

15. ANIMAL BIOCHEMISTRY

Unit 1:

Scope of Biochemistry and molecular biology in animal sciences. Structural and functional organization of prokaryotic and eukaryotic cells, viruses and bacteriophages. Compartmentalization of metabolic processes within the cell and fractionation of subcellular components. Structure and functions of biomembranes with special reference to active transport of ions and metabolites. Extra and intracellular communication. General description of cell culture, hybridoma and animal cloning techniques.

Unit 2:

Structure and properties of biologically important carbohydrates including storage and structural polysaccharides, mucopolysaccharides, blood group substances, peptidoglycans and bacterial polysaccharides. Structure and properties of fatty acids, acyl glycerol, glycerophospholipids, sphingolipids, glycolipids, sulfolipids, aminolipids, sterols, bile acids and prostaglandins. Basic principles of isolation, estimation and analysis of carbohydrates and lipids.

Unit 3:

Amino acids, structure and properties. Primary, secondary, tertiary and quaternary structure of proteins. Glycoproteins, lipoproteins, nucleoproteins, fibrous and globular proteins. Structure and functions of immunoglobulins, myoglobin and hemoglobin. Physical and chemical properties of proteins. Structure of different types of nucleic acids. Acid base properties, sedimentation behaviour, hyperchromic effect, base sequencing and restriction analysis of DNA. Computer applications in molecular biology, primer designing, sequence analysis and phylogenetic analysis.

Unit 4:

Major classes of enzymes, general properties, kinetics and mechanism of their action. Activation energy and transition state. Coenzymes and cofactors. Regulation of enzyme activity and enzyme inhibition. Isoenzymes and enzymes of clinical significance. Applications and scope of enzymes in bioprocess technology and genetic engineering.

Unit 5:

Bioenergetics, biological oxidation, respiratory chain and oxidative phosphorylation. Citric acid cycle and ATP generation. Glycolysis, pentose phosphate pathway and glycogenesis. Biosynthesis and oxidation of fatty acids. Volatile fatty acids as source of energy in ruminants. Ketogenesis and cause of ketosis in ruminants. Biosynthesis of sterols and phospholipids. Catabolism of amino acids, transamination and deamination, urea cycle. Intergration of carbohydrate, lipid and amino acid metabolism. Conversion of amino acids into other bioactive compounds. Biosynthesis of nutritionally non-essential amino acids. Metabolism of purines and pyrimidines. Disorders of lipid, carbohydrate, nucleic acid and amino acid metabolism. Inborn errors of metabolism and scope of gene therapy in combating genetic disorders.

Unit 6:

Mechanism of storage, transmission and expression of genetic information. DNA replication and control of gene expression in prokaryotes and eukaryotes. RNA synthesis and factors regulating transcription. Biosynthesis of proteins. Features of genetic code in prokaryotes and eukaryotes. Wobble hypothesis, post-translational

modification, degeneracy and regulation of translation. Basic principles of recombinant DNA technology and its scope in animal health and production. Recombinant proteins and vaccines, safety, ethical issues and IPRs in molecular biology.

Unit 7:

Structure and metabolic functions of water soluble and lipid soluble vitamins. Trace elements and their role in biological processes. Deficiencies and nutritional significance of vitamins and trace elements in domestic animals and poultry, nutraceuticals & probiotics. General description of nature of hormones, receptors and mechanisms of their action. Metabolic function of different hormones and associated disorders due to hypo or hyper secretions of major endocrine glands viz. pituitary, thyroid, adrenal, pancreas and gonads.

Unit 8:

Blood composition and biochemical constituents of erythrocytes, leucocytes and platelets. Important plasma proteins and their functions. Haemoglobin in oxygen and carbon dioxide transport. Role of kidneys in acid base balance. Composition and metabolism of muscle, connective, tissue, cartilage, bone, nervous, tissue, adipose tissue and mammary tissue. Clinical significance of iron, iodine calcium and phosphorus metabolism in domestic animals and poultry. Biochemical tests for hepatic and renal functions. Urine composition and analysis.

Unit 9:

Basic principles and use of latest photometric, chromatographic, electrophoretic and radioisotopic methods of biochemical analysis. Methods of isolation, purification and characterization of proteins, DNA and RNA. Basic principles of RIA, ELISA, PCR, RFLP and DNA fingerprinting NA probes, vectors, microarray, imaging, applications of nanotechnology, proteomics. Determination of enzymes, hormones, vitamins and other biochemical constituents with special reference to disease diagnosis in domestic animals.

Unit 10:

Environmental pollution in relation to animal health and production. Biotechnology in pollution control. Biochemical basis of pollutant tolerance, host defence mechanisms including antigenic and non-antigenic interactions. Free radicals, carcinogenesis and role of liver and kidneys in detoxification. Oncogenes and mechanism of immunosuppression in cancer therapy and organ transplantation.

16. ANIMAL BIOTECHNOLOGY

Unit 1: Cell Biology

Prokaryotic and eukaryotic cell architecture. Molecular organization and functions of cell membrane. Organisation and functions of the cytoplasm, cell organelles, endoplasmic reticulum, ribosomes, golgi complex, mitochondria, lysosomes, nucleus, nucleolus and subnuclear structures. Protein secretion and targeting. Intracellular digestion. Oxidative phosphorylation. Cell division, cell cycle, Cell growth and differentiation. Control of cell proliferation and self regulation. Cell motility. Cell trafficking and signaling. Apoptosis and molecular pathways.

Unit 2: Molecular Biology

Structure and chemical composition of nucleic acids. DNA replication in prokaryotic and eukaryotic cells. Genome organization. Structure and functions of DNA polymerases. Molecular mechanisms of DNA repair. Synthesis and processing of different types of RNA. RNA polymerases. Protein biosynthesis.

Genetics of mitochondria and plasmids. Transposons and intervening sequences. Minisatellites and microsatellites. Molecular mechanism of spontaneous and induced mutations.

Recombination in bacteria, viruses and fungi. Molecular mechanism of genetic recombination, transduction, transformation and conjugation.

Unit 3: Gene Structure and Regulation of Gene Expression

Organisation of prokaryotic and eukaryotic genome. Repeated and non-repeated DNA sequences. Structure and function of gene.

Expression of genetic information, transcription – mechanism of transcription in prokaryotes and eukaryotes, transcription unit, regulatory sequences and enhancers, transcription factors, post-transcriptional modifications. DNA-protein and protein-protein interactions.

Genetic code. Overlapping genes. Mechanism of translation and its control, post-translational modifications. Control of gene expression in prokaryotes and eukaryotes. Gene mining.

Unit 4: Genetic Engineering and Recombinant DNA Technology

Isolation and purification of DNA and RNA from prokaryotes and eukaryotes. Reverse transcription and cDNA synthesis. Restriction endonucleases, DNA and RNA modifying enzymes. Generation of DNA fragments, Cloning and expression vectors- plasmids, cosmids, phages, phagemid, shuttle vectors, BAC, YAC, MAC. Eukaryotic vectors-viral vectors (vaccinia, retro, adeno, baculo) and yeast expression system.

Cloning and expression in prokaryotic and eukaryotic hosts. DNA libraries (genomic and cDNA). Screening and characterization of DNA clones. Transformation of bacterial cells. Transfection in animal cells.

In situ mutagenesis. Site directed mutagenesis. Antibody engineering. Production of diagnostics, therapeutics and vaccines using r-DNA technology. Nano-delivery system. Genetically modified animal/fish. Genetic manipulation of gut microbes. Single cell protein. Reverse genetics. RNA interference (RNAi, siRNA, peptide nucleic acid). Gene silencing.

Genetically modified microbes for environment improvement, bioremediation, fermentation.

Safety aspects and regulations associated with recombinant DNA technology. Ethical issues related to use of biotechnology products. Patenting and Intellectual Property Rights.

Unit 5: Cell culture and Hybridoma Technology

Development and applications of cell and organ culture techniques. Nutrient requirements for cells of animal and fish origin. Media for culturing cells. Growth supplements. Primary cultures and established cell lines. Stationary, roller and suspension culture techniques. Large-scale production of cells using bioreactors, microcarriers and perfusion techniques.

Characterization and maintenance of cells, karyotyping, cryopreservation and revival. Detection of contaminants in cell cultures. Cell viability and cytotoxicity assays. Isolation and culture of lymphocytes.

Micro-manipulation of cells. Cell fusion, somatic cell hybrids, sub-cloning of cells. Principles and methods of hybridoma technology. Production and characterization of monoclonal antibodies and their applications.

Unit 6: Reproductive Biotechnology and Related Techniques

Superovulation. Embryo collection and evaluation. Embryo splitting, sexing, transfer and their applications. Semen sexing.

Cryopreservation of gamete and embryos. Synthetic hormones for induced breeding in fishes. Androgenesis, gynogenesis, triploidy and polyploidy in fishes.

artificial
In vitro fertilization. Embryo cloning. Nuclear transplantation. Transgenic technology. Production of transgenic animals/fish and gene farming. Gene knockout techniques. Identification and transfer of genes influencing production and disease resistance. Stem cells and their applications in animal and fish health and production.

Unit 7: Molecular Biology Techniques

Quantitation of protein and nucleic acids. Gel electrophoretic techniques. Isolation of plasmids. Molecular cloning. Nucleic acid probes. GFP from jelly fish and its applications. Nucleic acid hybridization including *in situ* hybridization and FISH techniques. Autoradiography. Blotting techniques. Nucleic acid sequencing methods including next generation sequencing (NGS). Protein purification methods. RFLP, RAPD and AFLP. DNA fingerprinting. Single Nucleotide Polymorphism (SNP). Polymerase Chain Reaction (PCR) and Real-time PCR. Microarray techniques. Biosensors. Bioinformatics in biotechnology (protein and nucleic acid data banks, sequence alignment, sequence editing, phylogenetic tree analysis using *in silico* tools).

17. ANIMAL GENETICS AND BREEDING

Unit 1 : Overview of Genetics

History and development of genetics. Classic researches and pioneer scientists in genetics. Mendalism and its deviations. Chromosomes and heredity. Sex in relation to chromosomes and genes. Linkage and crossing over. Artificial transmutation of genes. Penetrance and expressivity. Multiple factor inheritance. Gene modifiers. Non-chromosomal genes and their inheritance, Chromosomal aberrations. Mosaicism and chimerism.

Unit 2 : Advanced Genetics

Fine structure of chromosomes and chromosomal banding. Gene and mechanism of gene action. DNA replication. Central dogma. Protein synthesis. Genetic code and DNA cloning. Recombinant DNA technology. PCR. Gene banks. Split gene. Genetic control of hormone coordination, metabolism and metabolic diseases. Use of biotechnological tools in improving animal productivity. Application of immunogenetics. Biochemical polymorphism. Chromosomal studies in livestock improvement programmes. Development of clones in relation to animal productivity and maintaining biodiversity. Production of transgenic animals. Gene mixing for useful functions.

Unit 3 : Overview of Breeding

Brief history of domestication of livestock. Important breeds of livestock & poultry with special reference to economic characters. Evolution of genetic systems. Isolating mechanisms and origin of species / sub-species, their adaptation. Mating systems for different livestock and poultry. Genetic and phenotypic consequences and applications of inbreeding and out-breeding. Genetic basis of heterosis and its use. Diallele and polyallele crossing. Reciprocal and reciprocal-recurrent-selection. Combining ability. Developments in population and production of livestock and poultry in India. Status of Animal Genetic Resources in India.

Unit 4 : Genetic Properties of Population

Population Vs individual. Inheritance and continuity of population. Effective population size. Biodiversity. Description of animal population. Value and means; Average effect of gene and gene substitution. Components of total phenotypic variance of a population. Resemblances between relatives. Concept of heritability, repeatability; & phenotypic, genetic and environmental correlations. Methods of estimation, uses, possible biases and precision of estimates.

Unit 5 : Population Genetics

Gene and genotypic frequencies and factors affecting them. Hardy Weinberg Law and consequences of it. Prediction of selection response by different methods. Selection for threshold characters. Indirect selection and correlated response. Theoretical basis of change of population mean and variance on inbreeding and cross breeding. Genotype – environment interaction. Metric characters under natural selection. Quantitative trait loci and their applications. Marker-assisted selection.

Unit 6 : Genetic Strategies

Purpose-wise breeding strategies for livestock and poultry under different agro-climatic zones of India. Evaluation of past genetic improvement programmes for livestock and poultry in India. Bottlenecks in implementation of livestock breeding programmes in India. Evaluation and characterization of various indigenous breeds of livestock and poultry. *Ex-situ* and *In-situ* conservation of animal and poultry genetic resources. Development of new breeds / strains for better productivity in animals. Open nucleus breeding system in livestock improvement in India. Bio-technology and its role in improving animals and poultry production. Role of artificial insemination / frozen semen / embryo transfer / ONBS / MOET technology in animal breeding.

Formulation of breeding programmes : Purpose-wise, breed-wise, region-wise for different species of livestock and poultry. Programmes for genetic improvement of non-descript livestock population of different species. Evaluation and current recommendations of cross breeding programmes of cattle, sheep and goat in India.

Unit 7 : Selection & Selection Experiments

Basis and methods of selection. Construction of selection indices. Different methods of sire evaluation. Selection differential and intensity of selection. Prediction of response. Improvement of response. Effect of selection on variance. Realised heritability. Long-term and short-term objectives of selections. Selection experiments in livestock and poultry. Role of control population in selection experiments. Selection for disease resistance and development of general and specific disease resistant strains / breeds. Purpose based selection and breeding of domestic animals and poultry. Genetic-slippage. Estimation of genetic divergence and its implications in livestock improvement programmes. Selection for better feed conversion efficiency in meat animals and poultry.

Unit 8 : Genetic Laboratory Techniques

Culturing *Drosophila* stock. Study of *Drosophila* with markers. Gene sequencing. Blood group typing. Karyotyping and chromosomal mapping. Concept of recombinant DNA techniques cloning and gene mapping. Nucleic acid hybridization. Development of breed descriptors at molecular level for different livestock and poultry breeds. Biochemical polymorphism analyses – blood groups, transferrins, milk proteins. Collection and storage of samples for DNA fingerprinting; isolation and quantification of DNA from blood and semen; Restricted enzyme digestion of genome DNA, Analysis and transfer of DNA from agarose electrophoresis; Nucleic acid hybridization; Analysis of DNA fingerprinting, PCR-RFLP assay. Cryogenic preservation of animal germplasm.

Unit 9 : Research Techniques for Quantitative Animal Genetics

Use of computers in handling animal breeding data. Estimation of variances and covariances. Development of statistical models for analyses of breed data and to quantify environmental variance. Estimation of inbreeding and relationship. Estimation of inbreeding rate in a closed herd / flock. Estimation and interpretation of genetic and phenotypic parameters. Development of efficient selection programmes and procedures. Estimation of genetic gains. Designing and evaluation of breeding strategies like reciprocal recurrent selection, diallele and polyallele crossing. Designing field based progeny testing programmes. Development of efficient methods and traits for genetic evaluation of males under indigenous conditions. Data bank concept.

Unit 10 : Laboratory Animal Breeding

Laboratory animal species *viz* mice, rat, guinea pig, rabbit, dog and monkey – Their chromosome numbers – genome size – major genes. Physiological, nutritional, reproduction parameters, maintenance protocol – pedigree recording, planned mating. Selection and Mating methods /systems- monogamous, polygamous and others. Genetic control and monitoring-Record keeping-Ethics and legislation for management and use of laboratory animals. Nomenclature for different strains, inbred lines (SPF line, Knockout mice, etc.) – Animal model for human disease. Specific utility of different laboratory species for different requirements.

18. ANIMAL NUTRITION

Unit 1: Energy and Proteins: Nutritional significance of carbohydrates, lipids and proteins. Cell-wall fractionation. Available energy from organic nutrients. Partitioning of dietary energy. Basal metabolic rate. Energy retention. Factors affecting energy utilization. Direct and indirect calorimetry. Dietary lipids - their digestion, absorption and metabolism. Essential fatty acids. Effect of dietary fat on milk and body composition. Proteins - digestion, absorption and utilization. Comparative efficiency of amino acids as energy source. Essential and critical amino acids. Protein evaluation. Metabolizable protein concept. Protein energy inter-relationship. Energetic of protein utilization for maintenance and different productive functions.

Unit 2: Minerals, Vitamins and Feed Additives Minerals: Classification of minerals, Physiological functions, Deficiency symptoms and toxicity - Inter-relationships - Synergism and antagonism - Requirements - Different sources and bio-availability - Role of chelated minerals. Vitamins: Physiological functions and co-enzyme role - Deficiency symptoms, hyper-avitaminosis. Requirements, Sources and vitamin analogues - Antivitamins - Feed Additives: Nutritional role. Prebiotics - Probiotics, phytochemicals other metabolic modifiers. Role of phyto-chemicals as growth promoters.

Unit 3: Rumen eco-system and functions Rumen and its environment. Development of functional rumen. Digestion kinetics in reticulo-rumen. Role of rumen microbes, Significance of rumen fungi- Defaunation and transfaunation. Microbial fermentation in rumen. VFA production, inter-conversion and utilization. Dietary protein breakdown. Microbial protein synthesis. NPN compounds and their utilization. Ammonia toxicity - Role of slow release urea compounds. Manipulation of rumen fermentation. Bio-hydrogenation and utilization of dietary lipids. Methanogenesis and methane inhibitors.

Unit 4: Non-ruminant Nutrition Comparative gastrointestinal physiology of monogastrics - digestion and metabolism of organic nutrients in poultry and swine. Significance of minerals and vitamins in mono-gastrics. Inter relationship in nutrient sparing activity. Feeding systems. Role of feed additives - Factors affecting nutritional quality and performance. Special nutritional needs of rabbits, horses and companion animals.

Unit 5: Nutrient Requirements Energy protein requirements for maintenance and productivity in ruminants and non-ruminants. Colostrum feeding of calf, mineral and vitamin requirements. Dry matter intake in relation to productivity. DM: water intake ratio. Palatability. Nutritional intake and energy density. Feeding standards - NRC, ARC, Kearn and Indian. Nutrient requirements under temperate and tropical environment. Feeding strategies during stress and natural calamities - Ration formulation - least cost rations.

Unit 6: Forage Conservation and Evaluation Natural and cultivated forages-Their composition and nutritive values. Nutritive value Index. Forage quality evaluation in range animals -Role of indicator methods-Advances in silage and haymaking- Factors affecting quality of conserved forages- Quality criteria and grading of silage and hay under tropics-artificial drying of forages.

Unit 7: Feed Processing and Technology Methods of feed processing - physical, chemical and biological effect of processing on nutritional quality and utilization. Pelleted and extruded feeds. Quality control of raw feedstuffs and finished feeds: Significance of BIS (standards). Handling and storage of raw and finished feeds. Methods to improve shelf life of fat rich feeds, By-products of newly introduced commercial crops including residues of genetically modified feeds. Alternative feed resources. Current approaches in enriching tropical feed resources - concept of total mixed ration and advances in complete diet formulation.

Unit 8: Anti-metabolites and Toxic Principles Naturally occurring anti-nutritional factors and common toxins in feeds and forages. Methods of detoxification. Health hazards due to residual pesticides in feeds and forages - Environmental pollutants.

Unit 9: Elements of Research Methodology Principles of animal experimentation - Experimental designs in nutritional research. Modern methods of feed evaluation - *In vitro*, gas production and nylon bag techniques, Rumen simulation techniques - Rusitec Tracer techniques in nutrition research - Role of NIR Spectroscopy - Feed microscopy in quality evaluation of feedstuffs.

Unit 10: Clinical Nutrition

Role of nutrition to control digestive and metabolic disorders (milk fever, ketosis, ruminal acidosis-laminitis, bloat), metabolic profile tests. Role of nutrition in immunity, nutrition and reproduction, nutrients as antioxidants. Role of nutrition in management of GI parasites.

19. ANIMAL PHYSIOLOGY

Unit 1: Cellular Basis of Animal Physiology

Animal cell ultra-structure, composition and functions. Physio-chemical laws and membrane phenomena. Body fluid and its dynamics. Transport of through biological membrane.

Unit 2: Blood and Circulation

Composition of blood, structure & functioning of its constituents. Blood coagulation and anti coagulants. Hemoglobin and its polymorphism. Anaemias. Sreticule-endothelial System. Body defense mechanism and immunogenesis.

Electrophysiology of heart. Electro-cardiography – Principles and interpretation. Hemodynamics and concerned biophysical principals. Capillary fluid exchange and lymphatic circulation. Neural and humoral control of heart and blood vessels. Cardiac Output and vascular reflexes. Autoregulation mechanism in the heart Regional circulation – coronary, pulmonary, cerebral, muscle, kidney and skin, blood brain barrier. Circulatory shock and hypertension and cardiac failure.

Unit 3: Respiration

Mechanics of respiration. Neural and chemical control of respiration. Gaseous transport and exchange. Hypoxia. Physiology of hypo-barrism and high altitude. Work and exercise physiology. Respiration in birds.

Unit 4: Excretion

Modern concepts of urine formation. Control of renal circulation. Secretion and absorption in renal tubules. Regulation of acid-base balance by blood buffers, lungs and kidneys. Hormonal and renal regulation of body fluids and electrolyte balance. Physiology of micturition. Uremia and other renal disorders. Renal functions in birds.

Unit 5: Digestion

Control of motility and secretion of alimentary canal. Gastric hormones and reflexes in the control of digestive functions. Control of rumen motility. Digestion in ruminant and monogastric animals. Absorption from rumen and the digestive tract. Manipulation of rumen microflora to enhance fibre digestion and microbial protein synthesis. Nitrogen recycling and rumen bypass mechanisms. Post-ruminal digestion. Physiology of rumen disorders. Avian digestion (different features).

Unit 6: Muscle Physiology

Muscle types and their intra-cellular contractile mechanisms. Electrophysiology of muscles. Neuromuscular junction. Excitation contraction coupling, its biochemical and ionic mechanisms. Molecular basis of muscle contraction. Rigor mortis.

Unit 7: Nervous System

General organization of nervous system. Neurone structure and fuction. Excitability and transmission of impulse in neuron and muscle. Junctional transmission. Neuro-transmitters. Reflex action. Initiation of impulses from sense organ / receptors. Functions of spinal cord, brain stem and cerebellum. Limbic system and cerebral cortex. Hypothalamus and its autonomic functions in endocrine and visceral regulation. Ascending and descending tracts. Cerebral cortex, its role in motor and sensory functions. Physiology of learning and memory. Physiology of pain. Special senses (hearing, vision, taste, smell etc.).

Unit 8: Endocrinology

Hormones. Hormone receptors. Mechanism of hormone action at cellular and sub-cellular levels. Feedback control of hormone secretion. Hypothalamic – hypophyseal axis. It should include (i) Hypothalamic – hypophyseal axis controlling secretions from thyroid, parathyroid, adrenal and gonads, (ii) Endocrine control of general metabolism. Releasing and inhibiting factors.

Pineal gland and its hormones. Hormones of hypophysis and all other endocrine glands. Mechanisms of different hormone actions. Endocrine disorders.

Unit 9: Reproduction

Gonadal hormones and their functions in male and female. Neuro-endocrine-gonadal axis and feedback regulation. Male spermatogenesis. Accessory sex glands. Sexual behaviour erection, ejaculation etc. Semen evaluation. Factors affecting reproduction. Artificial insemination – collection, preservation and transport and semen diluents. Freezing of semen. Oogenesis. Follicular development. Ovulation. Corpus luteum. Reproductive cycles in animals. Factors affecting reproductive cycles. Female reproductive hormones. Oestrous synchronization, super-ovulation. Sperm capacitation and acrosomal reaction. Sperm and ovum transport in female genital tract. Fertilization. Implantation. Maternal recognition of pregnancy, Maintenance of pregnancy and its hormonal control. Physiology of placenta. Physiology of parturition and its hormonal control. Embryo transfer – collection, preservation, transport and transfer of embryos. Oocytoculture. In vitro fertilization. Mammary gland growth before puberty, during pregnancy and after parturition and its hormonal control. Lactation-Hormonal control of lactation and milk let-down. Maintenance and cessation of lactation. Mammary gland involution. Milk precursors and synthesis of milk constituents. Methods of studying mammary uptake of nutrients, Ultrastructure of lactating mammary gland. Milk composition in different animals. Avian reproduction-ovulation, egg formation, oviposition and their hormonal control. Spermatogenesis and semen composition.

Unit 10: Physiology of Growth

Concept and definition. Growth regulation and factors affecting prenatal and post-natal growth. Role of growth in production. Growth curve and growth measurement, body confirmation and evaluation of carcass quality.

Unit 11: Climate Physiology

Physiology of climate stress. Effects of stress on production and reproduction. Neural and hormonal regulation of body temperature in homeotherms. Mechanism of adaptation. Photoperiodicity and biological rhythms. Design of shelters / animal houses for different class of livestock for different climate conditions.

Unit 12: Behavioral Physiology

Different types of behaviour in animals like feeding, grazing, drinking and thermoregulatory behaviour, neuro-endocrine control of behaviour in livestock.

20. ANIMAL REPRODUCTION AND GYNAECOLOGY

Unit 1: Veterinary Gynaecology

Biology of sex. Development of female genitalia. Functional anatomy of female reproductive system of farm animals. Growth, puberty and sexual maturity. Reproductive cycles (oestrous cycle) in female farm animals. Oogenesis and folliculogenesis. Follicular dynamics and ovulation. Transport and survival of gametes, fertilization, cleavage, implantation and maternal recognition of pregnancy. Development of foetus and foetal membranes. Placenta- classification and functions. Gestation and pregnancy diagnosis in farm animals.

Unit 2 : Reproductive Endocrinology

Reproductive hormones, classification, synthesis, chemical composition and mechanism of action. Hypothalamus, pituitary, thyroid, gonadotropic, gonadal, placental and pineal gland hormones. Prostaglandins, pheromones, growth factors and hormone antagonists and their significance in animal reproduction. Hormonal assays. Hormonal regulation of male and female reproduction. Clinical uses of hormones.

Unit 3 : Accidents during Gestation

Pregnancy, Pseudocyesis, Ectopic pregnancy, Abnormalities of fertilization and foetal development, Superfecundation and superfetation. Abortion – bacterial, viral, mycotic, protozoal, physical, toxic and miscellaneous causes, diagnosis and prevention, Dropsy of foetal membrane and foetus, Maceration, mummification, Pyometra, Antepartum vagino-cervical prolapse, Uterine torsion and displacement of uterus.

Unit 4 : Veterinary Obstetrics

Pelvis and pelvimetry. Parturition – Signs approaching parturition, initiation and stages of parturition, induction of parturition and postpartum period. Presentation, position and posture. Causes and forms of dystocia and its treatment. Epidural anaesthesia. Obstetrical maneuvers including fetotomy and Caesarean section. Post-partum complications in domestic animals, retention of placenta, uterine prolapse, endometritis, metritis, septic metritis. Post parturient metabolic disorders.

Unit 5 : Andrology

Comparative anatomy of male reproductive system. Thermoregulation of testis and blood testis barrier, Growth, puberty and sexual maturity. Spermatogenesis including cycle of somniferous epithelium and spermatogenic wave. Sperm morphology and ultra-structure of spermatozoa, sperm transport, maturation and storage in male genital tract, Secretions of male reproductive tract including accessory glands and their role in reproduction, Sexual / mating behaviour. Semen and its composition, biochemistry of semen and sperm metabolism, sperm abnormalities and its classification, sperm separation and spermatozoa karyotyping.

Unit 6 : Male Infertility

Fertility, infertility and sterility in male domestic animals. Causes and forms of male infertility. Testicular hypoplasia, cryptorchid, testicular degeneration, orchitis, affections of epididymis, vas deference, penis, prepuce and accessory glands & their management, tumors of the male reproductive tract, nutritional infertility, Vices in the males.

Evaluation of male for breeding soundness, reproductive health status. Effect of parental drugs and vaccines on semen quality.

Unit 7 : Frozen Semen Technology and Artificial Insemination

History and development of artificial insemination. Advantages and disadvantages of AI and frozen semen, selection of bulls for AI purpose. Management of breeding bulls, methods of semen collection in different domestic animals, semen evaluation including latest techniques for evaluation of motility and fertilization.

Ideal extenders, extenders for liquid semen. Preservation of semen at various temperatures. Processing and preservation of liquid semen. Extenders for frozen semen, principles and techniques of semen freezing. Cold shock and ultra-low temperature shock. Cryoprotectants. Semen additives. Evaluation of frozen semen. Transport and storage semen. Handling of frozen semen, Liquid nitrogen and its containers. Insemination techniques. Planning and organization of semen bank.

Unit 8 : Reproductive Technology

Synchronization of oestrous cycle in domestic animals, control of ovulation. Embryo transfer technology – History, advantages and disadvantages, superovulation, collection, evaluation, preservation and transfer of oocytes / embryos.

History of *in vitro* maturation and fertilization. Recovery of oocytes *in vitro* and *in vivo*, maturation, fertilization, culture, evaluation, preservation and transfer of oocytes / embryos. Micromanipulation of embryos. Embryo splitting and cloning. Stem cells and production of transgenic animals. Sex determination and gene insertion. Establishment of laboratory for ETT, IVM, IVF and IVC.

Use of Ultrasonography, laparoscopy and ovum-pick technology in farm animals.

Unit 9 : Infertility in Cows and Buffaloes

Fertility, infertility and sterility. Evaluation of herd fertility. Incidence and economic role of infertility, forms of infertility, congenital and hereditary defects, infectious diseases. Pathological conditions of ovary, oviduct, uterus, cervix and vulva. Management causes of infertility. Hormonal causes of infertility, anestrus, repeat breeding, cystic ovarian degeneration, sexual health control and reproductive health programmes. Breeding soundness examination of cows and buffaloes.

Unit 10 : Reproduction and Infertility in Ovine / Caprine

Puberty, sexual maturity, breeding season, oestrous cycle, Breeding and conception, gestation, parturition, peri-parturient and obstetrical complications. Synchronization of oestrous cycle. Embryo transfer. Causes of infertility and their management.

Unit 11 : Reproduction and Infertility in Swine

Estrous cycle, synchronization of oestrous cycle, Hormonal control of reproduction. Various forms of infertility in swine and their management. Various obstetrical problems and their management.

Unit 12 : Equine Reproduction

Physiology and pathology of equine reproduction. Research techniques and methodology for the study of equine reproduction. Equine andrology. Reproductive behaviour and management of stallion. Semen collection, examination and artificial insemination. Pregnant mare behaviour . Application of modern reproductive techniques in equine reproduction. Equine infertility.

Unit 13 : Canine and Feline Reproduction

Functional anatomy of dog and cat reproductive system, oestrous cycle and endocrinology of oestrous cycle and detection of optimum breeding time. Exfoliative vaginal cytology. Methods of pregnancy diagnosis, contraception. Medical termination of pregnancy. Infertility in bitches, disorders of oestrous cycle, pseudopregnancy, pyometra, cystic endometrial hyperplasia, tumors of reproductive tract. Difficult

whelping – types and methods of handling dystocia. Caesarean section. Ovarian hysterectomy. Peri-parturient complications. Semen collection, evaluation, techniques of artificial insemination, infertility in male including testicular tumors – cryptorchid, affections of prostate.