RECENT CONCEPTS IN EPIDEMIOLOGY AND DISEASE FORECASTING 2+1 SEM - I

Objective

To learn about different epidemiological aspects of major diseases and to develop suitable disease forecasting system.

Theory

UNIT-I: Review of epidemiological concepts and applications, recent concepts.

UNIT-II: Epidemiology of economically important diseases in the region (haemorrhagic septicemia, foot and mouth disease, surra, brucellosis, PPR, swine fever, IBD, fowl typhoid, avian Influenza, sheep pox etc.

UNIT-III: Geographical Information System and its applications in epidemiology, various expert systems and their role in epidemiology.

UNIT-IV: Modeling and application of various models in disease forecasting. Epidemiological software.

Practical

Epidemiological exercises of economically important diseases in the region, use of Geographical Information System in epidemiology, various expert systems, modeling and various models used in disease forecasting, use of various epidemiological softwares.

Suggested Readings

Noordhuizen JPTM, Franklin K, Thrusfield MV & Graat EAM. 2003. *Application of Quantitative Methods in Veterinary Epidemiology*. IBD.

VPE 706 HERD HEALTH MANAGEMENT 2+1 SEM - I

Objective

Adoption of holistic approach to address issues of herd health without affecting production.

Theory

UNIT-I: General principles, interactions between health and production.

UNIT-II: Dairy cattle: mastitis, brucellosis and haemoprotozoan control and health management of dairy cows and calves.

UNIT-III: Health and production in swine, sheep, goats and poultry.

Practical

Visit to farms, assessment of their problems, systematic programme or control of a specific disease and its impact, economics.

Suggested Readings

Radostits & Blood DC. 1996. *Herd Health*. Book Power.

VPE 707 SURVEY, SURVEILLANCE AND DATA MANAGEMENT 2+1 SEM - II

Objective

To demonstrate different methodologies and procedures involved in conducting survey and surveillance, collection, analysis & interpretation of data.

Theory

UNIT-I: Over-view of concepts of survey and surveillance, purpose and method of sampling, size of sample, questionnaires.

UNIT-II: Goals and types of surveillance, monitoring, mechanism of surveillance and surveillance network.

UNIT-III: Disease/data recording and reporting, vet. recording schemes, vet. information system and data bases.

UNIT-IV: General concepts for emergence of new diseases and re-emergence of old diseases. Epidemiology of globally and nationally important emerging/re-emerging diseases and designing of strategies for their prevention and control.

Practical

Development of questionnaires on selective topics, survey of livestock and poultry farmers to find out usefulness/effectiveness of vaccination/ artificial insemination/ other practices, surveillance of important diseases in different parts of state, analysis and presentation of data, development of suitable software.

Suggested Readings

Selected articles from journals.

VPE 708 MOLECULAR APPROACHES INEPIDEMIOLOGY 2+1 SEM - II

Objective

Learning of recent advanced molecular techniques for establishing disease diagnosis.

Theory

UNIT-I: The concept of molecular basis of a disease, molecular determinants of pathogenicity of infectious agents and their transmissibility to susceptible populations of livestock and poultry.

UNIT-II: Laboratory biosafety, antigenic, genetic and biological characterization of field isolates of pathogens incriminated in field outbreaks, differentiation of field and vaccine strains, the concept of marker vaccines, and correlation of pathotypes and genotypes of a pathogen.

UNIT-III: Immunological tests, immunoblotting techniques and use of monoclonal antibodies in

different ELISAs for antigenic analysis. Application of nucleic acid based assays viz. polymerase chain reaction (PCR) assays, nucleotide sequencing, restriction endonuclease analysis and RFLP analysis for genomic characterization using the field material directly or after extraction of nucleic acid from small scale cultures, use of radio- actively labeled or non radioactive oligo-nucleotide probes in dot-blot and Southern hybridizations.

Practical

Extraction and isolation of nucleic acid from field isolates of the causative pathogens, digestion with restriction endonucleases and electrophoresis in agarose gel in order to obtain fingerprints and their comparative analysis. SDS-PAGE for protein profiling. Western blotting and ELISA for screening of field samples.

Suggested Readings

Selected articles from journals.

VPE 790 SPECIAL PROBLEM 0+2 SEM - I, II

Objective

To provide expertise in handling practical research problem(s).

Practical

Short research problem(s) involving contemporary issues and research techniques.

VETERINARY PUBLIC HEALTH AND EPIDEMIOLOGY
List of Journals

- Abstracts on Hygiene and Communicable Diseases
- Applied and Environmental Microbiology
- Avian Diseases
- Avian Pathology
- British Veterinary Journal
- Emerging Infectious Diseases
- Epidemiology and Infection
- Food Science and Technology Abstracts
- Indian Journal of Comparative Microbiology, Immunology and Infectious Diseases
- Infection and Immunity
- Journal of Food Protection
- Journal of Food Science and Technology
- Journal of Veterinary Public Health
- Letters in Applied Microbiology
- Quarterly Bulletin of O.I.E.
- Tropical Animal Health and Production
- Veterinary Microbiology
- Veterinary Record
- World Animal Health

e-Resources

- www.who.int/zoonoses/vph/en (W.H.O. website related to zoonotic diseases)
- www.fao.org (Website of Food and Agriculture Organization)
- www.cdc.gov (website of CDC publications)
- http://calvados.c3sl.ufpr.br/ojs2/index.php/veterinary/ (Archives of Veterinary Science)
- http://www.pjbs.org/ijps/ijps.htm (International Journal of Poultry Science)
- http://www.medwellonline.net/java/fp.html (Journal of Animal and Veterinary Advances)
- http://www.jstage.jst.go.jp/browse/jpsa (Journal of Poultry Science)
- http://www.jstage.jst.go.jp/browse/jvms/-char/en (Journal of Veterinary Medical Science)
- http://www.cipav.org.co/lrrd/ (Livestock Research for Rural Development)
- http://www.jstage.jst.go.jp/browse/jpestics (Journal of Pesticide Science)
- http://www.vetsci.org (Journal of Veterinary Science)

Suggested Broad Topics for Master's and Doctoral Research

- Prevention and control of emerging and re-emerging food-borne infections and intoxications
- Prevention and control of major zoonotic diseases of local importance
- Environmental pollution and health problems
- Food safety, risk analysis and shelf life
- Food adulteration and food safety
- Molecular and epidemiological studies on infectious diseases of livestock and poultry
- Surveillance of economically important diseases of farm animals and poultry
- Development of immunodiagnostic/ sero-diagnostic tests for field application
- Monitoring of protective immunity induced by vaccines under different schedules
- Diagnostic assay for milk adulterants
- Diagnostic assays and epidemiological studies in respect of toxicants in livestock and poultry feeds

VETERINARY SURGERY AND RADIOLOGY

Course Structure

COURSE NO.	COURSE TITLE	CREDITS	SEM
VSR 601	PRINCIPLES OF SURGERY	2+0	I
VSR 602	CLINICAL PRACTICE - I	0+3	I
VSR 603	CLINICAL PRACTICE - II	0+3	II
VSR 604	SMALL ANIMAL ANAESTHESIA	2+1	I
VSR 605	LARGE ANIMAL ANAESTHESIA	2+1	II
VSR 606	DIAGNOSTIC IMAGING TECHNIQUES	2+1	I
VSR 607	VETERINARY OPHTHALMOLOGY AND DENTISTRY	1+1	II
VSR 608	SMALL ANIMAL SOFT TISSUE SURGERY	2+1	I
VSR 609	LARGE ANIMAL SOFT TISSUE SURGERY	2+1	II
VSR 610	ORTHOPAEDICS AND LIMB SURGERY	2+1	I
VSR 691	MASTER'S SEMINAR	1	I, II
VSR 699	MASTER'S RESEARCH	20	I, II
VSR 701	CLINICAL SURGICAL PRACTICE - I	0+2	I
VSR 702	CLINICAL SURGICAL PRACTICE - II	0+2	II
VSR 703	CLINICAL SURGICAL PRACTICE - III	0+2	I
VSR 704	ANAESTHESIA OF WILD AND LABORATORY ANIMALS	1+1	II
VSR 705	ADVANCES IN ANAESTHESIOLOGY	2+1	I
VSR 706	ADVANCES IN DIAGNOSTIC IMAGING TECHNIQUES	2+1	II
VSR 707	NEUROSURGERY	2+1	I
VSR 708	EXPERIMENTAL SURGICAL TECHNIQUES IN ANIMALS	1+1	II
VSR 789	SPECIAL PROBLEM IN ANAESTHESIA	0+2	I, II
VSR 790	SPECIAL PROBLEM IN SURGERY	0+2	I, II
VSR 791	DOCTORAL SEMINAR I	1	I, II
VSR 792	DOCTORAL SEMINAR II	1	I, II
VSR 799	DOCTORAL RESEARCH	45	I, II

VETERINARY SURGERY AND RADIOLOGY
Course Contents

VSR 601 PRINCIPLES OF SURGERY 2+0 SEM - I

Objective

To impart the basic knowledge of principles of surgery.

Theory

UNIT-I: Wound healing, current concepts of inflammation and management, wound infections, antimicrobial therapy, principles of surgical asepsis, sterilization and disinfection.

UNIT-II: Systemic effects of surgical stress, haemorrhage and haemostasis, metabolism of the surgical patient, fluid therapy in surgical patients, acid-base balance, shock. Hyperalimentation. Blood transfusion. Host defense mechanism.

UNIT-III: Biomaterials, surgical immunity, pre-operative assessment of the surgical patient, post-operative care of the surgical patient. Chemotherapy of tumors.

UNIT-IV: Operating room emergencies, cardio-pulmonary embarrassment and resuscitation, monitoring of surgical patient.

UNIT-V: Principles of laser surgery, cryosurgery, electrosurgery, lithotripsy and endoscopy, physiotherapy, stem cell therapy etc.

Suggested Readings

Fossum TW. (Ed.). 2002. *Small Animal Surgery*. Mosby.

Slatter DH. (Ed.). 2002. *Textbook of Small Animal Surgery*. WB Saunders.

VSR 602 CLINICAL PRACTICE – I 0+3 SEM - I

Objective

To impart practical training in anaesthesia, diagnostic imaging techniques and surgery.

Practical

Client management, public relations, code of conduct, management of surgical affections, designing of surgical hospital, hospital management, database management, attending to surgical cases, surgical facilities, equipments, disaster management.

Suggested Readings

Auer JA. (Ed.). 2006. *Equine Surgery*. WB Saunders. Fossum TW. (Ed.). 2002. *Small Animal Surgery*. Mosby.

Fubini SL & Ducharme NG. (Ed.). 2004. *Farm Animal Surgery*. WB Saunders. Slatter DH. (Ed.). 2002. *Textbook of Small Animal Surgery*. WB Saunders.

VSR 603 CLINICAL PRACTICE – II 0+3 SEM - II

Objective

To impart practical training in surgery, anaesthesia and diagnostic imaging techniques.

Practical

Client management, animal welfare and rehabilitation, public relations, code of conduct, management of surgical affections, designing of surgical hospital, hospital management, database management, attending to surgical cases, surgical facilities, equipments and personnel, disaster management.

Suggested Readings

Auer JA. (Ed.). 2006. *Equine Surgery*. WB Saunders. Fossum TW. (Ed.). 2002. *Small Animal Surgery*. Mosby.

Fubini SL & Ducharme NG. (Ed.). 2004. *Farm Animal Surgery*. WB Saunders. Slatter DH. (Ed.). 2002. *Textbook of Small Animal Surgery*. WB Saunders.

VSR 604 SMALL ANIMAL ANAESTHESIA 2+1 SEM - I

Objective

To impart the basic and practical knowledge of principles of small animal anaesthesia.

Theory

UNIT-I: General considerations for anaesthesia, peri-operative and post-operative pain and its management.

UNIT-II: Sedation: analgesia and pre-medication, anaesthetic agents (injectable anaesthetics, dissociative anaesthetics, inhalation anaesthetics), muscle relaxants, neuromuscular blocking agents and local analgesia.

UNIT-III: Anaesthetic techniques, anaesthetic equipments, artificial ventilation. UNIT-IV: Anaesthesia of small animals, pediatric and geriatric patients, birds.

UNIT-V: Monitoring of anaesthesia, anaesthetic emergencies, complications and their management, euthanasia.

Practical

Anaesthetic equipments and instrumentation, artificial ventilation, use of various preanaesthetic and anaesthetic agents in small animals, anaesthetic triad, balanced anaesthesia, total intravenous anaesthesia.

Suggested Readings

Hall LW & Clarke KW. (Eds.). 1991. *Veterinary Anaesthesia*. Bailliere Tindall. Paddleford RR. (Ed.). 1999. *Manual of Small Animal Anesthesia*. 2nd Ed. WB Saunders. Thurmon JC, Tranquilli WJ & Benson JG. (Eds.). 1996. *Lumb and Jone's Veterinary Anaesthesia*. Williams & Wilkins.

Thurmon JC, Tranquilli WJ & Benson JG. (Eds.). 1999. *Essentials of Small Animal Anesthesia and Analgesia*. Lippincott Williams & Wilkins.

VSR 605 LARGE ANIMAL ANAESTHESIA 2+1 SEM - II

Objective

To impart the basic and practical knowledge of principles of large animal anaesthesia and mechanism of pain.

Theory

UNIT-I: General considerations for anaesthesia, peri-operative pain, and post-operative pain and its management.

UNIT-II: Pre-anaesthetic and anaesthetic adjuncts, injectable anaesthetics, dissociative anaesthetics, inhalation anaesthetics.

UNIT-III: Local anaesthetics, neuromuscular blocking agents.

UNIT-IV: Anaesthetic techniques, anaesthetic machines, breathing systems, artificial ventilation.

UNIT-V: Monitoring of anaesthesia, anaesthetic emergencies and complications, anaesthesia of pediatric and geriatric patients, euthanasia.

Practical

Anaesthetic equipments and instrumentation, artificial ventilation, use of various preanaesthetic and anaesthetic agents in large animals, anaesthetic triad, balanced anaesthesia, total intravenous anaesthesia.

Suggested Readings

Hall LW & Clarke KW. (Eds.). 1991. *Veterinary Anaesthesia*. Bailliere Tindall. Muir WW & John AE. (Eds.). 1991. *Equine Anesthesia*. Mosby.

Thurmon JC, Tranquilli WJ & Benson JG. (Eds.). 1996. *Lumb and Jone's Veterinary Anaesthesia.* Williams & Wilkins.

VSR 606 DIAGNOSTIC IMAGING TECHNIQUES 2+1 SEM - I

Objective

To impart the basic and practical knowledge of principles of diagnostic imaging techniques and interpretation of radiographs, ultrasonograph/CT/ MRI and other imaging techniques.

Theory

UNIT-I: Conventional and digital X-ray machine, quality of radiation, formation of radiograph technique chart, artifacts and their prevention, special diagnostic radiographic procedures, radiographic quality, radiographic accessories, differentiation of radiographic densities in relation to clinical diagnosis.

UNIT-II: Principles of radiographic interpretation, plain and contrast radiographic techniques of small and large animals, image intensification.

UNIT-III: Principles of radiation therapy, medical radioisotope curves, radiation laws and regulations.

UNIT-IV: Principles of ultrasound, basic physics, transducers, equipment controls, display models, terminology of echotexture and artifacts, application of ultrasound in small and large animals.

UNIT-V: Doppler techniques echocardiography and its application, introduction to MRI, CT scan, nuclear medicine, xeroradiography, positron emission tomography technique and other imaging techniques.

UNIT-VI: Electromagnetic radiations, hazards of electromagnetic radiations and protection and bio-safety.

Practical

Acquaintance with imaging equipments, dark room processing techniques and X-ray film handling, formulation of technique chart with fixed kVp and variable mAs, basics of radiographic interpretation of diseases, computer aided image acquisition and retrieval, radiographic positioning of different regions in domestic animals, angiography, cardiac catheterization and other contrast radiographic techniques of different types, interpretation of ultrasonographs, MRI, CT scans etc.

Suggested Readings

Bargai U, Bharr, JW & Morgan JP. (Eds.). 1989. *Bovine Radiology*. Iowa State University Press, Ames.

Bushong SC. (Ed.). 1975. *Radiologic Science for Technologists*. CV Mosby.

Gillette EL, Thrall DE & Lebel JL. (Eds.). 1977. *Carlson's Veterinary Radiology*. Lea & Febiger.

Goddard PJ. (Ed.). 1995. *Veterinary Ultrasonography*. CABI.

Kealy JK. (Ed.). 1987. *Diagnostic Radiology and Ultrasonography in Dogs and Cats*. 2nd Ed. Saunders, Philadelphia.

Morgan JP. (Ed.). 1972. *Radiology in Veterinary Orthopaedics*. Lea & Febiger. Singh AP & Singh J. (Eds.). 1994. *Veterinary Radiology*. CBS.

Thrall DE. (Ed.). 2007. *Textbook of Veterinary Diagnostic Radiology*. 5th Ed. Saunders, Philadelphia.

VSR 607 VETERINARY OPHTHALMOLOGY AND DENTISTRY 1+1 SEM - II

Objective

To impart the basic and practical knowledge of diagnosis and treatment of diseases of eye and teeth in domestic animals.

Theory

UNIT-I: General Anatomical and physiological considerations for ophthalmic surgery. UNIT-II: Ophthalmic examination and diagnosis, local anaesthesia of eye, ocular therapeutics, diagnostic instruments.

UNIT-III: General consideration for eye surgery, diseases and surgery of eye lids, lacrimal

apparatus, naso-lacrimal duct.

UNIT-IV: Diseases of conjuctiva, cornea, sclera, iris, orbit, lens, vitreous and aqueous humor, retina and optic nerve.

UNIT-V: Ocular manifestation of systemic diseases.

UNIT-VI: Anatomy of teeth, examination of teeth. Diseases of teeth- congenital anomalies (retained deciduous teeth, impacted teeth, abnormalities in the shape of teeth). Diseases of teeth- acquired diseases (dental caries, fracture of teeth, endodontic disease, dental materials and dental radiography). Restorative dentistry, periodontal disease, tooth extraction, gum diseases. Current techniques in dentistry.

Practical

Ophthalmic instrumentation, examination of the eye and its adnexa, preparation of patient for eye anaesthesia and surgery, canthotomy, tarsorrhaphy, transplantation of cornea, keratoplasty, anterior chamber paracentasis, flushing of naso-lacrimal duct, iridectomy, lens extraction/implantation. Dentistry instrumentation, dental radiography, teeth cleaning, tooth extraction.

Suggested Readings

Gelatt KN. (Ed.). 1981. *Veterinary Ophthalmology*. Lea & Febiger.

Gelatt KN. (Ed.). 2000. *Essentials of Veterinary Ophthalmology*. Blackwell.

Gelatt KN. (Ed.). 2007. *Atlas of Veterinary Ophthalmology*. 4th Ed. Blackwell Publ. Lavach JD. (Ed.). 1990. *Large Animal Ophthalmology*. CV Mosby.

Oehme FW & Prier JE. (Eds.). 1974. *Textbook of Large Animal Surgery*. Williams & Wilkins.

Slatter DH. (Ed.). 1981. *Fundamentals of Veterinary Ophthalmology*. WB Saunders. Tyagi RPS & Singh J. (Eds.). 1993. *Ruminant Surgery*. CBS.

VSR 608 SMALL ANIMAL SOFT TISSUE SURGERY 2+1 SEM - I

Objective

To familiarize with various surgical affections of different body systems and their treatment in small animals.

Theory

UNIT-I: Skin and adnexa- the integument, management of skin wounds, principles of plastic and reconstructive surgery, pedicle grafts, skin grafts, burns, electrical chemical and cold injuries.

UNIT-II: Surgical approaches/ affections of ear, oral cavity and pharynx, abdomen, thorax, the salivary glands, oesophagus, stomach, intestines, rectum and anus, liver and biliary system, pancreas.

UNIT-III: Hernias- abdominal hernia, diaphragmatic hernia, perineal hernia, inguinal, scrotal, and umbilical hernia etc. Surgical approaches to thoracic wall, Pleura.

UNIT-IV: Respiratory system- functional anatomy, diseases of upper respiratory system and lower respiratory system.

UNIT-V: Surgical anatomy of the cardiovascular system, cardiovascular physiology, diagnostic methods, cardiac disorders, principles of vascular surgery, basic cardiac procedures, hypothermia, basic peripheral vascular procedures, peripheral vascular disorders, portacaval shunts and anomalies. Haemolymphatic system, bone marrow, spleen, tonsils, lymph nodes and lymphatics, thymus.

UNIT-VI: Male reproductive system- anatomy of the male genital organs, diagnostic and biopsy techniques, surgical affections of male genital organs; female reproductive system- anatomy, diagnostic techniques, surgical affections of female genital organs.

UNIT-VII: Urinary system- anatomy of the urinary tract, principles of urinary tract surgery, kidneys, ureters, surgery of the bladder, surgical diseases of the urethra, medical dissolution and prevention of canine uroliths, feline urologic syndrome.

UNIT-VIII: Endocrine system- pituitary, adrenals, thyroid, parathyroid, surgical affections of mammary glands and tail. Surgical affections of nervous system, special sense organs.

Practical

Practice of various surgical techniques of skin and adnexa, alimentary system, hernias, respiratory system, cardiovascular system, male and female reproductive systems, urinary system, mammary glands and tail.

Suggested Readings

Fossum TW. (Ed.). 2002. *Small Animal Surgery*. Mosby.

Slatter DH. (Ed.). 2002. *Textbook of Small Animal Surgery*. WB Saunders.

VSR 609 LARGE ANIMAL SOFT TISSUE SURGERY 2+1 SEM - II

Objective

To familiarize with various surgical affections of different body systems and their treatment in large animals.

Theory

UNIT-I: Abdominal wall, integumentary system - skin and appendages; mammary gland, tail, affections of oral cavity.

UNIT-II: Surgical affections of respiratory system, cardiovascular and lymphatic system. UNIT-III: Surgical affections of digestive system, urinary and genital system.

UNIT-IV: Surgical affections of nervous system, special sense organs.

Practical

Practice of various surgical techniques of skin, alimentary system, hernias, respiratory system, cardiovascular system, male and female reproductive system, urinary system, mammary glands and tail. Surgical affections of nervous system, special sense organs.

Suggested Readings

Auer JA. (Ed.). 2006. *Equine Surgery*. WB Saunders.

Fubini SL & Ducharme NG. (Eds.). 2004. *Farm Animal Surgery*. WB Saunders.

Oehme FW & Prier JE. (Ed.). 1994. *Textbook of Large Animal Surgery*. Williams & Wilkins.

Tyagi RPS & Singh J. (Eds.). 1993. *Ruminant Surgery*. CBS.

VSR 610 ORTHOPAEDICS AND LIMB SURGERY 2+1 SEM - I

Objective

To familiarize with various affections of bones, joints, tendons, ligaments and foot as well as their treatment in animals.

Theory

UNIT-I: Fractures and dislocations, fracture healing, ligaments and tendons - repair techniques.

UNIT-II: Treatment of fractures of different bones in domestic animals, bone diseases. UNIT-III: Various affections of the joints, their diagnosis and treatment.

UNIT-IV: Conformation of the limb, anatomy of hoof.

UNIT-V Lameness and allied surgical conditions of fore limbs/hind limbs, rehabilitation of orthopaedic patient.

Practical

Internal and external fixation of fractures and dislocation, arthrotomy, tenotomy, examination of limbs for lameness, nerve blocks, injections in joints, operations for arthritis, hoof surgery and corrective shoeing, physiotherapy. Instrumentation, neurological examination, imaging the spine; skull and brain, surgical approach to the cervical spine; thoracolumbar spine and brain.

Suggested Readings

Auer JA. (Ed.). 2006. *Equine Surgery*. WB Saunders.

Fubini SL & Ducharme NG. (Eds.). 2004. *Farm Animal Surgery*. WB Saunders.

Newton CD & Nunamaber DM. (Eds.). 1985. *Textbook of Small Animal Orthopaedics*. JB Lippincott.

Oehme FW & Prier JE. (Eds.). 1974. *Textbook of Large Animal Surgery*. Williams & Wilkins.

Tyagi RPS & Singh J. (Eds.). 1993. *Ruminant Surgery*. CBS.

VSR 701 CLINICAL SURGICAL PRACTICE – I 0+2 SEM - I

Objective

To impart practical training in surgery, anaesthesia and diagnostic imaging techniques.

Practical

Client management, public relations, code of conduct, management of surgical affections, designing of surgical hospital, hospital management, database management, attending surgical cases, surgical facilities, equipments and personnel.

VSR 702 CLINICAL SURGICAL PRACTICE – II 0+2 SEM - II

Objective

To impart practical training in surgery, anaesthesia and diagnostic imaging techniques.

Practical

Client management, public relations, code of conduct, management of surgical affections, designing of surgical hospital, hospital management, database management, attending surgical cases, surgical facilities, equipments and personnel.

VSR 703 CLINICAL SURGICAL PRACTICE – III 0+2 SEM - I

Objective

To impart practical training in surgery, anaesthesia and diagnostic imaging techniques.

Practical

Client management, public relations, code of conduct, management of surgical affections, designing of surgical hospital, hospital management, database management, attending surgical cases, surgical facilities, equipments and personnel.

VSR 704 ANAESTHESIA OF WILD AND LABORATORY ANIMALS 1+1 SEM - II

Objective

To impart the basic and practical knowledge of chemical immobilization, sedation and anaesthesia of laboratory animals, captive and free ranging wild animals.

Theory

UNIT-I: General considerations in chemical restraint of captive and free ranging wild animals.

UNIT-II: Methods of administration of anaesthesia in captive, free ranging animals and laboratory animals.

UNIT-III: Local and general anaesthesia in exotic species, wild animals, zoo animals and laboratory animals.

UNIT-IV: Anaesthetic emergencies and complications.

Practical

Familiarization with capture equipments, local anaesthetic techniques, use of various preanaesthetic and anaesthetic agents in laboratory animals, monitoring of patient during general anaesthesia.

Suggested Readings

Selected articles from journals.

VSR 705 ADVANCES IN ANAESTHESIOLOGY 2+1 SEM - I

Objective

To impart the advanced knowledge of animal anaesthesia.

Theory

UNIT-I: Considerations for general anaesthesia, drug interactions in anaesthesia, perioperative pain and distress, effects of anaesthetics on CNS function.

UNIT-II: Pharmacology of preanaesthetics and anaesthetic adjuncts; injectable anaesthetics; dissociative anaesthetics; inhalation anaesthetics; local anaesthetics; muscle relaxants and neuromuscular blocking agents.

UNIT-III: Anaesthetic machines and breathing system, airway management and ventilation,

acid-base physiology and fluid therapy during anaesthesia, monitoring of anaesthetized patients, anaesthetic emergencies and accidents.

UNIT-IV: Anaesthesia for selected diseases (cardiovascular dysfunction, pulmonary dysfunction, neurologic diseases, renal diseases, hepatic diseases, gastrointestinal diseases, endocrine diseases, airway diseases).

UNIT-V: Anaesthesia for special patients (ocular patients, heart patients, caesarian section patients, trauma patients, neonatal and geriatric patients), euthanasia.

Practical

Various procedures for catheterization of heart and great vessels, haemodynamic changes and pulmonary function tests during trials of anaesthetics, electrocardiographic, encephalographic evaluation of central nervous system activity, cybernetics, data acquisition and retrieval.

Suggested Readings

Selected articles from journals.

VSR 706 ADVANCES IN DIAGNOSTIC IMAGING TECHNIQUES 2+1 SEM - II

Objective

To impart the advanced theoretical and practical knowledge of diagnostic imaging techniques and their interpretations.

Theory

UNIT-I: Biological effects of radiations (alpha, beta, X-ray and gamma rays) *in vivo* and *in vitro* cellular response following radiation as an immunosuppressive agent.

UNIT-II: Isotopes (natural and man-made); cyclotron reactor, half-life, decay pattern, storage and handling of radioactive material, fluoroscopy, magnetic resonance imaging and computerised axial tomography, xeroradiography, doppler techniques, indications for ultrasound diagnosis.

UNIT-III: Methods in the detection of isotopes, Geiger-Mullar tubes, photo-multiplier tube, medical use of isotope, dosimetry, nuclear medicine and its use in diagnosis of thyroid, kidney, bone and liver function studies.

UNIT-IV: Labelling of isotope and biological uses, detonation and fission products.

UNIT-V: Radiation therapy in cancer patients, biological effects of radiation physics, physics of radiation.

UNIT-VI: Doppler techniques echocardiography and its application, MRI, CT scan, nuclear medicine, xeroradiography, positron emission tomography technique etc.

UNIT-VII: Electromagnetic radiations, hazards of electromagnetic radiations and protection and bio-safety.

Practical

Radiation safety measures, handling radioactive material, measurement of thyroid function and cardiac output, demonstration of advanced radiological techniques.

Suggested Readings

Selected articles from journals.

VSR 707 NEUROSURGERY 2+1 SEM - I

Objective

To impart theoretical and practical knowledge of treatment of surgical affections of nervous system in animals.

Theory

UNIT-I: Nervous system- anatomy and physiology.

UNIT-II: Clinical neurology, pathogenesis of disease of the central nervous system. UNIT-III: Diagnostic methods- electrodiagnostic methods, neuroradiology.

UNIT-IV: Fundamentals of neurosurgery, surgical approaches to brain, surgical diseases of peripheral nerves, surgical approaches to the spine, diseases of the spinal column, intervertebral disc diseases.

UNIT-V: Intracranial surgery.

Practical

Instrumentation, neurological examination, imaging the spine; skull and brain, surgical approach to the cervical spine; thoracolumbar spine and brain.

Suggested Readings

Selected articles from journals.

VSR 708 EXPERIMENTAL SURGICAL TECHNIQUES IN ANIMALS 1+1 SEM - II

Objective

To familiarize with designing of experiments and various surgical models for research.

Theory

UNIT-I: General considerations and protocols for designing experiments.

UNIT-II: Surgical models of various systems. Care and feeding of genobiotic experimental animals.

UNIT-III: Rumen and intestinal fistulae, production of experimental peritonitis and ascitis, nephrectomy, adrenalectomy.

UNIT-IV: Cannulation of various blood vessels and lymphatics, portacaval shunt. UNIT-V: Principles of transplantation of organs and use of prosthetic material.

UNIT-VI: Tissue engineering-*in vitro*, *in vivo*, *ex vivo* techniques, regenerative therapy.

Practical

Various experimental surgical techniques and special problems related to veterinary surgery, radiology and anaesthesiology, transplantation of skin, fascia, tendon and blood vessels.

Suggested Readings

Selected articles from journals.

VSR 789 SPECIAL PROBLEMS IN ANAESTHESIA 0+2 SEM - I, II

Objective

To impart practical exposure to experimental models related to anaesthesia for research.

Practical

Investigative anaesthetic problems in clinical or experimental models. Didactic and interpersonnel learning-teaching, problem solving self-learning strategies in problems related to anaesthesia.

VSR 790 SPECIAL PROBLEMS IN SURGERY 0+2 SEM - I, II

Objective

To impart practical exposure to experimental models related to surgery for research.

Practical

Investigative surgical problems in clinical or experimental models. Didactic and interpersonnel learning-teaching, problem solving self-learning strategies in problems related to surgery.

VETERINARY SURGERY AND RADIOLOGY
List of Journals

- American Journal of Veterinary Research
- Australian Veterinary Journal
- British Veterinary Journal
- Canadian Veterinary Journal
- Compenduim of continuing Education for the practicing Veterinarian
- Cornell Veterinarian
- Equine Practice
- Equine Veterinary Journal
- Indian Journal of Veterinary Research
- Indian Journal of Veterinary Surgery
- Indian Veterinary Journal
- Journal of American Veterinary Medical Association
- Journal of American Animal Hospital Association
- Journal of Bone and Joint Surgery –A & B
- Modern Veterinary Practice
- Journal of Camel Practice and Research
- Journal of Veterinary Emergency and Critical Care
- Journal of Small Animal Practice
- Journal of Veterinary Dentistry
- Journal of Veterinary Medicine – Series A
- Veterinary Anaesthesia and Analgesia
- Veterinary clinics of North America – Small animal practice
- Veterinary clinics of North America – Equine practice
- Veterinary clinics of North America – Exotic animal practice
- Veterinary clinics of North America – Large animal practice
- Veterinary clinics of North America – Food animal practice
- Veterinary Ophthalmology
- Veterinary Radiology and Ultrasound
- Veterinary Record
- Veterinary Research Communication
- Veterinary Surgery

e-Resources

- www.blackwellpublilshing.com/journalasp (Veterinary Surgery)
- www.blackwellpublilshing.com/summit.asp (Veterinary anesthesia and Analgesia)
- www.blackwellpublilshing.com/journalasp (Veterinary Radiology and Ultrasound)
- www.blackwellpublilshing.com/journalasp (Veterinary Ophthalmology)
- www.indianjournal.com/ijor.aspx (Indian Journal of Veterinary Surgery)

Suggested Broad Topics for Master's and Doctoral Research

- Evaluation of preanaesthetics and anaesthetics in domestic and laboratory animals
- Management of pain in animals
- Management of surgical disorders of different body systems in domestic animals
- Diagnostic imaging in animals

ANIMAL GENETICS AND BREEDING
Course Structure

COURSE NO.	COURSE TITLE	CREDITS	SEM
AGB 601*	ANIMAL CYTOGENETICS AND IMMUNOGENETICS	2+1	I
AGB 602	MOLECULAR GENETICS IN ANIMAL BREEDING	2+1	II
AGB 603*	POPULATION AND QUANTITATIVE GENETICS IN ANIMAL BREEDING	2+1	I
AGB 604*	SELECTION METHODS AND BREEDING SYSTEMS	3+1	II
AGB 605*	BIOMETRICAL TECHNIQUES IN ANIMAL BREEDING	3+1	I
AGB 606	CONSERVATION OF ANIMAL GENETIC RESOURCES	2+0	I
AGB 607	CATTLE AND BUFFALO BREEDING	2+1	II
AGB 608	SMALL FARM ANIMAL BREEDING	2+0	II
AGB 609	POULTRY BREEDING	2+1	I
AGB 610	LABORATORY ANIMAL BREEDING	1+0	II
BST 612	STATISTICS FOR BIOLOGICAL SCIENCES	2+1	I, II
AGB 691	MASTER'S SEMINAR	1	I, II
AGB 699	MASTER'S RESEARCH	20	I, II
AGB 701	RECENT ADVANCES IN ANIMAL GENETICS	2+0	I
AGB 702	RECENT TRENDS IN ANIMAL BREEDING	2+0	II
AGB 703	ADVANCES IN BIOMETRICAL GENETICS	2+1	1I
AGB704**	ADVANCES IN SELECTION METHODOLOGY	2+1	I
AGB 705	BIOINFORMATICS IN ANIMAL GENETICS AND BREEDING	2+0	I
AGB 706	ADVANCES IN MOLECULAR CYTOGENETICS	2+0	II
AGB707**	UTILIZATION OF NON-ADDITIVE GENETIC VARIANCE IN FARM ANIMALS	2+1	I
AGB 791	DOCTORAL SEMINAR I	1	I, II
AGB 792	DOCTORAL SEMINAR II	1	I, II
AGB 799	DOCTORAL RESEARCH	45	I, II

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

ANIMAL GENETICS AND BREEDING
Course Contents

AGB 601 ANIMAL CYTOGENETICS AND IMMUNOGENETICS 2+1 SEM - I

Objective

To educate about basic principles of cytogenetics and immunogenetics and their applications in improving farm animals.

Theory

UNIT-I: Development in animal cytogenetics and immunogenetics of farm animals. Immunoglobulins and their types: antigen-antibody interactions, Immune response, ELISA.

UNIT-II: Major histocompatibility complex; genetics of biochemical variants and their applications; Ir-genes and concepts of disease resistance including major genes; hybridoma and its significance; concept of immuno-fertility, BoLA, BuLA, TLRs, Interleukins.

UNIT-III: Chromatin structure of eukaryotes; chromosome number and morphology in farm animals banding and karyotyping; chromosomal and genetic syndromes, DNA packing in chromosomes, Z+B DNA, FISH chromosome painting and PRINS. RH Panel Mapping.

UNIT-IV: Mutation and assays of mutagenesis; sister chromatid exchanges; recombinant DNA technique and its application in animal improvement programme.

Practical

Polymorphism of haemoglobulins, transferrins, enzymes/proteins; preparation of monovalent blood reagent-isoimmunization, titre testing and absorption of polyvalent serum; identification of bar bodies; in vitro and in vivo preparation of somatic metaphase chromosomes; screening of chromosomal abnormalities; microphotography and karyotyping; banding procedures for comparing the chromosomal complement, FISH and PRINS.

Suggested Readings

Hare WCD & Elizabeth L Singh 1999. *Cytogenetics in Animal Reproduction*. CABI. Roitt I. 1997. *Essential Immunology*. Blackwell.

Stine GJ. 1989. *The New Human Genetics*. Wm C Brown Publ.

Summer AT & Chandley AC. 1993. *Chromosome Today*. Chapman & Hall.

AGB 602 MOLECULAR GENETICS IN ANIMAL BREEDING 2+1 SEM - II

Objective

To educate about molecular techniques to identify molecular markers as an aid to selection.

Theory

UNIT-I: Basic concept: Genesis and importance of molecular techniques; Genome organization – physical and genetic map, current status of genome maps of livestock.

UNIT-II: Molecular markers and their application; RFLP, RAPD, Microsatellite/ Minisatellite markers, SNP marker, DNA fingerprinting.

UNIT-III: DNA sequencing, Genome sequencing, Genomic Library, Polymerase Chain Reaction (PCR), its types (PCR-RFLP, AS-PCR etc.) and applications; Transgenesis and methods of gene transfer.

UNIT-IV: Statistical techniques for analyzing molecular genetic data, Quantitative Trait Loci (QTL) mapping and its application in animal breeding, Genome scan, Candidate gene approach, Genomic selection, Marker Assisted Selection- basic concept.

Practical

Extraction and purification of genomic DNA, Gel electrophoresis, Restriction enzyme digestion of DNA and analysis, PCR, PCR-RFLP, PCR-SSCP, Bioinformatics tool for

DNA sequence analysis, Design of primer, Isolation of RNA, cDNA synthesis, Statistical methods for analyzing molecular genetic data.

Suggested Readings

Akano IE 1992. *DNA Technology*. IAP Academic Press.

Micklos DA, Fryer GA & Crotty DA. 2003. *DNA Science*. Cold Spring Harbour. Setlow JK. 2006. *Genetic Engineering – Principles and Methods*. Springer.

AGB 603 POPULATION AND QUANTITATIVE GENETICS IN ANIMAL BREEDING 2+1 SEM - I

Objective

To study genetic structure of animal population and importance of genetic variation and covariation among traits.

Theory

UNIT-I: Individual verses population. Genetic Structure of population. Factors affecting changes in gene and genotypic frequencies and their effect on genetic structure of animal popultions. Approach to equalibrium under differnet situations: Viz: Single autosomal locus with two alleles, single sex-linked locus, two pairs of autosomal linked and unlinked loci.

UNIT-II: Small population: random genetic drift, effective popultion size, pedigreed populations, regular and irregular inbreeding systems.

UNIT-III: Quantitative genetics-gene effects, population mean and variance and its partitioning, biometric relations between relatives.

UNIT-IV : Genetic and phenotypic parameters-their methods of estimation, uses, possible biases and precision. Scale effects and threshold traits.

Practical

Problems relating to gene and genotypic frequencies under different conditions. Estimation orf inbreeding in regular and irregular systems. Estimation of effective population size. Computation of quantiatative genetic effects. Estimation of variance components. Computation of heritability, repeatability, genetic, environmental and phenotypic correlations and their standard errors.

Suggested Readings

Bulmer MG. 1980. *The Mathematical Theory of Quantitative Genetics*. Clarendon Press. Crow JF & Kimura M. 1970. *An Introduction to Population Genetics. Theory*. Harper & Row.

Falconer DS & Mackay TFC. 1996. *An Introduction to Quantitative Genetics*. Longman. Jain JP. 1982. *Statistical Techniques in Quantitative Genetics*. Tata McGraw-Hill.

Pirchner F. 1981. *Population Genetics in Animal Breeding*. S. Chand.

AGB 604 SELECTION METHODS AND BREEDING SYSTEMS 3+1 SEM - II

Objective

To explain the methodology of selection and breeding systems for genetic improvement of livestock and poultry.

UNIT-I: Type of selection and their genetic consequences. Response to selection and its prediction and improvement of response to selection.

UNIT-II: Theoretical aspects of accuracy and efficiency of different base of selection. Prediction of breeding value using different criteria. Combined Selection. Correlated response to selection and efficiency of indirect selection.

UNIT-III: Selection of several traits. Evaluation of short term and long term selection experiments viz: bidirectional selection and asymmetry of response, selection plateux and limit.

UNIT-IV: Genetic aspects and consequences of various mating systems. Effects of mating systems on mean and variance. Application of various mating system in animal improvement. Selection for general and specific combining ability. Genetic polymorphysim and its application in genetic improvement.

Practical

Estimation of breeding values from different sources of information. Prediction of direct and correlated response to different bases of selection. Computation of breeding values using different sources of information for female and male selection. Compuatation of realized heritability and genetic correlation. Selection index: Computation, Accuracy and response in component traits.Estimation of hetrerosis for different types of crosses. Estimation of GCA and SCA.

Suggested Readings

Falconer DS & Mackay TFC. 1996. *An Introduction to Quantitative Genetics*. Longman. Jain JP. 1982. *Statistical Techniques in Quantitative Genetics*. Tata McGraw-Hill.

Tomar SS 1996. *Text Book of Population Genetics*. Vol. I. *Qualitative Inheritance*; Vol. II. *Quantitative Inheritance*. Universal Publ.

AGB 605 BIOMETRICAL TECHNIQUES IN ANIMAL BREEDING 3+1 SEM - I

Objective

To educate about the various biometrical techniques for data analysis and their applications in animal breeding research.

Theory

UNIT-I: Review of basic concepts in statistical inference and balanced experimental designs. Nature of structure of animal breeding data and sources of variation.

UNIT-II: Introduction to matrix algebra, types of matrices and matrix operations. Determinants and their properties, methods of finding inverse of a matrix and their application.

UNIT-III: ANOVA, Regression and Correlations, Henderson's methods for estimation of variance components, Basic concepts of linear models, Least-squares analysis, maximum likelihood; Method of estimation; Generalized LS and weighted LS. Fisher's discriminant function and its application, D^2 - Statistics in divergent analysis.

UNIT-IV: Linear models in animal breeding, Methods of analysis of unbalanced animal breeding data. Adjustment of data. Data base management and use of software packages in animal breeding.

Practical

Matrix applications, determinant and inverse of matrices; Building of models for various types of data; Estimation of variance components; Least squares method for analysis of research data; Collection, compilation, coding, transformation and analysis of animal breeding data by using above biometrical techniques with computer application.

Suggested Readings

Henderson CR. 1984. *Application of Linear Models in Animal Breeding*. Univ. of Guelph. Kaps M & Lamberson WR. 2004. *Biostatistics for Animal Science*. CABI.

Mather K & Jinks Jl. 1977. *Introduction to Biometrical Genetics*. Chapman & Hall. Searle Sr. 1971. *Linear Models*. John Wiley & Sons.

Singh RK & Choudhary BD. 1977. *Biometrical Methods in Quantitative Genetic Analysis*. Kalyani.

AGB 606 CONSERVATION OF ANIMAL GENETIC RESOURCES 2+0 SEM - I

Objective

To educate about the concept of conservation of Animal Genetic Resources and their sustainable utilization.

Theory

UNIT-I: Domestic Animal Diversity in India, its origin, history and utilization. Present status and flow of Animal Genetic Resources and its contribution to livelihood security. Methodology for genotypic characterization of livestock and poultry breeds through systematic surveys. Fodder availability; management of breed; physical, biochemical and performance traits and uniqueness of animals of a breed; social, cultural and economic aspects of their owners/communities rearing the breed.

UNIT-II: Methodology for molecular genetic characterization, diversity analysis and relationship among the breeds. Concept of conservation, *In-situ* and *ex-situ* (*invivo* and *in- vitro*); models of conservation; prioritization of breeds for conservation. National and international strategies for conservation of Animal Genetic Resources.

UNIT-III: Status, opportunities and challenges in conservation of AnGR. IPR issues pertaining to animal genetic resources/animal products or by-products. Registration of livestock breeds and protection of livestock owner's rights in India.

Suggested Readings

Lasley JF. 1987. *Genetics of Livestock Improvement*. 3rd Ed. IBH. Nicholas FW. 1987. *Veterinary Genetics*. Claredon Press.

Ross CV. 1989. *Sheep Production and Management*. Prentice Hall.

Schmidt GM & Van Vleck LD. 1974. *Principles of Dairy Science*. WH Freeman.

Van Vleck LD, Pollak EJ & Bltenacu EAB. 1987. *Genetics for Animal Sciences*. WH Freeman.

AGB 607 CATTLE AND BUFFALO BREEDING 2+1 SEM - II

Objective

To educate about the concept of cattle and buffalo breeding.

Theory

UNIT-I: History of dairy cattle and buffalo breeding. Breeds of cattle and buffallo and their Characterisation.Inheritance of important economic traits. Recording and handeling of breeding data. Standardization of records. Computation of correction factors for the adjustment of the data. Estimation of breeding values of the cows and bulls.

UNIT-II: Sire evaluation methods using single trait and multiple traits: construction of Sire indices, Sire evaluation under animal model, sire mode; and maternal grand sire model. Open nucleus breeding systems with MOET.

UNIT-III: Methods of cross breeding.Breeding of type, milk quality and production efficency. Plans for developing new breeds of dairy cattle. History of development of important breeds of dairy cattle.

UNIT-IV: Considerations in the import of exotic germplasm for breeding cattle in the tropics. Appraisal of buffalo and cattle breeding programme. Role of breed assocaitions in dairy improvement.

Practical

Performance recording – milk recording - Estimation of economic traits – Standardization of records – Index cards – Sire evaluation –Comparison of latest methods - Computation of genetic parameters – Genetic gain – Estimation of heterosis – Culling and replacement.

Suggested Readings

Lasley JF. 1987. *Genetics of Livestock Improvement*. 3rd Ed. IBH. Nicholas FW. 1987. *Veterinary Genetics*. Claredon Press.

Ross CV. 1989. *Sheep Production and Management*. Prentice Hall.

Schmidt GM & Van Vleck LD. 1974. *Principles of Dairy Science*. WH Freeman.

Van Vleck LD, Pollak EJ & Bltenacu EAB. 1987. *Genetics for Animal Sciences*. WH Freeman.

AGB 608 SMALL FARM ANIMAL BREEDING RESOURCES 2+0 SEM - II
(Sheep, Goat, Swine and Rabbit)

Objective

To educate about the small farm animal breeding concepts.

Theory

UNIT-I: Breeds–Economic traits–Prolificacy-Breeding records and standardization.

UNIT-II: Genetic parameters – Selection of males and females – Breeding systems. Development of new breeds.

UNIT-III: Breeding policy – Breeding research – Conservation of breeds. UNIT-IV: Culling and replacement – EADR.

Suggested Readings

Ross CV. 1989. *Sheep Production and Management*. Prentice Hall.

Turner HN & Young SSY. 1969. *Quantitative Genetics in Sheep Breeding*. MacMillan. Van Vleck LD, Pollak EJ & Bltenacu EAB. 1987. *Genetics for Animal Sciences*. WH Freeman.

AGB 609 POULTRY BREEDING 2+1 SEM - I

Objective

To educate about the advances in poultry breeding practices.

Theory

UNIT-I: Origin and history of poultry species: Chicken, turkey, duck and quail – Important qualitative traits in poultry including lethals – Economic traits of egg-type chicken and their standardization – Selection criteria – Aids to selection: Index selection and Osborne index – Restricted selection index – Economic traits of meat – type chicken and their standardization.

UNIT-II: Selection criteria and selection indices – Response to selection – Genetic controls – Genotype and environment interaction – Inbreeding, and its effects on production traits in egg and meat-type chickens – Inbred lines – Strain development – Crossing : strain and line crosses – Introduction to diallel cross – Utilisation of heterosis and reciprocal effect – Reciprocal recurrent selection and recurrent selection.

UNIT-III: Industrial breeding – Artificial insemination in chicken – Autosexing – Random Sample Test.

UNIT-IV: Biochemical variants and immunogenetics of poultry – Use of molecular genetics in poultry breeding – Quantitative trait loci and marker–assisted selection – Conservation of poultry genetic resources.

Practical

Inheritance of qualitative traits – Economic traits of egg-type and meat-type chicken – Procedures of standardization – Estimations of heritability, correlation between various production traits, inbreeding co-efficient and heterosis – Selection of sires and dams – Osborne index – Restricted selection index – Collection and evaluation of semen and insemination – Diallel cross.

Suggested Readings

Crawford RD.1990. *Poultry Breeding and Genetics*. Elsevier. Hutt FB. 2003. *Genetics of Fowl*. Norton Greek Press.

Singh RP & KumarJ. 1994. *Biometrical Methods in Poultry Breeding.* Kalyani.

AGB 610 LABORATORY ANIMAL BREEDING 1+0 SEM - II

Objective

To educate about the laboratory animal breeding principles.

Theory

UNIT-I: Introduction to laboratory animal genetics – Breeding colonies of mice, rats, hamsters, guinea pigs and rabbits.

UNIT-II: Selection and mating methods/systems – mongamous, polygamous and others. UNIT-III: Development of genetically controlled laboratory animals – Rules for nomenclature, inbred strains, outbred stocks, mutant stocks, recombinant inbred strains, transgenic strains, gene targeting and production of 'gene knock-out' animals.

UNIT-IV: Genetic control and monitoring – Record keeping – Ethics of laboratory animal use.

Suggested Readings

Van Vleck LD, Pollak EJ & Bltenacu EAB. 1987. *Genetics for Animal Sciences*. WH Freeman.

AGB 701 RECENTADVANCES IN ANIMAL GENETICS 2+0 SEM - I

Objective

To impart knowledge about the latest tools and techniques of animal genetics and their uses in animal sciences.

Theory

UNIT-I: Eukaryotic genome: Gene families, Pseudogenes SnRNPs, Gene conversion, tandemly repeated genes, Nuclear Organiser region, mRNA splicing, Minisatellites, Microsatellites and its usage.

UNIT-II: Transprosons, RNA processing Transcuplion regulation of gene expression, selective gene amplification, post transceptional regulation. The proteasome and longevity of proteins.

UNIT-III: Transgenic animals their benefits in livestock production, somatic cell nuclear transfer, transgenic animals in biomedical research, ethical consideration of transgenic animals; gene therapy and transgenic animal production. Pharming of Pharmaceutical.

UNIT-IV: Radiation hybrid panels and their usage in livestock, microdissection of chromosomes, *In-situ* hybridization, chromosome painting, meiotic crossing over, genome selection; Structure and functions of major histocompatibility complex, T Cell receptor, CD4, Toll Like Receptors and their functions.

Suggested Readings

Selected articles from journals.

AGB 702 RECENT TRENDS IN ANIMAL BREEDING 2+0 SEM - II

Objective

To acquaint with recent trends in animal breeding and designing of need-based breeding strategies.

Theory

UNIT-I: Biometrical models and their analytical techniques on simulated and actual animal breeding data using computer application and use of programme in the field of animal breeding.

UNIT-II: Formulation of detailed breeding plans ongoing breed improvement programmes and their impact analysis in various species of livestock under different situations.

UNIT-III: Advanced techniques in genetic manipulation for multiplication and improvement of livestock species.

Suggested Readings

Selected articles from journals.

AGB 703 ADVANCES IN BIOMETRICAL GENETICS 2+1 SEM - II

Objective

To impart knowledge about recent advances in population genetic theory and application in animal breeding.

Theory

UNIT-I: Mating designs; genetic basis of tripple test cross analysis (TTC); triallel analysis, partial diallel crosses and mating design for studying reciprocal and maternal differences.

UNIT-II: Models for studying the inheritance of endosperm characters; classificatory problems; discriminant function, D^2 analysis; principal component analysis.

UNIT-III: Use of genetic parameters for prediction of recombinant inbred lines; advances in studies of genotype environment interaction and selection indices.

UNIT-IV: Generation matrix and its use in population genetics; gene mapping of QTL (quantitative trait loci).

Practical

Estimation of genetic parameters – Diallel analysis – Triallel analysis – D2 analysis – Problems in Matrix.

Suggested Readings

Selected articles from journals.

AGB 704 ADVANCES IN SELECTION METHODOLOGY 2+1 SEM - I

Objective

To educate about the latest advances in selection theory and their application in animal breeding.

Theory

UNIT-I: Fundamental theorem of natural selection; Selection in finite populations effect on genetic structure and variance. Optimum designs for the estimation of genetic parameters. Design of selection experiments for testing selection theory.

UNIT-II: Methods of measurement of genetic and environmental trends. Advances in selection indices Multistage, Restricted and retrospective selection indices.

UNIT-III: Multi-information, Empirical evaluation of selection theory: genetic slippage, limits to

selection, asymmetry of response, selection experiments, effect of selection on varaiance.

UNIT-IV: Selection for threshold traits; single and multiple trait best linear unbiased estimation (BLUE) and prediction (BLUP); selection under single and multiple trait animal models; direct and correlated response through various selection indices, relationship between BLUP and selection index; fundamentals of marker assisted selections.

Practical

Estimation of relative economic values; determination of culling levels and selection intensity; construction of various indices; estimation of direct and correlated response; QTL analysis using LDMAS & LEMAS.

Suggested Readings

Selected articles from journals.

AGB 705 BIOINFORMATICS IN ANIMAL GENETICS AND BREEDING 2+0 SEM - I

Objective

To educate about basic concepts of bioinformatics and their applications in Animal Genetics and Breeding.

Theory

UNIT-I: Overview of bioinformatics, Database concepts, Algorithms, Information resources for protein and genome databases: Gene Bank, EMBL, SWISSPROT, PROSITE.

UNIT-II: Nucleotide and protein sequence analysis, Pair-wise and multiple sequence alignments, Phylogeny, Micro-array processing, Clustering, Analysis software, Secondary database search.

UNIT-III: Genetic characterisation, Use of bioinformatics tools for identifying QTL and selection of elite germplasm.

Suggested Readings

Selected articles from journals.

AGB 706 ADVANCES IN MOLECULAR CYTOGENETICS 2+0 SEM - II

Objective

To educate about the advances in cytogenetics and their application in animal genetic and breeding

Theory

UNIT-I: Structure of eukaryotic chromosomes – Evolution of karyotype – Various in vitro cell culture techniques – Cell lines and utility – Genotoxicity.

UNIT-II: Somatic cell genetics – Stem cell genetics – Molecular cytogenetics and gene mapping – ISH, FISH, Radiation hybrid mapping, Fibre-FISH, PRINS.

UNIT-III: Positional cloning – Spectral karyotyping.

UNIT-IV: Image analysis – Chromosome walking – Chromosome painting.

Suggested Readings

Selected articles from journals.

AGB 707 UTILISATION OF NON-ADDITIVE GENETIC VARIANCE IN FARM ANIMALS 2+1 SEM - I

Objective

To educate about the recent advances in estimation of non-additive genetic variation and possible use in developing synthetic population of livestock and poultry.

Theory

UNIT-I: Heterosis – forms and genetic basis; detection and estimation of non-additive genetic variance – average dominance, overdominance.

UNIT-II: Partitioning of between cross variance – general combining ability, specific combining ability and reciprocal effects; methods of analyzing diallel crosses; utilization of non-additive genetic variance.

UNIT-III: Crossbreeding systems – crossbreeding effects; recurrent and reciprocal recurrent selection and their forms.

UNIT-IV: Development of specialized sire and dam lines; inbred lines and their maintenance; inbreeding and hybridization.

Practical

Computation of degree of dominance using NC Plans; analysis of partial and complete diallel cross data; estimation of crossbreeding effects; estimation of genetic correlation among paternal purebred and crossbred half sibs; computation of response through RS and RRS.

Suggested Readings

Selected articles from journals.

BST 612 Statistics for Biological Sciences (2+1)

Theory

Unit 1: Introduction to Statistics; Classification and graphical representation of data: Histogram, Frequency polygon, frequency curve and Ogive; Descriptive statistics.

Unit 2: Concept of probability; Theoretical distributions (Binomial, Poisson and Normal), their properties and applications; Elementary ideas of Sampling.

Unit 3: Inferential statistics: estimation and hypothesis testing; Z, t, F and Chi-square test of significance with applications in animal sciences; ANOVA, ANCOVA and Experimental designs (CRD, RBD and LSD)

Unit 4: Correlations: Simple, Multiple, partial, rank correlations; Regression: Simple and multiple linear regressions; Non-parametric tests; Introduction to multivariate statistical analysis: Principal component analysis, Discriminant analysis; Introduction to various statistical softwares.

Practical

Classification and tabulation of data; Graphical representation of data: Bar, Pie, Histogram, Frequency polygon, Frequency curve and ogive; Measures of central tendency (Mean, median, mode); Measures of dispersion (Range, QD, Variance, SD, SE, CV); Z, t, F and Chi-square tests; ANOVA for CRD and RBD; Correlation and regression analysis; Analysis of data using Excel, SPSS and R software.

Books:

Chandel, S.R.S. 1964. A Handbook of Agricultural Statistics, Achal Prakashan, 2nd edition

Dillon WR & Goldstein M. 1984. Multivariate Analysis - Methods and Applications. John Wiley.

Goon AM, Gupta MK & Dasgupta B. 1983. Fundamentals of Statistics. Vol. I. The World Press.

Hogg RV & Craig TT. 1978. Introduction to Mathematical Statistics. Macmillan.

Petrie A. and Watson P. 2013. Statistics for Veterinary and Animal Science, 3rd edition John Wiley.

Siegel S, Johan N & Casellan Jr. 1956. Non-parametric Tests for Behavior Sciences. John Wiley.

Snedecor, G.W. and Cochran, W. G. 1968. Statistical methods. Oxford IBH publishing Co. Pvt. Ltd.

ANIMAL GENETICS AND BREEDING
List of Journals

- Animal Breeding Abstract
- Animal Science
- Asian – Australasian Journal of Animal Science
- Biometrics
- Data Agricultural Scandinavica
- Genetics
- Heredity
- Hoard's Dairyman
- Indian Buffalo Journal
- Indian Journal of Animal Breeding & Genetics
- Indian Journal of Animal Production & Management
- Indian Journal of Animal Science
- Indian Journal of Animal Science
- Indian Journal of Dairy Science
- Indian Journal of Dairy Science
- Indian Journal of Poultry Science
- Indian Journal of Small Ruminant
- Indian Veterinary Journal
- Journal of Animal Science
- Journal of Dairy Science
- Journal of Indian Society of Agriculture Statistics
- Livestock Production Science
- Newzealand Journal of Agri. Research
- The Cell
- Theoretical and Applied Genetics
- Veterinary Record
- World Animal Review
- World Poultry Science Journal
- World Rev. Animal Production.

e-Resources

- http://www.ncbi.nlm.nih.gov/
- http://www.genome.gov
- http://www.hgsc.bcm.tmc.edu/projects/bovine
- http://www.animalgenome.org
- http://www.blackwell-synergy.com
- http://www.genomics.liv.ac.uk
- http://www.biomedcentral.com
- http://www.genomealliance.org.au
- http://www.csiro.au
- http://www.isag.org.uk
- http://www.ebi.ac.uk/imgt/
- http://www.csrees.usda.gov

Broad Topics for Master's and Doctoral Research

- Characterization and cataloging of chromosomal profiles of different species of livestock and poultry.
- Studies on Major Histo-compatibility Complex in reference to traits of economic importance.

- To study mutagenic and cytogenic effects of pesticides and agro-chemicals on the genome of domestic animals.
- Molecular characterization of milk proteins/DGATI gene in cattle and buffalo.
- Comparative gene mapping of indigenous vs exotic livestock species including poultry.
- Studies on crossbreeding parameters for evolving synthetic germplasm of livestock and poultry.
- Designing of selection strategies and breeding systems for improving market-based commercial traits.
- Optimization of breeding strategies for genetic improvement of indigenous livestock and poultry based on field data.
- Evaluation of breeding strategies for conservation of indigenous livestock and poultry breeds.
- Development of synthetic germplasm suitable for rural husbandry with low inputs.
- Genetic studies of neutraceutical animal products of livestock and poultry.
- Genetic-economic evaluation and multiplication of superior germplasm of livestock and poultry.
- Selection strategies for traits of economic importance incorporating molecular markers.
- Evaluation of models for evolving field recording systems.
- Genetic studies on disease resistance in livestock and poultry
- Animal Genetic Resources characterization and evaluation using field survey and molecular markers.
- Animal Genetic Resource enhancement through selection/crossbreeding/reproductive biotechnology/molecular biology.
- Identification of molecular markers for economic traits.
- Genetic basis for improvement in quantitative traits.
- Breeding tools for Sire evaluation.
- Appropriate models for evaluating animal breeding values.
- Transgenesis and gene transfer.

ANIMAL NUTRITION
Course Structure

COURSE NO.	COURSE TITLE	CREDITS	SEM
ANN 601*	ANIMAL NUTRITION – ENERGY AND PROTEIN	3+0	I
ANN 602*	ANIMAL NUTRITION – MINERALS, VITAMINS AND FEED ADDITIVES	3+1	II
ANN 603	FEED TECHNOLOGY	1+1	II
ANN 604*	FEED CONSERVATION STORAGE AND QUALITY CONTROL	2+2	I
ANN 605	RUMINANT NUTRITION	2+1	I
ANN 606	NON-RUMINANT NUTRITION	1+1	I
ANN 607	NUTRITION OF COMPANION / LABORATORY, WILD AND ZOO ANIMALS	2+1	II
ANN 608*	RESEARCH TECHNIQUES IN ANIMAL NUTRITION	1+3	II
ANN 609	NON CONVENTIONAL FEED STUFF AND TOXIC CONSTITUENTS / ANTIMETABOLITES IN ANIMAL FEEDSTUFF	2+1	II
ANN 691	MASTER'S SEMINAR	1	I, II
ANN 699	MASTER'S RESEARCH	20	I, II
ANN 701**	MODERN CONCEPTS OF FEEDING RUMINANTS AND FORAGE UTILIZATION	3+0	I
ANN 702	MODERN CONCEPTS OF FEEDING MONOGASTRIC ANIMALS	2+0	I
ANN 703	NUTRITION AND RUMEN FERMENTATION	1+1	II
ANN 704	ADVANCES IN MICRONUTRIENTS	1+0	II
ANN 705**	ADVANCED TECHNIQUES IN NUTRITION AND RESEARCH	1+2	I
ANN 706	ADVANCES IN FEED TECHNOLOGY	1+1	II
ANN 707	CLINICAL NUTRITION	1+1	I
ANN 708	NUTRIENT AND DRUG INTERACTION	2+0	II
ANN 709**	NEW FEED RESOURCES AND TOXICANTS IN ANIMAL FEEDING	2+0	II
ANN 791	DOCTORAL SEMINAR I	1	I, II
ANN 792	DOCTORAL SEMINAR II	1	I, II
ANN 799	DOCTORAL RESEARCH	45	I, II
SERVICE COURSE			
ABM 531	FEED BUSINESS MANAGEMENT	2+0	I

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

ANIMAL NUTRITION
Course Contents

ANN 601 ANIMAL NUTRITION – ENERGY AND PROTEIN 3+0 SEM - I

Objective

Familiarization with fundamental concepts of energy and proteins, metabolism of carbohydrate, fat and protein and their efficiency of utilization. Requirement of carbohydrates, fat and proteins for various physiological functions.

Theory

UNIT-I: Basic terminology and classification of carbohydrates, fats and proteins. Fundamental concepts of Digestion and metabolism of Carbohydrate Fat and Protein in different species of animals. Gluconeogenesis, Recent advances in glucogenic precursors on acetate utilization. NPN metabolism, urea fermentation potential and metabolizable protein. Amino acids imbalance, antagonism and toxicity.

UNIT-II: Measures of feed energy. Partitioning of feed energy. Efficiency of energy and Protein utilization. Feeding standards- comparative appraisal and limitations.

UNIT-III: Rumen degradable Protein (RDP), and rumen undegradable protein (UDP) and Kinetics. Energetics of protein synthesis and turn over. Quantification of microbial protein synthesis. Protein quality determination in monogastrics and utility.

UNIT-IV: Energy balance, Fasting catabolism. Direct and indirect calorimetry.Determination of energy and protein requirements. Energy and protein requirement for maintenance, growth, pregnancy and lactation in ruminants, companion animals and poultry.

Suggested Readings

Blaxter K. 1989. *Energy Metabolism in Animal and Man*. Cambridge Univ. Press. Bondi A. 1987. *Animal Nutrition*. Wiley InterScience.

Cramptan EW & Harris LE. 1969. *Applied Animal Nutrition*. WH Freeman.

Maynard LA, Loosli JK, Hintz HF & Warner RG. 1987. *Animal Nutrition*. McGraw-Hill.

McDonald P, Edwards RA & Greenhalgh JFD. 1995. *Animal Nutrition*. Longman.

Ponds WG, Church DC, Pond KR & Schoknecht PA. 2005. *Basic Animal Nutrition and Feeding*. Wiley Dreamtech India.

Singh UB. 1987. *Advanced Animal Nutrition for Developing Countries*. Indo-Vision.

ANN 602 ANIMAL NUTRITION – MINERALS, VITAMINS AND FEED ADDITIVES 3+1 SEM - II

Objective

Role, requirement, functions, deficiency and toxic effects of vitamins, essential, probably essential and toxic minerals. Understanding soil-plantanimal-human relationship for utilization of minerals. Recent trends in the use of feed additives, probiotics, prebiotic and enzymes in animal feeding.

Theory

UNIT-I: Essential minerals, general role of minerals, soil-plant-animal-human relationship, requirement of minerals, factors affecting requirements. Macro elements and micro elements, their distribution, metabolism, physiological functions, deficiencies and excesses, requirements and sources. Probable essential minerals. Toxic minerals. Definition, history, classification, chemistry, functions, deficiencies and excesses, requirements and sources of water soluble and fat-soluble vitamins.

UNIT-II: Critical minerals for ruminants and non-ruminants, chelates and chelated minerals. Inter-relationship of minerals with other nutrients. Impact of minerals arising from industrial affluent on animal health and production. Critical limits of minerals in edible herbages. Bioavailability studies in minerals. Impact of minerals on reproduction. Area specific minerals.

UNIT-III: Relationship of vitamins with other nutrients. Critical vitamins for ruminants and non-ruminants.Feed additives including probiotics Prebiotics, Symbiotics and feed enzymes. Research techniques in nutrition.

Practical

General principles of mineral estimation, Sampling and processing techniques, Estimation of macro- and micro-minerals. Determination of bioavailability of minerals. Formulation of mineral mixture for various species. Identification of adulterants and quality control. Atomic absorption spectrometry in mineral estimation. Preparation of diets for mineral studies.Principles of vitamin estimation. Estimation of some important vitamins (vitamin A,E,C). Formulation of vitamin mixture for various species.

Suggested Readings

Banerjee GC. 1988. *Feeds and Principles of Animal Nutrition*. Oxford & IBH. Krishna G & Ranjhan SK. 1991. *Special Analytical Techniques*. Kalyani.

McDonald P, Edwards RA & Greenhalgh JFD. 1995. *Animal Nutrition*. Longman. McDowell LR. 2003. *Minerals in Animal and Human Nutrition*. Reed Elsvier India. Peter RC. 2005. *Applied Animal Nutrition Feeds and Feeding*. Pearson Prentice Hall.

Ponds WG, Church DC, Pond KR & Schoknecht PA. 2005. *Basic Animal Nutrition and Feeding*. Wiley Dreamtech India.

Reddy DV. 2003. *Principles of Animal Nutrition and Feed Technology*. Oxford & IBH. Underwood EJ & Shuttle 1999. *The Mineral Nutrition of Livestock*. 3rd Ed. CABI.

ANN 603 FEED TECHNOLOGY 1+1 SEM - II

Objective

Introduction to the subject, formula feed manufacturing and different operations involved. Layout, designing, operation and management of feed mill.

Theory

UNIT-I: Importance of feed technology in relation to animal productivity. The integrated biological, chemical and physical basis for evaluating the inherent nutritional quality of feed ingredients and feeds. Familiarization of various feed mill equipments, layout and operations. Problems of feed manufacturing units and control measures. Quarantine measures.

UNIT-II: Introduction to the formula feed manufacturing including principles of material handling, grinding, mixing, pelleting and other major processing operations. Crumbling, Flaking, Popping, Extrusion. Principles of instrumentation and analysis, with emphasis on application to quality control and research in the feed industry.

UNIT-III: The formulation of concentrate mixtures, premixes and rations using computer. Automated feed mill. Personal management in feed plants, laws and regulation of feed manufacturing industry. Codex alimentarius, HACCP. Organizational charts for small, medium and large feed plants, labour standard, planning and production programme, handling of plant equipment. Merits and demerits of automated feed plant

Practical

Identification of feed ingredients and their specifications, as well as compound feed for different categories of livestock and poultry. Feed microscopy. Formulating premixes. Introduction to Pulverisers, pelletisers, complete feed blocks equipments Plant layout and design of different capacity of feed mills, problems related to feasibility, records keeping in different sections of feed mill. Experiential learning at the feed plant for preparing feed, urea molasses mineral blocks, mineral mixture.

Suggested Readings

Banerjee GC. 1988. *Feeds and Principles of Animal Nutrition*. Oxford & IBH. Givens DI.2000. *Forage Evaluation in Runminant Nutrition*. Great Britain Publ. Gohl BO. 1985. Tropical Feeds. FAO.

Lohan OP, Chahal SM & Kishore N. 1998. *Feed Quality Evaluation Techniques*. CCS Haryana Agricultural Univ. Press.

McEllihnery, Robert R. 1994. *Feed Manufacturing Technology*. The American Feed Industry Assoc.

Perry TW. 2004. *Feeds and Feeding*. Prentice Hall.

Ponds WG, Church DC & Pond KR. 1995. *Basic Animal Nutrition and Feeding*. John Wiley & Sons.

Zaworski F. 1997. *Feed Industry Red Book*. ZMAG Publ.

ANN 604 FEED CONSERVATION, STORAGE AND QUALITY CONTROL 2+2 SEM - I

Objective

To acquaint with inherent nutritional quality of feed ingredients and feeds. Evaluation of feeds and fodders and feed preservation techniques. Procurement and storage of feed ingredients. Losses during storage and its control.

Theory

UNIT-I: Principles of feed and fodder processing and preservation techniques, their merits and demerits. Procurement, planning and purchase procedures; traditional and modern farm level storage structures. Feed storage and godown management, estimation of storage capacity and stack plan.

UNIT-II: Evaluation of processed and preserved feeds and forages. Role of moisture, temperature and relative humidity during storage of feedstuffs and their effect on biotic factors. Handling and storage of liquid feed Ingredients.Physical and chemical changes in feeds during storage; storage losses; insect pests and rodents in feed stores and their control; Role of fungi, tolerance limits and measures to check them in stored products.

UNIT-III: Factors affecting the quality of feed and feedstuffs on preservation. Microbiological evaluation of processed and preserved feeds, Effect of preservation on nutritional value of feed. Properties and mode of action of pesticides and fumigants; principles of good sanitation and hygiene of godowns.

UNIT-IV: Proximate composition, Limitations of various systems of analysis, Partitioning of forage fibre by Van Soest method, Quality control of fed ingredients, Specifications of feed ingredients and finished feeds, BIS standard., Pesticide and insecticide residues in feeds

Practical

Laboratory evaluation of preserved and processed feed and forages. Physical properties of feeds and feedstuffs; identification of insect-pests and fungi in stored products; techniques for detection of hidden infestation in grains; quality control and inspection of stored feed materials; moisture equilibrium determination and estimation of chemical changes including alcoholic acidity, rancidity and uric acid in feeds during storage. Weende proximate analysis, Van Soest fibre fractionation, Enzymatic evaluation, Pro rata deduction (Feed laws), urea, FFA, peroxide value, adulterants, and heavy metal.

Suggested Readings

Givens DI. 2000. *Forage Evaluation in Ruminant Nutrition*. Great Britain Publ. Khare BP. 1994. *Stored Grain Pests and their Management*. Kalyani.

Krishna G & Ranjhan SK. 1991. *Special Analytical Techniques in Nutritional Biochemistry*. Kalyani.

Lohan OP, Chahal SM & Kishore N. 1998. *Feed Quality Evaluation Techniques*. CCS Haryana Agricultural Univ. Press.

McEllihnery Robert R. 1994. *Feed Manufacturing Technology*. The American Feed Industry Assoc.

Ponds WG, Church DC & Pond KR. 1995. *Basic Animal Nutrition and Feeding*. John Wiley & Sons.

ANN 605 RUMINANT NUTRITION 2+1 SEM - I

Objective

Requirement of nutrients for different physiological functions in various ruminant species. Latest concepts of feeding the nutrients for maximising production.

Theory

UNIT-I: Nutrients and their metabolism with special reference to milk, meat and wool production.

UNIT-II: Feeding standards, their history, comparative appraisal and limitations. Classification of feedstuffs. Nutrient requirements for calves, heifers, dry, pregnant and lactating cows, buffaloes, sheep and goat.

UNIT-III: Introduction to rumen microflora and fauna. Development of rumen. Role of milk replacers and calf starters.

UNIT-IV: Feed formulation of large and small ruminants for different physiological stages. Concept of complete feed. Limiting nutrients and strategic feeding of high yielding ruminants. Concept of by-pass nutrients and their impact on production, reproduction and immune status.Importance of CLA, omega fatty acids, Scope for value addition in milk, Different systems of feeding buffalo for beef production. Feeding during natural calamities, feeding in various agro-climatic zones of India.

Practical

Design and planning of feeding experiments. Identification of feed and fodder on the basis of its composition. Artificial rumen technique, Methods for evaluation of feedstuffs-in vitro gas, *in sacco* digestion kinetics. Determination of nutritive value of feeds and fodders by metabolism trial in dairy cattle, determination of nutritive value of pastures by the use of range techniques, study of rumen metabolic profile. Preparation of bypass Nutrients Identification of rumen microbes and rumen studies.

Suggested Readings

Dhority BA. 2003. *Rumen Microbiology*. Nottingham Univ. Press.

Kellems RO & Church DC. 2002. *Livestock Feeds and Feeding*. Prentice Hall. Ranjhan SK. 2001. *Animal Nutrition in the Tropics*. Sangam Books.

ANN 606 NON-RUMINANT NUTRITION 1+1 SEM - I

Objective

Requirement of nutrients and feeding of various non-ruminants species for efficient quality production.

Theory

UNIT-I: Nutrients, their metabolism and requirements for poultry and swineduring different stages of growth and production. Limiting iminoacids-lysine and methionine.

UNIT-II: Feeding systems and feed additives, feed formulations for different purposes including least cost rations.

UNIT-III: Quality control of poultry and swine rations for efficient egg and meat production. Nutrition in relation to disease and stress.

UNIT-IV: Nutritional factors affecting quality of the products. Hind gut fermentation and its importance, Nutrient requirements of rabbits and equines, Nutritional manipulation for producing value added egg, meat / pork.

Practical

Design and planning for poultry and swine feeding experiments, formulation and compounding of general and least cost rations, determination of nutritive value of poultry and swine feeds by balance experiments, evaluation of protein quality,Visit to poultry and piggery units, feed and fodder stores, Use of software in least cost feed formulations. Basic principles governing the least cost formulation software's.

Suggested Readings

Leeson S & Summers JD. 2005. *Commercial Poultry Nutrition*. International Publ. House. Ponds WG, Church DC, Pond KR & Schoknecht PA. 2005. *Basic Animal Nutrition and Feeding*. Wiley Dreamtech India.

Rose SP. 1996. *Principles of Poultry Science*. CABI.

Stevan l, Scott ML & John DS. 2001. *Nutrition of the Chicken*. Univ. of Guelph.

ANN 607 NUTRITION OF COMPANION, LABORATORY WILD AND ZOO ANIMALS 2+1 SEM - II

Objective

Preparation, storage and evaluation of feeds and feeding standards of companion/ laboratory /wild and zoo animals.

Theory

UNIT-I: Feed Habbits, food Patterns, digestive structure and functions companion, laboratory , wild and zoo animals. Natural dietary habits. Nutritional requirements of various species of animals.

UNIT-II: Feeding standards and feeding habits of companion / laboratory animals. Importance of colostrum and feeding of neonates and growing animals. Feeding and care of nursing mothers. Feeding of sick and old animals. Post Surgical nutrition.

UNIT-III: Ration formulation for captive animals. Artificial feeding and feeding during emergency. Nutritive characteristics of forages for wild animals. Adequacy of forage plants for wild and zoo animals. Diets used in captivity. Raising orphans. Nutritional melodies. . Nutrition of semi wild and semi domestic animals like mithun and yak under special topography.

UNIT-IV: Composition, presentation, sterilization, palatability, assessment and storage of companion/laboratory animal diets. Companion food tables and their nutritional assessment. Mistakes and misleading information on companion food labels and labeling. UNIT-V: Nutraceuticals in companion / laboratory foods and animal foods. Nutritional deficiency diseases. Geriatric nutrition – corrective measures.

Practical

Formulation and preparation of hygienic, balanced diets and feeding for companion/laboratory animals. Characteristics of ration formulation and feeding schedules wild and zoo animals. Feeding schedules for sick and orphan wild / zoo animals. Artificial and emerging feeding. General feeding habits and different feed constituents of wild and captive animals. Research methodology of companion/laboratory animals. Processing and storage of companion/laboratory diets. Visit to Zoological parks and wildlife sanctuary.

Suggested Readings

Case LP. 1995. *Canine and Feline Nutrition*. St. Louis Publ.

Church DC. 1980. *Digestive Physiology and Nutrition in Ruminants*. Oxford Press.

Givens DI, Owel E, Aford REF & Omed HM. 2000. *Forage Evaluation in Ruminant Nutrition*. CABI.

Petter WL & Pearson AEG. 1971. *The Laboratory Animals- Principles and Practices*. Academic Press.

Reddy DV. 2003. *Applied Nutrition*. Oxford & IBH.

Robbins C & Cunha T. 1994. *Wildlife Feeding and Nutrition*. Reed Elsvier.

ANN 608 RESEARCH TECHNIQUES IN ANIMAL NUTRITION 1+3 SEM - II

Objective

Planning and designing of experiments, use of various techniques in estimating chemical and bio-chemical constituents in feeds, fodders, blood, milk, rumen liquor, meat, wool etc.

Theory

UNIT-I: Principles of animal experimentation. Specialized feed compounding. Introduction and principle of GLC, HPLC, AAS, tracer technique, flame photometer, NIR, SF6, amino acid analyzer.

UNIT-II: Importance and principle of various techniques in estimating chemical and biochemical constituents and toxic principles in feeds, fodders. Importance, principles and procedures for

estimating chemical and biochemical constituents in blood, milk, rumen liquor, meat, wool etc.

Practical

Cell Wall partitioning, Lignin as internal marker in feedstuffs, Mineral estimation by atomic absorption spectrophotometer, In-vitro/in-sacco determination of digestibility and digestion kinetics. Determination of energy content of feed, faeces and urine using bomb calorimeter. Methodology for quality improvement of animal feeds. Interpretation and presentation of results. Tracer techniques in Animal Nutrition. Quality evaluation of silage and hay, feed energy estimation; nitrate, urea, aflatoxin, salmonella, glycosides and sedimentation tests. Blood profile, meat quality.

Suggested Readings

Bondi AA. 1987. *Animal Nutrition*. Wiley InterScience.

Gupta PC, Khatta VK & Mandal AB. 1988. *Analytical Techniques in Animal Nutrition*. CCS HAU Press.

Pandey DN & Bajpai A. 2003. *Recent Trends in Animal Nutrition and Feed Technology for Livestock, Pets and Laboratory Animals*. International Book Distr.

Reddy DV. 2003. *Principles of Animal Nutrition and Feed Technology*. Oxford & IBH.

ANN 609 NON-CONVENTIONAL FEEDSTUFFS AND TOXIC CONSTITUENTS/ANTIMETABOLITES IN ANIMAL FEEDSTUFF 2+1 SEM - II

Objective

To understand the importance of alternate feeds and their use in augmenting profit in livestock farm. Different toxins present in feed stuffs, their properties and detoxification techniques.

Theory

UNIT-I: Present and future feed requirements and current availability for livestock and poultry. Use of non-traditional feeds – By-products of agricultural, industrial, food processing units and forest by-products. Evaluation by chemical and biological methods. Formulation of economical rations. Level of inclusion of various non conventional feeds in livestock ration.

UNIT-II: Classification of toxic principles in animal feedstuffs. Chemico-physical properties of various toxins. Effect of toxins on biological system and nutrients utilization in different species of livestock. Detoxification of toxin principles by various physical, chemical and biological techniques. Insecticide and pesticide residue detection.

Practical

Estimation of various protease inhibitors; tannins; and mycotoxins in various feeds and feedstuffs. Nitrates, HCN, oxalates, insecticide and pesticide residues, saponins, Gossypol, mimosine, heavy metals.

Suggested Readings

Banerjee GC. 1988. *Feeds and Principles of Animal Nutrition*. Oxford & IBH. Liner IE. 1980. *Toxic Constituents of Animal Food Stuffs*. Academic Press.

Lohan OP, Chahal SM & Kishore N. 1998. *Feed Quality Evaluation Techniques*. CCS Haryana Agricultural Univ. Press.

McDonald P, Edwards RA & Greenhalgh JFD. 1995. *Animal Nutrition*. Longman.

Ponds WG, Church DC & Pond KR. 1995. *Basic Animal Nutrition and Feeding*. 4th Ed. John Wiley & Sons.

Ranjhan SK. 2001. *Animal Nutrition in the Tropics*. Sangam Books.

Reddy DV. 2003. *Principles of Animal Nutrition and Feed Technology*. Oxford & IBH.

ANN 701 MODERN CONCEPTS OF FEEDING RUMINANTS AND FORAGE UTILIZATION 3+0 SEM - I

Objective

To impart knowledge of modern concepts in nutrient requirement and feeding and enhanced utilization in ruminant and recent development in analysis of forages.

Theory

UNIT-I: Developments in ruminant digestive physiology – Energy protein requirement and measurement – Requirements of other nutrients. Importance of energy and protein quantity and quality Feed input and milk output relationship.

UNIT-II: Concept of limiting amino acids for high yielders. Strategic feeding of high yielding dairy cows and meat producing ruminants. Concept of Phase feeding. Bypass Nutrient technology. Feeding during stress. Nutrition-immunity interaction. Designer milk and meat. Rumen manipulation to reduce methanogenesis. Nitrogen oxide emission and heavy metal residues. Metabolic profile tests.

UNIT-III: Use of conserved forages in ruminant feeding. Chemical composition of common and newer forage – Factors affecting nutritive value of commonly available grasses, pastures, silage, hay and crop residues, voluntary intake of fodder at different stages of growth. Newer methods of forage evaluation – calculated in vitro ME and DOMD by using prediction equations. Merits and demerits of using leaf protein. Top feeds and their effective utilization – pasture consumption and evaluation studies.

UNIT-IV: Seminars on current topics of special interest.

Suggested Readings

Selected articles from journals.

ANN 702 MODERN CONCEPTS OF FEEDING MONOGASTRIC ANIMALS 2+0 SEM - I

Objective

To impart knowledge on modern concepts in nutrient requirement and feeding of monogastric livestock.

Theory

UNIT-I: Nutritional factors affecting egg quality and hatchability in poultry. Feeding for designer eggs.Role of essential fatty acids, amino acids imbalance, toxicity and interactions in monogastrics.

UNIT-II: Developments in digestive physiology of swine – equines – Measurement of protein and energy requirements – Influence of processing of feeds and fodders in mono- gastric animal nutrition.

UNIT-III: Modern concepts of amino acid nutrition at various physiological status – Role of vitamins and minerals in health and disease. Advances in new generation feeds and feed additives.

Suggested Readings

Leeson S & Summers JD. 2005. *Commercial Poultry Nutrition*. International Publ. House. Ponds WG, Church DC, Pond KR & Schoknecht PA. 2005. *Basic Animal Nutrition and Feeding*. Wiley Dreamtech India. Selected articles from journals.

ANN 703 NUTRITION AND RUMEN FERMENTATION 1+1 SEM - II

Objective

To impart knowledge on nutrient requirements for neonatal and post natal development of livestock, recent concepts of rumen fermentation and its manipulation.

Theory

UNIT-I: Nutrient requirements for fertility and gestation, prenatal growth and foetal nutrition. Post-natal feeding, growth and developments – Body composition at prenatal and postnatal stages, abnormalities due to malnutrition.

UNIT-II: Rumen microflora and microfauna –considerations and limitations in relation to ruminant feeding practices. Manipulation of rumen fermentation – physical, chemical and biological means – Role of sulphur and phosphorus in rumen fermentation –. Modeling ruminant digestion and metabolism – principles.

Practical

Microbial and protozoal count, Determination TVFA by chromatography. Estimation of ammonia in rumen liquor – study on protection of protein in relation to degradability, Rumen fermentation products – Artificial rumen techniques. Rumen enzyme assay

Suggested Readings

Selected articles from journals.

ANN 704 ADVANCES IN MICRONUTRIENTS 1+0 SEM - II

Objective

To impart knowledge on nutrient requirements for neonatal and post natal development of livestock, recent concepts of rumen fermentation and its manipulation.

Theory

UNIT-I: Developments in the study of major, minor and toxic minerals in animals – animal – soil - plant interrelationship – concepts in absorption and transport of micronutrients – Kinetics and metabolism physiological and biochemical interactions among nutrients – interrelationship of minerals and vitamins in relation to metabolism and requirements – mineral toxicities in relation to livestock feeding.

UNIT-II: Developments in vitamin and mineral requirements for growth, reproduction and lactation – Identification and correction of deficiencies and toxicities of minerals in farm animals.

UNIT-III: Bio-availability of macro and micro nutrients – factors affecting the bio- availability of minerals – bio-marker concept for mineral requirement for correction of deficiencies and toxicity of minerals.

Suggested Readings

Peter RC. 2005. *Applied Animal Nutrition Feeds and Feeding*. Pearson Prentice Hall. Ponds WG, Church DC, Pond KR & Schoknecht PA. 2005. *Basic Animal Nutrition and Feeding*. Wiley Dreamtech India.

Selected articles from journals.

ANN 705 ADVANCED TECHNIQUES IN NUTRITION AND RESEARCH 1+2 SEM - I

Objective

To impart knowledge on use of advanced analytical techniques in nutrition research.

Theory

UNIT-I: Developments in analysis of nutrients in feeds. Estimation of toxins and mycotoxins – Application of atomic absorption spectrophotometer, HPLC – Enzymatic methods of feed analysis – Isotopes in nutrition research – Feed microscopy – Analytical aspect of feeds and fodders using N.I.R.

UNIT-II: Faecal innoculum as alternative to rumen liquor in in vitro studies – Degradability of feeds by various techniques – rates of VFA and microbial production.

Practical

Estimation of major, minor and toxic minerals by atomic absorption spectrophotometer, Estimation of mycotoxin by HPLC, Estimation of oxalate, nitrates, tannin and mimosine, VFA fractionation by GC. SF6 Technique, amino acid analyzer, NIR, HPLC, Purine derivatives, milk fat and FA estimation.

Suggested Readings

Selected articles from journals.

ANN 706 ADVANCES IN FEED TECHNOLOGY 1+1 SEM - II

Objective

To impart knowledge on modern feed processing methods and automated feed plant layout.

Theory

UNIT-I: Feed and fodder processing – Particle size reduction – bulk density – processing of grains and oil seeds – processing of roughages – feed plant layout and design – feed plant management – storage of feeds.

UNIT-II: Non conventional feed resources – Formulation of concentrates, premixes and rations – improvement of nutritive value of poor quality roughages – liquid feed supplements. Solid state fermentation (SSF) technology.

Practical

Feed microscopy tests for certain adulterants and anti nutritional factors, Feed plant design– processing of roughages – feed plant sanitation, Wild seed identification – qualitative tests for rancidity, minerals and adulterants, Visit to commercial feed plant.

Suggested Readings

Selected articles from journals.

ANN 707 CLINICAL NUTRITION 1+1 SEM - I

Objective

Impact of nutrition on health, immunity, digestive/metabolic disorders, reproductive performance, bacterial and parasitic infestations, organic toxins and stress nutrition, feeding management of sick animals.

Theory

UNIT-I: Nutritional factors responsible for disorders. Metabolic disorders and production diseases in farm animals. Prevention of metabolic disorders – recommended dietary regimen.

UNIT-II: Effect of coccidiostats and dietary antigens in early weaned livestock. Nutrition in relation to emerging diseases. Effect of nutrition on fertility, reproduction and lactation. Toxic minerals and counter action (Selenium and fluorine).

UNIT-III: Stress nutrition and post surgical nutrition. Nutritional manipulation and feeding of sick animals. Pesticides residues in feeds and fodders and their impact on animal health, reproduction and production.

Practical

Determination of blood glucose, blood urea nitrogen, SGOT SGPT, total protein, cholesterol and ketone bodies, Metabolic profile tests.

Suggested Readings

Selected articles from journals.

ANN 708 NUTRIENT AND DRUG INTERACTION 2+0 SEM - II

Objective

To impart knowledge on the effects of drugs on nutrient utilization.

Theory

UNIT-I: Effects of drugs on digestion and absorption of nutrients – Drugs and intestinal microbial interaction – Effect of drugs and antibiotics as feed additives. Physiological effects – Use and abuse.

UNIT-II: Nutrients in drug detoxification – Antagonists – Hormones and their effect on growth and carcass qualities. Drug residues in animal products - milk and meat – effect on food change. Legal aspects of drugs in animal products.

Suggested Readings

Selected articles from journals.

ANN 709 NEW FEED RESOURCES AND TOXICANTS IN ANIMAL FEEDING 2+0 SEM - II

Objective

To impart knowledge on newer feed resources and their value in animal feeding and various toxic substances prevalent in feeds and fodders.

Theory

UNIT-I: Demand and availability of feed – formulation of database in computer – strategy in food animal production – agricultural by-products – Agroindustrial by-products, Farm waste, crop residues, organic wastes of animal origin. Slaughter house waste, industrial waste and their feeding value in animals.

UNIT-II: Processing to enhance feed utilization and availability. Possible health hazards due to waste utilization-chemical and nutritional changes in waste product due to processing. Quality standard and their acceptance.

UNIT-III: Naturally occurring toxicants – Toxicants of plants and non-microbial origin. Naturally occurring alkaloids, mycotoxins and their toxicity – Acquired toxicants, pesticides, weedicides and heavy metals.

UNIT-IV: Effect of toxins on rumen fermentation and nutrient utilization. Methods of detoxification. Food and feed contaminants – their impact on animal performance.

Suggested Readings

Selected articles from journals.

ANIMAL NUTRITION
List of Journals

- Animal Feed Science and Technology
- Animal Nutrition and Feed Technology
- Animal Research
- Animal Science Journal
- Archives of Animal Nutrition
- Australian Journal of Animal Sciences
- British Journal of Nutrition
- British Poultry Science
- Canadian Journal of Animal Sciences
- Feed Industry Review
- Feed International
- Feed Management
- Feed Stuffs
- Feed Trends
- Grass and Forage Science
- Indian Journal of Animal Nutrition
- Indian Journal of Animal Science
- Indian Journal of Dairy Science
- Indian Journal of Poultry Sciences
- International Journal of Sheep and Wool Science
- Italian Journal of Animal Science
- Journal of Animal and Feed Sciences
- Journal of Animal Nutrition
- Journal of Animal Physiology and Animal Nutrition
- Journal of Food Science and Technology
- Livestock Research for Rural Development
- Malaysian Journal of Nutrition
- Nutrition Journal
- Pakistan Journal of Nutrition
- Small Ruminant Research

e- Resources

- http://www.vivo.colostate.edu/hbooks/pathphys/digestion/index.html
- http://www-biol.paisley.ac.uk/kinetics/contents.html
- http://en.wikipedia.org/wiki/Enzyme_kinetics#column-one
- http://mark.asci.ncsu.edu/SwineReports/2004-2005/Contents.htm
- http://www.das.psu.edu/dairynutrition/
- http://www.vet.ed.ac.uk/clive/cal/RUMENCAL/Frames/frmMega.html
- http://www.uky.edu/~dhild/biochem/supp.html
- http://vanat.cvm.umn.edu/run/plate7.html
- http://www.ales2.ualberta.ca/afns/drtc/
- http://www.clfmaofindia.org/
- http://www.nianp.res.in/
- http://www.nutrisocietyindia.com/
- http://www.fao.org
- http://www.codexalimentarius.net/web/index_en.jsp
- http://www.ars.usda.gov
- http://www.fao.org/ag/AGA/AGAP/FRG/afris/default.htm

- http://www.aphca.org/
- http://www.fao.org/ag/AGA/AGAP/FRG/frg1.htm
- http://www.fao.org/prods/index.asp
- http://www.fao.org/ag/AGA/AGAP/FRG/Feedsafety/feedsafety.htm

Suggested Broad Topics for Masters and Doctoral Research

- Utilization of non conventional feed/ fodder resources
- Evolving / Assessing feed additives / supplements
- Manipulation of rumen fermentation to enhance productivity
- Feed processing for efficient utilization
- Improving palatability, digestibility of companion food
- Preservation and storage of feed / fodder
- Developing functional foods though dietary manipulation
- Neonatal growth stimulants
- Developing sick diet / Geriatric diet to companion/ domestic/ Wild animals
- Problem solving approach like formulating area specific mineral mixture
- Developing residue free animal produce through dietary management
- Addressing global issues /pollutants through feeding manipulation

LIVESTOCK PRODUCTION MANAGEMENT

Course Structure

COURSE NO.	COURSE TITLE	CREDITS	SEM
LPM 601*	CATTLE AND BUFFALO PRODUCTION AND MANAGEMENT	2+1	I
LPM 602*	SHEEP AND GOAT PRODUCTION AND MANAGEMENT	2+1	II
LPM 603	SWINE PRODUCTION AND MANAGEMENT	1+1	I
LPM 604	LABORATORY ANIMAL PRODUCTION AND MANAGEMENT	1+1	II
LPM 605	SHELTER MANAGEMENT	1+1	I
LPM 606	PRINCIPLES OF ENVIRONMENTAL HYGIENE AND WASTE MANAGEMENT	2+0	II
LPM 607	CLIMATOLOGY AND ANIMAL PRODUCTION	1+0	I
LPM 608*	POULTRY FARM AND HATCHERY MANAGEMENT	2+1	I
LPM 609	FARM ANIMAL BEHAVIOR	1+0	II
LPM 610	INTEGRATED LIVESTOCK FARMING SYSTEM	2+1	II
LPM 611	EQUINE PRODUCTION AND MANAGEMENT	1+1	I
LPM 612	WILDLIFE MANAGEMENT AND CONSERVATION	2+0	II
LPM 613	LIVESTOCK BUSINESS MANAGEMENT	1+1	I
LPM 691	MASTER'S SEMINAR	1	I, II
LPM 699	MASTER'S RESEARCH	20	I, II
LPM 701**	ADVANCES IN CATTLE AND BUFFALO PRODUCTION AND MANAGEMENT	3+0	I
LPM 702**	ADVANCES IN SHEEP AND GOAT PRODUCTION AND MANAGEMENT	2+1	II
LPM 703	ADVANCES IN SWINE PRODUCTION AND MANAGEMENT	2+1	I
LPM 704	ADVANCES IN LABORATORY ANIMAL PRODUCTION AND MANAGEMENT	1+0	II
LPM 705**	ADVANCES IN POULTRY PRODUCTION AND MANAGEMENT	2+1	I
LPM 706	ADVANCES IN ENVIRONMENTAL MANAGEMENT	1+1	II
LPM 707	ADVANCES IN EQUINE MANAGEMENT	2+0	I
LPM 791	DOCTORAL SEMINAR I	1	I, II
LPM 792	DOCTORAL SEMINAR II	1	I, II
LPM 799	DOCTORAL RESEARCH	45	I, II
SERVICE COURSE			
ABM 533	POULTRY AND HATCHERY MANAGEMENT	2+0	I

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

LIVESTOCK PRODUCTION MANAGEMENT
Course Contents

LPM 601 CATTLE AND BUFFALO PRODUCTION AND MANAGEMENT 2+1 SEM - I

Objective

To acquaint students on basic aspects of dairying in India compared with developed countries, problems and prospectus of dairying, detailed aspects of care and management of different classes of dairy cattle and buffaloes.

Theory

UNIT-I: Introduction – Development of Dairy Industry in India and world - Present status and future prospects of livestock development in India

UNIT-II: Important breeds of cattle and buffalo, traits of economic importance and their inter-elationships - Selection of high quality animals - Role of management in improving the reproduction efficiency in farm animals. - Housing and rearing systems.

UNIT-III: Breeding Management: System of breeding Economic traits. Methods of Breeding - Prenatal and postnatal care and management of cattle and buffalo -Care of neonate and young calves - Management strategies for reducing mortality in calves, age at first calving and calving interval in cattle and buffaloes.

UNIT-IV: Management of labour, Milking management, Machine milking and hand milking, Different laws governing the livestock sectors to produce quality products on par with international standards - Technique of harvesting clean and hygienic livestock products, transportation of animals, health management. Wallowing in buffaloes- Management of draught animals and summer management

UNIT-V: Feed and fodder resources used for feeding of cattle and buffaloes– Scientific technique of feeding, watering – Computation of practical and economical ration, supply of green fodder around the year and enrichment of poor quality roughages.

Practical

Visits to cattle farms and critical analysis of various types of managerial practices - Study of breeding management in the farm- Analysis of practical feeding management- Disease control- Housing – milking - calf, heifer and adult management- Dairy Cattle and Buffalo judging - Project preparation for external funding and commercial farms and enterprises for dairy products –marketing strategies for milk and milk products and meat.

Suggested Readings

Arora SP. 1997. *Feeding of Dairy Cattle and Buffaloes.* Kalyani.

Dutta G. 1994. *Care and Management of Dairy Cattle and Buffaloes.* 3rd Ed. ICAR. Thomas CK & Sastry NSR.1991. *Dairy Bovine Production*. Kalyani.

LPM 602 SHEEP AND GOAT PRODUCTION AND MANAGEMENT 2+1 SEM - II

Objective

To acquaint students on status of sheep and goat farming in India, importance of record keeping, principles of housing and feeding, breeding management to improve the reproductive efficiency and detailed account on care and management of different classes of sheep and goat.

Theory

UNIT-I: Introduction - Population structure and importance- Advantages and disadvantages of sheep farming under different systems of management – type of housing and equipments- Important sheep and goat breeds- Advantages and disadvantages of sheep and goat farming.

UNIT-II: Breeding Management: Breeding seasons - fitness of purchase for first breeding - methods of detection of heat - Natural Service and artificial insemination - Care of the pregnant Animals - Breeding stock - Use of teaser- Culling.

UNIT-III: Feeding Management: Feeding methods - Principles to be followed in feeding and watering- feeder space, waterer space, Designing feeders and waterers. -Range management -

Stocking rate and pasture improvement and utilization; management under stall fed conditions, Transportation of sheep and goat.

UNIT-IV: Disease Management: Role of management in the prevention and control of diseases. Special Management: Deworming - Dipping and spraying- shearing -Avoidance of goatry odour in milk, Tupping

UNIT-V: Wool: Importance of wool - Fiber structure- Fleece characters - Goat fibres - Characters of mohair and pashmina, fur and Angora - Marketing of goat fibres/ wool.- Planning of sheep and goat farm of various sizes - Economics of sheep and goat farming.

Practical

Visit to sheep and goat farms and critical analysis of various managerial practices under different conditions. Study of practical housing management -Analysis of practical diseases control management - Shearing management -Record keeping. - Preparation of project for commercial farming -Characterization of sheep and goats; handling of sheep and goat; daily and periodical operations for sheep and goats - Methods of identification of sheep and goat. Cost of rearing sheep and goat for mutton and wool - Housing plans for various age and categories of sheep and goat - Dipping; Vaccination of sheep and goat - Shearing of wool.

Suggested Readings

Devendra C & Mecleroy GB. 1982. *Goat and Sheep Production in Tropics*. Longman. Gupta JL. 2006. *Sheep Production and Management.* BS Publ.

ICAR. 2002. *Handbook of Animal Husbandry* 3rd Ed. ICAR.

Kaushish 1994. *Sheep Production in the Tropics and Sub Tropics.* Scientific Publ.

LPM 603 SWINE PRODUCTION AND MANAGEMENT 1+1 SEM - I

Objective

To impart knowledge on various aspects of swine farming in India, principles of housing, breeding, feeding and health care of pigs, management practices at different stages of growth and economic pig production systems.

Theory

UNIT-I: Introduction - Population and importance - Economic contribution of pigs - Advantages and disadvantages of swine keeping - Systems of management -Problems in pig farming.

UNIT-II: Breeds of pigs - Selection of breeding stock - Breeding seasons - Age and weight at first services - Methods for detection of heat – Natural service and artificial insemination - Care of pregnant sows, piglets and growers - Care of breeding boar.

UNIT-III: Housing, sanitation and hygiene, disease prevention measures - Housing and equipment –Wallowing - Sanitation and hygiene - Role of management in the prevention and the control of diseases.

UNIT-IV: Feeding and management of new born, weaner and finishers, dry, pregnant and farrowing sows - Feeding principles to be followed - Methods of watering –Feeder space – Water space, etc - Marketing: Methods of marketing in swine production - Record keeping.

Practical

Visits to piggeries and critical Analysis of various types of managerial practices - Analysis of the trend and structures of pig population - Analysis of practical breeding management methods, practical disease control management- special management methods - Ageing and identification – Judging -Constraints and remedial measures in pig farming - Economics of production -Project preparation for research and commercial farms.

Suggested Readings

Boden (e) S.1995. *Swine Practice*. WB London.

Narayankhedkar SG. 1997. *Production and Management of Swine, Camel, Equine and Yak.* Tindall Publ.

LPM 604 LABORATORAY ANIMAL PRODUCTION AND MANAGEMENT 1+1 SEM - II

Objective

To educate the students become familiarize with various aspects of rabbit farming, problems and prospectus, principles of housing, breeding, feeding and health care of rabbits, rats, mice and guinea pigs, measures to reduce the mortality in young ones at different seasons.

Theory

UNIT-I: Introduction - Importance of rabbit for meat and fur production, rats, mice and guinea pigs, - Common breeds and strains.

UNIT-II: System of housing – Common diseases and their control measure. Management of specific pathogen free and gnotobiotic animals, concepts to related to welfare of laboratory animals.

UNIT-III: Breeding - Age at maturity, litter size - Weaning – Feeding of growers – Selection of replacement stock, transportation of rabbit.

UNIT-IV: Transportation of Laboratory animals – marketing of meat and fur.

Practical

Handling and restraining of laboratory animals - Visits to small animal farms and critical analysis of various types of managerial practices- Analysis of the trend and structures of Laboratory animals population - Analysis of practical breeding management methods - practical disease control management and special management methods - Ageing and identification – Judging -Economics of production.

Suggested Readings

Indian Soil Institute.1993. *Rabbit Management*. IBH & Oxford.

Reddy DV. 2007. *Applied Nutrition*: (*Livestock, Poultry, Human, Pet, Rabbit and Laboratory Animal Nutrition*). IBH & Oxford.

Ronald N & Penman S. 1991. *A Manual for Small Scale Rabbit Production*. South Asia Publ.

LPM 605 SHELTER MANAGEMENT 1+1 SEM - I

Objective

To familiarize students with type of houses suited for different livestock under varying climatic conditions.

Theory

UNIT-I: General principles in planning animal houses- farmstead and animal houses - Selection of site and planning; layouts for livestock farm of different sizes indifferent climatic zones in India - Farm structures - General principles of construction of enclosures, floor and road.

UNIT-II: Housing requirements of different classes of Livestock - Preparation of layouts, plans, arrangement of alleys- Fitting and facilities in the houses for horses, dairy cattle, calves, bulls, work cattle, dogs, pigs, sheep, goats, and poultry.

UNIT-III: Improvement of existing buildings; water supply; feed and fodder delivery systems - Economics of Livestock housing.

UNIT-IV: Housing - Disease control measures and sanitation of all classes of livestock

Practical

Score card for animal houses - Time and motion study in Animal houses -Preparation of plans for Animal houses for horses, cattle, sheep, pigs, goats, and other livestock - Dogs and other pet animals - Economics of livestock housing - Preparation of plan for animal houses of different sizes and climatic zones of India.

Suggested Readings

Sastry NSR & Thomas CK. 2006. *Livestock Production and Management*. Kalyani. Thomas CK & Sastry NSR 1991. *Dairy Bovine Production*. Kalyani.

Wathes CM & Charles DR. 1994**.** *Livestock Housing*. CABI.

LPM 606 PRINCIPLES OF ENVIRONMENTAL HYGIENE AND WASTE MANAGEMENT 2+ 0 SEM - II

Objective

To familiarize students on principles of air and water hygiene with reference to impurities and inclusions of water, collection and disposal of waste from the animal house, modern techniques in manure disposal and biosecurity measures to be adapted for hygienic production of livestock products.

Theory

UNIT-I: Animal air hygiene: Definition - Composition of air - Air pollution - Factors affecting outdoor and indoor pollution - Assessment of these factors on animal health and production - Methods to control these factors.

UNIT-II: Water Hygiene: Importance of water - Impurities and inclusions - Sterilization- Examination of water and water supplies - Collection of samples-Topographical physical, chemical, bacteriological and microscopic examination of water - Hygienic requirements and standards for drinking water- Quantity of water required by domestic animals - Methods of watering.

UNIT-III: Manure - Quantity of manure voided by domestic animals - Animal excreta factor in spread of disease - Hygienic and economic disposal of farm waste -Modern techniques used in automation / semi-automation in disposal of farm waste.

UNIT-IV: Environmental protection act, Air (Prevention and control of pollution) act and water (Prevention and control of pollution) act – Biosecurity measures to be adapted for efficient and healthy production.

UNIT-V: Effect of environmental pollution on livestock and its products directly and indirectly - Controlling environmental pollution - Different factors affecting the quality of livestock and its products meant for human consumption.

Suggested Readings

Baba MD. 2007. *Environmental Changes and Natural Disasters*. New India Publ. Overcash MR. 1983. *Livestock Waste Management*. CRC Press.

Thapliyal DC & Misra DS. 1996. *Fundamentals of Animal Hygiene and Epidemiology.* International Book Distr. Co.

LPM 607 CLIMATOLOGY ANDANIMAL PRODUCTION 1+0 SEM - I

Objective

To familiarize students on climate, weather, various climatic factors and their role in production and health of animals in both temperate and tropics, micro and macroclimatic conditions of animal house and assessing the heat tolerance of bovines.

Theory

UNIT-I: Definition of climate -Classification of climatic regions - Climatic factors- Assessment of climate - Study of climatic factors in relation to animal production.

UNIT-II: Light, natural and artificial light-mechanism of light action-photo period and light responses – Applications - Importance of light in production of animals and birds.

UNIT-III: Introduction of breeds into different climatic regions - Agro meteorology and weather forecasting for Animal Husbandry activities - Micro climate modification in animal houses.

UNIT-IV: Estimation of microclimatic conditions in Animal house - Measurement of Temperature, Relative humidity, Air Velocity and Mean temperature of the surrounding, measurement of intensity of light in animal houses – Construction of seismographs and hythergraphs -estimation of cooling power of atmosphere heat tolerance test in bovines.

Suggested Readings

Lal DS. 1998. *Climatology.* Sharda Pustak Bhavan, Allahabad.

McDowell RE. 1972. *Improvement of Livestock Production in Warm Climates*. WH Freeman.

Siddhartha K & Roger B. 1996. *Atmosphere, Weather and Climate.* ELBS.

LPM 608 POULTRY FARM AND HATCHERY MANAGEMENT 2+1 SEM - I

Objective

To acquaint students on basic aspects of housing, feeding, breeding and healthcare of poultry and comparing the performance under cage and floor system of management of poultry, biosecurity measures to be followed to reduce mortality and efficient hatchery management to produce healthy young ones.

Theory

UNIT-I: Poultry housing systems Cage Vs floor system, litter management and lights for poultry, rearing turkey, duck and quails.

UNIT-II: Management of chicks, growing, laying and breeding flocks, broiler production, selection and culling of laying flocks.

UNIT-III: Procuring, care and pre-incubation storage of hatching eggs - Method of incubation, sanitation disinfection and management of hatchery.

UNIT-IV: Embryonic development and factors effecting fertility and hatchability of eggs. UNIT-V: Chick sexing, packing and hatchery business - Transporting management off arm and hatchery waste.

Practical

Poultry Farm management - Brooding of chicks; selection of laying flocks -Disease preventive measures - Selection and care of hatching eggs; incubator operation, fumigation and candling setting and hatching, packaging of chicks -Waste management - Marketing of products.

Suggested Readings

Ensminger ME. 1992. *Poultry Science*. International Book Distr. Co. Hued LM. 2003. *Modern Poultry Farming*. Greenworld.

Powell-Owen W. 2008. *Poultry Farming and Keeping*. Daya Books. Prashad J. 2005. *Poultry Production and Management*. Kalyani.

Singh RA. 1996. *Poultry Production*. 3rd Ed. Kalyani.

LPM 609 FARM ANIMAL BEHAVIOR 1+0 SEM - II

Objective

To make acquainted students on principles of farm animal behaviour with regard to environmental influence, group formation, social behaviour and behavioural adaptations under domestication.

Theory

UNIT-I: Introduction to Animal behaviour - Importance of animal behaviour studies - Patterns of behaviour - Daily and seasonal cycles of behaviour – Physiological basis of behaviour.

UNIT-II: Environmental modification of behaviour - Developmental changes in behaviour - Genetic differences in behaviour - Behavioural disorders.

UNIT-III: Group formation - Social relationship, process of socialisation locality and behaviour - Practical application - Behavioural character for managemental practices - Favourable and unfavourable behaviour for domestication -Behavioural adaptations under domestication.

UNIT-IV: Physical environment and behaviour - Common vices and their remedial measures - Analysis of behaviour in relation to location - Analysis of behaviour in relation to climatic environment - Analysis of social behaviour.

Suggested Readings

Arora MP. 1995. *Animal Behaviour*. WB London. Bouenger EG. 1994. *Animal Behaviour*. WB London.

Fraser AF & Broom DM. 1997. *Farm Animal Behaviour and Welfare*. CABI. Fraser AF & Broom DM. 1999. *Farm Animal Behaviour and Welfare*.

Kumar V. 1996. *Animal Behaviour*. WB London.

LPM 610 INTEGRATED LIVESTOCK FARMING SYSTEM 2+1 SEM - II

Objective

To familiarize on various aspects viz., scope and limitations of integrated livestock farming system, recent approach and economic feasibility of different integration models for sustainable production.

Theory

UNIT-I: Scope and limitation of integrated farming systems - Sustainability of integrated Livestock Farming Systems and their economic importance.

UNIT-II: Integration of fish, arable farming and different livestock enterprises vis-à-vis gobar gas plant, FYM, solar and wind energy utilization, cattle, buffalo sheep, goat, pig, poultry, rabbit, silk worm, bee keeping etc.

UNIT-III: New approach for changing farming systems in present energy crises. UNIT-IV: Project formulation and evaluation of various livestock enterprises.

Practical

Various livestock farming units and their economic analysis - Evaluation of different farming systems and their economic importance - Preparing feasibility report for various farming projects.

Suggested Readings

Mukherjee TK. 1992. *Integrated Livestock Fish Production Systems*.

Raman KV & Balaguru T. (Eds.). 1992. *Farming Systems Research in India: Strategies for Implementation.* NAARM.

Renard C. (Ed.). 1997. *Crop Residues in Sustainable Mixed Crop/Livestock Farming Systems.* CABI.

Speirs M. & Opsen O. 1992. *Indigenous Integrated Farming System in the Sahel*. World Bank.

LPM 611 EQUINEPRODUCTION AND MANAGEMENT 1+1 SEM - I

Objective

To educate the students become familiarize with principles of housing, breeding, feeding and health care of different classes of horse, stable routines and measures to reduce the mortality in young ones at different seasons.

Theory

UNIT-I: Equine population in India - Breeds of native and exotic horses - Types and classes of light and work horses.

UNIT-II: Housing and routine management practices –Hygiene and maintenance of stable. Color and markings, Dentition and ageing selecting and judging horses- unsoundness and stable vices.

UNIT-III: Feeding and breeding of horses donkey and Mules, foaling, care of foal.

UNIT-IV: Foot care and shoeing care, Stud farms - Race clubs - Race horses and their care - Horse behaviour and training - Exercising - Basic Horsemanship.

UNIT-V: Health management & diseases control. Control of internal and external parasites of horse- Colic and its prevention.

UNIT-VI: Mode of transport - Facilities requirement - Cleaning, disinfection and preparation of vehicles Transport stress - Management during transport -Regulatory acts of states and centre in animal disease control and welfare. Precautions and requirements before, during and after transport – Laws governing the import and export of livestock and its products- - Horse passport and trading.

Practical

Control of horse for examination, passing of stomach tube, dentition and ageing, saddling, exercising of horse, hoof care.

Suggested Readings

Blancchard TL et al. 2002. *Manual of Equine Reproduction*. Mosby Publ. Frape D. 1986. *Equine Nutrition and Feeding*. Blackwell Publ.

Kacker RN & Panwar BS. 1996. *Text Book of Equine Husbandry*. Vikas Publ.

Mills DS & Nankervis KJ. 1998. *Equine Behaviour: Principles and Practice*. Blackwell Publ.
Pilliner S. 1994. *Care of the competition Horse*. BT Batsford.
Rose RJ & Hodgson DR. 2000. *Manual of Equine Practice*. WB Saunders.

LPM 612 WILD LIFE MANAGEMENT AND CONSERVATION 2+0 SEM - II

Objective

To acquaint students with the principles and concepts of wild life sanctuaries and national parks, classification of wild animals, role of authorities in conservation and management of wild animals in captivity.

Theory

UNIT-I: Zoo and captive wild animals - Principles and concepts – Ecology of wild life sanctuaries and National parks- wild life legislation in India - Status of forest in India - Biological and ecological basis of management of wild life.

UNIT-II: Voluntary organization on wild life - Rules and regulations of zoo authority of India - Wild life protection act - Zoological classification of wild animals -Funding agencies for wild life research and preparation of project. -Conservation of wild animals. UNIT-III: Wild life health control - Reproduction in zoos - Population analysis - Population manipulation - Habit analysis and design - The resources and its management - Distribution of important Indian animals - Zoo animals and birds - Breeding characteristics – Movements - Cover requirements - Food -Population density – Mortality

- Nesting losses caused by predators, predator and prey relationship - Human interference
- Refuge rehabilitation.

UNIT-IV: Restraints - Maps - Survey and plans of management systems - Principles, protective measures - Development and conservation of water supply- puberty- Breeding seasons - pregnancy - Parturition - Lactation postnatal survival of the young - Social factors among various species - Miscellaneous management procedures.

Suggested Readings

Berwick SH & Saharia VB. (Eds.). 1995. *The Development of International Principles and Practices of Wild Life Research and Management.* Deford Univ. Press.
Bobbins CT. 1983. *Wild Life Feeding and Nutrition.* Daya Publ. House. Giles RH. 1978. *Wild Life Management*. Wild Life Society.
Giles RH. 1984. *Wild Life Management Techniques*. 3rd Ed. Wild Life Society.
Jadhav NV, Baig MI & Devangare AA. 2004. *Handbook of Wild Animals and Livestock Management*.
WWF. 1994. *Wild Life (Protection) Act* 1972 (as Amended up to 1991). Natraj Publ.

LPM 613 LIVESTOCK BUSINESS MANAGEMENT 1+1 SEM - I

Objective

To acquaint students with knowledge in principles, planning, technical approach and preparing financial statement in Livestock Business Management and preparing projects for financing.

Theory

UNIT-I: Management principles - Planning - Techniques, strategic planning, organization structure, co-ordination and controlling techniques - Approaches to management.

UNIT-II: SWOT analysis, financial accounting - Accounting records - Balance sheet, fund flow statement - Cost and analysis for managerial decisions – Budgeting and control.

UNIT-III: Tools of financial analysis, working capital financing - Long term financial management - Investment analysis - Capital markets - Corporate risk management - Venture capital.

UNIT-IV: Marketing - Objectives, strategies - Selecting and managing marketing channels
- Pricing strategies - Sales promotion - Legislation relating licensing -Company law.

Practical

Preparation of financial statements, depreciation accounting methods, trend and variance analysis, cost-volume profit analysis - Financial planning and forecasting - Estimation of working capital requirement - Break even analysis -Visit to livestock business firms and banks - Preparing projects for financing.

Suggested Readings

Koontz H & O'Donnel C. 1999. *Essentials of Management*. Tata McGraw Hill.

Kotler P. 2000. *Marketing Management – Analysis, Planning and Control*. Prentice Hall of India.

Maheswari SN. 1998. *Management Accounting*. Tata McGraw Hill. Massie JL. 1995. *Essential of Management*. Prentice Hall of India. Srinivasan NP. 1998. *Management Accounting*. Sterling Publications.

LPM 701 ADVANCES IN CATTLE AND BUFFALO PRODUCTION AND MANAGEMENT 3+0 SEM - I

Objective

To acquaint students on latest developments on dairying in India compared with developed countries, problems and prospectus of dairying, detailed aspects of care and management of different classes of dairy cattle and buffaloes.

Theory

UNIT-I: Dairy farming in India – Global scenario - Present status and reasons for the same – Avenues for progress – The needs of the nation and how to achieve it.

UNIT-II: Advances in housing management of dairy cattle and buffaloes in various agro climatic zone of India - Management systems for cattle and buffaloes.

UNIT-III: Establishing Dairy Cattle Enterprise – Characteristics of a successful dairy farm – Choice of the foundation stock – Breeding Management Problems associated with reproduction.

UNIT-IV: Advances in Feeding Management of cattle and buffalo, Feed for milking herd, dry cows, bulls and calves, Management of high yielding animals.

UNIT-V: Milking Management – Biosynthesis of milk - Factors affecting the composition and yield of milk - milk ejection reflex - Milking systems –Sanitary standards for the f quality milk – Cessation of milking, advances in herd management- raising calves – growing heifers, replacements and culling –marketing, Computerization of dairy enterprises.

UNIT-VI: Advance in health management of dairy animals, metabolic diseases of high yielder- advances in preventive measures for production related diseases.

Suggested Readings

Clarence HE . 2007. *Dairy Cattle & Milk Production*. Daya Publ. House. Thomas CK & Sastry NSR. 1991. *Dairy Bovine Production*. Kalyani.

Selected articles from journals.

LPM 702 ADVANCES IN SHEEP AND GOAT PRODUCTION AND MANAGEMENT 2+1 SEM - II

Objective

To educate the students on advances in sheep and goat farming for improving their productivity through different management practices.

Theory

UNIT-I: Utility origin – Domestication - Numbers and distribution of meat and dual- purpose breeds - Methods of rearing – Range sheep production.

UNIT-II: The farm flock – Pure bred flock - Management during breeding season - The sexual seasons and its control - Puberty – Time of the year to breed – Flushing– Ram-Ewe ratio.

UNIT-III: Advances in feeding management, Nutrient deficiencies in range forage, Feed to supplement range forage, General feeding practices, Feeding materials, Lamb feeding, Use of

antibiotics and hormones, Hand feeding, Self feeding, Pellet feeding , Feeding lambs and ewes during lactation.

UNIT-IV: Recent development in sheep and goat management and their relevance under Indian economic conditions, needs and possibilities for future research.

UNIT-V: Role of sheep husbandry in dry farming in India, Present development programmes in sheep and goat production, Advances in reproduction, housing, feeding and watering, diseases, Shearing methods and culling of sheep and goat.

UNIT-VI: Role of goat in animal agriculture, Goat farming in India, selection of Breeding stock, Breeding problems, Housing, Principles of feeding, Practices, Crops and crop residues for goats, Milking practices.

Practical

Study of population trend and structure - Visit to sheep and goat farms and critical analysis of various farm practices, Analysis of breeding, feeding, housing - Disease control management, management of young ones and maturing systems Estimation of fibre diameter medullation percentage crimps, tensile strength, Grease, pH and moisture content of wool - Score card and grading of wool.

Suggested Readings

Gupta JL. 2006. *Sheep Production and Management*. CBS. Selected articles from journals.

LPM 703 ADVANCES IN SWINE PRODUCTION AND MANAGEMENT 2+1 SEM - I

Objective

To educate about the latest advances of swine farming in India, principles of housing, breeding, feeding and health care of pigs, management practices at different stages of swine.

Theory

UNIT-I: The past, present and future of Swine production systems in India and production policies adopted in advanced countries.

UNIT-II: Advances in breeding and selection – Prenatal and postnatal development - Growth reproduction and lactation - Economic traits of swine production.

UNIT-III: Advances in feeding and nutrition in pigs; automatic feeding and watering techniques, Feed stuffs, Energy, protein, minerals and vitamin sources, metabolic and nutritional disorders – Toxic substances.

UNIT-IV: Advances in housing of pigs, environmental physiology - Infectious diseases and parasitism. reduction in new born piglet mortality.

Practical

Marketing - Study of population trend and structure. Analysis of breeding, feeding, housing, health care, farrowing management, summer management and special management principles practiced.

Suggested Readings

Selected articles from journals.

LPM 704 ADVANCES IN LABORATORY ANIMAL PRODUCTION AND MANAGEMENT 1+0 SEM - II

Objective

To educate the students on the latest advances in problems and prospectus, principles of housing, breeding, feeding and health care of rabbits, rats, mice& guinea pigs, measures to reduce the mortality in young ones at different seasons.

Theory

UNIT-I: Importance and limitations of rabbits for meat and fur production, rats, mice and guinea pigs - Common breeds and strains.

UNIT-II: Advances in system of housing, common diseases and their control measure. UNIT-III: Breeding strategies - Age at maturity, litter size, Weaning, Feeding of growers, Selection of replacement stock, transportation of rabbit.

UNIT-IV: Transportation of Laboratory animals – marketing of meat and fur.

UNIT-V: Management of specific pathogen free and gnotobiotic animals, concepts to related to welfare of laboratory animals.

Practical

Visit to Rabbit farms - Study of the various chores in government farms and private farms - Critical analysis of breeding, feeding, disease control management and housing - Rabbit slaughter technique.

Suggested Readings

Selected articles from journals.

LPM 705 ADVANCES IN POULTRY PRODUCTION AND MANAGEMENT 2+1 SEM - I

Objective

To educate the students on advances in housing, feeding, breeding and health care in poultry farming.

Theory

UNIT-I: Planning, organization, executive and management of poultry farms and hatcheries of various sizes - alternative in poultry production.

UNIT-II: Demand, supply, present status of poultry production.

UNIT-III: Problems and new management techniques in poultry for egg and meat in India vis-à-vis in other countries of the world, automation in poultry houses, management of specific pathogen free flocks.

UNIT-IV: Poultry development policies and planning for higher production constraints in development and solutions, Ethology and entology in relation to poultry production.

Practical

Planning and preparation of research and commercial projects on broiler and layer production management.

Suggested Readings

Selected articles from journals.

LPM 706 ADVANCES IN ENVIRONMENTAL MANAGEMENT 1+1 SEM - II

Objective

To educate the students on advances in climate, weather, various climatic factors monitoring and their role in production and health of animals in both temperate and tropics, micro and macroclimatic conditions of animal house and environmental influences on the performance of farm animal production.

Theory

UNIT-I: The animal Industry and the quality of the environment – Management of the living environment - Microenvironment and macro environment.

UNIT-II: Air Pollution: Indoor and out door - Chemical, physical and bacteriological changes - Causes – Standards and the extent tolerated by animals - Effects on animal production.

UNIT-III: Fixing standards in relation to CO_2 - Air supply in relation to cubic space, temperature, air, velocity, relative humidity, dust particles, bacterial count, effective temperature and cooling power - Methods to get over pollution –Cleaning and washing - Air conditioning.

UNIT-IV: Utilization and disposal of animal waste, Health hazards, Waste utilization, technologies for processing and treatment of animal wastes, Health and economic impacts, Legal constraints, Microbiology of wastes, Waste properties, Gases and odour.

UNIT-V: Water Pollution: Significance, treatment and control - Funding agencies for animal welfare.

Practical

Assessment of various factors in Indoor and outdoor environment- Assessment of CO2, air supply, dust particles and bacterial count in air - Visit to sewage treatment plant - Planning farm

waste disposals - Physical chemical and bacteriological examination of water watering of farm animals.

Suggested Readings

Baba MD. 2004. *Environmental Changes and Natural Disasters*. New India Publ. Agency.

Selected articles from journals.

LPM 707 ADVANCES IN EQUINE MANAGEMENT 2+0 SEM - I

Objective

To familiarize the students on latest aspects of principles of housing, breeding, feeding and health care of different classes of horse, stable routines and measures to reduce the mortality in young ones at different seasons.

Theory

UNIT-I: New indigenous and exotic horses breeds- Types and classes of light and workhorses.

UNIT-II: Advances in housing and routine management practices –Hygiene and maintenance of stable. Color and markings, Dentition and ageing selecting and judging horses- unsoundness and stable vices.

UNIT-III: New Feeding techniques and breeding of horses donkey and Mules, foaling, care of foal.

UNIT-IV: Foot care and shoeing care, Stud farms, Race clubs, Race horses and their care, Horse behaviour and training, Exercising ,Basic Horsemanship.

UNIT-V: Advances in health management & diseases control. Control of internal and external parasites of horse- Colic and its prevention.

UNIT-VI: Mode of transport, Facilities requirement, Cleaning, disinfection and preparation of vehicles Transport stress, Management during transport ,Regulatory acts of states and centre in animal disease control and welfare. Precautions and requirements before, during and after transport, Laws governing the import and export of livestock and its products, Horse passport and trading.

Suggested Readings

Selected articles from journals.

LIVESTOCK PRODUCTION MANAGEMENT
List of Journals

- Asian Journal of Buffalo Production and Management
- Australian Journal of Animal Science
- British Poultry Science
- Canadian Journal of Animal Science
- Indian Dairyman
- Indian Journal of Animal Nutrition
- Indian Journal of Animal Production and Management
- Indian Journal of Animal Science
- Indian Journal of Dairy Science
- Indian Journal of Field Veterinarians
- Indian Journal of Poultry Science
- Internal Journal of Animal Science
- Journal of Animal Sciences
- Journal of Dairy Sciences
- Livestock Production Science
- Poultry Science
- The Indian Veterinary Journal
- World Poultry Science Journal

e-Resources

- www.pork.org
- www.ilri.org
- www.fao.org
- www.defra.org.uk
- www.aciar.gov.au
- www.asap.asn.au
- www.thepigsite.com
- www.epa.com
- http://animalscience.ucdavis.edu
- www.tanu.edu
- www.sciencedirect.com
- http://trop.edmgr.com
- www.nianp.res.in/
- http://www.aphca.org
- http://www.ars.usda.gov

Suggested Broad Topics for Master's and Doctoral Research

- **Dairy cattle and buffalo Production**
  - Pre and postpartum management of dairy animals
  - Reducing age at first calving
  - Reducing calf mortality
  - Reducing calving intervals
  - Increasing reproductive efficiency
  - Farming system research / extension approach
  - System approach to livestock development
  - Housing management of animals in semi arid region

- **Poultry Production**
  - Poultry housing system
  - Stocking density in poultry
  - Environmental effects on poultry
  - Feeding management of poultry
  - Methods of processing poultry manure
  - System of approach for poultry development
- **Small ruminant production**
  - Sheep and goat housing system
  - Impact study on scientific management of sheep and goat
  - Environmental effects on sheep and goat
  - Feeding management of sheep and goat
- **Rabbit production**
  - Rabbit housing system
  - Feeding management of rabbit
  - Productive and reproductive performance of rabbit under tropical climate
- **Swine production**
  - Swine housing system
  - Feeding management of swine
  - Productive and reproductive performance of pigs under tropical climate

LIVESTOCK PRODUCTS TECHNOLOGY

Course Structure

COURSE NO.	COURSE TITLE	CREDITS	SEM
LPT 601*	FRESH MEAT TECHNOLOGY	1+1	I
LPT 602	MEAT PROCESSING, PACKAGING, QUALITY		
	CONTROL AND MARKETING	2+1	II
LPT 603*	POULTRY AND FISH PRODUCTS TECHNOLOGY	2+1	I
LPT 604*	EGG AND EGG PRODUCTS TECHNOLOGY	1+1	I
LPT 605	ABATTOIR AND POULTRY PROCESSING PLANT		
	PRACTICES	1+1	II
LPT 606	SLAUGHTER HOUSE BYPRODUCTS TECHNOLOGY	2+1	II
LPT 607	PROCESSING AND MARKETING OF WOOL	2+1	II
LPT 608*	MARKET MILK PROCESSING AND DAIRY PLANT		
	PRACTICES	2+1	I
LPT 609	QUALITY CONTROL OF MILK AND MILK PRODUCTS	1+1	II
LPT 610	TECHNOLOGY OF MILK PRODUCTS	2+1	I
LPT 611	BIOTECHNOLOGY OF FOODS OF ANIMAL ORIGIN	1+1	II
LPT 612	IN-PLANT TRAINING	0+2	SEM Break
LPT 691	MASTER'S SEMINAR	1	I, II
LPT 699	MASTER'S RESEARCH	20	I, II
LPT 701	ADVANCES IN ABATTOIR PRACTICES AND ANIMAL		
	BYPRODUCTS UTILIZATION	2+1	I
LPT 702**	ADVANCES IN FRESH AND PROCESSED MEAT		
	PRODUCTS TECHNOLOGY	3+1	II
LPT 703	ADVANCES IN POULTRY PRODUCTS TECHNOLOGY	2+1	I
LPT 704**	ADVANCES IN MILK AND MILK PRODUCTS		
	TECHNOLOGY	3+1	I
LPT 705	ADVANCES IN QUALITY CONTROL OF LIVESTOCK		
	PRODUCTS	2+0	II
LPT 706	BIOTECHNOLOGICAL TECHNIQUES AND		
	PROCESSES IN ANIMAL PRODUCTS	1+1	II
LPT 791	DOCTORAL SEMINAR -I,	1	I, II
LPT 792	DOCTORAL SEMINAR- II	1	I, II
LPT 799	DOCTORAL RESEARCH	45	I, II
SERVICE COURSE			
ABM 523	TECHNOLOGY MANAGEMENT FOR LIVESTOCK PRODUCTS	2+0	I

*Compulsory for Master's programme;

**Compulsory for Doctoral programme

LIVESTOCK PRODUCTS TECHNOLOGY
Course Contents

LPT 601 FRESH MEAT TECHNOLOGY 1+1 SEM - I

Objective:

To impart knowledge about history, current status of meat industry, muscle composition, functions and sensory quality of meat. To educate on factors influencing quality of meat and nutritive value.

Theory:

UNIT-I: History and development of meat science and meat industry, current trends and prospects of meat industry-Structure and chemistry of animal tissues, muscle functions and postmortem changes- Rigor mortis – Effect of transport on meat quality – its veterinary and clinical importance – PSE and DFD in meat quality – Conversion of muscle to meat.

UNIT-II: Composition, nutritional content and general quality characterization and evaluation of meat and its products- meat microbiology –Factors affecting quality of meat

– Essential nutrients in meat and poultry meat – Tenderization. Chemical residues in meat, and their effects on the health of the consumer.

Practical

Microbiological sampling and evaluation of meat. Evaluation of physicochemical and sensory properties of meat and meat products. Estimation of pH – Colour - Water holding capacity – ERV – Tyrosine value – Thiobarbituric acid number – Estimation of texture profile of meat – Estimation of glycogen, R-value, myoglobin, proximate analysis of meat and meat products including poultry products – Estimation of drip loss - Determination of Sarcomere length, fibre diameter and myofibrillar fragmentation index. Retail and wholesale cuts.

Suggested Readings

Gracey JF. 1999. *Thornton's Meat hygiene*. 10th Ed. WB Saunders.

Kerry J, Kerry J & Ledward D. 2005. *Meat Processing-Improving Quality*. Woodhead Publishing Ltd., UK.

Pearson AM & Dutson TR. 1999. *Advances in Meat Research.* Vol. IX. *Quality Attributes and their Measurement in Meat, Poultry and Fish Products*. Aspen Publishers, Inc, Maryland, USA.

Swatland H & Compbell T. 2004. *Meat Cuts and Muscle Foods*. Nottingham Univ. Press.

LPT 602 MEAT PROCESSING, PACKAGING, QUALITY CONTROL AND MARKETING 2+1 SEM - II

Objective

To impart knowledge on preservation methods, product development, quality control and packaging practices in meat.

Theory

UNIT-I: Factors affecting fresh meat quality, ageing, basic principles of preservation, chilling, freezing, thermal processing, dehydration, irradiation and use of chemicals and antibiotics; meat curing and smoking.

UNIT-II: Comminuted meat; preparation of various kinds of fresh and cooked meat products-Canning – Heat processing – Sausages – Ham, Bacon, Tandoori- Barbecueing of Poultry.Senses of taste and olfaction-factors influencing sensory measurements, physical and chemical properties related to sensory evaluation, types of sensory panels, discriminate and descriptive testing.

UNIT-III: Meat adulteration and substitution – Different techniques for meat speciation – Agar gel immuno diffusion techniques – Démonstration of CIE, IEF, ELISA, PCR

UNIT-IV: Principles of packaging- Product characteristics affecting packaging requirements; packaging material and their characteristics - different methods of packaging meat – Vacuum packaging – MAP – Retort pouch processing.

UNIT-V: Marketing of meat, setting up of meat retailing unit and other meat merchandising

practices. MFPO, BIS Standards for meat products. National and international specifications and standards.

Practical

Proximate composition of meat, tyrosine value, nitrite content, TBARS value, peroxide value, Formulation of different meat products, emulsion stability, shear force value, cooking determinants, subjective and objective method of sensory evaluations.

Suggested Readings

Kerry J, Kerry J & Ledward D. 2005. *Meat Processing-Improving Quality*. Woodhead Publishing Ltd., UK.

Pearson AM & Dutson TR. 1999. *Advances in Meat Research*. Vol. IX. *Quality Attributes and their Measurement in Meat, Poultry and Fish Products*. Aspen Publishers, Inc, Maryland, USA.

Swatland H & Compbell T. 2004. *Meat Cuts and Muscle Foods*. Nottingham Univ. Press.

LPT 603 POULTRY AND FISH PRODUCTS TECHNOLOGY 2+1 SEM - I

Objective

To impart knowledge on structure, functional quality, microbiology, processing and preservation of poultry meat, eggs and fish.

Theory

UNIT-I: History and development of poultry meat and egg processing industry. Different species of poultry and their production potentials- commonly occurring anti nutrients, and antibiotics in poultry feed ingredients and its effect on egg and meat nutrition – Quality identification, quality maintenance, chemical, nutritional and microbiological quality of poultry meat. Preservation and packing techniques of shelled and liquid eggs. Quality identification of shell eggs and factors influencing the quality.

UNIT-II: Pre-slaughter care, transportation, resting, fasting, ante-mortem examination, methods of slaughter and slaughtering procedure-postmortem inspection, reasons for condemnation of carcass-yield and grading of dressed chicken, cutup parts and de boned meat.

UNIT-III: Structure, nutritive value, compositional chemistry, microbiology and functional properties of eggs. Low cholesterol eggs, GMP, HACCP procedures for food safety – Codex regulation for food products safety – WTO/GOI regulations for import and export of poultry products. National and international regulations, standards, quality control and marketing of fish and fish products, utilization of fish processing waste.

UNIT-IV: Fishery resources, marine and fresh water fishes, transportation, processing, preservation, grading, standards. Quality control, labeling and marketing of fish and fish products, utilization of fish processing waste.

UNIT-V: Post processing value added meat for export- Integration, poultry and fish processing and marketing-Storage, packaging and chilling, freezing, dehydration, canning, irradication, curing, smoking, barbecuing, cooking and preparation of further processed poultry and fish products.

Practical

Organization, sanitation and maintenance of poultry processing plants. Slaughtering, antemortem and postmortem inspection, meat cutting, grading, production of ready to eat, smoked and cured poultry meat Comminuted and other poultry based convenient items. Visit to poultry processing plant/egg processing plant. Postmortem inspection, carcass yield and grading. Meat bone ratio, quality maintenance, tenderization, water holding capacity. TBA values and preparation of further processed and freeze dried poultry products. Whole egg powder, shell meal, processing plant waste meal-HACCP-egg powder processing plant. Grading of shelled eggs, liquid eggs, egg powder foaming property , pasteurization of liquid egg, testing microbial load in different foRms of egg, visit of egg powder plant/egg processing plant, poultry and fish products and their Proximate analysis, microbiological and sensory evaluation and poultry meat and fish.

Suggested Readings

Mead GC.1989. *Processing of Poultry*. Elsevier.

Mountney GJ. *Poultry Products Technology*. 2nd Ed. AVI Publ.

Pearson AM & Gillett TA.1996. *Processed Meats*. 3rd Ed. Chapman & Hall. Stadelman W & Cotterill OJ. 2002. *Eggs Science and Technology*. 4th Ed. CBS. Suziki T. 1981. *Fish and Krill: Protein Processing Technology*. Applied Science Publ.

LPT 604 EGG AND EGG PRODUCTS TECHNOLOGY 1+1 SEM - I

Objective

To impart knowledge about composition and marketing of eggs and nutritive value of eggs, preservation methods –quality maintenance, functional and value added egg product development, packaging and standards.

Theory

UNIT-I: Preservation and maintenance of quality of eggs- spoilage of egg and its prevention.- Preparation of fast foods.

UNIT-II: Egg breaking plant lay out and organization- freezing- pasteurization desugarisation-dehydration – quality estimation.

UNIT-III: Principles involved in preparation of egg powder and other egg products- Development of convenient egg based products- packaging of egg and egg products.

UNIT-IV: Specifications, standards and marketing of egg and egg products-Quality control of egg products.

Practical

Evaluation of physical, chemical, functional and microbial quality of egg and egg products. Preservation of eggs- Preparation of dehydrated and convenient egg products- Visit to egg processing plant.

Suggested Readings

Romanoff AL & Romanoff AJ. 1949. *Avian Egg*. John Wiley & Sons. Stadelman WL & Cotterill OJ. 2002. *Egg Science and Technology*. 4th Ed. CBS.

LPT 605 ABATTOIR AND POULTRY PROCESSING PLANT PRACTICES 1+1 SEM - II

Objective

Teaching about abattoir design, sanitation and basic slaughterhouse practices, effluent treatment and proper disposal of wastes.

Theory

UNIT-I: Layout, designing – operation and maintenance of slaughter houses and processing plants-disposal of slaughter house effluents and different designs of effluent treatment plants - equipments, organization and Slaughter house, maintenance, record keeping and operation-sanitation of slaughterhouse- Sanitary practices in meat plant and their benefits; quality control.

UNIT-II: Pre-slaughter judging, inspection, grading, pre-slaughter care, slaughter of meat animals; Humane slaughter – Principles and methods of stunning – Ritual slaughter of food animals and poultry – Machineries for slaughter and dressing- processing of different kinds of meat animals- Ante-mortem inspection and Post-mortem examination of animals. Disposal and condemnation of unfit materials.

UNIT-III: Carcass quality appraisal, judgment and their grading, meat cutting, measuring yields. Application of HACCP, GMP, ISO 9000, ISO 14000, ISO 22000, BIS Standards and any recent standards for meat and processing industries.

Practical

Visit to slaughterhouse– Plan and outlay of modern abattoir- Procedure for slaughter of food animals and poultry - Ante-mortem and postmortem inspection, slaughtering, grading and meat cutting, carcass yield, meat bone ratio, measurement of effluent characteristics: pH, BOD, COD, suspended solids etc.

Suggested Readings

Gerrard F. 1977. *Meat Technology*. Northwood.

Gracey JF. 1999. *Thornton's Meat hygiene*. 10th Ed. WB Saunders.

LPT 606 SLAUGHTER HOUSE BYPRODUCTS TECHNOLOGY 2+1 SEM - II

Objective

To impart knowledge on animal by-products, processing and industrial utilization.

Theory

UNIT-I: Slaughterhouse byproducts industry in India and abroad – Importance of utilizing slaughterhouse offals – Rendering- Planning a by-product plant - Utilization of blood, bones, hooves, glands, intestines, feathers, glandular byproducts and other minor byproducts for industrial exploitation.

UNIT-II: Meat fat characteristics - Preservation and processing of ruminal contents – Ensiling of ruminal contents – Value added products preparation from slaughterhouse byproducts, processing of animal byproducts for pet foods.

UNIT-III: Flaying - Classification and factors affecting quality of hides and skin- Physical and chemical characteristics of hide and skin- Processing of hide and skin for manufacture of leather- Preparation and quality control of gelatin and glue. Microscopic, physical and chemical characteristics of leather; testing and marketing of leather- Preservation and packaging practices of various kinds of hides and skin.

UNIT-IV: Designing of animal byproduct plant. Collection and scope for further utilization of slaughter house byproducts. Waste treatment and pollution control- Environmental Audits- Regulations on pollution control.

Practical

Identification of quality defects in leather- preparation of sausage casing, blood meal, feather meal and meat meal. Demonstration of carcass meal – Meat meal – Bone meal - Preparation of animal casings – Grading of casings and wool – Preparation of slime meal

– Collection and preservation of glandular products – Preparation of pet foods - Visit to local by-products/ processing units. Quality evaluation of rendered animal fat.

Suggested Readings

Dilon M & Griffith C. 2001. *Auditing in the Food Industry - From Safety and Quality to Environmental and other Audits*. Woodhead Publ. Ltd.,UK.

GregoryNG. 1988. *Animal Welfare and Meat Science*. CABI.

Ockerman HW & Hansen CL. 2000. *Animal by-product processing and utilization*. Technomic Publ. Co. Ltd., Pennsylvania, USA.

Ockerman HW & Hansen CL. 2002. *Animal Byproducts Processing and Utilization*. CRC.

LPT 607 PROCESSING AND MARKETING OF WOOL 2+1 SEM - II

Objective

To impart knowledge on grading, manufacturing process, marketing and specifications of wool and specialty fibers- growth and structure of wool and fiber, their use.

Theory

UNIT-I: Status and prospects of wool -Grading of wool. Faults and impurities in wool and their removal.

UNIT-II: Wool types and their uses. Growth and molecular structure of wool fibre; physical and chemical properties of wool. Characteristics of hair fibres and their use, factors influencing quality of wool and hair fibres - Principles and steps involved in manufacturing processes of wool- specialty hair fibres.

UNIT-III: Physical and chemical testing of wool. Proclaimed wool and secondary raw material - Marketing of wool, specification and regulation for quality control.

Practical

Visit to wool industry and acquaintance with various steps of manufacturing wool and its quality control, physical and chemical testing of wool. Characterization of wool, grading of wool.

Suggested Readings

Bergen WV. 1963. *Wool Hand Book*. Vols. I, II. Inter Science.

LPT 608 MARKET MILK PROCESSING AND DAIRY PLANT PRACTICES 2+1 SEM - I

Objective

To impart knowledge about milk composition, legislation, milk processing techniques**,** cleaning and sanitation of dairy equipments.

Theory

UNIT-I: Milk standards and legislation and related agencies.

UNIT-II: Composition of milk, major and minor constituents of milk, physico-chemical, microbial and nutritional properties of milk and preservation of raw milk.

UNIT-III: Layout Designing and organization of dairy plant, Milk procurement, handling and transportation. Chilling, centrifugation, separation, clarification, bactofugation and homogenization. Thermal processing- pasteurization, UHT processing, sterilization, bactotherm and packaging, Storage and distribution of processed milk. Fortified, reconstituted and flavoured milks.

UNIT-IV: Membrane processing and related techniques; application of ultrafilteration, reverse osmosis; nanofiltration and microfiltration in the dairy industry.

UNIT-V: Current trends in cleaning and sanitization of dairy equipment, biological detergents, ultrasonic techniques in cleaning; biodetergents. Disposal of dairy effluents.

Practical

Platform tests. Determination of fat, SNF, TS, protein, lactose and ash contents of milk. Standardization, pasteurization and sterilization. HCT profile of milk systems. Judging of different types of milks. Layout plan of market milk plant.

Suggested Readings

Walstra P, Wouters JTM & Geurts TJ. 2006. *Dairy Science and Technology*. 2nd Ed. Taylor & Francis.

Web BH, Johnson AH & Alford JA. 1987. *Fundamental of Dairy Chemistry*. 3rd Ed. Westport AVI Publ.

LPT 609 QUALITY CONTROL OF MILK AND MILK PRODUCTS 1+1 SEM - II

Objective

To impart knowledge about quality control, TQM, HACCP, SPS, CAC and legal standards.

Theory

UNIT-I: Importance of quality control in dairy industry. PFA Act, BIS standards, AgMark standards and ISO standards of milk products.

UNIT-II: Total quality management in processing of milk products – HACCP and SPS. UNIT-III: Types of microorganisms associated with milk and milk products-Milk borne diseases.

UNIT-IV: Physico-chemical and microbial changes during procurement, processing and storage of milk and milk products.

UNIT-V: Fundamental rules for sensory evaluation, Hedonic scale, score cards and their use for grading of milk and milk products.

Practical

Determination of pH and acidity, electrical conductivity, viscosity, phosphatase test, MBRT, Resazurin test, DMC, SPC. Analysis of milk and milk products in reference to BIS/PFA standards. Grading of milk and milk products**.**

Suggested Readings

Jennes R & Patton S. 1969. *Principles of Dairy Chemistry*. Wiley Eastern.

Yadav JS, Grover S & Batish VK. 1993. *Comprehensive Dairy Microbiology*. Metropolitan Publ.

LPT 610 TECHNOLOGY OF MILK PRODUCTS 2+1 SEM - I

Objective

To impart knowledge about techniques for preparation of different milk products.

Theory

UNIT-I: Drying of milk and milk products; freeze dehydration, water activity; sorption behaviour of foods- dried ice cream mix – cream and butter powder.

UNIT-II: Hurdle technology and its application in development of dairy products.

UNIT-III: Manufacture of milk products; butter, evaporated milk, condensed milk, milk powders, ice cream and other frozen desserts. Manufacture of yoghurt-acidophilus milkbulgaricus milk- kumiss-kefir. Manufacture of cheddar-mozzarella- cottage and processed cheese. Manufacturing of indigenous milk products- paneer- channa- khoa- ghee- dahi and shrikhand.

UNIT-IV: Manufacturing of casein- caseinate- co-precipitates- Whey protein concentrate (WPC) - lactose- dairy whiteners; functional properties of whey proteins, casein- coprecipitates- Ultra Filtration retentate and their modifications.

UNIT-V: Evaluation of functional properties. Packing, storage and marketing of milk products. Defects in milk products, their preventions and remedies.

Practical

Preparation of butter- panneer- channa- ghee- ice cream- cheese-cheddar- Mozzarella and cottage cheese- khoa- dahi- yoghurt- casein- caseinate-coprecipate- determination of degree of browning chemical/physical methods; measurement of different functional properties of different milk products.

Suggested Readings

Aneja RP, Mathur BN, Banerjee AK & Chandan RC. 2002. *Technology of Indian Milk Products*. Dairy India.

Spreer E. 1993. *Milk and Dairy Products*. Marcel Dekker.

Walstra P, Wouters JTM & Geurts TJ. 2006. *Dairy Science and Technology*. 2nd Ed. Taylor & Francis.

LPT 611 BIOTECHNOLOGY OF FOODS OF ANIMAL ORIGIN 1+1 SEM - II

Objective

To impart knowledge about new techniques of biotechnology for improving food value.

Theory

Role of Biotechnology in productivity of livestock, Meat Speciation and quality control. Use of Biotechnology in production of food additive. Use of biotechnological tools for the processing and preservation and foods of animal origin, use of biotechnology improved enzymes in food processing industry, consumer concerns about risks and values, biotechnology and food safety. Future of food biotechnology in India.

Practical

Introduction of basic biotechnological techniques such as western blotting, enzyme isolation and identification, DNA extraction, amplification, different types of PCR, Acquaintance with RT-PCR, Multiplex PCR, gene identification and characterization**.**

Suggested Readings

Selected articles from journals.

LPT 612 IN-PLANT TRAINING 0+2 (S/US) SEM BREAK

Objective

To impart industrial exposure to post graduate students in meat, milk, poultry and fish industry.

Practical

LPT students will undergo in-plant training in any one of the specialized area of Livestock Products Technology for a period of three weeks in an institute in private/public sector industry. After completion of the training, the student will submit a training report. Evaluation will be based on viva-voce examination and a report submitted by student- Preparation of training report.

Suggested Readings

Selected articles from journals.

LPT 701 ADVANCES IN ABATTOIR PRACTICES AND ANIMAL BYPRODUCTS UTILIZATION 2+1 SEM - I

Objective

To impart knowledge on advances in animal byproducts utilization such as leather, fat, casings, gelatin and abattoir effluent treatment. To expose the importance of environmental pollution and their pollutants.

Theory

UNIT-I: Existing situation of slaughterhouses and processing plants in India – Collection of inedible and edible by-products for industrial uses – Disposal of slaughterhouse effluents – Effluent treatment plant – Different designs of effluent treatment plants- Sanitary and phytosanitary measures – Advances in chemistry and technology of leather. Latest techniques in handling, preservation, tannery procedure, manufacture and testing of leather.

UNIT-II: Progress in gelatin, glue and natural casings production. Latest technology for utilization of animal byproducts, industry-waste as food, pharmaceuticals and other miscellaneous byproducts. Characterization, processing and quality control of meat fat.

UNIT-III: Current trends in utilization of byproducts of egg, meat and poultry processing industry for feed, fertilizer and other useful products of economic importance- Organization, layout and operation of dry and wet rendering plants-Latest trends in disposal of slaughterhouse effluents and control of environmental pollution.

Practical

Visit to various slaughterhouses and meat processing plants – Plan and outlay of various components of modern abattoir – Designs of ETP - - Estimation of BOD and COD from abattoir effluents - Ante-mortem inspection of food animals – Methods of stunning – Stunning instruments – Electrical stunning – Slaughter and dressing of food animals – Post mortem inspection of carcasses of food animals – Fabrication of carcasses of food animals.

Suggested Readings

Gracey JF. 1999. *Thornton's Meat Hygiene*. 10th Ed. WB Saunders. Selected articles from journals.

Wilson W. 2005. *Wilson's Practical Meat Inspection*. 7th Ed. Blackwell Publ.

LPT 702 ADVANCES IN FRESH AND PROCESSED MEAT PRODUCTS TECHNOLOGY 3+1 SEM - II

Objective

To empower students on recent advances in processing, preservation, quality control, packaging, regulations and standards of meat. To bring out knowledge on harmful residues in meat and to impart information on meat species identification.

Theory

UNIT-I: Development of muscular tissue – Abnormal growth and developments in muscle – Genetic, nutritional and physiological aspects – Muscle proteins – Myofibrillar, sarcoplasmic and connective tissue proteins – Cytoskeletal proteins - Skeletal muscle fibre types – Lipid

profile – Factors affecting muscle function and composition - Stress on the animal – Stress and the meat quality- Latest findings in the area of pre-slaughter care of meat animals- Keeping and Eating quality of meat – Properties of fresh meat – Odour, Colour, Water holding capacity - texture profile – Artificial tenderization – Meat in human nutrition – Essential nutrients in meat and poultry meat – Prefabricated meat – Chemical residues in meat and their effects on the health of the consumer.

UNIT-II: Principles of preservation – Methods - temperature control – Refrigeration – Chilling – Freezing – Mechanisation of chiller and freezer – Thermal processing – Canning – retort processing - Intermediate moisture meat – Moisture control – Dehydration – Freeze drying – Curing – Smoking – Direct microbial inhibition – Irradiation – Use of antibiotics and chemical preservatives – Organic acids – Recent advances in preservation of meat. Meat adulteration and substitution – Different techniques for meat speciation - Packaging of meat and meat products- Critical assessment of ageing, chilling, freezing, smoking, curing, tenderization and irradiation techniques.

UNIT-III: Basic meat processing procedure-Functional properties of tissue component in meat processing-forming processed meat products. Approaches for new product development-different equipments used for processing of meat products- Indigenous and heritage meat products-purpose of smoking-composition of smoke-method of smoking liquid smoke preparation-Ham, bacon, sausages, patties, burger, meat loaves-various noval meat products.

UNIT-IV: Fermented meat products-heat processing-restructured meat products- Reformed meat products-Effect of massaging, tumbling and flaking techniques and quality-intermediate moisture meat-Enrobed meat products-Meat analogues and substitutes-Thermal processing of meat-Browning reaction- Enzymatic and non enzymatic-Protein changes in processed meat products lipid changes-protein and lipid interaction-protein and carbohydrate interaction.

UNIT-V: Meat additives and regulations pertaining to processed and convenient meat based products-Meat packaging and retailing practices-National and international standards, grading, specifications and quality control of meat and meat products.

Practical

Estimation of Colour - Estimation of texture profile of meat – Estimation of glycogen, Lactic acid, R-value, myoglobin, proximate analysis of meat and meat products –

Estimation of hydroxy proline - Histological structure of muscle - Estimation of emulsion stability, thawing in meat and meat products– Identification of different packaging material – Agar gel immuno diffusion techniques – Demonstration of CIE, IEF, ELISA, PCR – Different methods of packaging of meat and meat products including poultry products - Visit to different cold stores.Evaluation of carcass quality,Estimation of muscle fiber diameter, Estimation of lipid profile of meat. Organoleptic evaluation of meat- Estiamtion of Nitrate-Preparation of some noval meat products and studies on their shelf life-Total viable count and differential counts of meat and meat products-Visist of meat /poultry processing units.

Suggested Readings

Kerry J, Kerry J & Ledward D. 2005. *Meat Processing-Improving Quality*. Woodhead Publ. Ltd., UK.

Swatland H & Compbell T. 2004. *Meat Cuts and Muscle Foods*. Nottingham Univ. Press. Selected articles from journals.

LPT 703 ADVANCES IN POULTRY PRODUCTS TECHNOLOGY 2+1 SEM - I

Objective

Discussion on latest development in processing, preservation, quality control, packaging, regulations and standards of poultry meat.

Theory

UNIT-I: Indian scenario of poultry processing industry Advances in poultry dressing, meat yield, preservation, microbiology and quality control methods. Automation in broiler farming, catching, transporting, control of shrinkage and methods of slaughter.

UNIT-II: Preservation techniques, Room temperature preservation of poultry fast foods by multi hurdle technology, critical evaluation of application of refrigeration, tenderization, canning, dehydration, irradiation, curing, smoking and cooking techniques in poultry processing and development of additional processed products.– Regulation of CAC and European standards of poultry meat and meat products.

UNIT-III: Recent trends in packing and marketing of poultry and poultry products. Modified atmosphere packaging- Different packing materials for meat and cooked products.

UNIT-IV: Policies and marketing trends in poultry meat -Regulations, specifications, standards and use of additives in poultry products.

UNIT-V: Poultry product development formulation and profitability.

Practical

Cooked and uncooked meat quality standards- sensory evaluation of poultry meat packaging material- Modified Atmosphere Packaging-Factors influencing meat quality at different freezing temperatures and thawing.

Suggested Readings

Selected articles from journals.

LPT 704 ADVANCES IN MILK AND MILK PRODUCTS TECHNOLOGY 3+1 SEM - I

Objective

To disseminate knowledge about production of high quality milk, preservation method, advances in processing of milk and milk products and packaging.

Theory

UNIT-I: Principles and practices of production of high quality milk. Advances in methods of chilling and preservation of milk. Thermal processing of milk, principles and methods, types of UHT-processing plants. Advances in packaging of milk.

UNIT-II: Bacteriological, physical, chemical and nutritional effects of processing on milk

- New concepts in milk processing – radiation and microwave processing- Membrane processing in dairy industry such as Reverse Osmosis(R.O), Ultra Filtration (UF), Nano Filtration (NF) and Micro Filtration (MF)- Fouling and cleaning of membranes.

UNIT-III: New concepts in technology of dairy products. Cream powder, sterilized cream, frozen products, ice-cream mix, low, medium, high heat milk powder, milk based infant foods. Advances in starter cultures and their application, butter, butter spread, butter powder, cheese and cheese spread, probiotic products.

UNIT-IV: Indigenous dairy products, khoa powder, paneer/channa powder, gulab jamum powder, kulfi powder. Recent advances in utilization of dairy byproducts in product development, preservation of milk products. Application of immobilized enzyme in dairy products.

Practical

Use of Starter cultures, lyophilization process, Maintenance of cultures. Demonstration of Memeberane processing Technology, Advances in Packaging-Retort, Vacuum and Control Atmosphere Pacakaging Technology.

Suggested Readings

Walstra P, Wouters JTM & Geurts TJ. 2006. *Dairy Science and Technology*. 2nd Ed. Taylor & Francis.

Selected articles from journals.

LPT 705 ADVANCES IN QUALITY CONTROL OF LIVESTOCK PRODUCTS 2+0 SEM - II

Objective

To impart knowledge about the advances in quality control in dairy and meat industry.

Theory

UNIT-I: Recent advances in quality control in dairy and meat industry in special reference to Total Quality Management, HACCP – good manufacturing practices for manufacturing of quality and safe livestock products.

UNIT-II: PFA and BIS standards, International Standards Organization (ISO 9000), product quality certification, international standards for milk powders, American Dairy Products Institute (ADPI) standards.

UNIT-III: Rheology of milk products, preservatives, antioxidants, antibiotics and pesticides residue in milk- Advances in bacteriological and physico-chemical analysis of milk and milk products.

UNIT-IV: Importance of quality assurance of livestock products for domestic and export trade – quality standards for meat - Effect of processing on nutritional and chemical qualities of meat products – Sensory evaluation of meat products – Physicochemical and microbiological quality assessment and standards - Economics of processing and product development, good manufacturing practices, meat hygiene regulations in relation to slaughter houses and processing plants-international regulations-State Municipal and other regulations pertaining to meat trade-Meat Food Products Order-ISO certification- Codex alimentarius-Bureau of Indian standards.

Suggested Readings

Selected articles from journals.

LPT 706 BIOTECHNOLOGICAL TECHNIQUES AND PROCESSES IN ANIMAL PRODUCTS 1+1 SEM - II

Objective

To impart knowledge about biotechnological techniques, methods, starter cultures and industrial application of biotechnology in meat industry.

Theory

UNIT-I: Introduction, development and prospects of biotechnology in animal products, ancient and traditional food processing biotechniques.

UNIT-II: Modern biotechnological methods and processes in animal products development, chemical and physical factors required for growing microbial cultures in nutritive substrate-Meat species identification- Quality control – Screening products for contaminants – Polymerase Chain Reaction (PCR) based methods.

UNIT-III: Basic principles of the industrial use of bio-reactions for production of biomass upstream and downstream processing-application of micro-organisms as starter cultures in meat industry, microbial production of food ingredients.

Practical

Production, selection and purification of microbial cultures, making products using different microbial cultures, production of acidulation, buttery flavour, pigments, antimicrobial agents to improve the product quality and safety- Polymerase Chain Reaction (PCR).

Suggested Readings

Selected articles from journals.

LIVESTOCK PRODUCT TECHNOLOGY

List of Journals

- Advances in Food Research
- Beverage and Food World
- British Poultry Science
- Dairy Foods
- Dairy Indian
- Dairy Industries International
- Dairy Science Abstracts
- Flieshwirtschaft
- Food Processing
- Food Technology
- Food Technology
- Indian Dairy Man
- Indian Food Industry
- Indian Journal of Dairy Technology
- Indian Journal of Food Science and Technology
- Indian Journal of Poultry Science
- Indian Journal of Veterinary Research
- International Dairy Federation
- International Dairy Journal
- International Food Hygiene
- International Journal of Dairy Technology
- Journal of Animal Science
- Journal of Dairy Research
- Journal of Dairy Science
- Journal of Food Protection
- Journal of Food Science
- Journal of Meat Science
- Milk Industry
- Poultry Science
- Processed Food Industry
- Science of Food and Agriculture

e-Resources

- www.meatscience.org
- www.amis.org
- www.meatami.com
- www.mla.org.au
- www.FAO.org
- www.agresearch.co.nz/mirinz
- www.usa.gov
- www.fsis.usda.gov
- www.poultryhelp.com
- www.nddb.org
- www.ndri.res.in
- www.amul.com
- www.idfa.org

COLLEGE OF DAIRY SCIENCE AND TECHNOLOGY

DAIRY TECHNOLOGY

Course Structure - at a Glance

COURSE NO.	COURSE TITLE	CREDITS	SEM
DT 511*	ADVANCED DAIRY PROCESSING	3+1	I
DT 512*	ADVANCED FOOD PROCESSING	3+1	I
DT 513	RHEOLOGY OF DAIRY AND FOOD PRODUCTS	2+1	I
DT 514*	DAIRY PROCESS BIOTECHNOLOGY	2+1	I
DT 515	TRADITIONAL AND VALUE-ADDED DAIRY PRODUCTS	2+1	I
DT 521	MEMBRANE TECHNOLOGY IN DAIRY PROCESSING	2+1	II
DT 522	ADVANCED DAIRY AND FOOD PACKAGING	2+1	II
DT 523	ALTERNATIVE PROCESSES FOR THE DAIRY & FOOD INDUSTRIES	2+1	II
DT 524*	FUNCTIONAL FOODS AND NEW PRODUCT DEVELOPMENT	3+1	II
DT 525	TECHNOLOGY OF FOOD EMULSIONS, FOAMS & GELS	2+1	II
DT 591	MASTER'S SEMINAR	1+0	I, II
DT 599	MASTER'S RESEARCH	20	I, II
DT 611	ADVANCES IN LIPID TECHNOLOGY	3+0	I
DT 612	ADVANCES IN PROTEIN TECHNOLOGY	3+0	I
DT 621	PRODUCT MONITORING AND PROCESS CONTROL	3+0	II
DT 622#	R & D MANAGEMENT IN DAIRY INDUSTRY	3+0	II
DT 691	DOCTORAL SEMINAR I	1+0	I, II
DT 692	DOCTORAL SEMINAR II	1+0	I, II
DT 699	DOCTORAL RESEARCH	45	I, II
	SUGGESTED SUPPORTING COURSES		
ES 525	DAIRY BUSINESS MANAGEMENT	2+1	II
ES 529	STATISTICS IN INDUSTRIAL APPLICATIONS	3+1	II
CS 521	COMPUTER SOFTWARE	2+1	II
DCRT 524#	RESEARCH TECHNIQUES	2+1	II
DC 523	CHEMICAL QUALITY ASSURANCE	2+1	II
DM 523	MICROBIAL QUALITY & SAFETY IN DAIRY INDUSTRY	2+2	II
DE 524	ENVIRONMENTAL ENGINEERING	2+0	II

* Compulsory for Master's programme; # Cross-listed NOTE : *Doctoral students shall take a minimum of two 600-level courses*

DAIRY TECHNOLOGY
Course Contents

DT 511 ADVANCED DAIRY PROCESSING 3+1

Objective

To provide in-depth knowledge in various unit operations and basic concepts in dairy processing.

Theory

UNIT I

Use of bio-protective factors for preservation of raw milk: effects on physicochemical, microbial and nutritional properties of milk and milk products, present status of preservation of raw milk by chemical preservatives; thermal processing for preservation.

UNIT II

Methods of determining lethality of thermal processing, UHT processed milk products, their properties and prospects, types of UHT plants, aseptic fillers, heat stability and deposit formation aspects, effect on milk quality; techno- economic considerations; retort processing.

UNIT III

Principles and equipment for bactofugation and Bactotherm processes, Microfluidization of milk: Principle, equipment, effects and applications, Homogenization and their applications in dairy industry.

UNIT IV

Dehydration: advances in drying of milk and milk products; freeze concentration, freeze dehydration: physicochemical changes during freeze drying and industrial developments.

UNIT V

Water activity; sorption behaviour of foods, energy of binding water, control of water activity of different milk products in relation to their chemical; microbiological and textural properties; hurdle technology and its application in development of shelf-stable and intermediate-moisture foods, Use of carbonation in extending the shelf life of dairy products.

UNIT VI

Current trends in cleaning and sanitization of dairy equipment: biological; detergents; Automation; Ultrasonic techniques in cleaning; bio-detergents, development of sanitizers- heat; chemical; radiation, mechanism of fouling and soil removal; Bio-films, assessing the effectiveness of cleaning and sanitization of dairy products.

Practical

LP system for extension of keeping quality raw milk, determination of pH; HCT profile of milk systems, measurement of thiocyanate in milk system; determination of water activity and sorption isotherms of milk products; determination of thermal load during retort processing of milk and milk products; heat classification of milk powders; functional properties of powders: porosity, interstitial air content, occluded air content, flowability; determination of degree of browning-chemical/physical methods; freeze drying of milk/milk products, and heat sensitive products. Homogenization efficiency; cleaning efficiency in dairy equipment; visit to a UHT Processing plant. Thermal process calculations.

Suggested Readings

Burton H. 1998. *Ultra-high Temperature Processing of Milk and Milk Products*. Elsevier.

Fellow P. 1988. *Food Processing Technology*. Elliss Horwood Ltd.

Gould GW. 1995. *New Methods of Food Preservation*. Blackie.

IDF Bulletin 1981. *New Monograph on UHT Milk*. Document No. 133, Intern. Dairy Fed., Brussels.

Smit G. 2003. *Dairy Processing – Improving Quality*. CRC-Woodhead

Publ.

Troller JA & Christian HB. 1978. *Water Activity and Food, Food Science and Technology*. A Series of Monograph Academic Press, London.

Walstra P, Geurts TJ, Noomen A, Jellema A & Van Boekel MAJS. 1999.

Dairy Technology – Principles of Milk Properties and Processes.
Marcel Dekker.

DT 512 ADVANCED FOOD PROCESSING 3+1

Objective

To provide in-depth understanding of advances in theoretical and practical aspects of food processing.

Theory

UNIT I

Status of food processing industry in India and abroad; prospects and constraints in development of Indian food industry.

UNIT II

Post harvest management of fruits and vegetables, Harvesting indices, Biochemical and physical changes during ripening of fruits & vegetables, respiration and factors affecting it, role of ethylene in accelerated ripening, post harvest treatments for extension of shelf-life of fresh produce, Strategic interventions to minimize post harvest losses including vapour heat treatment, wax coating, chemicals, etc.

UNIT III

Principles of chilling & refrigeration storage of foods, quality changes in cold stored products, controlled and modified atmospheric storage. Freezing of foods, principle and equipments for freezing, defects in frozen foods, re-crystallization, freezing of fruits and vegetables, freeze concentration of fruit juices.

UNIT IV

Application of heat energy to foods for preservation and processing, concept of drying rate of foods, industrial drying processes of foods; changes during drying, advanced drying processes (Freeze drying, infra red drying and microwave drying), Canning of fruits & vegetables, unit processes involved in canning, types of cans for thermal processing of foods.

UNIT V

Basic principles involved in fermentation, Technological aspects of pickled vegetables like sauerkraut, cucumbers, Technology of wine, beer and distilled alcoholic beverages, defects in alcoholic beverages.

UNIT VI

Conversion of muscle into meat, rigor mortis, freezing and canning of meat, curing & smoking of meat, fermented sausages, cooking of poultry, utilization of milk ingredients in processed meat and poultry products.

UNIT VII

Advances in milling of rice (solvent extractive milling) and Turbo milling of wheat. Bakery products; role of ingredients, Developments in manufacturing processes for bakery products such as breads; biscuits; pizza bases, cake etc; changes during processing of bakery products. Utilization and importance of dairy ingredients in bakery products.

UNIT VIII

Definition, classification and technologies of fabricated and formulated foods and their nutritional aspects. Imitation dairy products and dairy analogues. Principle of extrusion processing, design and working of extruder, classification, application in food and dairy processing. Food additives, including stabilizers, emulsifiers, antioxidants, preservatives, etc. for formulated foods.

UNIT IX

Important group of enzymes involved in food processing; Application of enzymes in food processes like enzymes juice extraction, juice clarification, in bread manufacture, meat tenderization, ice cream manufacture, de-sugaring of egg, etc.

UNIT X

Newer concepts in food processing including organic foods, processing of organic raw material,

genetically modified foods.

Practical

MAP and its effect on shelf-life of fresh fruits and vegetables, Preparation of squash, cordial, nectar and whey beverages, whey based soups, Manufacture of bread, pizza base, biscuits and cake, Application of milk ingredients in caramel, egg-less cake, mayonnaise, canning of fruits & vegetables, manufacture of chicken soup, comminuted meat products, enzymatic extraction and clarification of fruit juices, Preparation of soymilk and tofu, Drying of fruits & vegetables, efficacy of blanching treatment. Manufacture of sauerkraut/fermented vegetables.

Suggested Readings

Fellows PJ. 2000. *Food Processing Technology: Principles and Practices*. 2nd Ed. CRC-Woodhead Publ.

Fennema CR. 1975. *Principles of Food Science.* Part II. *Physical Principles of Food Preservation.* Marcel Dekker.

Guy R. 2001. *Extrusion Cooking: Technologies and Applications*. CRC-Woodhead Publ.

Honseney RC. 1986. *Cereal Science and Technology*. American Association of Cereal Chemists, St. Paul, Minnesota.

Hui YH, Meunix-Goddick L, Hansen AS, Josephsen J, Nip WK, Stanfield PS & Toldra F. 2004. *Handbook of Food and Beverage Fermentation*. Marcel Decker.

Hui YH, Nip WK, Rogers RW & Young DA. 2001. *Meat Science and Application*. Marcel Decker.

Norman W & Desrosier IN. 1987. *The Technology of Food Preservation*. 4th Ed. CBS Publ.

Penfield MP & Campbell AM. 1990. *Experimental Food Science*. 3rd Ed.

Academic Press.

Ramaswamy H & Marcotte M. 2006. *Food Processing: Principle and Application*. Taylor & Francis.

Vangarde JS & Woodburn M. 1994. *Food Preservation and Safety: Principles and Safety*. Iowa State University Press, Iowa.

DT 513 RHEOLOGY OF DAIRY & FOOD PRODUCTS

Objective

To explain the basics of food rheology, and to familiarize the students with rheological instruments and their use in relation to dairy and food products.

Theory

UNIT I

Introduction to rheology of foods: Definition of 'texture', 'rheology' and 'psychophysics' – their structural basis; physical considerations in study of foods; salient definitions –Stress tensor and different kinds of stresses.

UNIT II

Rheological classification of Fluid Foods : Shear-rate dependence and time dependence of the flow-curve; Non-Newtonian fluids; thixotropy; Mechanisms and relevant models for non-Newtonian flow; Effect of temperature; Compositional factors affecting flow behaviour; Viscosity of food dispersions – dilute and semi-dilute systems, concentration effects.

UNIT III

Comparative assessment of different types of Viscometers, and their Merits and Limitations: Co-axial cylinders, Spindle- or Impeller-type viscometers, Cone-plate viscometer, Capillary viscometers, Falling-sphere viscometer, Vibratory viscometers, Extrusion viscometer, Orifice viscometer.

UNIT IV

Rheology of semi-solid and solid food ; Rheological characterization of foods in terms of stress-strain relationship; Viscoelasticity; Transient tests - Creep Compliance and Stress Relaxation; mechanical models for viscoelastic foods: Maxwell, Kelvin, Burgers and generalized models and their application; Dynamic measurement of viscoelasticity.

UNIT V

Large Deformations and failure in foods: Definitions of fracture, rupture and other related phenomena; Texture Profile Analysis; Instrumental measurements – Empirical and Fundamental methods; Rheometers and Texture Analyzers; Measurement of Extensional viscosity; Acoustic measurements on crunchy foods.

UNIT VI

Rheological and textural properties of selected dairy products: Measurement modes and techniques; Effect of processing and additives (stabilizers and emulsifiers) on food product rheology; Relationship between instrumental and sensory data.

Practical

Study of different types of viscometers viz., co-axial cylinder viscometer, spindle viscometer, falling-ball viscometer, extrusion viscometer, impeller viscometer, orifice viscometer; Flow behaviour of fluid dairy products;

Thixotropy in ice-cream mix; force-deformation study in selected dairy products using Texture Analyzer; Back extrusion; Effect of test conditions on the texture profile parameters of cheese and similar products; stress relaxation studies in solid foods; Use of Cone Penetrometer and FIRA-NIRD extruder for measurement of butter texture; Use of a Viscoamylograph for study on the gelatinization behaviour of starch/cereals flours.

Suggested Readings

Barbosa-Canovas GV, Kokini JL, Ma L & Ibarz A. 1997. *Rheology of Semi-liquid foods*. *Adv. Food & Nutr. Res*., 39:1-69.

DeMann JM, Voisey PW, Rasper VF & Stanley DW. 1976. *Rheology and Texture in Food Quality*. AVI Publ.

NDRI. 1996. *Sensory Evaluation and Rheology of Milk and Milk Products*. Lecture Compendium, CAS/DT Short Course, Aug. 22-Sept. 13, 1996. Dairy Technology Division, NDRl, Karnal.

Sherman P. 1970. *Industrial Rheology*. Academic Press.

DT 514 DAIRY PROCESS BIOTECHNOLOGY 2+1

Objective

To project the importance of biotechnology in dairy processing and impart knowledge on all aspects of dairy process biotechnology in production and preservation of dairy products employing the principles of biotechnology.

Theory

UNIT I

Definition of biotechnology; development and impact of biotechnology on food and dairy industry.

UNIT II

Microbial rennet and recombinant chymosin, characteristics and application in cheese making; exogenous free and microencapsulated enzymes, immobilized enzymes-their application in accelerated ripening of cheese; enzymatically modified cheeses (EMC) their utilization in various food formulations.

UNIT 3

Technological requirements of modified micro-organisms for production of cheese and fermented milk products; technological innovations in the development of functional dairy foods with improved nutritional therapeutic and pro-biotic attributes; physiologically active bio-peptides/ nutraceuticals; protein hydrolysates – their physicochemical, therapeutic properties,

production and application in food formulations; production of bio-yoghurt, pro-biotic cheese and fermented milks; bifidus factors in infant food formulations.

UNIT IV

Protein hydrolysates-production, their physicochemical, therapeutic properties, de-bittering and application in food formulations; Enzymatic hydrolysis of lactose for preparation of whey and UF-permeate beverages.

UNIT V

Microbial polysaccharides their properties and applications in foods, production of alcoholic beverages and industrial products from starch; whey and other by-products; bio-sweeteners-types properties and their applications in dairy and food industry.

UNIT VI

Bio-preservatives - characteristics and their application in enhancing the shelf life of dairy and food products.

Practical

Effect of exogenous enzymes on hydrolysis of protein and fat in culture containing milk systems; to study the various factors affecting the coagulation of milk by microbial rennets. Manufacture and evaluation of pro-biotic cheese and fermented milks; determination of glycolysis, proteolysis and lipolysis in cheese and fermented milk; enzymatic process for manufacture of low lactose milk whey products; preparation of casein hydrolysates; visit to a bio-processing unit.

Suggested Readings

Chirikjian JG. 1995. *Biotechnology-Theory and Techniques*. Jones & Bartlett Publ.

Goldberg I. 1994. *Functional Foods*. Chapman & Hall.

Gutierrez-Lopez GF & Barbosa- Conovas GV. 2003. *Food Science and Food Biotechnology*. CRC Publ.

Lee Byong H.1996. *Fundamentals of Food Biotechnology*. VCH Publ.

Roger A. 1989. *Food Biotechnology*. Elsevier.

Wiseman A. 1988. *Principles of Biotechnology*. Surrey Univ. Press, New York.

DT 515 TRADITIONAL AND VALUE ADDED PRODUCTS 2+1

Objective

To project the significance and status of traditional and value added dairy products in Indian dairy industry.

Theory

UNIT I

Present status of traditional dairy products; globalization of traditional dairy products; plans and policies of the Government and developmental agencies.

UNIT II

Process schedule of heat-desiccated, coagulated and fermented traditional dairy products; process improvement in production of milk sweets.

UNIT III

New products based on fruits, vegetables and cereals; application of mem-brane technology; microwave heating for industrial production of traditional dairy products.

UNIT IV

Advances in industrial production of ghee, flavour and texture simulation.

UNIT V

Techno-economic aspects for establishing commercial units for traditional products.

UNIT VI

Convenience traditional dairy products; use of natural and permitted synthetic preservatives and new packaging systems.

Practical

Microwave heating of traditional milk delicacies for shelf life extension; application of membrane technology for improving the quality of traditional products from cow and buffalo milk; preparation of feasibility report for establishing commercial units for traditional products.

Suggested Readings

Achaya KT & Rangappa KS. 1975. *Indian Dairy Products*. 2nd Ed. Asia Publ. House.

Aneja RP, Mathur BN, Chandhan RC & Banerjee AK. 2002. *Technology of Indian Milk Products*. Dairy India Publ., Delhi.

De S. 1980. *Outlines of Dairy Technology*. Oxford Univ. Press Publ., New Delhi.

Gould GW. 1995. *New Methods of Food Preservation*. Blackie.

NDRI. 1998. *Advances in Traditional Dairy Products*. Lecture Compendium, Dairy Technology Division, NDRI, Karnal.

NDRI. 2006. *Developments in Traditional Dairy Products*. Lecture Compendium, Dairy Technology Division, NDRI, Karnal.

DT 521 MEMBRANETECHNOLOGYINDAIRYPROCESSING 2+1

Objective

To explain the basics of membrane technology and its applications in dairy processing.

Theory

UNIT I

Membrane techniques: classification and characteristics of filtration pro-cesses; types of membranes commercially available; membrane hardware, design of membrane plants, modeling of ultrafiltration (UF) processes, mass transfer model, resistance model; membrane flouling-problem and treatment, cleaning and sanitization of different types of membranes.

UNIT II

Factors affecting permeate flux during ultrafiltration and reverse osmosis of milk and sweet and sour whey, energy requirements for processing of milk and whey.

UNIT III

Applications of ultrafiltration, reverse osmosis, nanofiltration and microfiltration in the dairy industry. Developments in the manufacture and utilization of food and pharmaceutical grade lactose from UF permeate. Preparation of special foods like low lactose powder and dairy whiteners using UF retentate, whey protein concentrates, casein and coprecipitates.

UNIT IV

Demineralisation: Importance of demineralisation, different processes available for demineralization: their principle, plant and operation.

UNIT V

Functional properties of whey proteins (WPC & WPI), casein, co-precipitates and UF milk retentate and their modifications. Evaluation of functional properties of proteins.

Practical

Study of the effect of types of milk, temperature of milk and trans-membrane pressure on the permeate flux during ultrafiltration process; performance of ultrafiltration membrane with respect to permeate flux and volume concentration ratio during processing of acid and sweet whey; study the effect of types of milk, temperature and applied pressure on the permeate flux during the reverse osmosis process; nanofiltration of milk, whey and permeate; microfiltration of skim milk and whey; preparation of whey protein concentrate and its utilization in dairy products; measurement of different functional properties of casein and whey protein: whipping ability; water binding; emulsification properties; gelling; viscosity and solubility.

Suggested Readings

Cheryan M.1998. *Ultrafiltration and Microfiltration Handbook*. Technomic Publ. House.

IDF.1996. *Advances in Membrane Technology for Better Dairy Products*.

Bull. No: JI1.

Renner E & Abd El-Salam MH. 1991. *Application of Ultrafiltration in the Dairy Industry*. Elsevier.

Sienkiewizc T & Tiedel CL. 1990. *Whey and Whey Utilization*. Verlag Th. Mann Gelsenkirchen-Buer, Germany.
Zadow JG. 1994. *Whey and Lactose Processing*. Elsevier.

DT 522 ADVANCED DAIRY AND FOOD PACKAGING 2+1

Objective

To impart basic and advanced knowledge of dairy and food packaging.

Theory

UNIT I

Status of current packaging; types of packaging materials; criteria for selection of proper packaging; testing of packaging materials.

UNIT II

Adhesives; graphics; coding, and labeling used in food packaging.

UNIT III

Protective packaging of foods; packaging of food products sensitive to oxygen, light, moisture; active packaging; special problems in canned foods.

UNIT IV

Packaging of dairy products; packaging of convenience foods, packaging of fruits, vegetables, and fruit juices.

UNIT V

Packaging of fats and oils; packaging of spices; packaging of meat and poultry: packaging of fish and other seafoods.

UNIT VI

Modified atmosphere packaging, controlled atmosphere packaging, shrink and stretch packaging.

UNIT VII

Retort pouch technology, microwavable, biodegradable, and edible packages.

UNIT VIII

Industrial packaging: unitizing, palletizing, containerising, distribution systems for packaged foods including prevention of shock damage to articles during transportation.

UNIT IX

Safety aspects of packaging materials; sources of toxic materials and migration of toxins into food materials.

Practical

Testing of packaging materials for quality assurance like determination of thickness, GSM, grease resistance, bursting strength, tearing resistance, WVTR, puncture resistance; estimation of shelf life of vegetables and seasonal fresh fruits; packaging of turmeric powder and ground red chilli powder, vacuum packaging of dairy products.

Suggested Readings

Carol F, Steinhart M, Ellin D, Barbara A & Cochrane. 1995. *Food Safety*.
Marcel Dekker.
Coles R, McDowell D & Kirwan M.J. 2003. *Food Packaging Technology*.
Oxford Blackwell.
Frank A, Paine H & Paine Y. 1983. *A Handbook of Food Packaging*.
Leonard Hill.
Gordon L Robertson. 2006. *Food Packaging: Principles and Practice*. 2nd Ed.
CRC Press.
Malhlouthi M. 1994. *Food Packaging and Preservation*, Blackie.
Raija A. 2006. *Novel Food Packaging*. Woodland Publ. Co.

DT 523 ALTERNATIVE PROCESSES FOR DAIRY AND FOOD INDUSTRY 2+1

Objective

To develop an understanding of the basic principles underlying the novel/non-conventional food processing techniques, equipment required, features and actual and potential applications.

Theory

UNIT I

Irradiation: sources and properties of ionizing radiation; mechanism of interaction with microorganisms and food components microbial inactivation in dairy and food products, chemical effects, packaging, industrial irradiation systems, benefits and limitations; safety aspects, national and international regulations.

UNIT II

High frequency heating: Principles of dielectric heating and factors affecting it, design and working of microwave oven, continuous microwave heating units, applications in dairy and food processing, microwavable packaging safety aspects of microwaves, merits and demerits of dielectric heating.

UNIT III

Infra-red heating: Interaction of infra-red (IR) radiation with penetration properties, equipment; dairy and food application, advantages and disadvantages of IR heating.

UNIT IV

Ohmic heating: Principle of electric resistance heating, design of an ohmic heater, operational variables, power considerations, factors affecting heating efficiency, merits and limitations, food applications and future scope.

UNIT V

Ultrasonic treatment of food: Mechanism of ultrasound induced cell damage, generation of ultrasound equipment, design of power ultrasonic system, types of ultrasonic reactors, application of power ultrasound in food processing, effects on food constituents, ultrasound in consideration with other process alternatives - thermosonication, advantages and future prospects.

UNIT VI

High hydrostatic pressure processing: Principle of microbial inactivation, barotolerance of microorganisms, effect on food constituents, equipment, dairy and food application, merit and demerits.

UNIT VII

Pulsed electric field processing: Description/ mechanism and factors affecting microbial inactivation effects on food components; present status and future scope for food applications.

Practical

Study of a microwave oven; Determination of power output of a Microwave oven; Temperature profile in a microwave oven cavity; Microwave absorption by various food packaging materials; Heating behaviour of water, milk, cream and other milk products – effect of composition; Shelf-life extension of pasteurized milk employing microwave heating;Effect of shape and size of water/milk container on microwave heating;Cooking of 'instant' products in a microwave oven; Drying of casein, 'instant' wheat, 'instant' rice, etc. in a microwave oven; Miscellaneous food processing/heating applications of microwaves; Visit to a commercial food irradiation facility.

Suggested Readings

Gaonkar KG. (Ed.). 1995. *Food Processing: Recent Developments*.

Elsevier. Gould GW. (Ed.). 1995. *New Methods of Food Preservation*. Blackie.

NDRI. 2001. *Advances in Preservation of Dairy and Food Products*.

Lecture Compendium, Dairy Technology, NDRI, Karnal.

Povey MJW & Mason TJ. (Eds.). 1998. *Ultrasound in Food Processing*.

Blackie.

Thorne S. 1991. *Food Irradiation*. Elsevier.

DT 524 FUNCTIONAL FOODS AND NEW PRODUCT DEVELOPMENT 3+1

Objective

To impart the knowledge of functional ingredients, nutraceuticals and their utilization in development of new food products including health foods, functional foods and specialty foods.

Theory

UNIT I

Definition, classes of functional foods, status of functional foods in world and India. Concept of new product development, classes of nutraceuticals and functional foods. Safety; marketing strategy and consumer response; economic analysis and costing of novel foods, recent advances in different categories and type of dairy product.

UNIT II

Nutritional status and dietary requirement of different target group and deficiency diseases, in special reference to micronutrients. Dietary and therapeutic significance of dairy nutrients, bioactive components in dairy products like lactose, whey proteins, milk minerals, CLA, fermented milks etc.

UNIT III

Food fortification, techniques for fortifying dairy foods with minerals and vitamins, High protein foods prospective nutraceuticals for fortification of dairy foods. Nutritional significance of dietary fibers, classes of dietary fibers, fortification techniques for fibers in dairy foods.

UNIT IV

Infant nutrition and dietary formulations for meeting normal and special needs of infants, current status of infant foods, additives for infant foods. Foods for aged persons, design consideration, ingredients for geriatric foods.

UNIT V

Technological aspects of reduced calorie foods, alternatives for calorie reduction, low calorie sweeteners, bulking agents and their application, fat replacers and their utilization in low calorie dairy foods.

UNIT VI

Nutritional and health significance of sodium in foods, Alternatives for sodium in foods, techniques for reducing sodium in processed dairy foods. Bio-flavours and flavour enhancers.

UNIT VII

Sports foods, ingredients for sports foods, dairy components in sports foods, sports drinks, design consideration, ergogenic aids in sports nutrition.

UNIT VIII

Herbs, various classes of herbs, their therapeutic potential and application in foods with special reference to dairy products like functional drinks, herbal ghee etc.

UNIT IX

Prebiotic substances and their utilization in functional foods, symbiotic foods, technological aspects and recent development in probiotics, prebiotics and synbiotics.

UNIT X

Definition and various classes of phytochemicals, their role in CVD, Cancer and immune system enhancer, utilization in functional foods, phytosterol, phytoestrogens, glucosinolates, organosulphur compounds, flavonoids, carotenoids, etc.

UNIT XI

Special foods/nutrients for CVD, cancer, IBD, diabetics, persons suffering with milk allergy and lactose intolerance with special emphasis on dairy nutrients and foods.

Practical

1. Determination of total fiber, neutral detergent fiber in foods
2. Manufacture of fiber enriched milk beverage
3. Manufacture of low calorie burfi/ice cream
4. Preparation of flavoured milk using artificial sweetener and its estimation

5. Determination of antioxidant activity of food/food components
6. Determination of bioavailability of nutrients
7. Development of malted milk food and weaning food
8. Determination of β-galactosidase activity and application of lactases for lactose free dairy products
9. Determination of prebiotic potential of certain plant/milk components and their application in synbiotics dairy foods
10. Preparation of sports beverage, herbal dairy drinks
11. Preparation of high protein products

Suggested Readings

Chadwick R. 2003. *Functional Foods*. Springer.

Desai BB. 2000. *Handbook of Nutrition and Diet*. Marcel Dekker.

Gibson G & William C. 2000. *Functional Foods*. CRC Press.

Goldberg I. (Ed.). 1994. *Functional Foods*. Chapman & Hall.

Haberstroh CE. 1991. *Fat and Cholesterol Reduced Foods*. Gulf Publ. Co.

Mazza G. 1998. *Functional Foods. Biochemical and Processing Aspects*. Technomic Publ. Co.

Mitchell H. 2006. *Sweeteners and Sugar Alternatives in Food Technology*. Oxford's Blackwell Publ.

Mitchell JR & Ledward DA. 1986. *Functional Properties of Food Macromolecules*. Elsevier.

Mudambi SR & Rajagopla MV. 1981. *Fundamentals of Foods and Nutrition*. Wiley Eastern.

Nabors Lyn O'Brien 2001. *Alternative Sweeteners*. Marcel Dekker. Pomeranz Y. 1991. *Functional Properties of Food Components*. Academic Press.

Sadler MJ & Saltmarch M. 1998. *Functional Foods: The Consumer, The Products and the Evidence*. Royal Society of London.

Saltmarch M & Butriss J. (Ed.). 2000. *Functional Foods II: Claims and Evidence*. Royal Society of Chemistry, London.

Schmidl MK & Labuza TP. 2000. *Essentials of Functional Foods*. Aspen Publ.

Shi J, Mazza G & Maguer M Le. 2002. *Functional Foods: Biochemical and Processing Aspects*. CRC Press.

Smith J. 1993. *Technology of Reduced Additives*. Blackie.

Watson RR. 2003. *Functional Foods and Neutraceuticals in Cancer Prevention*. Iowa State Press, Iowa.

DT 525 TECHNOLOGYOFFOODEMULSIONS,FOAMSANDGELS 2+1

Objective

To impart basic knowledge regarding food dispersion systems, their formation, behaviour, and factors affecting their stability.

Theory

UNIT I

Food dispersions, their characteristics and factors affecting food dispersions.

UNIT II

Food emulsions; emulsifiers and their functions in foods; the HLB concept in food emulsifiers; emulsion formation and stability; polymers and surfactants.

UNIT III

Milk foams and their applications, structure of foams, egg foams and uses, foam formation and stability.

UNIT IV

Theory of gel formation; pectic substances and jellies; fruit pectin gels; milk jellies.

UNIT V

Structure of dairy foods representing emulsions, foams and gels; physical structure of fat rich, concentrated, fermented, coagulated and dried products.

UNIT VI

Techniques for evaluation of structure for food emulsions, foams and gels. **Practical**

Determination of the rate of formation and stability of emulsions; Emulsifying properties of milk proteins and other food ingredients; Properties of different types of emulsifiers and their role in food emulsions; Examination of foam formation and determination of foam stability; Milk proteins and other food ingredients in food foams; foaming in dairy systems; Studies on gel formation and gel properties; Food gels – Gelatin-based, pectin-based, etc.; Properties of various gelling agents for foods.

Suggested Readings

Blanshard JMV & Lillford P. 1987. *Food Structure and Behaviour*.
Academic Press.
Haseuhuetti GL.1977. *Food Emulsifiers and their Application*. Chapman & Hall.
McClement DJ.1999. *Food Emulsions - Principles, Practice and Techniques*. CRC Press.
Srinivas D & Alain P.1977. *Food Proteins and their Applications*. Marcel Dekker.

DT 611 ADVANCES IN LIPID TECHNOLOGY 3+0

Objective

To explain the physicochemical and nutritional characteristics of fats and oils, and their processing and utilization for food purposes.

Theory

UNIT I

Current Trends in the fats & oil Industry in India and abroad: Sources and utilization of animal, vegetable and marine fats/oils - An overview.

UNIT II

Basic chemistry structure aspects of fats and oils in general, and milk- fat in particular, in relation to their processing, properties, utilization and significance in human diet.

UNIT III

The changing concepts in the role of edible fats and oils in human nutrition and health: PUFA, MUFA, CLA, Omega fatty acids, Trans fatty acids, Phytosterol, etc.

UNIT IV

Sources and classification of commercial edible fats and oils : Innovations in the production and processing of oils and fats from different sources, e.g. animal, plant, marine and microbial lipids for utilization in the dairy and food products; Non-conventional fats/oils for edible purpose – rice bran oil, microbial lipids.

UNIT V

Advances in refining including degumming, bleaching and deodorization oils and fats – Existing technologies and new developments - application of membrane techniques; Winterization.

UNIT VI

Physico-chemical properties of oils & fats; Polymorphism, crystallization kinetics; New antioxidants.

UNIT VII

Modification of fats and oils: Physical modification – Fractionation; Chemical modification – Hydrogenation and Interesterification; enzymatic/microbial modification of fats/oils; Cholesterol reducing treatments.

UNIT VIII

Applications of fats and oils: Margarine and low-fat table spreads; Bakery and confectionery fats; Coatings; Shortenings; Salad dressings; Technology of cooking oils, salad oils and oil based dressings; Frying process and systems; Changes in fats and oils during frying; Snack foods - Processing systems; Modified fats and oils for use in bakery and confectionery products, shortenings and spreads.

UNIT IX

Fat replacers, technological developments in low calories spreads and other fat-based products.

UNIT X

Advances in technologies for production of plasticisers, emulsifiers and protective coatings.

Suggested Readings

Cambie RC. 1989. *Fats for the Future*. International Union of Pure and Applied Chemistry. Ellis Horwood.

Gunstone FD & Padley FB. (Eds.).1997. *Lipid Technologies and Applications*. Marcel Dekker.

Hamilton RJ.1995. *Developments in Oils and Fats*. Blackie.

Hoffman G.1989. *Chemistry and Technology of Edible Oils and Fats and their High-Fat Products*. Academic Press.

Hui YH. (Ed.).1996. *Wiley Bailey's Industrial Oil and Fat Products*. Vols.

I-IV. Interscience Publ., John Wiley & Sons.

Kamal BS & Kakuda Y.1994. *Technological Advances in Improved and Alternative Sources of Lipids*. Blackie.

Karleskind A. (Ed.). 1996. *Oils and Fats Manual*. Vol. II. *Properties, Production and Applications*. Lavoisier Tec-Doc Publ.

Khan R.1993. *Low-Calories Foods and Food Ingredients*. Blackie.

DT 612 ADVANCES IN PROTEIN TECHNOLOGY 3+0

Objective

To explain the characteristics of food proteins and to familiarize students with their implications in processing, their interactions in food systems and their nutritional role**.**

Theory

UNIT I

Characteristics of proteins from plant, animal and microbial origins.

UNIT II

Denaturation of proteins: Effect of processing parameters on denaturation. Effect of denaturation on the physicochemical and biological properties of proteins in food systems.

UNIT III

Protein interactions with food constituents: protein-protein interactions. Protein-lipid interactions, protein-polysaccharide interactions, and protein-ion interactions. Significance of protein interactions: formation and stabilization of casein micelle, stability of concentrated milk products, and role of protein in food structure.

UNIT IV

Protein Nutrition: Recent concepts in protein nutrition in man: Enzyme development and protein digestion. Effect of processing on nutritive value of proteins. Mass and institutional feeding programs: Amino acid fortification of foods and concepts in protein supplementation and complementation.

UNIT V

Protein hydrolysates-- Production and processing; De-bittering of protein products; Bioactive peptides: their production and properties.

UNIT VI

Recent Technologies: Augmentation of world resources for protein foods:
protein from plants, animals and microorganisms.

UNIT VII

Textured vegetable proteins and spun fibre technology: Extrusion cooking-selection of ingredients and formulation, control of operational parameters, microstructure of extrusion cooked foods.

Suggested Readings

Encyclopaedia of Food Science, Food Technology and Nutrition. 1993.
Vols. I-VII, Academic Press.
Fennema OR. 1985. *Food Chemistry*. Marcer Dekker.
Fox PF. 1983. *Development in Dairy Chemistry*. Vol. II. Applied Science Publ.
Fox PF. 1992. *Advanced Dairy Chemistry*. Vol I. *Proteins* . Elsevier. Macrac R, Robinson RK & Sadler MJ. 1993. *IDF Special Issue* 9303. Walstra P & Jenness R. 1984. *Dairy Chemistry and Physics*. John Wiley &
Sons.

DT 621 PRODUCT MONITORING AND PROCESS CONTROL 3+0

Objective

To develop the understanding of the concept of monitoring and optimization of food quality/characteristics and familiarize the students with the techniques involved.

Theory

UNIT I

The concept of Product-Process Monitoring in dairy and food industries: Definition of 'quality'; Optimization paradigm; Quality-prediction model based on quality kinetics and process state equations – Simulation modeling. Process/Product Optimization: Optimization procedures – Search methods, Response surface, Differentiation & Programming methods; Neural Networks; Optimization software.

UNIT II

Process Control: Objectives; Control loop – Loop elements and their functions; Modes of process control; Control techniques; control equipment.

UNIT III

Real-time Instrumentation : Sensors; their classification based on Proximity, working principle; examples of applications in process control; Requirements of on-line sensors; Biosensors – Construction, types, working principles, applications, merits and limitations; Time-temperature indicators – partial-history & full-history indicators; Commercial devices; Applications and limitations; E-Nose & E-Tongue – Simulation of natural organs; Components & their functions; Applications.

UNIT IV

Flavour analysis: Flavour bioassays – Gas Chromatography-Olfactometry techniques; Isolation, Separation and detection/Identification of flavour compounds – GC-MS, LC-MS, NMR, FTIR; analysis of chiral compounds.

UNIT V

Formation of flavour compounds in milk and milk products during heat processing (including UHT processing, caramelization and extrusion cooking), fermentation and ripening (cultured. products and cheese flavour, with special reference to bitteness) and storage (Maillard browning); Aroma losses/retention during the drying process (in relation to milk powder, cheese powder and dry cultured products); Industrial processes for extraction of desirable and undesirable volatile components from fresh and/or stored products by supercritical fluid (SCF) technique.

UNIT VI

Monitoring of Food Structure: (a) Application of Thermal Analysis (DTA and DSC vis-a-vis dilatometry) and Pulse Nuclear Magnetic Resonance (PNMR) spectroscopy in determination of solid-fat content (SFC) of butter in relation to various processing and storage aspects; Glass transitions in dairy products; Starch gelatinization.

UNIT VII

Monitoring of Food Structure: (b) Elucidation of crystal characteristics of milk fat in ghee and other fat-rich products by means of X-ray Crystallography with reference to the impact of cooling and storage/handling conditions on the crystal nature and product texture; Process-

induced changes in sub-microscopic particulate properties of milk products; structure-texture relationship.

UNIT VIII

Monitoring of Food Structure: (c) Influence of heat processing and freezing treatments on protein denaturation and other conformational as well as aggregation-disaggregation phenomena as monitored through Spectropolarimetry, Circular Dichroism and related techniques.

UNIT IX

Monitoring of Food Structure: (d) Particle-size analysis: Image analysis; Dynamic light scattering; Laser diffraction; Sieving, and other techniques.

UNIT X

Emerging Spectroscopic techniques in assessment of foods : Raman Spectroscopy and Electron Spin Spectroscopy – Working principles and applications - Monitoring of irradiated foods, detection of lipid auto-oxidation, etc.; Microwave & NIR absorption/reflection methods for Compositional analyses – Automated milk analysers; Proximate principles in cheese and milk powder.

UNIT XI

Ultrasound in product monitoring: Speed- and Attenuation-based measurements of liquid levels, density, mass flow, etc.

UNIT XII

Monitoring of Chemical Contaminants: Heavy metal quantification by Atomic Absorption Spectrophotometer; Quantification of Agrochemicals by HPLC; Spectrofluorimetric determination of mycotoxins; Detection and quantification of Drug Residues.

UNIT XIII

Colour Characterization : Colour and appearance (gloss and translucence) monitoring through visual colorimeter, tri-stimulus colorimeters and reflectance spectrophotometer, CIE, Hunter-Lab, Munsel and other systems of three-dimensional expression of colour; Colour-based Sorting of foods; Computer Vision – Principles, applications and Benefits.

UNIT XIV

Objective Assessment of Subjective food-quality characteristics - Pitfalls and Promises.

Suggested Readings

Acree TE & Teranishi R. 1993. *Flavour Science: Sensible Principles and Techniques*. Amer. Chem. Soc., Washington.

Bartlett PN, Elliott JM & Gardner JW. 1997. *Electronic Noses and their Application in the Food Industry*. Food Technology: 51 (12) 44-48.

Davenel A. 1996. On-line Control and Problems with Sensors. In: *Quality Control for Foods and Agricultural Products.* (J.L. Mutton, Ed.). VCH Publ., London.

Kress-Rogers E & Brimelow CJB. (Eds.). 2001. *Instrumentation and Sensors for the Food Industry*. CRC Press, Woodhead Publ. Ltd.

Mann CMD & Jones AA. I994. *Shelf-life Evaluation of Foods*. Blackie. Peleg M & Bagley EB. 1983. *Physical Properties of Foods*. AVI Publ. Schartel BJ & Firstenberg ER. 1988. *Biosensors in the Food Industry:*

Present and Future. *J. Food Protect*. 51(10): 811-820.

DT 622 RESEARCH AND DEVELOPMENT MANAGEMENT IN DAIRY INDUSTRY 3+0

Objective

To provide in-depth knowledge to research scholar in selection and management of research project in the area of new product development and in patenting and transfer of technology processes.

Theory

UNIT I

Current Status of R&D Efforts in Dairy Processing in India and abroad.

UNIT II

Resource Management: Management of financial and human resources in dairy Industry: a) Structure and design of Research and Development orgnisation; b) Analysis of organization behaviour – Transactional analysis; and c) Personnel management – Typology analysis, individual and the organization, team building, human behaviour at work, motivation.

UNIT III

Management of R&D functions: a) Criterion for the selection of R&D projects; Technology Development Process and b) Techniques for monitoring R & D functions.

UNIT IV

Patenting Laws; Indian Patenting Act/International Protocols for technology transfer; Transfer of technology from Lab to Plant, HACCP, GMP/GHP practices in dairy processing. ISO14001, Total Quality Management (TQM), Six-Sigma concept.

UNIT V

Project proposal writing for research funding, Development of feasibility and technical report for dairy plant establishment, evaluation and report writing of projects.

Suggested Readings

Encyclopedia of Food Technology and Nutrition. 1993. Academic Press.

General Information on Patents. The Patent Office, Kolkatta.

IPR Bulletins (TIFAC) (www.tifac.org.in)

NAARM. 1990. *Agricultural Research Management*. National Academy of Agricultural Research Management, Hyderabad.

DAIRY MICROBIOLOGY

Course Structure - at a Glance

COURSE NO.	COURSE TITLE	CREDITS	SEM
DM 511	MICROBIAL MORPHOLOGY AND TAXONOMY	2+1	I
DM 512*	MICROBIAL PHYSIOLOGY	2+1	I
DM 513	METHODS IN MICROBIOLOGY	2+2	I
DM 514	ENVIRONMENTAL MICROBIOLOGY	2+1	I
DM 515*	MICROBIOLOGY OF PROCESSED DAIRY FOODS	3+1	I
DM 516	APPLICATION OF BIOTECHNOLOGY IN DAIRY INDUSTRY	2+1	I
DM 521*	DAIRY STARTER CULTURES	2+1	II
DM 522	MICROBIAL GENETICS	2+1	II
DM 523*	MICROBIAL QUALITY AND SAFETY IN DAIRY INDUSTRY	2+2	II
DM 524	FEED AND RUMEN MICROBIOLOGY	2+1	II
DM 525	PROBIOTICS AND FERMENTED DAIRY PRODUCTS	2+1	II
DM 526	MICROBIAL FERMENTATION AND TECHNOLOGY	2+1	II
DM 591	MASTER'S SEMINAR	1+0	I, II
DM 599	MASTER'S RESEARCH	20	I, II
DM 611	MICROBIAL DIVERSITY AND PHYSIOLOGY	3+0	I
DM 612	ADVANCES IN MICROBIAL GENETICS	3+0	I
DM 621	ADVANCES IN DAIRY AND FOOD MICROBIOLOGY	3+0	II
DM 622	MICROBIOLOGY OF FOOD-BORNE PATHOGENS	3+0	II
DM 691	DOCTORAL SEMINAR I	1+0	I, II
DM 692	DOCTORAL SEMINAR II	1+0	I, II
DM 699	DOCTORAL RESEARCH	45	I, II

* Compulsory for Master's programme.

NOTE : *Doctoral students shall take a minimum of two 600-level courses*

DAIRY MICROBIOLOGY
Course Contents

DM 511 MICROBIALMORPHOLOGYANDTAXONOMY 2+1

Objective

To educate about the taxonomy and morphological features of the various microorganisms, viz., bacteria, fungi and viruses.

Theory

UNIT I

Evolution of life on earth**,** history and diversity of microorganism

UNIT II

Principles of classification and taxonomy of Eubacteria (Bacteria and Archaea): Major characteristics used in taxonomy: Cultural, Morphological, Biochemical, Physiological, Genetic and Molecular Characteristics; Numerical Taxonomy (Taxometrics) and Chemotaxonomy. Assessing Microbial Phylogeny: Chronometers. Phylogenetic trees, r-RNA, DNA and proteins as indicators of phylogeny.

UNIT III

Cell ultra-structure (prokaryotes and eukaryotes) cell wall: structure, chemical composition, synthesis and inhibition, cell membrane, cytoplasmic inclusions, cytoskeleton, cell appendages, capsule, flagella, pili, sporulation structure of endospore, composition and function of spore constituents, induction and germination

UNIT IV

Fungi: Distribution, Importance and recent Classification, Study of Yeasts and Moulds in Dairy Foods

UNIT V

History, Development and Scope of Virology. Classification and Nomenclature, General characteristics of Viruses (Acellular Organization and Viral Genome), Viral Reproduction, Brief account of Viroids and Prions.

Practical

- Simple and differential staining; gram, spore, acid-fast staining, cell wall, flagella, nucleoids, capsule, and inclusion/storage bodies
- Preparation of bacterial protoplasts and spheroplasts
- Measuring dimensions of microorganisms (bacteria) using micrometry,
- Study of morphology of fungi,
- Detection and enumeration of bacteriophages in Cheese whey
- Application of computer software in bacterial identification
- Electron microscopic observation of Ultra-structure of Microbial Cell(Demonstration)

Suggested Readings

- Alberts B, Johnson A, Lewis I, Raff M, Roberts K & Walter P. 1998.
- *Essentials of Cell Biology*. Garland Publ.
- Alexopoulos C. 2008. *Introductory Mycology*. Wiley Publ.
- Black JG. 2005. *Microbiology: Principles and Explorations*. 6th Ed. John Wiley & Sons.
- Dimmock NJ & Primrose SB.1994. *Introduction to Modern Virology*. 4th Ed., Blackwell.
- Holt JG, Krieg NR, Sneath PHA, Staley JT & Williams ST. 1997. *Bergey's*
- *Manual of Determinative Bacteriology*. 9th Ed. Williams & Wilkins. Krejer van-Rij NJW.1998. *The Yeasts: A Taxonomic Study*. 4th Ed. Elsevier. Madigan MT, Martinko JM & Parker J. 2005. *Brock Biology of*
- *Microorganisms*. 11th Ed. Prentice Hall. London.
- Prescott LM, Harley JP & Klein DA. 2002. *Microbiology*. 5thth Ed. McGraw Hill.
- Salyers AA & Whitt DD. 2001. *Microbiology - Diversity, Disease and the Environment*. Fitzgerald Science Press.
- Tortora GJ, Berdell RF & Christine L Case. 2006. *Microbiology: An Introduction*. 9th Ed. Benjamin Cummings.

DM 512 MICROBIAL PHYSIOLOGY 2+1

Objective

- To familiarize the student with the various aspects of growth and energy generating activities of bacteria for the betterment of human life.

Theory

UNIT I

Bacterial growth: growth phases and kinetics, synchronous, continuous, and associative growth, Diauxic phenomenon; factors affecting bacterial growth; growth measurement.

UNIT II

Effect of environment on the growth of bacteria: temperature, air, osmotic pressure, pH, hydrostatic pressure, surface tension, metals, electromagnetic and other waves, sonics, various chemicals; their application in dairy industry; mechanisms of action of antimicrobials such as antimicrobials.

UNIT III

Bacterial nutrition; nutrient media; nutritional groups of bacteria; role of growth factors; active and passive transport.

UNIT IV

Electron transport chain: Electron transport chain; fermentation, respiration and photosynthesis

Practical

Measurement of bacterial growth by direct methods (cell number, SPC, DMC) and indirect methods (turbidometric methods, MPN, cell mass. Preparation of growth curve; determination of generation time. Determination of cell activity; carbohydrate fermentation; acid production/pH alteration; starch, lipid, casein and gelatin hydrolysis. Effect of different factors viz., physical (temperature, pH, osmotic pressure, surface tension), chemical (dyes, antibiotics, phenol) and nutritional (amino acid supplements, vitamin supplements, protein hydrolysates, casamino acids) on bacterial growth.

Suggested Reading

Caldwell DR. 1995. *Microbial Physiology and Metabolism*. WMC Brown Publ.

Koch L. 1995. *Bacterial Growth and Form*. Chapman & Hall.

Moat AG, Foster JW & Spector MP. 2002. *Microbial Physiology*. 4th Ed. Wiley-Liss.

Nicoloi S Panikov. 1995. *Microbial Growth Kinetics*. Chapman & Hall.

Todar K. 2002. *Todar's online Textbook of Bacteriology*. University of Wisconsin-Madison**.** http://www.sciencedirect.com/science/bookseries/00652911

DM 513 METHODS IN MICROBIOLOGY 2+2

Objective

To impart knowledge and skills related to microbiological analytical systems in microbiology and related sciences

Theory

UNIT I

Microscopy: principles, design and functions of bright field, dark field, phase contrast and fluorescence microscope; principle, design and application of transmission and scanning electron microscopes for the study of sub-cellular organization and microstructure of dairy foods

UNIT II

Techniques for protein analysis and other molecular separation: electrophoresis, chromatography, ultracentrifugation; Enzyme analyses and substrate determination methods

UNIT III

Molecular Biology Techniques for nucleic acid analysis: amplification, investigation of mutations and gene expression

UNIT IV

Aerobic and Anaerobic culturing techniques for isolation of obligate and facultative organisms

UNIT V

Use of animal models in toxicity studies

Practical

- Familiarization with the construction and design of a compound microscope; use of light microscope accessories; microscopic analysis of different types of bacteria by bright field and dark field; phase contrast and fluorescence microscopes
- Disruption of bacterial cells by ultra-sonification
- Demonstration of chromatographic techniques
- Demonstration of aerobic and anaerobic culturing techniques
- Demonstration of use of animal models in toxicity studies,
- Demonstration of PCR technique as a tool for identification and characterization of microorganism

Suggested Readings

Gerhardt P, Murray RGE, Wood WA & Kreig NR. 1994. *Methods for General and Molecular Biology*. ASM Press.

Hartley WG. 1993. *The Light Microscope; It's Use and Development*.

Science Publishing Co.

Herman B. 1998. *Fluorescence Microscopy*. Bios Scientific Publ. Kaufman PB, Wu W, Kim D & Cseke LJ.1995. *Molecular and Cellular*

Methods in Biology and Medicine. CRC Press.

Singer S. 2001. *Experiments in Applied Microbiology*. Academic Press. Wilson K & Walker J. 2008. *Principles and Techniques of Biochemistry*

and Molecular Biology. 6th Ed. Cambridge University Press.

DM 514 ENVIRONMENTAL MICROBIOLOGY 2+1

Objective

To understand the fundamentals of environmental microbiology for overall effects of microorganisms in combating the pollution in the environment.

Theory

UNIT I

Microorganisms as components of the environment and their role in nutrient cycling; extreme environments and microbial ecology.

UNIT II

Microbes in aquatic and terrestrial environment; aero-microbiology; microorganisms as indicators of environment pollution; bio-organic pollution.

UNIT III

Microbial toxicants and pollutants and their biodegradation; organic pollutants and their degradation; biodegradation of plastics and polymers.

UNIT IV

Biofouling and biofilms; bioremediation and metabolic engineering; water pollution and control.

UNIT V

Biological treatments of food industry wastes; Issues concerning release of genetically engineered microorganisms in environment; environment laws.

Practical

Determination of BOD in industrial wastes; Determination of composite micro-flora of selected environmental samples; Detection of low levels of xenobiotics, microbial toxins and residual antibiotics in environmental samples; Isolation of bacteria capable of degrading organic and microbial pollutants from environmental samples; Isolation and characterization of bio-indicators from environmental samples; Visit to a sewage and sludge treatment plant.

Suggested Readings

Bitton G. 1994. *Waste-water Microbiology*. John Wiley & Sons.

Hurst CJ, Crawford RL, Garland JL, Lipson DA & Mills AL. 2007. *Manual of Environmental Microbiology*. 3rd Ed. ASM Press.

Maier RM, Pepper IL & Gerba CP. 2000. *Environmental Microbiology*.
Elsevier.

Mitchell R. 1995. *Introduction to Environmental Microbiology*. 8th Ed.
Prentice-Hall of India.

Pepper IL & Gerba CP. 2004. *Environmental Microbiology*: *A Laboratory Manual*. 2nd Ed. Elsevier.

DM 515 MICROBIOLOGYOFPROCESSEDDAIRYFOODS 3+1

Objective

To understand microbiology of processed foods, significance of different food microorganisms, their control and other related aspects.

Theory

UNIT I

Developments in food microbiology, microbial ecology of processed food; factors that influence microbes in foods.

UNIT II

Thermal processes for shelf stable-products, low temperature food preservation, current concepts in irradiation technology; Biopreservation.

UNIT III

Stress induced injury to microorganisms, enumerations of stressed cells, predictive modeling for food spoilage; industrial strategies for ensuring safe foods.

UNIT IV

New methods for controlling spoilage of foods; active packaging and antimicrobial packaging (AMP), modified atmosphere packaging (MAP) and shelf life of processed foods, Intermediate moisture foods and Hurdle concept.

UNIT V

New prospects and problem in fermented foods, Nutraceuticals and Bioactive foods, Genetically Modified (GM) foods and their acceptance.

Practical

- Productions of antimicrobial substances.
- Application of bacteriocins, Biopreservation of foods
- Application of hurdle concepts for enhanced shelf stability of processed foods
- Induction of bacterial cell injury and recovery of injured cells
- Effect of MAP on quality and shelf life of processed foods.

Suggested Readings

Doyle MP, Benchat LR & Monteville TJ. 1997. *Food Microbiology: Fundamentals and Frontiers*. ASM Press.

Ray B. 2003. *Fundamental Food Microbiology*. CRC Press.

Robinson RK. 1998. *Developments in Food Microbiology.* Vols. I-III.
Elseveir.

Susan KH & Theodore PL. 1986. *Biotechnology in Food Processing*.
Noyes Publ.

DM 516 APPLICATIONOFBIOTECHNOLOGYINDAIRYINDUSTRY 2+1

Objective

To impart knowledge in the application of Biotechnology in Dairy / Food Industry to the students of Dairying at Master's level

Theory

UNIT I

History and Development of Biotechnology; Status of Biotechnology Industries in India to meet the demands of Dairy and Food Industry

UNIT II

Genetic improvement of lactic starters to enhance their technological functions for industrial applications e.g. acid, flavour, EPS, probiotic functions, Metabolic engineering of lactic acid bacteria, Production of recombinant dairy / food enzymes / proteins e.g. Chymosin, lactoferrin, lysozyme, lipases, proteases, immunoglobulins etc. Detection of GMOs and GM foods and their safety from public health point of view

UNIT III

Dairy based Functional foods/Health foods and Nutraceuticals. Value addition in dairy products through fortification/supplementation with bioactive components and probiotic cultures, Nutrigenomics

UNIT IV

Application of molecular tools, biosensors, etc. for detection of food borne and spoilage pathogens

UNIT V

Molecular tools for studying Biodiversity; Regulatory standards for GMOs and GM foods.

Practical

- Plasmid isolation from *E. coli*
- Agarose gel electrophoresis
- Transformation of *E. coli* with plasmid (Amp^r)
- Growth of Starter cultures on MRS for 'lac' marker
- Induction of 'lac' mutation using UV rays or ethidium bromide
- PCR assays for identification of LAB and food-pathogen detection

Suggested Readings

Bains W. 1993. *Biotechnology from A to Z.* Oxford Univ. Press, Oxford. Crueger W & Crueger A. 1984. *Biotechnology: A Textbook of Industrial Microbiology*. Science Tech.

Joshi VK & Pandey A. (Ed.). 1999. *Biotechnology. Food Fermentation*. (2 Vol. set). Education Publ.

Knorr D. 1982. *Food Biotechnology*. Marcel Dekker.

DM 521 DAIRY STARTER CULTURES 2+1

Objective

To familiarize the students with the starter organisms, their metabolism and genetics; different types of starters, propagation, preservation and applications of starters.

Theory

UNIT I

Introduction and annual utilization of starter cultures; History and taxonomy of starter cultures; Classification of starter organisms: The genus Lactococcus; The genus Leuconostoc; The genus Streptococcus; The genus Pediococcus, The genus Lactobacillus.

UNIT II

Adjunct starter organisms; The genus Bifidobacterium; The genus Enterococcus; The genus Propionibacterium; The genus Brevibacterium. Miscellaneous microorganisms: Molds and yeasts.

UNIT III

Metabolism of starter organisms: biochemical characterization of lactic acid bacteria; carbohydrate, citrate and protein metabolism of starter cultures.

UNIT IV

Genetics of starter cultures: plasmids and plasmid instability; industrially significant genes and

systems; genetic modification of lactic acid bacteria through transduction; conjugation; protoplast transformation; electroporation and chromosomal integration, transposons and insertion sequences.

UNIT V

Starter types: single, mixed and multiple strain starter cultures; propagation and preservation of starter cultures; commercial starter preparations: concentrated and super-concentrated starters;

UNIT VI

Growth inhibition of lactic acid bacteria by antibiotics, bacteriocins; immunoglobulins and bacteriophage: sources, types and characteristics of phages associated with starters, phage control during starter handling and growth, mechanisms of phage resistance in LAB.

UNIT VII

Probiotic cultures, health and nutritional benefits, requirements for ability to survive and grow in the intestine, control of intestinal infections. Role of starter cultures in cheese making and ripening of different cheese varieties.

Practical

- Isolation of lactococcal cultures from fermented milks.
- Examination of purity and activity of starter cultures.
- Preservation of starter cultures by freeze drying and other methods.
- Preparation of concentrated starters and quality evaluation.
- Inhibition of starters by antibiotic residues and other inhibitors.
- Plasmid profiles of some lactococcal cultures.
- Identification of lactic starters by molecular biology techniques (demonstration).
- Conjugal transfer of plasmids in lactococci (demonstration).
- Production of bacteriocins by LAB.

Suggested Readings

Cogan TM & Accolas JP. 1995. *Dairy Starter Cultures*. VCH Publ.

Law BA. 1997. *Microbiology and Biochemistry of Cheese and Fermented Milks*. 2nd Ed. Blackie.

Marth EM & Steele JL.1998. *Applied Dairy Microbiology*. Marcel Dekker.

Robinson RK. 1998. *Developments in Food Microbiology.* Vol. IV. Elsevier.

Salminen S & Wright AV. 1998. *Lactic Acid Bacteria*. Marcel Dekker.

Wood BJ & Warner PJ. (Eds.). 2003. *Genetics of Lactic Acid Bacteria*. Springer- Verlag.

DM 522 MICROBIAL GENETICS 2+1

Objective

To understand the fundamentals of structure, functions and synthesis of macromolecules and their genetic manipulation.

Theory

UNIT I

Macromolecules: DNA, RNA, their structure, types, organization, function and their properties, DNA replication, damage and repair.

UNIT II

Gene Expression and its regulation in Prokaryotes and Eukaryotes: Transcription; Genetic Code Translation and post translational modifications; Negative and positive regulation of gene expression; Operon Models (lac and trp operon).

UNIT III

Mutagenesis, mutation and mutants; Lamda phage and its gene organization.

UNIT IV

Plasmids and their properties, transposable elements; Bacterial Recombination- Transformation, Conjugation and Transduction.

UNIT V

Fundamental aspects of genetic engineering - Vectors, Restriction enzymes, gene cloning, gene banks, expression of cloned genes. Applications of Genetic Engineering- Restriction Mapping, site directed mutagenesis, polymerase chain reaction and application of genetic engineering in dairy and food industry.

Practical

- Isolation and quantitative estimation of chromosomal DNA from *E.coli* and *Lactobacillus* by mini prep method.
- Isolation of plasmid DNA from *E.coli* and *Lactobacillus* by miniprep method.
- Isolation of Eukaryotic (yeast) chromosomal DNA
- Calcium chloride induced transformation of *E.coli* hosts with plasmids
- Induction of random mutation in *E.coli* and *Lactobacillus* by UV radiations and chemical mutagens
- Curing of plasmids with chemical mutagens (Ethidium Bromide) and elevated temperature
- Preparation of chloroplast and their regeneration and uptake in bacteria
- Use of restriction enzymes cleavage and ligation of DNA fragments
- P.C.R. based detection of microorganisms.

Suggested Readings

Friedberg EC & Walker GC. 1995. *DNA Repair and Mutagenesis*. Jones & Bartlett Publ.

Friefelder D. 1987. *Microbial Genetics*. Jones & Bartlett Publ.

Lewin B. 1980. *Gene Expression.* Vols. I, II. John Wiley & Sons.

Old EW & Primrose SB. 1981. *Principles of Gene Manipulation.* Blackwell.

Strickberger MW. 1985. *Genetics*. Macmillan Publ.

Synder L & Champness W. 2003. *Molecular Genetics of Bacteria*. ASM Publ.

Uldis N Streips & Ronald E Yasbin (Eds.). 2004. *Modern Microbial Genetics*. John Wiley & Sons.

Watson JD. 2003. *Molecular Biology of Genes*. W.A. Benjamin.

Wilson WH. 1985. *Genetic Recombination*. Benjamin/Cummings Publ.

DM 523 MICROBIAL QUALITY AND SAFETY IN THE DAIRY INDUSTRY 2+2

Objective

To impart current knowledge pertaining to quality and safety functions in dairy processing unit

Theory

UNIT I

Principles of Quality and safety systems including QMS, HACCP,SAFE, GMP, SSOP, personnel hygiene and food handling in dairy industry

UNIT II

Establishment of Microbiological standards, guidelines and specification for foods; microbiological criteria; two and three class attributes plan for sampling

UNIT III

Rapid detection methods including commercial detection kits; automatic detection techniques for hygiene indicators, pathogenic organisms, antibiotic/ pesticide residues and aflatoxin M1 in dairy foods

UNIT IV

Public health concern associated with milk and milk products; type of microbial spoilage, defects and control measures

UNIT V

Trends in food borne diseases and implications; method of diseases transmission; principles of safety in a food microbiological laboratory

Practical

Conventional and rapid techniques for Microbiological quality evaluation of raw and pasteurized milk and other dairy products for hygiene indicators

i.e. aerobic plate count, *Staph aureus*, coliform, enterococci, enterobacteriaceaea counts, yeast and molds count ; detection of common dairy pathogens and other contaminants from milk and milk products i.e *E. coli* , *B. cereus* , salmonella, Listeria, antibiotic residues and aflatoxin M1; shelf life studies of dairy products; effect of storage condition and packaging material on microflora of dairy foods.

Suggested Readings

Marshall RT. 1992. *Standard Methods for the Examination of Dairy Products*. 16th Ed. APHA.

Morgan MRA, Smith CJ & William PA. 1992. *Food Safety and Quality Assurance*. Elsevier.

Mortimore S & Wallace C. 1994. *HACCP; A Practical Approach*.

Chapman & Hall.

NRC. 1985. *An Evaluation of Role of Microbiological Criteria for Foods and Food Ingredients*. Subcommittee on Microbiological Criteria Committee on Food Protection. National Academic Press, Washington.

Patel PD. 1994. *Rapid Analysis Techniques in Food Microbiology*. Blackie. Robinson RK. 1990. *Dairy Microbiology.* Vols. I, II. Applied Science Publ. Yadav JS, Grover S & Batish VK. 1993. *Comprehensive Dairy*

Microbiology. Metropolitan Publ.

DM 524 FEED AND RUMEN MICROBIOLOGY 2+1

Objective

To understand the basics of microbiology of feed and rumen ecosystem for its outcome on dairy production, processing and management.

Theory

UNIT I

Biofertilizers; microbial inoculants for fodder crops; legume-rhizobium symbiosis; production and application of biofertilizers.

UNIT II

Silage fermentation: microbial and chemical changes; use of additives and inoculants; losses during ensiling.

UNIT III

Bioconversion of crop-residues by solid state fermentation; single-cell protein production; advantages and disadvantages.

UNIT IV

Rumen microbial ecosystem; numbers, types, characteristics and functions of rumen bacteria, fungi and protozoa.

UNIT V

Methods for isolation, enumeration and cultivation of rumen microbes; their role in rumen metabolism and fiber degradation; exploitation of fibrolytic microorganisms as direct-fed microbials/ microbial feed additives.

Practical

Isolation of rhizobium bacteria from fodder legume plants; preparation of rhizobium inoculant for fodder leguminous crops; estimation of moisture, NH_3-N and pH in silage; enumeration of silage microorganisms; estimation of lactic, acetic and butyric acids in silage; sampling technique of rumen liquor and direct microscopic count of bacteria and protozoa; anaerobic cultivation techniques for bacterial and fungal counts in rumen liquor; use of anaerobic jar, roll-tube technique, estimation of hydrolytic enzyme activities of rumen liquor/ rumen microbes; SCP production from cellulose in submerged fermentation; bioconversion of straw by solid state fermentation.

Suggested Readings

Hobson PN & Stewart CS. 1997. *The Rumen Microbial Ecosystem*. 2nd Ed.
Chapman & Hall.
Makkar HPS & McSweeney CS. 2005. *Methods in Gut Microbial Ecology for Ruminants.* Springer.
Pandey A. 1994. *Solid-state Fermentation*. Wiley Eastern.
Wallace RJ & Chesson A. 1995. Biotechnology in Animal Feeds and Animal Feeding. VCH Publ.
Woolford MK. 1984. *The Silage Fermentation*. Marcel and Dekker.

DM 525 PROBIOTICS AND FERMENTED DAIRY PRODUCTS 2+1

Objective

To impart knowledge on basic and applied aspects of probiotics and fermented dairy products.

Theory

UNIT I

Introduction and history of probioitcs and fermented dairy products.

UNIT II

Classification of fermented dairy products. Consumption statistics and scope for fermented dairy products.

UNIT III

Microbiology of yoghurt and related products. Microbiology of acidophilus products, dahi, misti dahi, bhapa dahi, lassi, cultured butter milk, shrikhand, kefir, koumiss, yakult, villi, bifidus milk products, kishk, and milk based products containing probiotic cultures.

UNIT IV

Factors influencing the quality and storage stability of fermented milks. Methods used in their manufacture, evaluation and quality control.

UNIT V

Nutritional and therapeutic value of these products in human diet. Use of fermented milks in diet and cancer control.

Practical

- Manufacture of different fermented milks and their microbiological and chemical analysis.
- Study of shelf life of fermented milks using different methods of preservation.
- Microbiological assay of vitamins or amino acids in fermented milk.

Suggested Readings

Cogan TM & Accolas JP. 1995. *Dairy Starter Cultures*. VCH Publ.
Law BA. 1997. *Microbiology and Biochemistry of Cheese and Fermented Milks*. 2nd Ed. Blackie.
Marth EM & Steele JL.1998. *Applied Dairy Microbiology*. Marcel Dekker.
Robinson RK. 1998. *Developments in Food Microbiology*. Vol. IV.
Elsevier.
Salminen S & Wright AV. 1998. *Lactic Acid Bacteria*. Marcel Dekker.
Wood BJ & Warner PJ. (Eds.). 2003. *Genetics of Lactic Acid Bacteria*.
Springer-Verlag.

DM 526 MICROBIAL FERMENTATION TECHNOLOGY 2+1

Objective

To disseminate recent information on basic and applied aspects of fermentation technology and its industrial application to the students along with hands on training.

Theory

UNIT I

Introduction to fermentation. Historical perspective, Fermentation as a means for enhancing shelf life of foods and pickles.

UNIT II

Rate of microbial growth and death, Fermentation kinetics, mass transfer diffusion, membrane transport, dialysis, nutrient uptake.

UNIT III

Fermenter/ Bioreactor design, operation, measurement and control in fermentation. Aeration and Agitation in fermentation; Oxygen requirement, Adsorption coefficient bubble aeration, mechanical agitation, correlation between mass transfer coefficients and operating variables.

UNIT IV

Types of fermentation, submerged / solid state, Batch / continuous fermentation. In situ sterilization, Scale up in fermentation, Product recovery, Role of Immobilization, Downstream processing for Recombinant proteins and bio-assays

UNIT V

Industrial production of Lactic acid, Penicillin, Betagalactosidase, amino acids, vitamins, ethanol.

Practical

- Follow up of bacterial growth in batch culture.
- Different methods of microbial cultivation
- Fermenter operation and measurement.
- Production of starters, baker yeast culture, alcohol, alcoholic beverages.

Suggested Readings

Crueger W & Crueger A. 1984. *Biotechnology: A Textbook of Industrial Microbiology*. Science Tech.

Joshi VK & Pandey A Ed. 1999. *Biotechnology. Food Fermentation*. (2 Vol. set). Education Publ.

Stanburry PP & Whitker A. 1984. *Principles of Fermentation Technology*. Pergamon Press.

Steinkraus KH. 1983. *Handbook of Indigenous Fermented Foods*. Marcel Dekker.

DM 611 MICROBIAL DIVERSITY AND PHYSIOLOGY 3+0

Objective

To understand the advances in microbial diversity and physiology for its interface with all other branches of microbiology.

Theory

UNIT I

Bacterial growth: cell division, phases of bacterial growth, factors affecting microbial growth, kinetics of growth, continuous culture system, diauxic and synchronous growth, advances in growth measurement.

UNIT II

Prokaryotic cellular structures, biosynthesis of bacterial cell-wall, enterobacterial common antigens, role of membrane in regulation of cell-wall and DNA synthesis, physiology and genetic aspects of sporulation.

UNIT III

Autotrophy, nutritional classification, chemolithotrophic electron transport systems: hydrogen oxidizing bacteria, sulfate reducing hydrogen bacteria, methanogenic hydrogen utilization, nitrifying bacteria, sulfur oxidizing bacteria, carbon monoxide oxidizing organisms, economic importance of autotrophs.

UNIT IV

Membrane transport systems: types of transport: ion transport, iron transport, simple diffusion, facilitated diffusion, active transport, mechanosensitive channel, ATP binding cassette transporter family, chemiosmotic driven transport, phosphotransferase system.

UNIT V

Environmental selection and microbial stress response: osmotic stress, aerobic to anaerobic transitions, oxidative stress, pH stress and acid tolerance, thermal stress and nutritional stress, extremophiles.

Suggested Readings

Caldwell RD.1999. *Microbial Physiology and Metabolism*. WCB Publ.

Kim BH & Gadd G. 2008. *Bacterial Physiology and Metabolism*. Cambridge Univ. Press.

Moat AG, Foster JW & Spector MP. 2004. *Microbial Physiology*. 4th Ed. John Wiley & Sons.

Rhodes PM & Stanbury PF. 2008. *Applied Microbial Physiology: A Practical Approach.* Oxford Univ. Press.

White D. 2006. *The Physiology and Biochemistry of Prokaryotes*. 3rd Ed. Oxford Univ. Press.

DM 612 ADVANCES IN MICROBIAL GENETICS 3+0

Objective

To familiarize the students with basic concepts of Microbial Genetics and impart them knowledge in advancements of Microbial Genetics and Genetic Engineering

Theory

UNIT I

Essentials of Microbial Genetics – Introduction, Historical perspective and principles; Nucleic Acids: Structure and Function of DNA and RNA; DNA Replication –Recent models; Genetic Code

UNIT II

Mutations – Spontaneous and Induced mutations; Types of mutations; Mutagenic agents - Physical and Chemical; Molecular basis of Mutagenesis; DNA Damage and Repair – Molecular Mechanisms; Site Directed Mutagenesis – Methods of directed mutagenesis, mechanism and applications

UNIT III

Gene Expression – Transcription, Translation and Regulation of Gene Expression - Operon models (Lac, Gal and Trp)

UNIT IV

Plasmids – Structure and replication; Transposable elements – IS and Tn elements; molecular mechanism of transposition; Genetic Recombination: Transformation, Transduction and Conjugation; Recombination methods as a tool for Gene mapping

UNIT V

Genetic Engineering / rDNA – Principles of recombinant DNA technology; Restriction Enzymes – Types, Mode of action and application as a tool for gene manipulation, Vectors – Cloning and expression vectors; PCR cloning, Microarray technology, Gene Silencing and Gene knock out

Suggested Readings

Bates AD & Maxwell A. 2006. *DNA Topology*. Univ. Press, Oxford. Bergman NH. 2007. *Comparative Genomics*. Vols. I, II. Humana Press. Hardin C, Edwards J, Ricll A & Prescotti D. 2001. *Cloning, Gene Expression and Purification*. Univ. Press, Oxford.

Dale J & Schantz MV. 2002. *From Gene to Genome: Concepts and Application of DNA Technology*. New John Wiley & Sons.

Dyson MR & Durocher Y. 2007. *Expression Systems*. Scion Publ.

Hartl D, Jones L & Elizabeth W. 2000. *Genetic Analysis of Genes and Genomes*. Jones Bartkett Publ.

Keuzer H & Massey A. 2001. *Recombinant DNA and Biotechnology*. 2nd Ed.. ASM Press.

Lewin B. 2004. *Gene VIII*. Pearson Edu.

Malacinski GM. 2003. *Essentials of Molecular Biology.* 4th Ed. Jones & Bartlette Publ.

Streips UN & Yasbin RE. 2002. *Modern Microbial Genetics*. 2nd Ed. John Wiley & Sons.

Synder L & Champness W. 2003. *Molecular Genetics of Bacteria*. 2nd Ed.
ASM Publ.
Watson JD. 2003. *Molecular Biology of Gene*. 5th Ed. The Benjamin/ Cummings.
Winnacker EL. 2003. *From Gene to Clones*. Panima Publ.

DM 621 ADVANCES IN DAIRY AND FOOD MICROBIOLOGY 3+0

Objective

To study and understand the current trends and recent concepts related microbiology of dairy and other foods products.

Theory

UNIT I

Lactic acid bacteria and food fermentations important metabolic pathways of microorganisms; current status of metabolism of starters cultures; current trends in lactic starter for industrial applications, novel starter preservation techniques.

UNIT II

Modern concepts in cheese ripening; Bacteriology and starter rotations, improving starter cultures for food fermentation by genetic manipulation, recombination technology.

UNIT III

Bacteriocins of lactic acid bacteria, structure, function transport and mode of action; Application of bacteriocins in foods biopreservation.

UNIT IV

Current trends in food safety; newly emerging pathogens; Ecology and survival strategy of pathogens in foods. Novel technology in control of food based pathogens. Concepts in food toxicology; food borne toxins, current concepts in food quality and safety management

Suggested Readings

Adams MR, Moss MO. 2002. *Food Microbiology.* 2nd Ed. Panima Publ. Batt CA, Patel PA & Robinson RK. 1999. *Encyclopedia of Food Microbiology*. (Set 1-3). Academic Press.
DeVuyst & Vandamme. 2000. *Bacteriocins of Lactic Acid Bacteria*.
Blackie.
Jay JM, Lossener MJ & Golden DA. 2005. *Modern Food Microbiology*.
Springer- Verlag.
Marth EH & Steele JL. 2001. *Applied Dairy Microbiology*. Marcel Dekker.
Ray B. 2003. *Fundamental Food Microbiology*. CRC Press.
Robinson RK. 2002. *Dairy Microbiology Handbook: The Microbiology of Milk and Milk Products*. 3rd Ed. John Wiley & Sons.
Salminen S, Atte VW & Ouwehand A. 2004. *Lactic Acid Bacteria*. Marcel Dekker.
Wood B & Warner PJ. 2003. *Genetics of Lactic Acid Bacteria*. Springer-Verlag.

DM 622 MICROBIOLOGY OF FOOD-BORNE PATHOGENS 3+0

Objective

Upon satisfactory completion of this course, students should have developed knowledge, understanding and application of Foodborne pathogens at an advanced level.

Theory

UNIT I

Foodborne Pathogens**:** Host Invasion; Pathogenesis; Molecular approaches for detection, identification, typing and analysis of foodborne pathogens; Biosensor –based detection of foodborne pathogens.

UNIT II

Staphylococcal Gastroenteritis**:** Incidence in Foods, Staphylococcal Enterotoxins: Types and Incidence, The Gastroenteritis Syndrome, Prevention of Staphylococcal and other Food-Poisoning Syndromes

UNIT III

Botulism: Analysis of Dairy Products for *C. botulinum* and Botulinal Toxin, Clinical Manifestations, Outbreaks, Prevention; *Bacillus Cereus* food poisoning: Analysis of Dairy Products for *B. cereus* and Toxin, clinical manifestation, outbreaks, prevention.

UNIT IV

Brucellosis: Clinical Manifestations, Outbreaks, Prevention; Foodborne Listeriosis, Clinical Manifestations, Thermal Properties, Virulence Properties, Animal Models and Infectious Dose, Listeriosis Syndromes, Prevention.

UNIT V

Salmonellosis: Isolation and Detection Methods, Clinical Manifestations, Outbreaks, Prevention. Foodborne Gastroenteritis Caused by *Escherichia coli*, Enteropathogenic *E. coli*, Enterohemorrhagic *E. coli* O157:H7, Clinical Manifestations, Outbreaks, Prevention. Campylobacteriosis: Isolation and Identification, Clinical manifestations, Outbreaks, Prevention. Yersiniosis: Isolation and Identification, Clinical manifestations, Outbreaks, Prevention

Suggested Readings

Doyle MP, Beuchat LR & Montville TJ. 2001. *Food Microbiology: Fundamentals and Frontiers*. 2nd Ed. ASM Press.

Food and Drug Administration. *Food-borne Pathogenic Microorganisms and Natural Toxins Handbook: The Bad Bug Book.* http://www.cfsan.fda.gov/cgi-bin/printall.cgi

Fratamico PM, Bhunia AK & Smith JL. 2005. *Food-borne Pathogens: Microbiology and Molecular Biology*. Caister Academic Press.

Hocking AD. *et al.* 2003. *Food-borne Microorganisms of Public Health Significance*. 6th Ed. AIFST (NSW Branch) Food Microbiology Group, Sydney.

Jay JM. 2000. *Modern Food Microbiology*. 6th Ed. Aspen Publ.

Labbe RG & Garcia S. 2001. ***G****uide to Food-borne Pathogens*. John Wiley & Sons.

Marth EH & Steele JM. 2001. *Applied Dairy Microbiology*. 2nd Ed. Marcel Dekker.

Robinson RK, Batt CA & Patel PD. 2000. *Encyclopedia of Food Microbiology.* Vols.I-III. Academic Press.

DAIRY CHEMISTRY

Course Structure - at a Glance

COURSE NO.	COURSE TITLE	CREDITS	SEM
DC 511	PHYSICOCHEMICAL ASPECT OF MILK CONSTITUENTS AND MILK PRODUCTS	2+1	I
DC 512*	MILK CARBOHYDRATES, MINERALS AND WATER SOLUBLE VITAMINS	2+1	I
DC 513*	CHEMISTRY OF MILK LIPIDS	2+1	I
DC 514	FOOD CHEMISTRY	3+1	I
DC 521*	CHEMISTRY OF MILK PROTEINS	3+1	II
DC 522*	CHEMISTRY OF MILK PRODUCTS	3+1	II
DC 523	CHEMICAL QUALITY ASSURANCE	2+1	II
DCRT 524	RESEARCH TECHNIQUES	2+1	II
DC 591	MASTER'S SEMINAR	1+0	I, II
DC 599	MASTER'S RESEARCH	20	I, II
DC 611	ADVANCES IN CHEMISTRY OF MILK PROTEINS	3+0	I
DC 612	ADVANCES IN CHEMISTRY OF MILK LIPIDS	3+0	I
DC 621	ADVANCES IN THE CHEMISTRY OF MILK PROCESSING	3+0	II
DC 622	ADVANCES IN ANALYTICAL TECHNIQUES IN DAIRY CHEMISTRY	3+0	II
DT 622#	R & D MANAGEMENT IN DAIRY INDUSTRY	3+0	II
DC 691	DOCTORAL SEMINAR I	1+0	I, II
DC 692	DOCTORAL SEMINAR II	1+0	I, II
DC 699	DOCTORAL RESEARCH	45	I, II

* Compulsory for Master's programme;

\# Cross-listed with Dairy Technology

NOTE : Doctoral students shall take a minimum of two 600-level courses

DAIRY CHEMISTRY
Course Contents

DC 511 PHYSICO-CHEMICAL ASPECTS OF MILK CONSTITUENTS AND MILK PRODUCTS 2+1

Objective

To impart knowledge in understanding the physico-chemical aspects of milk and milk products with special reference to their processing and quality assurance.

Theory

UNIT I

Kinetics: Order and molecularity of a reaction; reactions obeying the kinetics of zero, 1st, 2nd and 3rd order; kinetics of denaturation of whey proteins; the role of enzymes as a biological catalyst; factors affecting the rate of enzyme action- (i) concentration of substrate, (ii) concentration of enzyme, (iii) concentration of reaction products, (iv) pH, (v) temperature, (vi) time, (vii) activators, and (viii) inhibitors; concept of activation energy.

UNIT II

Electrochemistry: Electrolytic dissociation; activity, ionic strength; salt equilibria in milk; dissociation constant of acids and bases; effect of ionic strength on dissociation constant; buffers; limitation of buffers; Good's buffer; buffer capacity and buffer index of milk; electrode potential; concentration cells; ion-selective electrodes.

UNIT III

Surface chemistry: Adsorption at solid-vapour (gas) inter-phase; monolayer and multilayer adsorption; capillary condensation; adsorption isotherms; hysteresis; adsorption at solid-liquid and liquid-liquid interphase; Gibb's equations. water activity: sorption of water on milk constituents and milk products- its relation to stability of dairy products.

UNIT IV

Interfacial tension; micelles-- definition, critical micelle concentration - formation and stability; emulsions-, foams- and gels--their formation, struc-ture and stability; importance of these phenomena in milk and milk products.

UNIT V

Properties of colloidal systems with special reference to electrical, optical, hydrodynamic (shape and hydration) and rheological aspects; colloidal stability of casein micelles; membrane phenomenon and Donnan membrane effect.

Practical

Determination of the order of hydrolysis of an ester/carbohydrate and measurement of activation energy; determination of the progress curve obtained during the hydrolysis of P-nitrophenyl phosphate by milk alkaline phosphatase; determination of the Michaelis constant for the digestion of casein by trypsin; preparation of a Tris/phosphate/citrate buffer of a given molarity/ionic strength and pH; determination of pH of the buffer; estimation of calcium ions of milk using an ions selective electrode; determination of viscosity of condensed milk using falling ball viscometer; measuring the stability of an oil-in-water emulsion stabilised by milk proteins; foaming capacity and foam stability of caseins/whey proteins; drawing of an adsorption isotherm of water on casein.

Suggested Readings

Damodran S & Paraf A. 1997. *Food Proteins and their Applications*. Marcel Dekker.

Fox PF & Mc Sweeney PLH. 1998. *Dairy Chemistry and Biochemistry*. Blackie.

Freifelder D. 1982. *Physical Biochemistry: Application to Biochemistry and Molecular Biology*. WH Freeman.

Mitchell JR & Ledward DA. 1986. *Functional Properties of Food Macromolecules*. Elsevier.

Moore WJ. 1983. *Basic Physical Chemistry*. Prentice Hall.
Ronald J.1987. *Physical Properties of Foods*. Elsevier.
Walstra P & Jenness R. 1984. *Dairy Chemistry and Physics*. John Wiley & Sons
Wong NP, Jenness R, Keeney M & Elmer HM. 1988. *Fundamentals of Dairy Chemistry*. 3rd Ed. Van Nostrand Reinhold Co.

DC 512 MILK CARBOHYDRATES, MINERALS AND WATER SOLUBLE VITAMINS 2+1

Objective

To impart basic knowledge on all aspects of milk carbohydrates, minerals and water soluble vitamins and to project the importance of these milk constituents on the quality of milk and milk products as well as in human health.

Theory

UNIT I

Lactose: Occurrence, isomers, molecular structure.

UNIT II

Physical properties: crystalline habits, hydrates, lactose glass, equilibrium of different isomers in solution, solubility, density, sweetness.

UNIT III

Chemical properties: Hydrolysis, pyrolysis, oxidation, reduction, degradation with strong bases**,** derivatives, dehydration and fragmentation**,** browning reactions and its mechanism.

UNIT IV

Minerals: Major and miner minerals, factors associated with variation in salt composition.

UNIT V

Physical equilibrium amongst milk salts, partitioning of salt constituents and factors affecting it. Effect of various treatments on salt equilibrium.

UNIT VI

Salt balance and its importance in the processing of milk, protein mineral interaction, distribution and importance of trace elements in milk.

UNIT VII

Water soluble vitamins: Thiamin, riboflavin, niacin, pantothenic acid, pyridoxine, biotin, folin and cyanocobalamin.

UNIT VIII

Molecular structures of these vitamins, levels in milk and milk products, biological significance, factors affecting their levels.

UNIT IX

Ascorbic acid: structure and its relation to Eh of milk and milk products.

Practical

Estimation of lactose in milk by volumetric, gravimetric, ploarimetric and colorimetric methods. Estimation of sodium and potassium by flame photometry, calcium and magnesium by EDTA method, phosphorus by colorimetric (Fiske and Subbba Rao) method. Citric acid and iron by colorimetric methods, vitamin C in milk (volumetric method) and brown colouring matter/burnt particles in milk powder.

Suggested Readings

Fox PF.1985. *Developments in Dairy Chemistry.* Vol. III. Applied Science Publ.
Jennes RG.1995. *Handbook of Milk Composition.* Academic Press. Jenness R & Patton S. 1969. *Principles of Dairy Chemistry*. John Wiley & Sons.
Walstra P & Jenness R. 1984. *Dairy Chemistry and Physics*. John & Wiley. Wong NP, Jenness R, Kenney M & Elmer MH. 1988. *Fundamentals of Dairy Chemistry*. Van Norstand Reinhold Co.

DC 513 CHEMISTRY OF MILK LIPIDS 2+1

Objective

To impart the basic knowledge on all aspects of milk lipids and to project the importance of milk lipids in the quality of milk products as well as in human health.

Theory

UNIT I

Milk lipids: classification, gross composition and physical properties; neutral and polar lipids and their role in milk and milk products.

UNIT II

Fatty acids profile: composition, properties and factors affecting them.

UNIT III

Unsaponifiable matter: composition with special reference to sterols and fat soluble vitamins and caretenoids, chemistry, physiological functions and levels of milk.

UNIT IV

Chemical properties: hydrolysis by alkali, water and enzymes; hydrogenation and halogenation; transesterification and interesterification; oxidation by chemical reagents.

UNIT V

Auto-oxidation: Definition, theories, induction period, secondary products of auto oxidation, factors affecting, prevention and measurement; antioxidants: Definition, types, reaction mechanism and estimation.

Practical

Determination of melting point/slip point, peroxide value, TBA value, carbonyl value, unsaponifiable matter; estimation of total cholesterol by direct and indirect method; vitamin A, total phospholipids and free fatty acids in ghee; preparation of fatty acid esters and their analysis on GLC; estimation of antioxidants such as BHA.

Suggested Readings

Akoh CC & Min DB. 1997. *Food Lipids: Chemistry, Nutrition and Biotechnology*. Marcel Dekker.

Fox PF. 1983. *Development in Dairy Chemistry*. Vol. II. Applied Science Publ.

Mathur MP, Datta Roy D & Dinakar P. 1999. *Text Book of Dairy Chemistry*. ICAR.

Walstra P & Jenness R. 1984. *Dairy Chemistry and Physics*. John Wiley & Sons.

Wong NP, Jenness R, Keeney M & Elmer HM. 1988 *Fundamentals of Dairy Chemistry*. Van Nostrand Reinhold Co.

DC 514 FOOD CHEMISTRY 3+1

Objective

To impart knowledge on different aspects of food components.

Theory

UNIT I

Forms of water in foods, water solute interactions and food stability, solute mobility and food stability; role of ice in the stability of food at sub-freezing temperatures.

UNIT II

Forms, swelling, gelatinization; food applications and role of starch in bread making; modification of starches for industrial applications, physico-chemical changes taking place during malting, mutual interactions of hydrocolloids and interactions with proteins and lipids; role of hydrocolloids in different food preparations.

UNIT III

Functional properties of food proteins; structure-function relationship and their modifications, denaturation of food proteins; effect of pressure on food proteins, enzymes & their application in food industry; physico-chemical properties of food lipids and their modifications.

UNIT IV

Indigenous and synthetic food pigments; legal requirements for food colourants; flavour compounds of different foods and flavour enhancers

UNIT V

Changes taking place during fermentation; drying and roasting of chocolate and cocoa; chemistry of tea manufacture; composition of coffee beans; physico-chemical changes during roasting of coffee beans.

Practical

Determination of level of artificial sweeteners and crude fiber in food products; starch in flour by polarization method; total amino acids and polyphenols in lemon juice; fat in grains; proteins in flour; tannins in coffee/tea, caffeine content in coffee; HMF in honey, and visit to a food industry.

Suggested Readings

Belitz HD & Grosch W. 1999. *Food Chemistry*. 2nd Ed. Spinger Verlag.

Fennema OR. 1985. *Food Chemistry*. Marcer Dekker.

Srinivas D & Alan Praf. 1997. *Food Proteins and their Applications*.

Marcel Dekker.

Turker GA & Woods LFJ. 1995. *Enzymes in Food Processing*. Blackie. Williams PA & Phillips GO. 2000. *Gums and Stabilizers for the Food Industry*. Royal Society of Chemistry.

DC 521 CHEMISTRY OF MILK PROTEINS 3+1

Objective

To impart knowledge on different aspects of milk proteins.

Theory

UNIT I

Distribution and fractionation of different nitrogen fractions, non-protein nitrogen constituents, nomenclature of milk proteins.

UNIT II

Major milk proteins: caseins (acids and micellar), methods of isolation; fractionation of casein and heterogeneity**,** physico-chemical properties, glycosylation, phosphorylation, amino acid composition, primary and secondary structure of different fractions; casein micelle models.

UNIT III

alpha-Lactalbumin and beta-lactoglobulin - distribution and methods of isolation; whey protein concentrates and their functional properties.

UNIT IV

Denaturation of caseins and whey proteins as affected by change of temperature, pH and additives; casein -whey protein interactions; genetic polymorphism and biosynthesis of milk proteins.

UNIT V

Minor milk proteins: proteose-peptone, immunoglobulins, lactoferrin, lipoprotein and fat globule membrane proteins.

UNIT VI

Milk enzymes: properties and their significance with particular reference to lipases, phosphatases, catalase, peroxidase, xanthine oxidase, lysozyme, lactoperoxidase and galactosyl transferase.

Practical

Estimation of different nitrogen fractions of milk by Kjeldahl method. Milk protein estimation by Folin method. Isolation of acid and micellar casein; urea fractionation of acid casein; separation of amino acids using thin layer/paper chromatography; isolation of alpha-lactalbumin and beta-

lactoglobulin by ammonium sulphate precipitation; polyacrylamide gel electrophoresis of milk proteins; estimation of milk enzymes like lipase, alkaline phosphatase and lactoperoxidase; fractionation of milk proteins by molecular sieving; estimation of hexoses and sialic acid in casein.

Suggested Readings

Fox PF. 1982. *Developments in Dairy Chemistry*. Vol. I. *Proteins*. Applied Science Publ.

Fox PF & McSweeney PLH. 1998. *Dairy Chemistry and Biochemistry*.

Blackie Academic Professional, Champman & Hall.

Fox PF. 1992. *Advanced Dairy Chemistry*. Elsevier.

Mathur M., Datta Roy D & Dinakar P. 1999. *Text Book of Dairy Chemistry*. ICAR.

Robert G Jensen 1991. *Handbook of Milk Composition*. Academic Press. Walstra P & Jenness R.1984. *Dairy Chemistry and Physics*. John Wiley &

Sons.

Wong NP, Jenness R, Keeney M & Elmer HM. 1988 *Fundamental of Dairy Chemistry*. 3rd Ed. Van Nostrand Reinhold Co.

DC 522 CHEMISTRY OF MILK PRODUCTS 3+1

Objective

To project the physico-chemical changes and effects of various milk constituents of the milk products during manufacture and storage.

Theory

UNIT I

Physico-chemical changes taking place during manufacturing and storage of concentrated milk; structure and physico-chemical properties of dried milk as affected by different process treatments; stability of milk powder; physical properties of instant milk powder.

UNIT II

Role and mechanism of action of stabilizers and emulsifiers in ice cream. Physiological and biochemical response of infants to human milk and formulated foods.

UNIT III

Heat stability of concentrated milk as affected by different process variables; milk constituents and additives; milk clotting enzymes from different sources (animal and plant); their isolation; purification and action.

UNIT IV

Changes taking place during manufacturing and ripening of cheese; chemical defects in cheese. Theory and metabolic pathways of fermentation.

UNIT V

Size distribution of fat globules and factors affecting it; creaming phenomena; mechanism of churning; physico-chemical characteristics; grading and standards of butter.

UNIT VI

Genesis of flavour; aroma and texture in ghee; adulteration of ghee and its detection.

Practical

Determination of lactose and sucrose in condensed milk and ice-cream; determination of heat stability of milk and its concentrate; determination of moisture in skim milk powder/infant food by vacuum oven; determination of fat in cream by Gerber and Rose-Gottlieb methods; determination of moisture, fat (Gerber method), curd and salt in butter; determination of diacetyl and acetyl methyl carbinol in butter/cultured products; determination of RM, Polenske value, iodine value, saponification value of ghee; determination of nitrite, nitrate, free amino acids and free fatty acids in cheese; determination of rennet clotting time of milk.

Suggested Readings

Fox PF. 1985. *Developments in Dairy Chemistry.* Vol. III. Applied Science Publ.

Gurr MI. 1981. *Comparative Aspects of Feeding Human and Artificial Milk for Infant Feeding*. J. Dairy Res.: 48, 519.

ISI. 1981. *Handbook of Food Analysis S.P. 18 (Part II) Dairy Products*. ISI Specifications, Manak Bhavan, New Delhi.

Law BA. 1997. *Microbiology and Biochemistry of Cheese and Fermented Milks*. 2nd Ed. Blackie Academic and Professional, Chapman & Hall.

Mathur MP, Roy DD & Dinakar P.1999. *Textbook of Dairy Chemistry*.

ICAR.

Official methods of A.O.A.C. 11th and 15th Eds.

Prevention of Food Adulteration Act (PFA) 1954 and PFA Rules1955. Walstra P & Jenness R. 1984. *Dairy Chemistry and Physics*. John Wiley & Sons.

Wong NP, Jeness R, Keeney M & Elmer HM. 1988. *Fundamentals of Dairy Chemistry*. Van Nostrand Reinhold Co.

DC 523 CHEMICAL QUALITY ASSURANCE 2+1

Objective

To project the importance of chemical quality assurance and quality control in relation to dairy industry and impart basic knowledge on all aspects of chemical quality assurance.

Theory

UNIT I

Concept of quality assurance and quality control in relation to dairy industry; quality management systems - ISO 9000; total quality management (TQM); hazard analysis of critical control points (HACCP); good manufacturing practices (GMP); role of international organisations such as ISO; IDF; CAC; AOAC; WTO and national organisations like BIS; CCFS.

UNIT II

PFA and Agmark; significance of milk and milk products order (MMPO) and APEDA (Agricultural and Processed Foods Export Development Authority) in dairy industry; guidelines for setting up quality control laboratory; sampling of milk and milk products; dairy detergents and sanitizers; calibration of milk testing glassware; preparation of standard reagents.

UNIT III

Instrumentation in analysis of milk and milk products; detection of adulterants in milk and milk products; packaging materials in relation to quality assurance of dairy products.

UNIT IV

Chemical residues: pesticides; antibiotics; heavy metals; radionuclides etc; in dairy products.

Practical

Preparation of standard solutions and buffers; testing of available chlorine content in hypochlorites/bleaching powder; determination of purity of common salt for butter and cheese making; detection of common adulterants in milk and foreign fat/oil in ghee; checking the calibration of lactometers; hydrometers; butyrometers; milk pipette and thermometer; qualitative colour tests to distinguish between azo dyes and natural dyes in butter; detection of pesticide residues and antibiotics in milk.

Suggested Readings

AOAC. 2000. *Official Methods of Association of Official Analytical Chemists,* USA.

IDF 1997. *Monograph on Residues and Contaminants in Milk and Milk Products.* Special Issue No. 9701.

IDF 1993. *Quality Assurance (QA) and Good Lab. Practices (GLP) in Dairy Laboratories*. Special Issue No. 9302.

ISI 1981. *Handbook of Food Analysis* S.P. 18 (Part II) *Dairy Products*. ISI Specifications, Manak Bhavan, New Delhi.

Prevention of Food Adulteration Act (PFA)1954 and *PFA Rules* 1955. 10th Ed. Aug. 2006.

Ralph Early. 1995. *Guide to Quality Management System for Food Industry*. Blackie..

DCRT 524 RESEARCH TECHNIQUES 2+1

Objective

To impart the advanced knowledge on the use of analytical techniques in Dairy Chemistry.

Theory

UNIT I

Electrophoresis: principle and types, isoelectricfocussing.

UNIT II

Chromatography: column, TLC, GLC, HPLC, gel-permeation, ion-exchange, affinity.

UNIT III

Spectrophotometry: UV, visible, IR and flame photometry; potentiometry:
principle, various electrodes; electrometric measurements of pH, buffers.

UNIT IV

Radiotracer technique: nuclear transformation, nuclear decay, measurement of radioactivity and safety precautions for radioactive materials.

UNIT V

Membrane processes; ultracentrifugation.

Practical

Preparation of methyl esters of fatty acids of milk fat followed by their GLC separation and estimation; TLC separation of amino acids; gel-filtration of biomolecules; preparation of a buffer and measurement of its pH electro-metrically and using indicators; SDS gel electrophoresis and molecular weight determination; determination of absorption spectra of BSA and demonstration of Beer's law; determination of sodium and potassium by flame photometry; ultracentrifugal preparation of micellar casein, separation of milk proteins using ion-exchange chromatography.

Suggested Readings

Clark JM & Switzer RL. 1977. *Experimental Biochemistry*. WH Freeman & Co.

Cooper TG. 1977. *The Tools of Biochemistry*. John Wiley & Sons.

Frank A Settle.1997. *Handbook of Instrumental Techniques for Analytical Chemistry*. Prentice Hall.

Nielsen S Suzanne 1994. *Introduction to the Chemical Analysis of Foods*.
Jones & Barlett Publ.

Sawhaney SK & Singh R. 1985. *An Introduction to Practical Biochemistry*.
Narosa Publ.

Stock R & Rice F. 1974. *Chromatographic Methods*. Chapman & Hall.

Wilson K & Walker J. 2000. *Practical Biochemistry: Principles and Techniques*. Cambridge Univ. Press.

DC 611 ADVANCES IN CHEMISTRY OF MILK PROTEINS 3+0

Objective

To impart knowledge on different aspects of milk proteins

Theory

UNIT I

Biosynthesis of milk proteins, proteins and lipoproteins of milk fat globule membrane (MFGM).

UNIT II

Amino acid sequence of caseins, structure - function relationship of casein and whey protein; association - dissociation equilibria.

UNIT III

Physical, chemical and enzymatic modification of milk proteins and their functional characteristics.

UNIT IV

Mechanism of action and biological role of specific and non-specific antimicrobial factors in milk - immunoglobulins, lactoferrin, lactoperoxidase and lysozyme.

UNIT V

Milk derived bioactive peptides - their properties; significance and application; bitter peptides in cheese; growth factors in milk; transgenic milk proteins and their significance.

UNIT VI

Therapeutic and allergy aspects of milk proteins; protein films and coatings; their properties and applications.

Suggested Readings

Damodaran S & Paraf A. 1997. *Food Proteins and their Applications*.
Marcel Dekker.
Fields Cregg B. 1997. *Solid Phase Peptide Synthesis: Methods in Enzymology*. Vol. 289. Academic Press.
Fox PF. 1995. *Advanced Dairy Chemistry*. Vol. 1. *Proteins*. Applied Science Publ.
IDF. 1993. *Proceedings of Seminar on Indigenous Antimicrobial Agents of Milk - Recent Developments*. Uppasala, Sweden.
Popay AI & Prosser CG.1997. *Biotech in Agric*. Series No. 18, CABI.
Visser Hans. 1992. *Protein - Interactions*. VCS.
Welch RAS, Burns DJW & Davis SR. 1997. *Milk Composition, Production and Biotechnology*. CABI.

DC 612 ADVANCES IN CHEMISTRY OF MILK LIPIDS 3+0

Objective

To impart the advanced knowledge on different aspects of milk lipids with special reference to their relation with human health.

Theory

UNIT I

Origin, composition, structure and physical chemistry of milk fat globule membrane. Comparative aspects of milk lipids from different species such as human, bovine, buffalo, sheep, goat, pig and camel.

UNIT II

Lipolytic enzymes from different species including human; bile salts; stimulated lipase and esterases. Biosynthesis of fatty acids; glycerol; neutral lipids; phospholipids; sphingolipids; cholesterol.

UNIT III

Essential fatty acids, prostaglandins and flavor compounds. Conjugated linoleic acids – different isomers, factors affecting their levels in dairy products and their significance.

UNIT IV

Chemistry of oxygen in relation to auto-oxidation of milk fat including effect of milk components and environmental factors, thermal oxidation, chemical and biological properties of heated and oxidized fats.

UNIT V

Significance of milk lipids in human health. Role of milk lipids in consumer acceptance of dairy products. Polymorphism and milk fat crystallization.

Suggested Readings

Bindra JS & Bindra R.1977. *Prestoglandins Synthesis*. Academic Press. Fox PF. 1995. *Advanced Dairy Chemistry.* Vol. II. *Lipids.* 2nd Ed. Chapman & Hall.
Fox PF & McSweeney PLH. 1998. *Dairy Chemistry and Biochemistry*.
Blackie Academic Professional, Champman & Hall.
Gurr MI. 1992. *Role of Fats in Food and Nutrition*. Elsevier.
Walstra P & Jenness R. 1984. *Dairy Chemistry and Physics*. John Wiley & Sons.
Wong NP, Jenness R, Keeney M & Elmer HM. 1988. *Fundamental of Dairy Chemistry*. 3rd Ed. Van Nostrand Reinhold Co.

DC 621 ADVANCES IN CHEMISTRY OF MILK PROCESSING 3+0

Objective

- To highlight the impact of processing parameters on the milk constituents with special reference to chemical changes involved.
- To impart the knowledge on the status and chemistry of contaminants in milk and milk products.
- To impart the basic knowledge on the chemistry and significance of additives.

Theory

UNIT I

Heat induced changes and interactions between protein, lipids, carbohydrate and minerals during processing of milk. Effect of heat on the proteins of concentrated milk systems. Inactivation of milk indigenous enzymes during processing.

UNIT II

Milk fat replacers, chemistry of artificial sweeteners and fortified milk.

UNIT III

Physical changes in the fat globules in unhomogenized and homogenized milk; cold agglutination – its mechanisms and role.

UNIT IV

Specific and non – specific enzymatic coagulation of milk.

UNIT V

Status and formation of bioactive peptides in fermented milk products.

UNIT VI

Chemistry involved in high pressure processing of milk.

UNIT VII

Radio nuclides, drugs, pesticides, and polybiphenyls in milk.

Suggested Readings

Colette Shortt & John O' Brien. 2004. *Handbook of Functional Dairy Products*. CRC Press.

Fox PF & McSweeney PLH. 1998. *Dairy Chemistry and Biochemistry*.

Blackie Academic Professional, Chapman & Hall.

IDF. 1989. Bulletin 238. Intern. Dairy Fed., Brussels.

IDF. 1997. Special issue 9701. Intern. Dairy Fed., Brussels.

IDF.1995. Special issue. *Heat Induced Changes in Milk*. Intern. Dairy Fed., Brussels.

Leo ML Nollet. 2004. *Intense Sweeteners. Handbook of Food Analysis*. 2nd Ed. Marcel Dekker.

Mathur MP, Roy DD & Dinakar P. *Textbook of Dairy Chemistry*. ICAR.

Nabors Lyn O'Brien. *Alternative Sweeteners.* 3rd Ed. Marcel Dekker.

DC 622 ADVANCES IN ANALYTICAL TECHNIQUES IN DAIRY CHEMISTRY 3+0

Objective

To highlight the importance of modern analytical techniques used for analysis of milk and milk products.

Theory

UNIT I

Isoelectric focusing and 2-D polyacrylamide gel elctrophoresis (PAGE), Capillary zone electrophoresis, Blotting technique.

UNIT II

Differential scanning calorimetry, Radio immuno assay (RIA), Enzyme linked immunosorbent assay (ELISA).

UNIT III

High performance liquid chromatography (HPLC), Circular dichroism (CD), Protein sequencing, X-ray crystallography.

UNIT IV

Atomic-, Mass-, Infrared-, Fluorescence- Spectroscopy.

Suggested Readings

Blundell TL & Johnson LN.1976. *Protein Crystallography*. Academic Press.

Calter P. 2004. *Methods in Molecular Biology*. Vol. 244 2nd Ed. *Protein Purification Protocols*. Humana Press.

FL Creighton T.1998. *Protein Structure*. 2nd Ed. Portland Press.

Nielsen SS. 1994. *Introduction to Chemical Analysis of Foods*. Part IV.
Jones & Bertlett Publ.

Oliver RWA.1989. *HPLC of Macromolecules - A Practical Approach*. IRL Press.

Sawyer L. et al. 2002. *Milk Protein Structure-What can it tell the dairy industry*? *International Dairy Journal* 12: 299-301.

Settle F.1997. *Handbook of Instrumental Techniques for Analytical Chemistry*. Hall International.

Smith BJ. 1996. *Protein Sequencing Protocols, Methods in Molecular Biology*. Vol. 32. Humanta Press.

Swadesh J.1997. *HPLC - Practical and Industrial Applications*. CRC Press.

DAIRY ENGINEERING
Course Structure - at a Glance

COURSE NO.	COURSE TITLE	CREDITS	SEM
DE 511*	DAIRY AND FOOD ENGINEERING-I	3+0	I
DE 512*	HEAT TRANSFER	3+0	I
DE 513	TRANSPORT PHENOMENA	2+0	I
DE 514	REFRIGERATION ENGINEERING	2+1	I
DE 515*	DESIGN OF PROCESS EQUIPMENT	3+0	I
DE 521*	DAIRY AND FOOD ENGINEERING-II	3+0	II
DE 522	BIO-THERMAL PROCESS ENGINEERING	3+0	II
DE 524	ENVIRONMENTAL ENGINEERING	2+0	II
DE 525*	INSTRUMENTATION AND PROCESS CONTROL	2+1	II
DE 591	MASTER'S SEMINAR	1+0	I, II
DE 599	MASTER'S RESEARCH	20	I, II
DE 611	ADVANCES IN DAIRY PROCESS ENGINEERING	3+1	I
DE 612	ADVANCED HEAT TRANSFER	3+0	I
DE 621	COMPUTATIONAL METHODS AND SIMULATION IN DAIRY & FOOD ENGINEERING	2+0	II
DE 622	PHYSICO-CHEMICAL PROCESSES	3+0	II
DE 690	SPECIAL PROBLEMS	0+2	I, II
DE 691	DOCTORAL SEMINAR I	1+0	I, II
DE 692	DOCTORAL SEMIANR II	1+0	I, II
DE 699	DOCTORAL RESEARCH	45	I, II

* Compulsory for Master's programme

NOTE : *Doctoral students shall take a minimum of two 600-level courses*

DAIRY ENGINEERING
Course Contents

DE 511 DAIRY AND FOOD ENGINEERING-I 3+0

Objective

To disseminate the knowledge of properties of products and unit operations involved in dairy and food engineering

Theory

UNIT I

Engineering properties of dairy and food materials and their significance in equipment design; processing and handling of dairy and food products.

UNIT II

Concept of rheology: ideal elastic, plastic and viscous behaviour, viscoelasticity, rheological models and constitutive equations, Maxwell model, Kelvin model and Burgers model, viscoelastic characteristion of materials, stress-strain behavour, creep, stress relaxation, non-Newtonian fluids and viscometry.

UNIT III

Rheology and texture of food materials: methods of texture evaluation, subjective and objective measurements, mechanical tests, firmness, hardness, dynamic hardness, objective methods of measuring texture, rheological properties of dairy products, strength of food materials.

UNIT IV

Aerodynamic and hydrodynamic characteristics: drag coefficient, terminal velocity and Reynold's number, application of aerodynamic properties to the separation, pneumatic handling and conveying of foods.

UNIT V

Design of single and multi-effect evaporators: design of spray dryer and its components, separation and recovery of dried product, design of recovery system, selection and design of auxiliary equipment.

Suggested Readings

Charm SE. 1971. *The Fundamental of Food Engineering*. AVI Publ. Heldman DR & Singh R.P. 1984. *Food Process Engineering*. The AVI
Publ.
Mohsenin NN. 1986. *Physical Properties of Plant and Animal Materials*.
Gorden & Breach Science Publ.
Rao MA & Rizvi SSH. 1986 *Engineering Properties of Foods*. Marcel Dekker.
Watson EL & Harper IC. 1989. *Elements of Food Engineering*. AVI Publ.

DE 512 HEAT TRANSFER 3+0

Objective

To develop competence in Heat Transfer Analysis.

Theory

UNIT I

One-dimensional steady state heat conduction through fins (Extended surfaces): actual and approximate solution. Efficiency, effectiveness and design of profile area of fins.

UNIT II

Two-dimensional steady state heat conduction: analytical and numerical solution.

UNIT III

Unsteady state heat conduction: analytical solution.

UNIT IV

Forced convection heat transfer in flow over a flat surface: hydrodynamic and thermal boundary layer, continuity equation, momentum equation and energy equation, heat transfer coefficient/ Nusselt number in laminar and turbulent region of boundary layer. Stanton number; Coulburn Analogy; Empirical co-relations.

UNIT V

Forced convection heat transfer in flow through tubes: Nusselt number in the entrance region and fully developed laminar and turbulent region.

UNIT VI

Condensation and Boiling Heat transfer: Film wise condensation on vertical surface; Nusselt equation, Boiling liquids.

UNIT VII

Heat Exchangers: classification, overall heat transfer coefficient. Performance analysis of parallel flows and counter flow heat exchangers: LMTD and effectiveness-NTU approach. Use of computer software for process heat transfer applications.

Suggested Readings

Domkundwar S & Arora SC. 1979. *A Course in Heat and Mass Transfer*.
Dhanpat Rai & Sons.
Gupta CP & Rajendra Parkash. 1986. *Heat Transfer*. Nem Chand & Bros., Roorkee.
Holman JP & Ganesan. 2002. *Heat Transfer*. Tata McGraw Hill.
Incropera FP & Dewitt DP. 1996. *Fundamentals of Heat and Mass Transfer*. John Wiley & Sons.
Kreith F. 1965. *Principles of Heat Transfer*. International Text Book Co. Kumar DS. 2002. *Heat and Mass Transfer*. S. K. Kataria & Sons, New
Delhi.

DE 513 TRANSPORT PHENOMENA 2+0

Objective

To develop competence in momentum, energy and mass transfer analysis.

Theory

UNIT I

Introduction to transport transport properties and energy and mass transfer.

UNIT II

phenomena – Molecular transport mechanism, their proportionality constants in momentum, Steady-state equations - Momentum transport equations for Newtonian and non-Newtonian fluids, continuity equation in different co-ordinates.

UNIT III

Equations of motion - Navier–Stokes equations and their application in viscous fluid flow between parallel plates and through pipes.

UNIT IV

Turbulent transport mechanism -- Mathematical analysis; eddy viscosity and eddy diffusivity; velocity, temperature and concentration distribution; time smoothing equations. Inter-phase transport in isothermal system - friction factors for various geometries.

UNIT V

Mass transfer -- Fick's law of diffusion, diffusion of gases and liquids through solids, equimodal diffusion, isothermal evaporation of water into air, mass transfer coefficients.

UNIT VI

Dimentional analysis – Buckingham Pi-theorem and matrix method, application to transport phenomena, analysis among mass, heat and momentum transfer, Reynolds' analogy.

UNIT VII

Boundary layer concept - Theoretical and exact solutions for heat, mass and momentum transfer.

Suggested Readings

Bird RB. 1994. *Transport Phenomena*. John Wiley & Sons.
Treybal RE. 1968. *Mass Transfer Operations*. McGraw Hill.
Yuan SW. 1969. *Foundations of Fluid Mechanics*. Prentice Hall of India.

DE 514 REFRIGERATION ENGINEERING 2+1

Objective

To impart knowledge of design, construction, operation, control and maintenance of commercial refrigeration systems: cold storages and Air conditioning plants.

Theory

UNIT I

Vapour compression refrigeration system: major components and their different types; theoretical vapour compression cycle, theoretical COP; Effect of operating parameters on COP; actual vapour compression cycle; multi-pressure commercial refrigeration systems.

UNIT II

Vapour absorption refrigeration system: Ammonia-Water system, Vapour absorption refrigeration cycle and its representation on Enthalpy-composition diagram; Absorption system calculations.

UNIT III

Heat Pumps: different 'heat pump circuits'; analysis of heat pump cycle; Use of heat pumps in dairy plant for energy conservation.

UNIT IV

Non-conventional refrigeration systems: Thermo electric refrigeration, vortex tube, cooling by adiabatic demagnetization.

UNIT V

Design elements of Refrigeration equipments: compressor condenser, evaporator, cooling tower, spray pond etc. Balancing of different components.

UNIT VI

Design of cold storage and air- conditioning systems: types of cooling loads and their calculation, design of cold storage for food products, construction of cold storage, equipment selection, insulating materials, vapour barriers, Ice bank tank.

UNIT VII

Control and maintenance of a commercial refrigeration plant: Pressure regulating valves, Thermostatic valves, LP/ HP cutouts, high to low side bypass valve, condenser water regulating valve, capacity control devices, pump down control, defrosting methods, liquid charging; General preventive maintenance of refrigeration plant.

Practical

- To find and compare the theoretical and actual COP of a small refrigeration unit on Refrigeration Tutor.
- Study and design of refrigeration components of a bulk milk chiller
- Visit to a commercial refrigeration plant for cold storage/ ice bank unit and calculation of its theoretical COP by making cycle on P-h chart.
- Calculation of theoretical work and comparing it with actual work for some specified cooling job in a commercial plant.
- Study of various control and safety devices in a commercial refrigeration plant.
- Design problems on cold storage for different food/ dairy products.
- Use of Computer software specific to cold store AC design
- Study the working of an actual heat pump system.

Suggested Readings

Ananta Krishnan CP & Simha NN. 1987. *Technology and Engineering of Dairy Plant Operation*. Luxmi Publ.

Andrew D Althhouse & Carl H. Turnquist 1958. *Modern Refrigeration and Air-conditioning*. Good Heart Wilcox Co.

Arora CP. 2000. *Refrigeration and Air-conditioning*. Tata McGraw Hill. Carrier Air-conditioning. 1965. *Handbook of Air-conditioning System*

Design. McGraw Hill.

Domkundwar S. 1980. *A Course in Refrigeration and Air-conditioning*.

Dhanpat Rai & Sons.
Gunther Raymond C. 1957. *Refrigeration and Air-conditioning and Cold Storage*. Chilton Co.
Jordan RC & Priester GB. 1971. *Refrigeration and Air conditioning*.
Prentice Hall of India.
Langley BC. 1978. *Refrigeration and Air-conditioning*. Reston Publ. New-Comer JL. 1981. *Refrigeration and Air-conditioning*. Venus Trading Co.

DE 515 DESIGN OF PROCESS EQUIPMENT 3+0

Objective

To provide basic knowledge of various procedures for the design of dairy equipment.

Theory

UNIT I

Design of vessels: codes and regulations, design for pressure and temperature, loading; allowable stress, minimum thickness after forming, corrosion mechanism, corrosion control, design for internal and external pressure, cylindrical and spherical shells, formed heads, reinforcement openings, fabrication requirements, inspection, tests and non-destructive examination, pressure tests, design and stress evaluation.

UNIT II

Design of milk storage tank: horizontal and vertical silos, insulated and uninsulated, nozzles and mountings.

UNIT III

High-pressure vessels: constructional features, material for high pressure, multi shell construction, solid walled vessel.

UNIT IV

Supports for vessel: bracket support, leg support, skirt support, saddle support.

UNIT V

Heat exchangers: shell and tube heat exchangers, construction codes, general design considerations, U- tube heat exchangers, double pipe exchanger, scraped surface exchanger, spiral tube exchangers, joints; welded tube joints, baffles and tube bundles, tube sheet, double tube sheet construction, plate type heat exchanger; air cooled heat exchangers. Computer software for design of heat exchanger.

UNIT VI

Design of reactor vessel: material of construction, agitation, classification, heating systems, design consideration tank coils.

Suggested Readings

Evans FL. 1974. *Equipment Design Handbook*. Vol II. Gulf Publ.
Foust AS. et. al.1960. *Principles of Unit Operations*. John Wiley & Sons. Hesse CR & Ruston JH. 1964. *Process Equipment Design*. Affiliated East-
West Press.
Joshi MV & Mahajani VV. 1976. *Process Equipment Design*. Macmillan India.

DE 521 DAIRY AND FOOD ENGINEERING-II 3+0

Objective

To develop competence in shelf life simulation of dairy products.

Theory

UNIT I

Water activity and states: a thermodynamic quantity, water sorption isotherms, hysteresis, theories of sorption hysteresis, water activity measurement methods, water binding, control of water activity and moisture, principles of IMF and their application.

UNIT II

Permeability and shelf-life: theoretical considerations, permeability to gases and vapours, measurement methods, permeability of multilayer materials, permeability in relation to packaging requirements of food products.

UNIT III

Calculation of shelf life and requirements for packaging, deteriorative reactions, accelerated testing, relationship between transport properties of the package and shelf life of packaged products, simulation of product-package-environment interaction, shelf life simulation for moisture, oxygen and light sensitive products.

UNIT IV

Theory of ultra filtration and reverse osmosis, selection and types of membrane and properties concentration polarization, mathematical description of flow through membrane, application and use in dairy industry.

UNIT V

Microwave energy absorption, physical parameters in microwave heating processes, heat transfer phenomena, equipment and application in dairy food industry.

Suggested Readings

Cheryan M. 1998. *Ultrafiltration and Microfiltration Handbook.* Technomic Publ.

Duckworth R. 1975. *Water Relations in Foods.* Academic Press. Robertson GL. 1992. *Food Packaging (Principles and Practices).* Marcel Dekker.

Rockland LB & George F Stewart. 1991. *Water Activity: Influence on Food Quality*. Academic Press.

Toledo RT. 1997. *Fundamentals of Food Process Engineering*. CBS Publ.

DE 522 BIO-THERMAL PROCESS ENGINEERING 3+0

Objective

To teach the students on biological processes associated with food and dairy industries.

Theory

UNIT I

Introduction to biochemical engineering: Biochemical kinetics, kinetics of substrate utilization, enzyme reaction, growth of microorganisms, fermentors, pasteurization and sterilization and thermal destruction.

UNIT II

Design and analysis of fermentation vessels: residence time distribution, reactors in food processing, reactor types, analysis of reactor systems.

UNIT III

Mixing in reactors: mixing equipments, power consumption, gas- liquid mixing, liquid -liquid dispersion, solids suspension and solid- liquid mass transfer. Scale up of mixers and alternative mixing devices.

UNIT IV

UHT systems and recent advances: factors affecting spoilage of food, Aseptic packaging systems and conditions.

UNIT V

Thermo-bacteriology: Survivor curve, thermal death curve, Arrheneous curve, techniques for determination of heat resistance of micro organisms, analysis of thermal resistance data, processing in containers, process time, lethality, design of batch and continuous sterilisation cycles in vat.

Suggested Readings

Bailey JE & Ollis DF. 1977. *Biochemical Engineering Fundamentals*. McGraw Hill.

Blanch HW & Clark DS. 1996. *Biochemical Engineering*. Marcel Dekker.

Das H. 2005. *Food Processing Operations Analysis*. Asian Books.

McNeil B & Harvey LM. 2007. *Fermentation: A Practical Approach*. Oxford Univ. Press.

Pauline MD. 2005. *Bioprocess Engineering Principles*. Academic Press.

Rudra Pratap. 2006. Getting Started with MATLAB 7. Oxford Univ. Press.

Stumbo. 1965. *Thermobacteriology in Food Processing*. Academic Press.

DE 524 ENVIROMENTAL ENGINEERING 2+0

Objective

To disseminate the knowledge pertaining to waste treatment in dairy and food processing plants.

Theory

UNIT 1

Waste water sources, characteristics, standards for disposal of dairy waste water.

UNIT II

Physical, chemical and biological characteristics of waste water, measurement of organic content in waste water.

UNIT III

Physical unit operations in waste water treatment: screening, racks, mixing, flocculation, sedimentation, floatation, elutriation, vacuum filtration & incineration.

UNIT IV

Chemical unit operations in waste water treatment: reaction kinetics, chemical precipitation, aeration and gas transfer process, rate of gas transfer, adsorption & disinfection.

UNIT V

Biological unit operations- aerobic and anaerobic cycles; kinetics of biological growth, application of kinetics to treatment systems, aerobic waste treatment, anaerobic waste treatment.

UNIT VI

Air conditioning systems: clean – room air conditioning; important pollutants of air; properties of particulate matter and air pollution control methods.

Suggested Readings

Conway R. & Ross RD. 1980. *Handbook of Industrial Waste Disposal*. Van Nostrand Reinhold.

Lewis & Athony. 1976. *Industrial Air Pollution Control Equipment for Particulate*. CRC Press.

Metcalf & Eddy. 2003. *Waste Water Engineering Treatment Disposal and Reuse*. Tata McGraw Hill.

Threkeld. 1970. *Thermal Environmental Engineering*. Prentice-Hall of India.

DE 525 INSTRUMENTATION AND PROCESS CONTROL 2+1

Objective

To impart basic knowledge on principles of measurements and process control, understanding the working and selection of instruments and devices for simple applications.

Theory

UNIT I

Instrument Terminology: Elements of generalized measurement system, static and dynamic characteristics of instruments.

UNIT II

Transducers: Electrical, mechanical, magnetic and optical transducers for measurement of process variables like temperature, pressure, flow, level, consistency, pH and humidity.

UNIT III

Indicating and Recording Devices: Digital indicators, strip and circular chart recorders.

UNIT IV

Principles of Automatic Process Control: Process characteristics, control system parameters, discontinuous, continuous and composite control modes. Final controlling elements, pneumatic and electric controllers.

UNIT V

Introduction to Computer Based Control: Computer based controller, data logging, supervisory control, flow chart, control system networks, basic structure and operation of programmable logic controllers (PLCs).

Practical

Study of various transducers for measurement of pressure, flow, level, humidity; temperature; study the controller and recorder of pasteurizer; the working of controllers in constant temperature water baths; to make ladder diagrams and flow sheet diagrams for control logics; to programme a PLC; computer interface of a PLC.

Suggested Readings

Eckman DP. 1972. *Automatic Process Control*. Wiley Eastern Pvt. Ltd. Johnson CD. 2006. *Process Control Instrumentation Technology*. Prentice-Hall of India.

Liplak BG. 1995. *Process Measurement and Analysis*. Butterworth- Heinman.

Sawhney AK & Sawhney P. 2007. *Electrical and Electronic Measurements and Instrumentation*. Dhanpat Rai & Sons.

DE 611 ADVANCES IN DAIRY PROCESS ENGINEERING 3+1

Objective

To learn process parameters estimations and designs of selected dairy equipment.

Theory

UNIT I

Evaporation: Classification, design of multiple-effect evaporator, temperature distribution, boiling point elevation, operation, feeding methods, condensate and air removal, scale formation and removal, heat and mass balance, vapor recompression.

UNIT II

Drying: Design data, performance and selection and design of dryer.

UNIT III

Mixing of materials: Factors in mixing, types, operation, mixing gas, liquid and solid, heat transfer in mixers, power requirement, transmission, scale-up of models.

UNIT IV

Material handling: System and devices, design of screw, belt, flight, apron conveyors, bucket elevators, power requirements, and applications, feeders and feeding mechanism.

Suggested Readings

Das H. 2005. *Food Processing Operations and Analysis*. Asian Books.

Fellows PJ. 1988. *Food Processing Technology, Principle & Practices*.

Ellis Horwood.

Toledo RT. 2007. *Fundamentals of Food Process Engineering*. Springer.

DE 612 ADVANCED HEAT TRANSFER 3+0

Objective

To develop analytical approach for heat transfer operation

Theory

UNIT I

Steady state one –dimensional problems, Bessel functions, composite structures, Principal of superposition, Heterogeneous solids. Power series solutions, Properties of Bessel functions. Extended surfaces. Approximate solutions for extended surfaces.

UNIT II

Steady state two and three- dimensional problems. Separation of Variables. Orthogonal functions. Boundary value problems. Characteristic value problems, Orthogonality of characteristics functions, Fourier series. Separation of variables; Steady two-dimensional spherical geometry; selection of coordinates, steady two-dimensional spherical geometry- Legendre polynomials. Steady three-dimensional geometry.

UNIT III

Unsteady problems- Separation pf Variables. Orthogonal functions. Distributed systems having stepwise disturbances. Use of one-dimensional chart. Time- dependent boundary conditions. Duhamel's superposition integral. Laplace transforms.

UNIT IV

Heat transfer in turbulent flow: turbulent flow, boundary layer, Prandtl analogy, temperature distribution in turbulent flow, empirical and practical correlation for convection heat transfer, heat transfer in packed beds.

Suggested Readings

Holman JP & Ganesan. 2002. *Heat Transfer*. Tata McGraw-Hill.

James. 1974. *Engineering Heat Transfer*. John Wiley & Sons.

Kaviany Massoud. 2002. *Principles of Heat Transfer*. John Wiley & Sons.

Kreith F & Bohn M. 1997. *Principles of Heat Transfer*. PWS Publ. Co.

DE 621 COMPUTATIONAL METHODS & SIMULATION IN DAIRY AND FOOD ENGINEERING 2+0

Objective

To develop competence in developing statistical/theoretical models.

Theory

UNIT I

Taylor's series expansion in development of numerical differentiation numerical differentiation procedures, forward difference, backward difference, central difference.

UNIT II

Numerical integration trapezoidal rule, Simpson's rule, improper integrals, Gauss-Legrendre Quadretuse method, numerical methods to solve ordinary differential equations.

UNIT III

Euler method, improved Guier method, Runge-Kutta method, Adam's P-c method, initial value problems, numerical solution of partial differential equation: explicit method, implicit method.

UNIT IV

Simulation concept, simulation methods and their limitations, statistical and theoretical models.

UNIT V

Problem formulation and development of models; solution and validation of models; data collection; processing and analysis; basic modeling problems on unit operations involved in dairy and food processing.

Suggested Readings

Franks & Roger GE.1972. *Modeling and Simulation in Chemical Engineering*. Willey-Interscience.

Kobayashi H. 1978. *Modeling and Analysis: An Introduction to System Performance Evaluation Methodology*. Addision-Wesley Publ.

Krishnamurthy EV & Sen SK. 1976. *Computer bases Numerical Algorithms*. Affiliated East-West Press.

Maisel H & Gougnoli G. 1972. *Simulation of Discrete Stochastic Systems*.

Science Research Assoc.

Reddy RN & Ziegler CA. 1992. *FORTRAN-77 with Applications for Scientists and Engineers*. Jaico.

DE 622 PHYSICO-CHEMICAL PROCESSES 3+0

Objective

To develop understanding with advanced processes, their operations and design

Theory

UNIT I

Adsorption process. Relationship between surface tension and adsorption, adsorption equilibria and adsorption isotherm. Sorption kinetics in continuous flow reactors, factors influencing adsorption.

UNIT II

Separation processes. Reverse osmosis. water and solute diffusion, nanofiltration, microfiltration,

membrane properties, concentration polarization, mathematical description of flow through a membrance, extractions, super critical fluid extraction.

UNIT III

Electrodialysis. Minimum energy requirements, selective iontransport, design of an electrodialysis system, ion-exchange process, exchange materials, kinetics of exchange, exchange isotherm, ion-selectivity.

UNIT IV

Aeration and gas transfer, gas transfer processes, rates of gas transfer, film transfer, liquid-phase transport.

Suggested Readings

Aiba SH, Arthur E & Mills N. 1973. *Bio-Chemical Engineering*. University Press.

Das H. 2005. *Food Processing Operations and Analysis*. Asian Books. Rao MA & Rizvi SSH. 1986. *Engineering Properties of Foods*. Marcel Dekker.

Pre-requisite Courses in Dairy Engineering for M. Tech. (DE) Students with B. Tech. (Dairy Technology) background

DE 411 DAIRY PLANT MAINTENANCE 2+1

Objective

To develop confidence with the students in handling maintenance issues of dairy/food plant

Theory

UNIT I

Introduction of course and its relevance, basic concepts of plant maintenance.

UNIT II

Elements of preventive maintenance program: Equipment data collection, reporting and recording, principles of lubrication, lubricants and preparation of lubrication schedule.

UNIT III

Maintenance organization, development of optimum organization.

UNIT IV

Planned overhaul and PERT planning, engineering and general stores, workshop facilities in relation to the size and types of dairy plants.

UNIT V

Care and maintenance of S.S. surfaces, and insulations, rubber and gasket materials, properties, grade and their selection.

Practical

Pipe fittings ,belt and chain conveyors, mechanical seals for milk pumps, method of determining plant performance ,calibration procedure and set-up for gauges, performance evaluation of HTST and associated components, upkeep of electric motors and starters, study of IBR, fire and explosives safety regulations ,study of IS, British SMS and DIN standards for dairy equipment, trouble shooting of few selected equipments, maintenance organization of experimental dairy. Estimation of the maintenance cost, PERT for overhauling – case study and with group discussion, various records, equipment date card, card file, log books of a dairy plant., specification writing for some select machines & their components .

Suggested Readings

Higgins L & Morrow LC. 1977. *Maintenance Engineering Hand-Book*.

McGraw Hill.

Keating FH. 1959. *Chromium-Nickel Austentic Steel*. Butterworths

Scientific Publ.

Newcomer JL. 1981. *Preventive Maintenance Manual for Dairy Industry*.

Venus Trading Co., Anand.

Stanier W. 1959. *Plant Engineering Hand-Book*. McGraw Hill.

DE 412 STRENGTH OF MATERIALS 2+0

Objective

To develop competence in stress analysis of machine parts.

Theory

UNIT I

Review of stresses in machine parts, temperature stresses, principal planes and stresses, Mohar's circle of stress.

UNIT II

Bending of beams, stress analysis in beams of two different materials, shear stresses in beams.

UNIT III

Strain energy in tension, compression, shear, bending and torsion. Impact loads on tension members, strength of biomaterials.

Suggested Readings

Bose BN. 1973. *Problems in Strength of Materials*. Bharti Bhawan, Patna. Divakaran S & Garg VK. 1969. *Strength of Materials*. Asia Publ. Junnarkar SB. 1964. *Key to Elements of Applied Mechanics*. Charaotar

Book Stall, Anand.

Morley A. 1924. *Strength of Materials*. Longmans.

Popov EP. 1978. *Mechanics of Materials*. Prentice- Hall of India.

DE 421 MACHINE TOOL ENGINEERING 2+1

Objective

To provide basic knowledge of construction and operation of various machine tools and metal cutting.

Theory

UNIT I

Principles of metal cutting: Geometry of single point cutting tools, drills and milling cutters, normal and effective rake, chip formation, shear plane and shear zone analysis. Cutting tool materials heating of tools and use of cutting fluids.

UNIT II

Types of grinding machines, grinding wheels, their selection, speed, and wheel materials, shaper and planer machines.

UNIT III

Types of lathe machines and lathe operations, Turret and Capstan lathes, lathe tools, types of milling machines, milling cutters, cutting speed, calculation of milling time.

UNIT IV

Types of drills and drilling machines, sawing machines, abrasive cutting, power hacksaw, speed and feed for drilling, shaping, milling and lathe operations.

Practical

Lathe operations such as facing, turning, taper turning and thread cutting, Use of radial drilling machine. Study the construction and operation of milling machine, plain milling on milling machine. Study the operation of a shaper and prepare a square job from a given round bar.

Suggested Readings

Chapman WAJ. 1972. *Workshop Technology*. Part-III. Edward Arnold. Gupta KN & Kaushish JP. 1978. *Workshop Technology (Theory and*

Practice). Vol. II. New Heights, New Delhi.

Raghuvanshi BS. 2003. *A Course in Workshop Technology*. Vol. II.

Dhanpat Rai & Sons, New Delhi.

Sen GC & Bhattacharya A. 1969. *Principles of Metal Cutting*. Central Book.

DE 422 UNIT OPERATIONS 2+0

Objective

To impart engineering knowledge of various unit operations related to agricultural and dairy processing.

Theory

UNIT I

Engineering properties of biological materials – Mechanical, electrical and thermal properties; aerodynamic characteristics and frictional properties; application of engineering properties in design and operation of processing equipment.

UNIT II

Handling of food products – Mechanics of bulk solids, selection of bulk handling equipment, operation and construction of conveyors and elevators.

UNIT III

Mechanical cleaning and sizing of food products – Size reduction, size characteristics, particle geometry, energy for size reduction of granular materials and dry powders, size- reduction equipment, performance characteristics of size reducers.

UNIT IV

Crystallization – Material and energy balance in crystallizers, principles of crystal growth, super saturation and nuclei formation, operation of batch and continuous crystallizers.

UNIT V

Distillation – Flash distillation of binary mixtures, differential distillation, steam distillation.

UNIT VI

Flow through porous media -- Absorption, extraction and extrusion operations.

Suggested Readings

Henderson SM & Perry ME. 1976. *Agricultural Process Engineering*.
AVI Publ.

McCabe WL & Smith JC. 1967. *Unit Operations in Chemical Engineering*.
McGraw Hill.

Spivakovsky A & Dyachkov V. 1966. *Conveyors & Related Equipments*.
Peace Publisher, Moscow.

DE 515 DAIRY PROCESS ENGINEERING 2+1

Objective

A pre-requisite course for engineers admitted to masters program in dairy engineering. To make up the basic knowledge of dairy plant and mechanics used in dairy industry.

Theory

UNIT I

Hygienic design concepts, sanitary pipes and fittings, CIP system, corrosion process and their control milking machine, bulk milk coolers, milk collecting center milk chilling units.

UNIT II

Milk reception equipments, milk tanks, stirrers and mixers, pasteurizers, sterilizers, centrifugation, homogenizer, packaging and filling machines.

UNIT III

Equipments for cheese, ice-cream, butter manufacture, special milk products, casein, whey, evaporators, dryers, cyclone separators, fluidized bed dryer.

UNIT IV

Ultra filtration and reverse osmosis, thermo compressor, MVR, drum dryers, tray dryers, butter churn.

UNIT V

Equipment for indigenous milk product manufacturing. Small capacity milk processing equipment, village level sterilization and ascetic packaging.

Practical

Identification of hygienic characteristics of pipes and fittings; technical specifications of milking and storage equipment, equipment for chilling & pasteurization; features of centrifuges; ice-cream freezers & packing machine; cheese vat; milking machine; press & packing machine; butter manufacturing equipment; different types of evaporators; different types of dryers, design of dairy plants; design of milk collecting and chilling unit.

Suggested Readings

Ahmad T. 1995. *Dairy Plant Engineering and Management*. Kitab Mahal, Allahabad.

Newcomer JL. 1981. *Preventive Maintenance Manual for Dairy Industry*. Venus Trading Co., Anand.

Kessler HG. 1981. *Food Engineering and Dairy Technology*. Verlag.

COMPULSORY NON CREDIT COURSES

(Compulsory for Master's programme in all disciplines; Optional for Ph.D. scholars)

COURSE NO.	COURSE TITLE	CREDITS	SEM
PGS 501	LIBRARY AND INFORMATION SERVICES	0+1	I, II
PGS 502	TECHNICAL WRITING AND COMMUNICATIONS SKILLS	0+1	I, II
PGS 503 (e-Course)	INTELLECTUAL PROPERTY AND ITS MANAGEMENT IN AGRICULTURE	1+0	I, II
PGS 505 (e-Course)	DISASTER MANAGEMENT	1+0	I, II

Contents

PGS 501 LIBRARY AND INFORMATION SERVICES 0+1 SEM - I, II

(To be taught by Faculty of Library Sciences)

Objective

To equip the library users with skills to trace information from libraries efficiently, to apprise them of information and knowledge resources, to carry out literature survey, to formulate information search strategies, and to use modern tools (Internet, OPAC, search engines etc.) of information search.

Practical

Introduction to library and its services; Role of libraries in education, research and technology transfer; Classification systems and organization of library; Sources of information- Primary Sources, Secondary Sources and Tertiary Sources; Intricacies of abstracting and indexing services (Science Citation Index, Biological Abstracts, Chemical Abstracts, CABI Abstracts, etc.); Tracing information from reference sources; Literature survey; Citation techniques/Preparation of bibliography; Use of CD-ROM Databases, Online Public Access Catalogue and other computerized library services; Use of Internet including search engines and its resources; e-resources access methods.

PGS 502 TECHNICALWRITINGANDCOMMUNICATIONS SKILLS 0+1 SEM - I, II

(To be taught by Faculty of English and Library Sciences)

Objective

To equip the students/scholars with skills to write dissertations, research papers, etc.

To equip the students/scholars with skills to communicate and articulate in English (verbal as well as writing).

Practical

Technical Writing - Various forms of scientific writings- theses, technical papers, reviews, manuals, etc; Various parts of thesis and research communications (title page, authorship contents page, preface, introduction, review of literature, material and methods, experimental results and discussion); Writing of abstracts, summaries, précis, citations etc.; commonly used abbreviations in the theses and research communications; illustrations, photographs and drawings with suitable captions; pagination, numbering of tables and illustrations; Writing of numbers and dates in scientific write-ups; Editing and proof-reading; Writing of a review article.

Communication Skills - Grammar (Tenses, parts of speech, clauses, punctuation marks); Error analysis (Common errors); Concord; Collocation; Phonetic symbols and transcription; Accentual

pattern: Weak forms in connected speech: Participation in group discussion: Facing an interview; presentation of scientific papers.

Suggested Readings

Chicago Manual of Style. 14th Ed. 1996. Prentice Hall of India.

Collins' Cobuild English Dictionary. 1995. Harper Collins.

Gordon HM & Walter JA. 1970. *Technical Writing*. 3rd Ed. Holt, Rinehart & Winston. Hornby AS. 2000. *Comp. Oxford Advanced Learner's Dictionary of Current English*. 6th Ed. Oxford University Press.

James HS. 1994. *Handbook for Technical Writing*. NTC Business Books.

Joseph G. 2000. *MLA Handbook for Writers of Research Papers*. 5th Ed. Affiliated East- West Press.

Mohan K. 2005. *Speaking English Effectively*. MacMillan India. Richard WS. 1969. *Technical Writing*. Barnes & Noble.

Robert C. (Ed.). 2005. *Spoken English: Flourish Your Language*. Abhishek.

Sethi J & Dhamija PV. 2004. *Course in Phonetics and Spoken English*. 2nd Ed. Prentice Hall of India.

Wren PC & Martin H. 2006. *High School English Grammar and Composition*. S. Chand & Co.

PGS 503 INTELLECTUALPROPERTYAND ITS (e-Course) MANAGEMENT IN AGRICULTURE **1+0 SEM - I, II**

(To be taught by IPR cell, DHRM)

Objective

The main objective of this course is to equip students and stakeholders with knowledge of intellectual property rights (IPR) related protection systems, their significance and use of IPR as a tool for wealth and value creation in a knowledge-based economy.

Theory

Historical perspectives and need for the introduction of Intellectual Property Right regime; TRIPs and various provisions in TRIPS Agreement; Intellectual Property and Intellectual Property Rights (IPR), benefits of securing IPRs; Indian Legislations for the protection of various types of Intellectual Properties; Fundamentals of patents, copyrights, geographical indications, designs and layout, trade secrets and traditional knowledge, trademarks, protection of plant varieties and farmers' rights and bio-diversity protection; Protectable subject matters, protection in biotechnology, protection of other biological materials, ownership and period of protection; National Biodiversity protection initiatives; Convention on Biological Diversity; International Treaty on Plant Genetic Resources for Food and Agriculture; Licensing of technologies, Material transfer agreements, Research collaboration Agreement, License Agreement.

Suggested Readings

Erbisch FH & Maredia K.1998. *Intellectual Property Rights in Agricultural Biotechnology*. CABI.

Ganguli P. 2001. *Intellectual Property Rights: Unleashing Knowledge Economy*. McGraw-Hill.

Intellectual Property Rights: Key to New Wealth Generation. 2001. NRDC & Aesthetic Technologies.

Ministry of Agriculture, Government of India. 2004. *State of Indian Farmer*. Vol. V.

Technology Generation and IPR Issues. Academic Foundation.

Rothschild M & Scott N. (Ed.). 2003. *Intellectual Property Rights in Animal Breeding and Genetics*. CABI.

Saha R. (Ed.). 2006. *Intellectual Property Rights in NAM and Other Developing Countries: A Compendium on Law and Policies*. Daya Publ. House.

The Indian Acts - Patents Act, 1970 and amendments; Design Act, 2000; Trademarks Act, 1999; The Copyright Act, 1957 and amendments; Layout Design Act, 2000; PPV and FR Act 2001, and Rules 2003; National Biological Diversity Act, 2003.

PGS 505 DISASTER MANAGEMENT 1+0 SEM - I, II

(e-Course) (Nodal Teaching Department – Agricultural Meteorology)

Objectives

To introduce learners to the key concepts and practices of natural disaster management; to equip them to conduct thorough assessment of hazards, and risks vulnerability; and capacity building.

Theory

UNIT I: Natural Disasters- Meaning and nature of natural disasters, their types and effects. Floods, Drought, Cyclone, Earthquakes, Landslides, Avalanches, Volcanic eruptions, Heat and cold Waves, Climatic Change: Global warming, Sea Level rise, Ozone Depletion.

UNIT II: Man Made Disasters- Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire. Oil fire, air pollution, water pollution, deforestation, Industrial wastewater pollution, road accidents, rail accidents, air accidents, sea accidents. UNIT III: Disaster Management- Efforts to mitigate natural disasters at national and global levels. International Strategy for Disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, Community-based organizations, and media. Central, State, District and local Administration; Armed forces in Disaster response; Disaster response: Police and other organizations.

Suggested Readings

Gupta HK. 2003. *Disaster Management*. Indian National Science Academy. Orient Blackswan.

Hodgkinson PE & Stewart M. 1991. *Coping with Catastrophe: A Handbook of Disaster Management*. Routledge.

Sharma VK. 2001. *Disaster Management*. National Centre for Disaster Management, India.

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