SRI VENKATESWARA VETERINARY UNIVERSITY, TIRUPATI

FACULTY OF VETERINARY SCIENCE

CATALOGUE OF POST GRADUATE COURSES
(As per ICAR Regulations-2009)

(As amended up to 27-10-2015)
The Indian Council of Agricultural Research, New Delhi has framed the Common Academic Regulations, Course curricula and syllabi for Post Graduate (Masters and Doctoral) Education in Agriculture and Allied Sciences for the first time for uniform implementation by SAUs/SVUs in India in the year 2009.

The University has implemented the said Common Academic Regulations, Course curricula and syllabi from the Academic year 2010-11 onwards with the approval of Academic Council and accordingly the Course catalogue was brought out.

In view of the changes made in course contents as approved by Academic Council and implemented from 2014-15 academic year in the Disciplines of Veterinary Medicine and Veterinary Public Health and Epidemiology as amended up to 27-10-2015 revised course catalogue is brought out to provide the relevant information to the students, teachers and other officials of the University.

The curriculum is meant to provide adequate emphasis on Practical skills and ability to collect information. The curriculum lays emphasis on an independent professional career of the Postgraduate. Thus, the overall emphasis is on developing a Postgraduate with a thorough knowledge of the subject and practical skills for animal welfare and enhancing livestock productivity.

Dr. K. VENUGOPAL NAIDU
CONTROLLER OF EXAMINATIONS

Dr. T.S.CHANDRASEKHARA RAO
DEAN, FACULTY OF VETERINARY SCIENCE
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INTRODUCTION

All postgraduate courses are divided into two series: 600-series courses pertain to Master’s level and 700-series to Doctoral level. A Ph.D. Student must take a minimum of two 700 series courses, but may also take 600-series courses if not studied during Master’s programme.

The courses are broadly divided into 4 groups as follows

- Basics Veterinary Subjects
- Veterinary Para Clinical Subjects
- Livestock Production Technology and Products Management
- Veterinary Clinical Subjects

Major subject: The subject (Department) in which the students takes admission

Minor subject: The subject closely related to students major subject. The advisory committee shall decide whether all minor courses shall be registered in one subject or in more than one subject.

Supporting subject: The subject not related to the major subject. It could be any subject considered relevant for student’s research work.

Out of 11 credit hours for minor and supporting subjects at Master and doctoral level, courses with a minimum of 6 credit hours should be taken from minor subject and courses with a minimum of 3 credit hours from supporting subject should be taken. Thus students will have the option to register courses of 6 to 8 credit hours in minor subject and of 3 to 5 credits in supporting subject. In case of M.V.Sc. in Veterinary Biotechnology the candidate has to register 9 credits in minor subjects and 5 credits in supporting subjects.

Clinical practice is compulsory in two semesters for MVSc Students in depts of Veterinary Medicine, Veterinary surgery & Radiology & Veterinary Gynaecology and obstetrics.

Four noncredit courses namely PGS 601 library and information services (0+1), PGS 602 Technical writing and communication skills (0+1), PGS 603 Intellectual property & its management (1+0) and PGS 606 disaster management (1+0) are mandatory at masters level and at doctoral level if not studied already.
Basic Veterinary Subjects

Veterinary Anatomy
Veterinary & Animal Husbandry Extension Education
Veterinary Biochemistry
Veterinary Physiology
Suggested list of specified Minor subjects(Departments)

<table>
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<th>Major Subject</th>
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<td>Veterinary Physiology, Veterinary Microbiology, Veterinary Medicine, Veterinary Biotechnology, Veterinary Pharmacology &amp; Toxicology, Animal Nutrition, Animal Genetics &amp; Breeding</td>
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<td>Veterinary Anatomy, Veterinary Biochemistry, Veterinary Pharmacology &amp; Toxicology, Animal Nutrition, Veterinary Gynaecology and Obstetrics, Livestock Production Management, Animal Genetics &amp; Breeding</td>
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</table>

* The choice of minor courses other than those listed above, may be allowed on the recommendations of advisory committee, if essentially required as per the research problem, with the concurrence of Head of the Department and Dean of the Faculty
### VETERINARY ANATOMY

#### Course Structure

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<td>COMPARATIVE OSTEOLOGY AND ARTHROLOGY</td>
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<td>COMPARATIVE SPLANCHNOLOGY</td>
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<tr>
<td>VAN 603</td>
<td>MYOLOGY, ANGIOLOGY, NEUROLOGY AND AESTHESIOLOGY OF OX</td>
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<td>VAN 604</td>
<td>GROSS ANATOMICAL TECHNIQUES</td>
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<td>THEORY AND PRACTICE OF HISTOLOGICAL AND HISTOCHEMICAL TECHNIQUES</td>
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<td>GENERAL HISTOLOGY AND ULTRASTRUCTURE</td>
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<td>MYOLOGY, ANGIOLOGY, NEUROLOGY AND AESTHESIOLOGY OF EQUINE, CANINE AND PORCINE</td>
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<td>VAN 702</td>
<td>PRINCIPLES AND APPLICATIONS OF BIOMECHANICS</td>
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<td>VAN 703</td>
<td>AVIAN ANATOMY</td>
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<td>VAN 704</td>
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<td>VAN 705</td>
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<td>THEORY AND APPLICATIONS OF ELECTRON MICROSCOPE</td>
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<td>HISTOENZYMOLOGY AND IMMUNOCYTOCHEMISTRY</td>
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<td>VAN 710</td>
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VETERINARY ANATOMY

Course Contents

VAN 601  COMPARATIVE OSTEOLOGY AND ARTHROLOGY  1+2

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

VAN 602  COMPARATIVE SPLANCHNOLOGY  2+2

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

VAN 603 MYOLOGY, ANGIOLOGY, NEUROLOGY AND AESTHESIOLOGY OF OX

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


VAN 604 GROSS ANATOMICAL TECHNIQUES 0+2

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

VAN 605 THEORY AND PRACTICE OF HISTOCHEMICAL TECHNIQUES 1+2

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
VAN 606  GENERAL HISTOLOGY AND ULTRASTRUCTURE  3+1

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
Williams & Wilkins, Lippincott.

VAN 607  SYSTEMIC HISTOLOGY AND ULTRASTRUCTURE  3+1

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

VAN 608 DEVELOPMENTAL ANATOMY 3+1
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

VAN 701 MYOLOGY, ANGIOLOGY, NEUROLOGY AND AESTHESIOLOGY OF EQUINE, CANINE AND PORCINE 0+3
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
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
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
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
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
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  HISTOENZYMOLGY AND IMMUNOCYTOCHEMISTRY  2+1

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

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
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
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

VAN 790  SPECIAL PROBLEM  0+2
Objective
To provide expertise in handling practical research problem(s).
Practical
Short research problem(s) involving contemporary issues and research techniques.
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.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 AND ANIMAL HUSBANDRY EXTENSION EDUCATION

#### Course Structure

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<tr>
<td>AHE 601</td>
<td>FUNDAMENTALS OF VETERINARY AND ANIMAL HUSBANDRY EXTENSION</td>
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<tr>
<td>AHE 602</td>
<td>COMMUNICATION FOR LIVESTOCK DEVELOPMENT</td>
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<td>AHE 603</td>
<td>DIFFUSION AND ADOPTION OF ANIMAL HUSBANDRY PRACTICES</td>
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<td>AHE 604</td>
<td>EXTENSION TECHNIQUES AND AUDIO VISUAL AIDS</td>
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<td>AHE 605</td>
<td>ANIMAL HUSBANDRY PROGRAMME PLANNING AND EVALUATION</td>
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<td>RESEARCH METHODOLOGY IN VETERINARY AND ANIMAL HUSBANDRY EXTENSION</td>
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<td>AHE 607</td>
<td>SOCIAL PSYCHOLOGY AND GROUP DYNAMICS</td>
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<td>DEVELOPMENTS IN THE CONCEPT OF EXTENSION</td>
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<td>GENDER AND LIVESTOCK DEVELOPMENT</td>
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<td>INFORMATION AND COMMUNICATION TECHNOLOGY IN LIVESTOCK DEVELOPMENT</td>
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<td>TRAINING FOR HUMAN RESOURCE DEVELOPMENT</td>
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<td>POLICIES AND REGULATIONS IN LIVESTOCK SECTOR</td>
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VETERINARY AND ANIMAL HUSBANDRY EXTENSION EDUCATION

Course Contents

AHE 601  FUNDAMENTALS OF VETERINARY AND ANIMAL HUSBANDRY EXTENSION  2+1

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
Mosher AT. 1978. An Introduction to Agricultural Extension. ADC.
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, feedback and barriers to communication.

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

Practical

Suggested Readings
UNIT II

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

AHE 604 EXTENSION TECHNIQUES AND AUDIO VISUAL AIDS  2+1
Objective
To train the students about various techniques/methods for transfer of animal husbandry technologies through suitable audio-visual aids.

Theory
UNIT I
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

AHE 605 ANIMAL HUSBANDRY PROGRAMME 2+1
PLANNING AND EVALUATION

Objective
To expose the students on planning, formulation, implementation and evaluation of various 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

Practical
Preparation of livestock development plan for a village. Developing instruments 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
AHE 606 RESEARCH METHODOLOGY IN VETERINARY AND ANIMAL HUSBANDRY EXTENSION

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

UNIT IV

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

Suggested Readings
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

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
AHE 608 ANIMALHUSBANDRY DEVELOPMENT PROGRAMMES  1+0

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

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

Suggested Readings

AHE 609 DEVELOPMENTS IN THE CONCEPT OF EXTENSION  1+0

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

UNIT IV
Various stakeholders in livestock development; stakeholder analysis, problem tree

Suggested Readings

AHE 610
HUMAN RESOURCE MANAGEMENT IN ANIMAL HUSBANDRY SECTOR

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

Theory
UNIT I

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

UNIT III

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

AHE 611 GENDER AND LIVESTOCK DEVELOPMENT 1+ 0
Objective
To acquaint the students with the concept of gender, its importance in livestock development, livestock development policies and programmes of the government to empower women.

UNIT I

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

Suggested readings

AHE 612 INFORMATION AND COMMUNICATION TECHNOLOGY IN LIVESTOCK DEVELOPMENT 1+1
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 network – 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

AHE 701 ORGANIZATIONAL MANAGEMENT 3+0
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
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

Objective
To sensitize students about the role of mass media, newspapers, 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

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 3+1
IN SOCIAL RESEARCH

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

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

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.

UNIT III
Training strategies, models of training.

UNIT IV
Planning, development and execution of training programmes.

UNIT V
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

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

Theory
UNIT I
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

Suggested Readings
Selected articles from journals.

AHE 706 EDUCATIONAL TECHNOLOGY

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

Theory
UNIT I
UNIT II
UNIT III
Student counselling and guidance, Student evaluation – meaning and methods, construction of measuring instrument – question banking.
UNIT IV

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

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

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

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

Practical
Short research problem(s) involving contemporary issues and research techniques.
List of Journals

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

e-Resources

www.informaworld.com (Journal of Agricultural Education and Extension)
www.blackwellpublishing.co (International Journal of Training & Development)
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 BIOCHEMISTRY

## Course Structure

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VETERINARY BIOCHEMISTRY

Course Contents

VBC 601  CHEMISTRY OF ANIMAL CELL  2+0

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. \( \Delta G \) 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

VBC 602  TECHNIQUES IN BIOCHEMISTRY  0+2

Objective
To make students well versed with methodologies used in biochemistry.

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

Suggested Readings
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

UNIT III

Suggested Readings
Theory

**UNIT I**

**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**

Suggested Readings


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

Objective
To give thorough 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**

**UNIT III**
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, $\Delta G$, 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
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 stabilizing NA 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

Suggested Readings

VBC 608 METABOLISM–III: INTEGRATION AND REGULATION 2+0

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, interaction with phosphoserine/tyrosine, integrations, drugs and toxins, cell cycle and CDKs that affect cell signaling.

UNIT IV

Suggested Readings

VBC 609 CENTRAL DOGMA AND PROTEIN FUNCTION 2+0
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
UNIT III
Actin structure, microfilament dynamics, actin-myosin reacting cycle, tubulin dimer, microtubules dynamics, kinesins, dyneins.
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

Suggested Readings

VBC 610 CLINICAL BIOCHEMISTRY OF ANIMALS 2+1
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.

UNIT IV

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
Jurisica I & Wigle D. 2006. Knowledge and Discovery in Proteomics. CRC.

VBC 611 BIOCHEMICAL BASIS OF DISEASES OF DOMESTIC ANIMALS 2+0

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

Theory

UNIT I
Biochemical alterations in body fluids of ruminants in hypoglycaemia, Ruminant ketosis.

UNIT II

UNIT III
Anemias of the newborn, cytosolic enzyme deficiencies and membrane abnormalities in erythrocytes. Porphyrisins 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
insufficiency. Metabolic diseases of Ca, P, Mg metabolism. Iron overload
and injection, inorganic polyphosphate metabolism.

Suggested Readings
Biochemistry. 4th Ed. Freeman.
Animals. 5th Ed. Academic Press.
at the Molecular Level. 2nd Ed. John Wiley & Sons.

VBC 612 ENDOCRINOLOGY AND REPRODUCTIVE BIOCHEMISTRY

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
Nes WR & McKean ML. 1977. Biochemistry of Steroids and other
Isoprenoids. University Park Press.
at the Molecular Level. 2nd Ed. John Wiley & Sons.

VBC 613 BIOCHEMICAL BASIS OF ANIMAL PRODUCTION

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

VBC 701 ADVANCES IN BIOCHEMISTRY OF RUMINANT DISORDERS 2+0
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 ENZYMEOLOGY 2+0
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
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
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
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.

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
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
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
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 ENZYMEOLOGY - I
2+0

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. Enzyme urea. 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 ENZYMEOLOGY - II
2+0

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

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

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

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 & 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

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

Practical
Short research problem(s) involving contemporary issues and research techniques.
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 Master’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
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<th>CODE</th>
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<td>COMPARATIVE PHYSIOLOGY OF RUMINANT DIGESTION</td>
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VETERINARY PHYSIOLOGY

Course Contents

VPY 601 PHYSIOLOGY OF DIGESTION 2+1

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

Suggested Readings

VPY 602 CARDIOVASCULAR AND RESPIRATORY PHYSIOLOGY 2+1

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

Suggested Readings

VPY 603 RENAL PHYSIOLOGY AND BODY FLUID DYNAMICS 2+1
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. Permelectivity of the glomerular capillary wall, structural basis of GFR, tubular reabsorption and transport.
UNIT III
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

VPY 604 HAEMATOLOGY 2+1
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

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

VPY 605 VITAMINS AND MINERALS IN ANIMAL PHYSIOLOGY 2+0
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

VPY 606 PHYSIOLOGY OF ANIMAL REPRODUCTION 2+1

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

VPY 607 CLINICAL PHYSIOLOGY 2+1

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


Suggested Readings


VPY 608 NEUROMUSCULAR PHYSIOLOGY 2+1

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

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

VPY 609 CHEMICAL BIOREGULATION IN PHYSIOLOGICAL FUNCTIONS

Objective
To acquaint the students about different endocrine glands of the body and their relationship with production.

Theory
UNIT I
Methods of study bioregulation including methods of endocrine analysis. Manipulation and disruption of biorhythms in homeostatic and natural ecosystem.

UNIT II

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

UNIT V

Suggested Readings
Objective
Training in various techniques for application in research in Animal Physiology.

Practical

Suggested Readings

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
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

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

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

ADVANCES IN NEURO-ENDOCRINOLOGY

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

Practical

Suggested Readings
Selected articles from journals.

VPY 705 MYOPHYSIOLOGY AND KINESIOLOGY 2+1
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

Practical

Suggested Readings
Selected articles from journals.

VPY 706 AVIAN PHYSIOLOGY 2+1
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

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
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 2+1
AND GROWTH

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

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

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

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
Tizard IR. 2004. Veterinary Immunology. 5th Ed. WB. Saunders.

VPY 711 PHYSIOLOGY OF STRESS 2+1

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
Objective To provide expertise in handling practical research problem(s).
Practical Short research problem(s) involving contemporary issues and research techniques.
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://arjournals.annualreviewes.org (Annual Review of Physiology)
www.jneurosci.org (Journal of Neuroscience)
www3.interscience.wiley.com (Journal of Physiology & Animal Nutrition)

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 Para-clinical Subjects

Veterinary Microbiology
Veterinary Parasitology
Veterinary Pathology
Veterinary Pharmacology and Toxicology
Veterinary Public Health and Epidemiology
### Suggested list of specified minor subjects (departments)

<table>
<thead>
<tr>
<th>Major Subject</th>
<th>Minor Subjects</th>
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<tr>
<td>Veterinary Microbiology</td>
<td>Veterinary Biotechnology, Veterinary Pathology, Vety. Public Health and Epidemiology, Veterinary Biochemistry</td>
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<tr>
<td>Veterinary Parasitology</td>
<td>Veterinary Microbiology, Veterinary Pharmacology &amp; Toxicology, Animal Biotechnology, Veterinary Pathology, Veterinary Biochemistry</td>
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<tr>
<td>Veterinary Pathology</td>
<td>Veterinary Microbiology, Veterinary Anatomy, Veterinary Medicine, Veterinary Parasitology, Veterinary Pharmacology &amp; Toxicology, Animal Nutrition</td>
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<tr>
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<td>Veterinary Physiology, Veterinary Biochemistry, Veterinary Medicine, Veterinary Pathology, Animal Biotechnology</td>
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<tr>
<td>Veterinary Public Health and Epidemiology</td>
<td>Veterinary Microbiology, Veterinary Pathology, Veterinary Biotechnology, Veterinary Pharmacology &amp; Toxicology, Veterinary Parasitology, Livestock Product Technology</td>
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</table>

* The choice of minor courses other than those listed above, may be allowed on the recommendations of advisory committee, if essentially required as per the research problem, with the concurrence of Head of the department and Dean of the Faculty.
## VETERINARY MICROBIOLOGY
### Course Structure

<table>
<thead>
<tr>
<th>CODE</th>
<th>COURSE TITLE</th>
<th>CREDITS</th>
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<tbody>
<tr>
<td>VMC 601</td>
<td>BACTERIOLOGY – I</td>
<td>3+1</td>
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<tr>
<td>VMC 602</td>
<td>BACTERIOLOGY – II</td>
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<td>VMC 603</td>
<td>VETERINARY MYCOLOGY</td>
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<td>GENERAL VIROLOGY</td>
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<tr>
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<td>PRINCIPLES OF IMMUNOLOGY</td>
<td>2+1</td>
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<td>VMC 607</td>
<td>VACCINOLOGY</td>
<td>2+0</td>
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<tr>
<td>VMC 608</td>
<td>DIAGNOSTICS OF INFECTIOUS DISEASES</td>
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<td>VMC 609</td>
<td>TECHNIQUES IN MICROBIOLOGY AND IMMUNOLOGY</td>
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<td>VMC 704</td>
<td>MICROBIAL TOXINS</td>
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<td>ADVANCES IN VIROLOGY</td>
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<td>VMC 707</td>
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<td>ONCOGENIC VIRUSES</td>
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<td>SLOW VIRAL INFECTIONS AND PRIONS</td>
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<td>CYTOKINES AND IMMUNOMODULATORS</td>
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<td>VMC 717</td>
<td>CURRENT TOPICS IN INFECTION AND IMMUNITY</td>
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<td>VMC 718</td>
<td>VETERINARY MICROBIAL BIOTECHNOLOGY</td>
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VETERINARY MICROBIOLOGY
Course Contents

VMC 601  BACTERIOLOGY - I  3+1
Objective
To impart knowledge on general microbiology and important aerobic bacteria.

Theory
UNIT I
Introduction to historical development of cellular organization, genetic & 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

VMC 602  BACTERIOLOGY - II  3+1
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, Dermatophilaceae, 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

VMC 603 VETERINARY MYCOLOGY 1+1
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, mycotomas, sporotrichosis, histoplasmosis, blastomycosis, coccidiodomycosis, 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

VMC 604 GENERAL VIROLOGY 2+1
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 neutralisation test, agar gel precipitation test, haemagglutination inhibition and ELISA.

Suggested Readings

VMC 605 SYSTEMATIC ANIMAL VIROLOGY 3+1

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 laryngeotracheitis virus, Marek’s disease virus, pseudorabies virus, malignant cattarrh fever virus; infectious canine hepatitis virus, egg drop syndrome virus, inclusion body hepatitis-hydropericardium virus, papiollomatosis, canine parvoviruses, feline panleucopenia virus.
UNIT II
New castle 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, BVDV-mucosal 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

VMC 606 PRINCIPLES OF IMMUNOLOGY 2+1
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
UNIT III

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

VMC 607 VACCINOLOGY 2+0

Objective
To understand science and practice of vaccines for prevention of bacterial and viral diseases.

Theory
UNIT I

UNIT II
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

Suggested Readings

VMC 608 DIAGNOSTICS OF INFECTIOUS DISEASES 1+2

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

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
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 ultrafiltration, 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
Practical

Biochemical, physiological and pathogenesis studies of various bacterial diseases.

Suggested Readings
Selected articles from journals

VMC 702 ADVANCES IN MYCOLOGY 2+1
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
Objective
To learn the basic aspects of bacterial genetics.

Theory
UNIT I
Procaryotic and Eucaryotic genome. Replication of eucaryotic and procaryotic 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

Practical

Suggested Readings
Selected articles from journals.

VMC 704 MICROBIAL TOXINS 2+1
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

Objective
To learn the molecular mechanisms of bacterial pathogenesis.

Theory
UNIT I
Molecular structure, production and mode of action of bacterial adhesins, invasions, impedins, agressins, 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

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

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

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
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
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
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
Objective
To learn advances in research on immune cell biology and cellular interactions in immune responses.

Theory
UNIT I

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

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
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

Suggested Readings
Selected articles from journals.

VMC 714 ADVANCES IN VACCINOLOGY 2+0
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
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. Discriminant 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
Objective
To provide training on production of monoclonal antibody and other immunobiologicals by various modern methods.
Theory

UNIT I

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

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

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

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

UNIT IV

Practical

Suggested Readings
Selected articles from journals.

VMC 790 SPECIAL PROBLEM 0+2
Objective
To provide expertise in handling practical research problem(s).

Practical
Short research problem(s) involving contemporary issues and research techniques.
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.oxfordjournals.org (Clinical Bacteriology)
www.benthem.org/open/tomvcj (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)
Professional Course Ware Web Sites:

www.ibpub.com
www.bact.wisc.edu
www.textbookbacteriology.net
www.mhhe.com/Prescott5
www.Highwirepress.stanford.edu
www.vibno/Epid/supercurseforvirology

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

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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, Troglocrematidae, 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
Dalton JP. 1999. Fasciolosis. CABI.
Khalil LF, Jones A & Bray RA. 1994. Keys to the Cestode Parasites of Vertebrates. CABI.
VETERINARY HELMINTHOLOGY - 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, Strongyloidae 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, Tetrarmeridae, Physalopteridae, Gnathostomatidae, Filaridae, 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

VPA 603 VETERINARY ENTOMOLOGY AND ACAROLOGY 2+1

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, Simuliiidae 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, Sarcophasgidae, 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
Kettle DS. 1995. Medical and Veterinary Entomology. CABI.
Mullen G & Durben L. 2002 Medical and Veterinary Entomology. Academic Press

VPA 604 VETERINARY PROTOZOOLOGY 2+1

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


VPA 605 PARASITOLOGICAL TECHNIQUES 0+2

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

Durr P & Gatrell A. 2004. GIS and Spatial Analysis in Veterinary Science. CABI.
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

VPA 607 TRENDS IN CONTROL OF LIVESTOCK AND POULTRY PARASITES
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

VPA 608 IMMUNOPARASITOLOGY 2+1

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, immunomodulations 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

VPA 609 PARASITIC ZOOONOSES 2+0

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

VPA 610 PARASITES OF ZOO AND WILD ANIMALS 2+1

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

Suggested Readings
NBII Wildlife Diseases Information Node can be reached at: http://wildlifediseases.nbii.gov
VPA 611  MALACOLOGY  1+1

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, Lymnaeidae, Thoridae, 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

VPA 701  APPLICATIONS OF REMOTE SENSING AND GEOGRAPHIC INFORMATION SYSTEM IN PARASITOLOGY  1+2

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

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 VI
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 VII
Types of immune responses produced by various parasites, novel and other
antigens, proteases and cytokines in vaccine production.
UNIT VIII
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

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

Practical  
Short research problem(s) involving contemporary issues and research techniques.
List of Journals

Advances in Parasitology
Trends in Parasitology
Veterinary 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
Experimental 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://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

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VETERINARY PATHOLOGY
Course Contents

VPP 601 GENERAL PATHOLOGY 2+1

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. Hypersensitivity 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

VPP 602 TECHNIQUES IN PATHOLOGY 1+1

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
Histochmical 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

VPP 603 ANIMAL ONCOLOGY 1+1
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

VPP 604 CLINICAL PATHOLOGY 1+2
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
VPP 605  
NECROPSY PROCEDURES AND INTERPRETATIONS-1  0+1

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

VPP 606  
NECROPSY PROCEDURES AND INTERPRETATIONS-II  0+1

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

VPP 607  
SYSTEMIC PATHOLOGY  2+1

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
An 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 etiolo, 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

VPP 608 PATHOLOGY OF INFECTIOUS DISEASES OF DOMESTIC ANIMALS 2+1
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

VPP 609 TOXICOPATHOLOGY 2+1
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

VPP 610 AVIAN PATHOLOGY 2+1

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

VPP 611 PATHOLOGY OF LABORATORY ANIMALS, FISH AND WILD ANIMALS 2+1

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

**VPP 612 VETEROLEGAL PATHOLOGY 1+0**

**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**

**VPP 701 PATHOLOGY OF NUTRITIONAL AND METABOLIC DISTURBANCES 2+1**

**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

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 ADVANCES IN DIAGNOSTIC PATHOLOGY 1+2

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, spectrophotometry 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

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

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

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, campylobacteriosis, 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

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

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 CELL INJURY 2+1

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

UNIT III
Inflammation- mechanism and types. Tissue repair and healing.
VPP 710  EXPERIMENTAL PATHOLOGY  1+1

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

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

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

Suggested Broad Topics for Master’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

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VETERINARY PHARMACOLOGY AND TOXICOLOGY

Course Contents

VPT 601 GENERAL PHARMACOLOGY 2+0

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

Suggested Readings

VPT 602 AUTONOMIC AND AUTACOID PHARMACOLOGY 2+1

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

VPT 603 CNS PHARMACOLOGY 2+1
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

VPT 604 DIGESTIVE AND RESPIRATORY PHARMACOLOGY 2+0
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

VPT 605  CARDIOVASCULAR AND RENAL PHARMACOLOGY  2+0

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
VPT 606 ENDOCRINE AND REPRODUCTIVE PHARMACOLOGY 2+0

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

VPT 607 CHEMOTHERAPY 2+1

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

VPT 608 TOXICOLOGY OF XENOBIOTICS 2+1
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
Stive KE & Brown TM. 2006. Principles of Toxicology. 2nd Ed. CRC Press.

VPT 609 TOXICOLOGY OF PLANTS AND TOXINS 2+0
Objective
To impart knowledge of toxicity of poisonous plants & 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 lathyrisim, thiamine deficiency and photosensitization.
UNIT III
Toxicology of mycotoxins: aflatoxins, rubratoxins, ochratoxins, trichothecenes, tremorgens and ergot.
UNIT IV

Suggested Readings

VPT 610 PHARMACOLOGICAL TECHNIQUES 1+1

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 EC₅₀, dissociation rate constants, potency ratio, pAᵦpDₓ and pD’ values. Specific tests for evaluation of tranquilizing, hypnotic, analgesic, anti-convulsant, general and local anesthetic, muscle relaxant, anti-inflammatory, antipyretic, antiarrhythmic, antihypertensive, antihyperglycemic and anticholesterimic activities. Determination of potency ratio, median effective, toxic or lethal doses. Bioassay techniques.

Suggested Readings
VPT 611

TECHNIQUES IN TOXICOLOGY

1+1

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, mutagenicity, 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


VPT 612

ETHNOPHARMACOLOGY

2+0

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


VPT 701 ADVANCES IN NEUROPHARMACOLOGY 2+0
Objective
To understand the molecular aspects of signaling by nervous system and the effect of drugs on ANS, CNS and purinergic system.
Theory
UNIT I
Central and autonomic neurotransmitters, neuromodulators, neurohormones and their receptor subtypes, receptor structure and signaling mechanisms.
UNIT II
Autonomic nervous system – Adrenergic, cholinergic transmission, Purinergic transmission, Drugs acting on ANS and purinergic system
UNIT III
Anaesthetics, sedatives, tranquilizers, analgesics, anti convulsants and their molecular mechanisms of action and adverse drug reactions.
UNIT IV
Analeptics, stimulants, cognition enhancers, euthanizing agents, performance enhancers, drugs affecting behaviour
UNIT V
Pharmacology of neurodegenerative diseases.
Suggested Readings: Selected articles from journals.

VPT 702 AUTACOID PHARMACOLOGY 1+0
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
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
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
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
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
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 & novel drug effects

UNIT II  
Genetic polymorphism.
UNIT III
Gene therapy: gene transfer technology, viral vectors, natural delivery strategies.

UNIT IV
Drugs & 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

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

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
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 pharmacoconomics.
UNIT III
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
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

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

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
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

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

Practical
Short research problem(s) involving contemporary issues and research techniques.
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/index.html (British Journal of Pharmacology)
www.dmd.aspetjournals.org (Drug metabolismand disposition)
http://jpet.aspetjournals.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.toxic.i.oxfordjournals.org (Toxicological Science)

Suggested Broad Topics for Master’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 PUBLIC HEALTH AND EPIDEMIOLOGY
### COURSE STRUCTURE

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VETERINARY PUBLIC HEALTH & EPIDEMIOLOGY
Course Contents

VPE 601 ELEMENTS OF VETERINARY PUBLIC HEALTH 1+1
Objective
To acquaint students with basics of veterinary public health.
Theory
UNIT I
The purposes 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; organisation, administration and implementation of veterinary public health services and programmes.
UNIT III
Public health team, administration and functions; place of veterinarian in the public health team; veterinary public health agencies and institutions in India and abroad.
Practical
Collection of information about set up of veterinary public health in different countries.
Suggested Readings

VPE 602 BACTERIAL AND RICKETTSIAL AGENTS OF PUBLIC HEALTH SIGNIFICANCE 2+1
Objective
To impart knowledge about importance and characteristic features of bacterial 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 Bacillus, Listeria, Mycobacterium, Clostridium, Staphylococcus, Enterococcus, Brucella and Leptospira
UNIT III
Description of Vibrio, Salmonella, Escherichia, Campylobacter, Yersinia, Lactobacillus, Pseudomonas and Micrococcus.
UNIT IV
Description of Coxiella, Rickettsia and Chlamydia.
Practical
Isolation and identification methods for important bacterial and rickettsial agents of public health significance from host, vehicle and environment.

Suggested Readings

VPE 603
VIRAL, FUNGAL AND PARASITIC AGENTS OF PUBLIC HEALTH SIGNIFICANCE 2+1

Objective
To impart knowledge about importance and characteristic features of viral, fungal and parasitic pathogens of public health significance.

Theory
UNIT I
Systematic study of viral agents of Japanese encephalitis, encephalomyelitis, rabies, influenza, KFD, Rift valley fever, and enteroviruses; their morphological and other characters, ecology, transmission and survivability in nature.

UNIT II
Description of fungal agents of public health importance belonging to genera: Aspergillus, Penicillium, Fusarium, Mucor, Histoplasma, Microsporum, Trichophyton and Sporotrichum.

UNIT III
Description of parasites of public health importance: Taenia, Echinococcus, Trichinella, Toxoplasma, Diphyllobothrium, Fasciola, and Cryptosporidium.

Practical
Isolation and identification methods for important fungal, viral and parasitic agents of public health significance from host, vehicle and environment.

Suggested Readings

VPE-604
ZOO NOSES & PUBLIC HEALTH 2+1

Objective:
To impart knowledge of epidemiology, prevention and control of important zoonotic diseases and to update the knowledge of biological weapons, biological hazards, biomedical hazards and bioterrorism and their prevention.
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, Aeromonashydrophilla, Bacillus cereus, Vibrio parahaemolyticus, cat scratch disease, chlamydioid, Lyme disease, borreliosis (relapsing fever)

UNIT III

Detailed description of viral zoonoses: food-borne viruses viz. rota, tickborne encephalitis, FMD,hepatitis A & E, Norwalk, entero, parvo,adeno, cytomegalo, astro, calci and corona viruses, influenza, rabies, vector-borne viruses 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 New castle and pox viruses.

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, cysticercosis, toxoplasmosis, trichinellosis, cryptosporidiosis, dracunculosis, fasciolopsiosis, sarcocystosis, liver fluke diseases, cutaneous and visceral larva migrants, schistosomiasis, leishmaniasis, trypanosomosis.

UNIT V

Biomedical hazards and biosafety, occupaitonal health risk management major agents and their characteristics which have been used in the past and those which can be used in future as biological weapons. Biological weapons, hazard analysis and combating bioterrorism. Bioethics and social ethics, advisory role of veterinarians.

PRACTICALS:

Isolation and identification of zoonotic agents, diagnostic procedures of zoonotic diseases. Detection and characterization of various organisms used as biological agents, use of disinfectants for their destruction.
PRINCIPLES OF FOOD HYGIENE AND SAFETY 2+1

Objective
To acquaint the students about principles of food hygiene and quality improvement practices.

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 spoilage, safety and preservation methods.

UNIT III
Microbiological standards and quality control (biological and other indicators of hygienic quality and spoilage) of foods to prevent food-borne infections.

UNIT IV
General principles of prevention of food-borne illnesses, GMP, HACCP, risk analysis.

Practical
Procedures of evaluation of hygienic/microbiological quality of raw and processed foods especially of animal origin by detection of biological and other indicators.

Suggested Readings
Jay JM. 1996. Modern Food Microbiology. CBS.
VPE 607  MEAT AND MILK HYGIENE  2+1

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 problem 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
Egg, food legislation, meat and milk adulteration.

Practical
Milk and meat inspection, quality control tests of meat, milk and fish.

Suggested Readings
WHO. 1962. Milk Hygiene. WHO.
Jay JM. 1996. Modern Food Microbiology. CBS.

VPE 608  ENVIRONMENTAL POLLUTION AND SAFETY  2+1

Objective
To impart education about pollutants in the environment and control.

Theory

UNIT I
Introduction to environmental hygiene, environment and health, microbial aspects of pollution.

UNIT II
Soil pollution, air pollution, water pollution and health.

UNIT III
Genetic risk from environmental agents, health problems from nuclear energy and radiation pollution, environmental estrogens and pesticides- pollution.

UNIT IV
Dissemination of excreted pathogens, animal-waste and human risk, principles of safe disposal of waste.

UNIT V
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, and animal waste, inspection of sewage and waste disposal plants/sites.
Suggested Readings

VPE 609 FISH, FISH PRODUCTS AND SEAFOOD HYGIENE 1+1
Objective
To impart knowledge regarding fish hygiene and fish borne diseases

Theory
UNIT I
Fisheries and resources, fish preservation, hygienic quality control

UNIT II
Hygienic disposal and utilization of byproducts of fish, hygienic handling, transportation and marketing of fish.

UNIT III
Fish borne diseases in relation to human health.

Practical
Study of physical and biological indicators of wholesome fish to determine hygienic status of raw and processed fish. Residue analysis in fish.

Suggested Readings

VPE 610 VETERINARY EPIDEMIOLOGY 2+1

THEORY
UNIT I
Definitions, scope, concepts, types, application and common terms used in epidemiology.

UNIT II

UNIT III

UNIT IV
Animal disease forcasting. Economics of livestock diseases. different strategies for prevention and control of diseases and syndromes. Disease free zones and zero disease concept.

UNIT V
Uses and evaluation of diagnostic tests. Design and evaluation of clinical trials. Epidemiological data: its nature, sources, collection, coding, storage, retrieval and presentation. Surveys,
sampling and collection of information, design questionnaires, disease monitoring and surveillance.

PRACTICAL
Visit to dairy, sheep, piggery and poultry farms – collection of data on common diseases and mortality- analysis of data. Visit to hospital, scrutiny of data and calculation of prevalence, incidence, morbidity, case fatality and survival rates of diseases. Designing 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. Screening of lactating animals for clinical and subclinical mastitis and other diseases.

SUGGESTED READINGS:
Veterinary Epidemiology – Michael Thrusfield (3rd edition) Blackwell Publishers, USA.
Veterinary Epidemiology – Principles and methods /Martin Meek and Willeberg

VPE 701
CURRENT TOPICS IN VETERINARY PUBLIC HEALTH     2+1

Objective
To acquaint with contemporary issues concerning VPH.

Theory
UNIT I
Contemporary status of Veterinary Public Health administration, organisation 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.

UNIT III
Role of biotechnology in food hygiene, Hazard Analysis Critical Control Point System (HACCP).

Practical
Special problems related to field investigations of outbreaks of food poisoning and zoonotic diseases in a community.

Suggested Readings
Selected articles from journals.

VPE 702
EMERGING AND RE-EMERGING ZOONOSES     2+1

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, H5N1 influenza virus; re-emerging zoonoses with new pathology viz. neurocysticercosis, campylobacteriosis, rabies, Guillain- 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 ANIMAL FOOD PRODUCTS** 2 +1
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.

Practical
Special problems on microbiological quality of foods of animal origin; detection, enumeration and identification of important food-borne pathogens.

Suggested Readings
Selected articles from journals.

**VPE 704 OCCUPATIONAL HEALTH HAZARDS** 2+1
Objective
To acquaint with occupational health hazards

Theory
**UNIT I**
Health/diseases associated with various occupations

**UNIT II**
Transportation, spread, maintenance and control of diseases affecting various occupational groups in contact with animals and their public health significance

Practical
Diagnosis of various occupational diseases of public health
significance, identification and characterization of causative agents

Suggested Readings
Selected articles from journals.

VPE 705 DISPOSAL AND RECYCLING OF WASTE 2+1

Objective
To educate about safe and economic disposal of waste.

Theory
UNIT I
Concept of ‘reduce, reuse and recycle’ in environmental management, role of holistic environmental biotechnology and microbial control of pollution

UNIT II
Safe disposal of animal waste and food plant waste, utilization/recycling of livestock waste.

UNIT III
Pollutants due to sewage, sewage treatment systems, solid waste and its management.

Practical
To study the role of microorganisms and chemicals in degrading waste, to study the factors influencing biodegradation.

Suggested Readings
Selected articles from journals.

VPE 706 BIOHAZARDS, BIOSECURITY AND DISASTER MANAGEMENT 2+0

Objective
To update knowledge on biological hazards and their prevention.

Theory
UNIT I
Biohazards and bioterrorism: case studies.

UNIT II
Innovative biosecurity approaches.

UNIT III
Regulations for safety in laboratories, hospitals, biological plants.

UNIT IV

Suggested Readings
VPE 707  FOOD PLANT SANITATION  2+1
Objective
To impart basic knowledge of sanitation in food plants.
Theory
UNIT I
Importance and maintenance of abattoir and meat plant sanitation.
UNIT II
Dairy plant sanitation.
UNIT III
Food plant waste disposal.
Practical
Evaluation of sanitation and disinfection procedures in food plants, evaluation of efficacy of disinfectants.
Suggested Readings
Selected articles from journals.

VPE 708  ADVANCES IN ENVIRONMENTAL POLLUTION CONTROL  2+1
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.
Objective
To learn about survey and surveillance methods, data collection and analysis and the development of suitable disease forecasting systems.

THEORY
UNIT I
Review of epidemiological concepts and applications, recent concepts. Epidemiology of economically important diseases in the region (haemorrhagic septicemia, foot and mouth disease, surra, brucellosis, PPR, swine fever, IBD and fowl typhoid).

UNIT II
Geographical Information System and its applications in epidemiology, various expert systems and their role in epidemiology. Modeling and application of various models in disease forecasting. Epidemiological software.

UNIT III
Classification of data, sources of data, data collection, questionnaires. Data storage, computerized and non-computerized recording techniques. Veterinary recording schemes, veterinary information systems and databases. Presenting numerical data: some basic definitions. Displaying numerical data.

UNIT IV
Over-view of concepts of survey and surveillance, purpose and method of sampling, size of sample, questionnaires. Goals and types of surveillance, difference from monitoring, mechanism of surveillance and surveillance network. Disease/data recording and reporting.

PRACTICAL
Epidemiology 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 soft-wares. Development of questionnaires. Survey among livestock farmers to find out usefulness/effectiveness of vaccination/ artificial insemination/ other practices, surveillance of important diseases. Collection, storage, analysis and Development of suitable software for diseases. Methods of presentation of data.

Suggested Readings
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 bio-safety, 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, immune blotting 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, ELISA for screening of field samples.

VPE 790 SPECIAL PROBLEM 0+2

Objective
To provide expertise in handling practical research problem(s).
Practical Short research problem(s) involving contemporary issues and research techniques.

Practical
Short Research Problem(s) involving contemporary issues and research techniques
List of Journals

Abstracts on Hygiene and Communicable Diseases
Applied and Environmental Microbiology
Emerging Infectious Diseases
Food Science and Technology Abstracts
Journal of Food Protection
Journal of Food Science and Technology
Journal of Veterinary Public Health
Letters in Applied Microbiology

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)

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
Shelf life
Food adulteration and food safety
Livestock Production Technology & Products Management
Animal Genetics & Breeding
Animal Nutrition
Livestock Production Management
Livestock Products Technology
Poultry Science
Suggested list of specified minor subjects (Departments)

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<tr>
<th>Minor Subjects</th>
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**Note:** The choice of minor courses other than those listed above, may be allowed on the recommendations of advisory committee, if essentially required as per the research problem, with the concurrence of Head of the department and Dean of the Faculty.
<table>
<thead>
<tr>
<th>CODE</th>
<th>COURSE TITLE</th>
<th>CREDITS</th>
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<tbody>
<tr>
<td>AGB 600</td>
<td>STATISTICAL METHODS FOR ANIMAL SCIENCES</td>
<td>2+1</td>
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<td>AGB 604</td>
<td>SELECTION METHODS AND BREEDING SYSTEMS</td>
<td>3+1</td>
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<td>BIOMETRICAL TECHNIQUES IN ANIMAL BREEDING</td>
<td>3+1</td>
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<tr>
<td>AGB 606</td>
<td>CONSERVATION OF ANIMAL GENETIC RESOURCES</td>
<td>2+0</td>
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<td>AGB 607</td>
<td>CATTLE AND BUFFALO BREEDING</td>
<td>2+1</td>
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<td>AGB 608</td>
<td>SMALL FARM ANIMAL BREEDING (SHEEP, GOAT, SWINE AND RABBIT)</td>
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<td>AGB 609</td>
<td>POULTRY BREEDING</td>
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<td>LABORATORY ANIMAL BREEDING</td>
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<td>AGB 691</td>
<td>MASTER’S SEMINAR</td>
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<td>AGB 699</td>
<td>MASTER’S RESEARCH</td>
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<td>AGB 701</td>
<td>RECENT ADVANCES IN ANIMAL GENETICS</td>
<td>2+0</td>
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<td>RECENT TRENDS IN ANIMAL BREEDING</td>
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<td>ADVANCES IN SELECTION METHODOLOGY</td>
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<td>AGB 705</td>
<td>BIOINFORMATICS IN ANIMAL GENETICS AND BREEDING</td>
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<td>AGB 799</td>
<td>DOCTORAL RESEARCH</td>
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AGB 600 STATISTICAL METHODS FOR ANIMAL SCIENCES
THEORY

Introduction, Collection, Classification and tabulation of data
Frequency Distribution – Number of Classes, Class Width, Tally Marks, Frequency, Class mid point, Cumulative Frequencies for Exclusive and Inclusive Types. Diagrammatic representation of data
Graphical representation of data – Histogram, Frequency Curve, Frequency Polygon, Pie chart and Ogives.
Arithmetic Mean, Median, Mode, Geometric mean and Harmonic mean for ungrouped and grouped data, Merits and Demerits
Measures of Dispersion – Definition, formulae, computation and applications of Range, Quartile Deviation, Mean Deviation
Variance, Standard Deviation, Coefficient of Variation, Definitions, formulae, Calculation, applications and uses
Moments, Skewness and kurtosis
Elementary Probability – Definition, Mutually exclusive events, independent events and dependent events, Addition and multiplication theorems of probability, fitting of binomial distribution
Poisson distribution – properties and fitting of the Poisson distribution
Normal distribution – Standard normal distribution – Properties of normal distribution
Fitting of the normal distribution
Tests of hypothesis – Introduction – level of significance, degrees of freedom, types of error – one-sided and two-sided tests of hypothesis – Power of the test – One sample and two sample Z-test
Student’s t-distribution – Properties – one-sample and two-sample t-tests
Student’s t-distribution – paired t-test
Chi-square distribution and Tests of goodness of fit-Yates Correction, 2x2 and R x C Contingency Tables
Analysis of variance – components of variance – One way and two-way classification – CD test
Simple correlation – Definition, Positive and Negative correlation – test of significance of correlation coefficient, coefficient of determination
Partial correlation coefficient estimation of parameters
Multiple correlation coefficient, spearman’s rank correlation – estimation of parameters
Regression – Simple model and estimation of parameters – Regression vs correlation
Multiple linear regression – Principle, procedure and method
Predicted values and residuals, test of significance of regression coefficients- Coefficient of determination
Experimental designs – Concepts – Replication, Randomization and local control
Completely Randomized Design (CRD) – Salient features and procedure – Critical difference test
Randomized Block Design (RBD) – Salient features – procedure – Least Significant Difference Test (LSD)
Latin square Design (LCD) – Salient features – procedure
Transformations – Square root transformation, Arc sin transformation and Logarithmic transformation – principles and procedures
Analysis of covariance – principle and procedure
Sampling methods – Introduction, principles
Simple random sampling and stratified random sampling
Cluster sampling, two stage sampling – applications and uses
Revision and recapitulation
PRACTICALS

Construction of frequency distribution table – Inclusive and exclusive methods of grouping
Continuous and discrete variables distribution
Diagrammatic representation of the data – bar diagram, component bar diagram, multiple bar diagram, pictograms. Graphical representation of data by histogram, frequency polygon, frequency curve and cumulative frequency curves
Computation of arithmetic mean and median for grouped and ungrouped data
Computation of mode, geometric mean and harmonic means
Computation of range, variance, standard deviation, standard error and coefficient of variation
Normal distribution – Fitting of the normal distribution
Test of hypothesis – One sample and two sample Z-test
Mean comparison – one sample and two sample t-test
Paired t-test – testing goodness of fit – Yates correction, 2 x 2 and R x C contingency tables
Chi-square test – testing goodness of fit – Yates correction, 2 x 2 and R x C contingency tables
Analysis of variance – one way and two way classifications – CD test
Computation of simple and multiple correlations and Spearman’s rank correlation coefficient
Estimation of simple linear regression coefficient, fitting regression equation and test of significance of regression coefficient
Fitting of multiple regression equations
Problems on CRD and RBD
Problems on Latin square design – estimation of components of covariance
AGB 601 ANIMAL CYTOGENETICS AND IMMUNOGENETICS 2+1

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.

AGB 602 MOLECULAR GENETICS IN ANIMAL BREEDING 2+1

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

AGB 603 POPULATION AND QUANTITATIVE GENETICS 2+1
IN ANIMAL BREEDING

Objective
To study genetic structure of animal population and importance of genetic variation and covariation among traits.

Theory

UNIT I

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

Suggested Readings

AGB 604 SELECTION METHODS AND BREEDING SYSTEMS 3+1
Objective
To explain the methodology of selection and breeding systems for genetic improvement of livestock and poultry.

Theory
UNIT I
Type of selection and their genetic consequences. Response to selection and its prediction and improvement of response to selection.
UNIT II
UNIT III
Selection of several traits. Evaluation of short term and long term selection experiments viz: bidirectional selection and asymmetry of response, selection plateaux and limit.
UNIT IV

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

Suggested Readings

AGB 605 BIOMETRICAL TECHNIQUES IN ANIMAL BREEDING 3+1

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, D2 - 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
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

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.
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

UNIT IV
Considerations in the import of exotic germplasm for breeding cattle in the tropics. Appraisal of buffalo and cattle breeding programmes. Role of breed associations in dairy improvement.

Practical

Suggested Readings
Lasley JF. 1987. Genetics of Livestock Improvement. 3rd Ed. IBH.

AGB 608 SMALL FARM ANIMAL BREEDING 2+0
(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
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

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
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
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
Objective
To impart knowledge about recent advances in population genetic theory and application in animal breeding.

Theory
UNIT I
Mating designs; genetic basis of triple 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, D2 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

Suggested Readings
Selected articles from journals.

AGB 704 ADVANCES IN SELECTION METHODOLOGY 2+1
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

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 BIOINFORMATICSINANIMALGENETICSANDBREEDING 2+0
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, SWISS-PROT, 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
Objective
To educate about the advances in cytogenetics and their application in animal genetic and breeding.

Theory
UNIT I

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 2+1 IN FARM ANIMALS

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.
List of Journals

- Animal Biotechnology
- Animal Production
- Animal Reproduction Science
- Animal Genetics
- Animal Science
- Animal Genetic Resource Information
- Asian-Australian Journal of Animal Sciences
- Biochemical Genetics
- Biometrical Journal
- Biometrics
- Biodiversity and Conservation
- British Veterinary Journal
- Canadian Journal of Animal Sciences
- Canadian Journal of Genetics and Cytology
- Chormosoma
- Chormosome Research
- Current Genetics
- Current Genomics
- Current Opinion in Genetics and Development
- Cytogenetics and Cell Genetics
- Developmental Genetics
- DNA Sequence
- DNA and Cell Biology
- Evolution
- Gene
- Gene Expression
- Gene Therapy
- Genetica
- Genetics
- Genetics and Molecular Biology
- Genetical Research
- Genome Research
- Genomics
- Heredity
- Immunogenetics
- Indian Journal of Animal Science
- Indian Journal of Experimental Biology
- Indian Journal of Heredity
- Indian Journal of Animal Reproduction
- Japanese Journal of Breeding
- Journal of Animal Genetics & Breeding
- Journal of Dairy Research
- Journal of Dairy Sciences

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Suggested Broad Topics for Masters and Doctoral Research

- 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
- Genetics of Disease Resistance
## ANIMAL NUTRITION

### Course Structure

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ANIMAL NUTRITION
Course Contents

ANN 601  ANIMAL NUTRITION – ENERGY AND PROTEIN  3+0

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
UNIT III
Rumen degradable Protein (RDP), and rumen undegradable protein (UDN) and Kinetics. Energetics of protein synthesis and turn over. Quantification of microbial protein synthesis. Protein quality determination in monogastras and utility.
UNIT IV

Suggested Readings
Objective

Theory
UNIT I
Definition, history, classification, chemistry, functions, deficiencies and excesses, requirements and sources of water soluble and fat-soluble vitamins.

UNIT II

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

Suggested Readings
ANN 603 FEED TECHNOLOGY 1+1

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
Gohl BO. 1985. Tropical Feeds. FAO.
ANN 604  FEEDCONSERVATION, STORAGE AND QUALITY CONTROL 2+2

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 feed 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

ANN 605 RUMINANT NUTRITION 2+1

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

ANN 606 NON-RUMINANT NUTRITION 1+1
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 swine during 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
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

ANN 607 NUTRITION OF COMPANION, LABORATORY, WILD AND ZOO ANIMALS 2+1
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

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
Givens DI, Owel E, Aford REF & Omed HM. 2000. Forage Evaluation in Ruminant Nutrition. CABI.

ANN 608  RESEARCH TECHNIQUES IN ANIMAL NUTRITION  1+3

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

Suggested Readings

ANN 609 NONCONVENTIONALFEEDSTUFFSANDTOXIC 2+1
CONSTITUENTS / ANTIMETABOLITES IN ANIMAL FEEDSTUFF

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

ANN 701 MODERNCONCEPTSOFFEEDINGRUMINANTSANDFORAGE3+0 UTILAZIATION

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

UNIT III
UNIT IV
Seminars on current topics of special interest.

Suggested Readings
Selected articles from journals

ANN 702 MODERNCONCEPTS OFFEEDINGMONOGASTRICANIMALS 2+0

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

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

Selected articles from journals

ANN 703 NUTRITION AND RUMEN FERMENTATION 1+1

Objective
To impart knowledge on nutrient requirements for neonatal and postnatal 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
Practical
- Microbial and protozoal count, Determination TVFA by chromatography.

Suggested Readings
- Selected articles from journals.

ANN 704 ADVANCES IN MICRONUTRIENTS

Objective
To impart knowledge on nutrient requirements for neonatal and postnatal development of livestock, recent concepts of rumen fermentation and its manipulation.

Theory
UNIT I

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

Suggested Readings
- Selected articles from journals.

ANN 705 ADVANCED TECHNIQUES IN NUTRITION AND RESEARCH

Objective
To impart knowledge on use of advanced analytical techniques in nutrition research.

Theory
UNIT I
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

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

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

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
Objective
To impart knowledge on the effects of drugs on nutrient utilisation

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

Suggested Readings
Selected articles from journals.

ANN 709 NEWFEEDRESOURCESANDTOXICANTSINANIMALFEEDING 2+0
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

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.
List of Journals

- Animal feed science and technology
- Animal research
- Animal science journal
- Archives of animal nutrition
- British journal of nutrition
- British poultry science
- Grass and forage science
- International journal of sheep and wool science
- Italian journal of animal science
- Journal of animal and feed sciences
- Journal of animal physiology and animal nutrition
- Livestock research for rural development
- Malaysian journal of nutrition
- Nutrition journal
- Pakistan journal of nutrition
- Small ruminant research
- Animal nutrition and feed technology
- Australian journal of animal sciences
- Canadian journal of animal sciences
- Feed industry review
- Feed international
- Feed management
- Feed stuffs
- Feed trends
- Indian journal of animal nutrition
- Indian journal of animal science
- Indian journal of dairy science
- Indian journal of poultry sciences
- Journal of animal nutrition
- Journal of food science and technology

e-Resources

- http://www-biol.paisley.ac.uk/kinetics/contents.html
- http://www.das.psu.edu/dairynutrition/
- 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/
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
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LIVESTOCK PRODUCTION MANAGEMENT
Course Contents

LPM 601 CATTLEANDBUFFALOPRODUCTIONANDMANAGEMENT  2+1

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-relationships - 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
LPM 602  SHEEP AND GOAT PRODUCTION AND MANAGEMENT  2+1

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, Tipping

UNIT V
Wool: Importance of wool - Fiber structure- Fleece characters - Goat fibers - Characters of mohair and pashmina, fur and Angora - Marketing of goat fibers / 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.
**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**

**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**
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

LPM 605 SHELTER MANAGEMENT 1+1

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 in different 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


Wathes CM & Charles DR. 1994. Livestock Housing. CABI.

LPM 606 PRINCIPLES OF ENVIRONMENTAL HYGIENE AND WASTE MANAGEMENT 2+0

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 a 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

LPM 607 CLIMATOLOGY AND ANIMAL PRODUCTION 1+0

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 - Microclimate 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 climographs and hythergraphs - Estimation of cooling power of atmosphere-heat tolerance test in bovines.

Suggested Readings
Siddhartha K & Roger B. 1996. Atmosphere, Weather and Climate. ELBS.

LPM 608 POULTRY FARM AND HATCHERY MANAGEMENT 2+1

Objective
To acquaint students on basic aspects of housing, feeding, breeding and health care 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 of farm 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

LPM 609 FARM ANIMAL BEHAVIOR 1+0

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 management
practices - Favourable and unfavourable behaviour for domestication - Behavioural adaptations under domestication.

UNIT IV

Suggested Readings
Fraser AF & Broom DM. 1997. Farm Animal Behaviour and Welfare. CABI.

LPM 610 INTEGRATED LIVESTOCK FARMING SYSTEM

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
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
Pilliner S. 1994. Care of the competition Horse. BT Batsford.
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

LPM 613 LIVESTOCK BUSINESS MANAGEMENT 1+1

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

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

LPM 701 ADVANCES IN CATTLE AND BUFFALO PRODUCTION AND MANAGEMENT

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 agroclimatic zone of India - Management systems for cattle and buffaloes.

UNIT III
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

UNIT VI
Advances in health management of dairy animals, metabolic diseases of high yielders- advances in preventive measures for production related diseases

Suggested Readings
Selected articles from journals.
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
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 1+0
AND MANAGEMENT
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 & 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 MANAGEMENT 2+1

Objective

To educate the students on advances in housing, feeding, breeding and health care in poultry farming.

Theory

UNIT I
Planning, organisation, 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.
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\textsubscript{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

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 CO\textsubscript{2} 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
Selected articles from journals.

LPM 707 ADVANCES IN EQUINE MANAGEMENT 2+0
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 work horses
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.
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 Poultry Science
- Indian Journal of Field Veterinarians
- 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
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

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* Non-Credit (Satisfactory/Unsatisfactory)
LIVESTOCK PRODUCTS TECHNOLOGY
Course Contents

LPT 601  FRESH MEAT TECHNOLOGY  1+1
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

Practical

Suggested Readings

LPT 602  MEAT PROCESSING, PACKAGING, QUALITY CONTROL AND MARKETING  2+1
Objective
To impart knowledge on preservations, methods, product development, quality control and packaging practices in meat.
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-Barbecuing 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 a 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, subjectice and objective method of sensory evaluations.

Suggested Readings
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, cut-up 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, irradiation, curing, smoking, barbecuing, cooking and preparation of further processed poultry and fish products.

Practical
Organization, sanitation and maintenance of poultry processing plants. Slaughtering, ante-mortem 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 foams of egg, visit of egg powder plant/egg processing plant poultry and fish products and its Proximate analysis, microbiological and sensory evaluation and poultry meat and fish.

Suggested Readings
Mountney GJ. Poultry Products Technology. 2nd Ed. AVI Publ.
LPT 604  EGG AND EGG PRODUCTS TECHNOLOGY  1+1

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

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

LPT 605  ABATTOIR AND POULTRY PROCESSING PLANT PRACTICES  1+1

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 its 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, judgement 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

LPT 606 SLAUGHTER HOUSE BYPRODUCTS TECHNOLOGY 2+1

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 by-products and other minor by-products for industrial exploitation.

UNIT II
Meat fat characteristics - Preservation and Processing of ruminal contents – Ensiling of ruminal contents – Value products preparation from slaughterhouse by-products, 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

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

LPT 607 PROCESSING AND MARKETING OF WOOL 2+1

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

LPT 608 MARKET MILK PROCESSING AND DAIRY PLANT PRACTICES 2+1

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

UNIT IV
Membrane processing and related techniques; application of ultrafiltration, 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

Suggested Readings

LPT 609 QUALITY CONTROL OF MILK AND MILK PRODUCTS 1+1

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

Suggested Readings

LPT 610 TECHNOLOGY OF MILK PRODUCTS 2+1
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

UNIT IV
Manufacturing of casein- caseinate- co-precipitates- Whey protein concentrate (WPC) - lactose- dairy whiteners; functional properties of whey proteins-casein- co-precipitates- Ultra Filtration retentate and their modifications.

UNIT V

Practical
Preparation of butter- panneer- channa- ghee- ice cream- cheese-cheddar-Mozzarella and cottage cheese- khoa- dahi- yoghurt- casein- caseinate-coprecipitate- determination of degree of browning chemical/physical methods; measurement of different functional properties of different milk products.

Suggested Readings
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
(Non Credit: Satisfactory/Unsatisfactory)

Objective
To impart industrial exposure to post graduate students in meat, milk, poultry and fish industry.

Practical
APT students will undergo in-plant training in any one of the specialized area of Animal 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 Project report.

Suggested Readings
Selected articles from journals.

LPT 701 ADVANCES IN ABATTOIR PRACTICES AND ANIMAL BYPRODUCTS UTILIZATION 2+1

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– SSOP – 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

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
Selected articles from journals.

LPT 702 ADVANCES IN FRESH MEAT AND PROCESSED MEAT PRODUCTS TECHNOLOGY 3+1

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
Prefabricated meat – Chemical residues in meat and their effects on the health of the consumer.

UNIT II

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

UNIT IV
Fermented meat products-heat processing-restructured meat products-Reformrd 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

Organoleptic evaluation of meat-Estimation 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-Visit of meat/poultry processing units.
Suggested Readings
Woodhead Publ. Ltd., UK.
Selected articles from journals.

LPT 703 ADVANCES IN POULTRY PRODUCTS TECHNOLOGY 2+1

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
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

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

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

Practical
Use of Starter cultures, lyophilization process, Maintenance of cultures.
Demonstration of Membrane processing Technology, Advances in Packaging-Retort, Vacuum and Control Atmosphere Packaging Technology.

Suggested Readings
Selected articles from journals.

LPT 705 ADVANCES IN QUALITY CONTROL OF LIVESTOCK PRODUCTS  2+0

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

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 products.

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, anti-microbial agents to improve the product quality and safety-Polymerase Chain Reaction (PCR).

Suggested Readings
Selected articles from journals.
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
Suggested Broad Topics for Master’s and Doctoral Research

- Development of shelf stable meat products
- Development of intermediate moisture meat products
- Application of active packaging for improving shelf life
- Development of low sodium meat products
- Development of low fat meat products
- Enrichment of meat with fiber
- Enrichment of meat with calcium
- Utilization of edible byproducts
- Utilization inedible byproducts
- Prevention of oxidative rancidity in meat products
- Development in processing of poultry meat.
- Recent advances in processing of egg and egg products.
- Recent advances in preservation and quality control of egg and egg products
- Development in packaging, regulations and standards of poultry meat.
- Development in preservation and quality control of poultry meat.
- Development of functional casinates for food industry
- Development of phytoformula
- Development of geriatric biofoods
- Development of hydrolysed lactose milk drinks to lactose intolerants
- Membrane utilization in indigenous dairy products
## POULTRY SCIENCE
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POULTRY SCIENCE
Course Contents

PSC 601  POULTRY BREEDING AND GENETICS  2+1

Objective
To impart knowledge on different systems of breeding, selection methods, design and implementation of breeding programme in developing egg-type and meat type birds. Modern tools in poultry breeding.

Theory
UNIT I

UNIT II
Systems of Breeding – Systems of Mating – Selection methods – Breeding programme for developing egg-type and Broiler type of birds – Developing hybrids - Other species of Poultry breeding and management - Formation and Management of inbred, pure lines, grand parent and parent stock.

UNIT III
Industrial breeding-Artificial insemination in chicken-Autosexing-Random SampleTest. Use of molecular genetics in poultry breeding-Quantitative trait loci and marker-assisted selection-Conservation of poultry genetic resources.

Practical
Breed of poultry – Factors affecting inheritance of qualitative and quantitative traits in poultry - Constructing index and Osborne index-Estimating heritability – Breeding program for developing commercial hybrid layers, broilers, Japanese quail, duck, turkey, fancy birds, Guinea Fowl and Pigeons – Semen collection, evaluation & insemination in chicken & turkey – Breeding records –Use of computers to maintain breeding records and for selection.

Suggested Readings

PSC 602  POULTRY NUTRITION AND FEEDING  2+1

Objective
Teaching about nutrients & their functions, nutrient requirements of poultry and factors influencing the same. Imparting knowledge of different types of feeds and feeding methods.

Theory
UNIT I
Digestive system, digestion, metabolism and absorption of feed in poultry – Factors influencing the feed consumption in birds – Macro and micro-nutrients – Nutrient requirements for various species of poultry. Partitioning of energy -
Calorie: protein ratio – Nutrient interrelationships – Factors influencing the nutrient requirements.

UNIT II

UNIT III

UNIT IV

Practical

Suggested Readings

PSC 603 COMMERCIAL LAYER PRODUCTION 2+1
Objective
To impart knowledge on different systems of rearing commercial egg laying birds, care and management of commercial layers for optimal egg production.

Theory
UNIT I
farm equipments – Automation in poultry houses and its maintenance – Management of layers in different systems of rearing.

UNIT II
Deep litter & cage system of management – Medication and vaccination schedules & procedure for layers – Lighting programme for egg type birds - Water quality standards, watering of layer and water sanitation – Brooder, grower and layer management – All in All out and Multiple batch system of rearing layers.

UNIT III
Management of layers during peak egg production and maintaining the persistency in production – Factors causing uneven growth and low egg production - Monitoring egg production curve.

UNIT IV
Culling of unproductive birds – Record keeping – Biosecurity & health management – Management during different seasons – Induced moulting - HACCP application for safe egg, value added egg production – Production of eggs free from harmful microbes, Mycotoxins & drug residues - Integration in layer production.

Practical
Layer farm lay out and blue print – Design of different chick, grower & layer houses, their specifications & blue print of deep litter and cage system – Selection & culling of layers, debeaking, dubbing, deworming, delicing, vaccination & other farm routines and operations – Farm sanitation, disinfection & waste disposal – Maintaining farm records – Visit to commercial layer farms – Record keeping – Calculating Hen day egg production, Hen housed egg production and other economic traits – Case study of production loss, reasons and corrective measures – Preparing project reports for layers under different batch systems – Calculating the cost of production of eggs.

Suggested Readings

PSC 604
COMMERCIAL BROILER PRODUCTION 2+1

Objective
To deal with different systems of rearing commercial broilers, manage mental practices for higher bodyweight with best feed efficiency in commercial broilers. Marketing of broilers efficiently.

Theory
UNIT I
Broiler Industry in India and the World – Systems of rearing broilers – Location, layout and design of Broiler houses – Broiler farm equipment.

UNIT II
Brooding and rearing of broilers- All in all out and multiple batch systems – Litter materials and deep litter management – Lighting for broilers – Environmentally controlled broiler houses & their management – Water quality and Watering of broiler and water sanitation- Management during different seasons.
UNIT III
Mash, crumble and pellet feeding of Broilers – weekly growth rate, feed conversion and livability in broilers- sex separate feeding – Feeding broilers for optimum growth rate & feed efficiency- Broiler performance indices – Broiler farm records.

UNIT IV

Practical
Location and blue print for a broiler farm – Broiler house design – Preparation of project report for broiler farm – Visit to broiler farms – Judging of live broilers and ready-to-cook broilers– Broiler vaccination, medication, brooding and transportation and farm routines. Record keeping - Calculating the cost of production of broilers – Feeding of broilers at different ages – Working out Feed efficiency – Case study on low body weights, reasons and corrective measures.

Suggested Readings

PSC 605 BREEDER STOCK, FLOCK HEALTH AND HATCHERY MANAGEMENT

Objective
To impart knowledge about care and management of breeders, hatchery operation, health management. And to study about common diseases and disorders of poultry, diagnosis, vaccination, prevention, control and treatment. Bio security measures in control of general & hatchery borne diseases.

Theory
UNIT I
History of Natural and Artificial incubation- embryo development-different breeder flocks – Planning a hatchery, breeder farm – Special care of breeder flock – Collection, selection and care of hatching eggs – Breeder male and female management – Flock testing & culling - Farm and hatchery equipments – Incubation practices – Ventilation and temperature control – Hatchery Management, Fumigation and sanitation – Breeder farm and hatchery operations, routine & schedule - Factors affecting fertility and hatchability.

UNIT II
Care of day old chicks and their vaccination - Restricted & controlled feeding of breeders – Sex separate feeding and nutrient supplementation. – Seasonal management of breeders – Location of hatchery – Layout and design of breeder houses, hatchery & other buildings.

UNIT III
Biosecurity, health management and waste disposal – Vaccination & medication schedule for breeders. Control of vertically transmissible & hatchery borne diseases.
UNIT IV

UNIT V
Hatching egg & SPF egg import and export regulations – Maintaining Salmonella and Mycoplasma free breeding flock – Application of HACCP and Good Management Practices (GMP) in hatchery management for better chick quality.

Practical
Breeder farms and hatchery records, selection, fumigation, care and storage of hatching eggs. Layout and blue prints for breeder farm and hatchery – Incubation requirements – Incubator management – Hatchery sanitation & fumigation procedures – Pedigree hatching – Hatchery waste disposal and recycling – Calculating cost of production of hatching eggs and day-old-chicks – Attending breeder farm routines & operation – Flock testing & culling of reactors – Analyzing hatchability results and hatchery records-Economics of layer and broiler hatchery.

Suggested Readings

PSC 606 MANAGEMENT OF POULTRY OTHER THAN CHICKEN 2+1
Objective
Care and management of different breeds, varieties of poultry other than chicken, methods of rearing and common diseases affecting them and their control measure.

Theory
UNIT I
Breeds and varieties of Turkey, Duck, Goose, Pigeon, Guinea fowl, Budgerigar, Japanese quail, Emu and Ostrich – Incubation periods & incubation procedure for different species – Housing, cage & equipments for different species – Duck, Turkey, Japanese Quail, Guinea fowl, Emu, Ostrich production and rearing under different systems.

UNIT II
Management and rearing of Turkey, duck, goose, Guinea fowl, Japanese quail, pigeon, emu and ostrich- Feeding standards and feeding, watering and rearing
systems and procedure for different species of poultry - Breeding policies of egg and meat production in different species – Preparation of Project reports for different species for commercial exploitation.

UNIT III
Common diseases affecting poultry other than chicken and their control – Regulations for import and export of different species of poultry – prevention of exotic diseases through import of poultry products and live birds.

Practical
Layout and design of housing & cages for other species of poultry. Visit to commercial Japanese quail, turkey and duck farms. Incubation and care of hatching eggs and young ones – Rearing practices followed by duck, quails and turkey farmers under field conditions. Preparing project reports for different species and calculating the cost of production.

Suggested Readings

PSC 607 Poultry Products Technology and Marketing 2+1

Objective
Composition and nutritive value of eggs and chicken meat, grading and preservation methods of eggs and meat, functional and value added poultry products, marketing of eggs and poultry meat.

Theory
UNIT I
Physical and chemical composition and nutritive value of eggs and meat – Grading of eggs & meat by different standards – Preservation of eggs - Egg quality deterioration - Factors affecting egg quality – Handling, processing, packaging materials, packaging, transport and marketing of eggs.

UNIT II
Quality control of poultry meat – Quality preservation – Marketing of egg and poultry meat – Marketing channels – Integration in poultry processing and marketing - Functional and value added eggs and meat – Further processing of eggs and meat – Various egg and meat fast foods.

UNIT III
Sanitary and phyto sanitary measures to ensure food safety – Post oviposition value addition to the eggs & Post processing value addition to the meat for export – Production of low cholesterol eggs – Microbial safety of poultry products – Import and export of poultry products – Further processing of poultry for export – Implementation of GMP and HACCP procedures for food safety – Codex regulations for poultry products safety.

Practical
Suggested Readings

PSC 608 POULTRY ECONOMICS, PROJECTS AND MARKETING 2+1
Objective
To study about measures of performance efficiency in poultry farms and its allied sector, components of project reports and preparation of viable projects related to poultry Industry.

Theory
UNIT I
Glossary of terms used in poultry economics & projects – Measures of performance efficiency in broiler, layer, breeder and other poultry species, hatcheries and other poultry related operations – Production standards and goals.

UNIT II
Planning poultry enterprise – Bank norms for poultry projects – Poultry insurance – Methods to improve the production efficiency and reduce the production cost - Components of project reports and preparing projects.

UNIT III
Integration in Poultry production – Marketing channels for eggs and meat – Integration in marketing of eggs and meat - Cost of production of egg, broiler, hatching egg, day-old chick, compounded feed - Effect of new economic policies on poultry industry – Viability of poultry projects.

Practical
Preparing different poultry projects for bank finance – Calculating the cost of production of various products under various systems-case study – Preparation of Balance sheet, break even points, benefit: cost ratio & other farm economic indices - Preparation of feasibility & viability reports.

Suggested Readings

PSC 609 PHYSIOLOGY OF POULTRY PRODUCTION 2+1
Objective
To study the basic principles of physiology of poultry production in relation to egg formation, production, incubation, stress and role of environment.

Theory
UNIT I
Skeletal system of poultry – Comb pattern, plumage - Physiology of poultry digestive system- Digestion, metabolism and absorption of feed and water – Role of enzymes – Poultry circulatory system – Respiratory system – Physiology of growth- muscle growth-bone growth and growth of body parts-Types of muscle fibre and functions.

UNIT II
Poultry nervous system and its function – Excretory system – Male and female reproductive system-Reproductive tract-Semen production-semen characteristics-

UNIT III
Neuro-endocrine control of egg production-Ovulation and Oviposition – Clutch and Pause.

Practical

Suggested Readings

PSC 701 APPLIED POULTRY NUTRITION 2+1
Objective
Teaching about nutrients and their functions, nutrient requirements of poultry and factors influencing the same. Different methods and forms of feeds and feeding of poultry.

Theory
UNIT I
Developments in the nutrient requirement for egg and meat-type chicken - Concepts in various poultry feeding procedures and methods for optimal production - Factors influencing the nutrient requirements, feed intake and feed efficiency in poultry- Problems encountered in nutritional deficiencies - Protein and energy utilization and calorie protein ratio, Vitamins, minerals and their interactions in poultry rations.

UNIT II
In Ovo - Juvenile nutrition for optimal growth rate and feed efficiency – Care in grower feeding - Nutrition and feeding of layers / breeders during peak egg production- Nutritional requirements for higher egg production, broiler meat production, higher fertility and hatchability and other special purposes.

UNIT III

UNIT IV
HACCP implementation in feed quality control – Production of drug, Mycotoxins and pesticide residue free feeds.

Practical
Computing of specialty and functional feeds – Estimation of available carbohydrate, Aflatoxin, tannins, hydro cyanic acid and other toxins in the feed. Evaluation of various feeds for its quality – Field methods of feed quality control

Suggested Readings
Selected articles from journals.

PSC 702 CONCEPTS IN COMMERCIAL POULTRY PRODUCTION 2+1

Objective
To impart knowledge on different systems of poultry rearing, care and management of commercial layers/broilers for optimal egg and meat production.

Theory
UNIT I
Global trends in poultry production - Advances in broiler production in India – concepts in egg production – Latest concepts in breeder management – advances in hatchery operations for higher hatchability & chick quality.

UNIT II
Optimal microclimatic condition in poultry houses and cages for higher production – Management of poultry in environmentally controlled houses – Management of poultry under adverse climatic conditions – advances in the management of other species of poultry - Behaviour patterns of poultry in different growing systems.

UNIT III
Advanced management techniques for egg and meat production - advances in lighting management, feeding management, litter management and manure management.

UNIT IV
The role of integration in poultry production – Factors influencing egg production in different species of poultry – Factors influencing growth rate and egg production - Automation in poultry production.

UNIT V
Regulations for cage-free egg production and organic chicken production – Functional feeds for functional foods – Production of HACCP and GMP certified table eggs, meat, chicks, hatching eggs and other value added products for export.

Practical
Performance study in commercial layer, broiler, Japanese quail, duck, turkey and other species of poultry farms by Interpretation of the farm records - Managemental routines of different species of poultry - calculating the cost of production –Estimation of microclimatic condition and comparing the productive traits – Modern poultry house and cage design for optimal efficiency and cost reduction.

Suggested Readings
Selected articles from journals.
PSC 703 DEVELOPMENTS IN POULTRY PRODUCT TECHNOLOGY 2+1

Objective
Composition and nutritive value of eggs and chicken meat, grading, packaging and preservation methods of eggs and meat, functional and value added poultry products, marketing of eggs and poultry meat.

Theory
UNIT I
Global trends in poultry and egg processing - Indian scenario of poultry processing industry - Nutrients & Non-nutrient components in regular and value added poultry products – various measures of egg and meat quality control – advances in value addition to poultry products.

UNIT II
Concepts in poultry meat and egg preservation – Newer concepts in meat tenderization, canning, dehydration, curing, irradiation, etc. - Modified atmosphere packaging - Other processed products - Room temperature preservation of poultry fast foods by multi hurdle technology.

UNIT III

UNIT IV
Improving the product quality to meet Codex & European standards – Standards for egg, meat and their products - Production of immunoglobulins, lecithin, lysozyme, sialic acid and other pharmaceutical products from eggs – Sanitary & phytosanitary measures for food safety.

Practical

Suggested Readings
Selected articles from journals.

PSC 704 EMERGING DISEASES OF POULTRY AND FLOCK HEALTH 2+1

Objective
To study about common diseases and disorders of poultry, their diagnosis, vaccination, prevention & treatment, emphasis on control of emerging poultry diseases of zoonotic importance, disease diagnostic techniques.

Theory
UNIT I
The concepts of disease prevention in poultry – Emerging and reemerging avian diseases -Factors influencing immuno suppression and stimulation – Developing immunity in poultry
UNIT II
Water sanitation, hatchery sanitation procedures - Control of vertically transmissible diseases – non-infectious and metabolic diseases in poultry and their control – Bio security – Mycotoxins and their control.

UNIT III

UNIT IV
Flock management for Specific pathogen free egg production – Maintaining the HACCP standards in poultry farms – developments in the Exim policies for flock health.

Practical

Suggested Readings
Selected articles from journals.

PSC 705 ADVANCED POULTRY BREEDING METHODS 2+1

Objective
To impart knowledge about different systems of breeding, selection methods and implementation of breeding programme in developing egg-type and broiler hybrids. Modern tools in poultry breeding.

Theory
UNIT I

UNIT II
Modern methods in commercial layer and broiler breeding, performance testing – Pure line breeding – Inbreeding and hybridization - Diallele mating, lethal and semi lethals in poultry. Pedigree hatching. Genotype versus environmental interaction.

UNIT III
Practical
Construction of selection index – Analysis of breeding data collected from breeding records – Problem in qualitative and quantitative inheritance- Estimation of heritability and standard error of heritability by different methods – analysis of heritability for different traits – Estimation of inbreeding coefficient – Artificial insemination in poultry.

Suggested Readings
Muir WM & Aggrey SE. 2003. Poultry Genetics and Biotechnology. CABI. Selected articles from journals.

Objective
To study about measures of performance efficiency in poultry farms and its allied sectors, hatcheries and developing poultry projects.

Theory
UNIT I

UNIT II

UNIT III
Future trends in broiler and egg production –factors influencing the profit margin in poultry enterprises.

Practical
Study of marketing channels of egg and meat, calculating cost of production of eggs, meat, day-old chick, feed and processing plants– preparing other related poultry projects.

Suggested Readings
### List of Journals

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<thead>
<tr>
<th>Journals</th>
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<tbody>
<tr>
<td>Avian Diseases</td>
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<td>Avian Pathology</td>
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<td>British Poultry Science</td>
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<td>Indian Journal of Poultry Science</td>
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### e-Resources

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Suggested Broad Topics for Master’s and Doctoral Research

- Breeding programs for different species of poultry to improve the economic traits.
- Utilization of conventional and unconventional feeds in poultry rations.
- Study on exogenous enzymes, probiotics for increasing the feed efficiency in poultry.
- Evolving ways and means for the improving the performance of commercial, broilers and layers for higher economic gains.
- Micro and trace minerals requirements study for broiler and layers.
- Designing and development of eco friendly and environmentally controlled houses for large commercial poultry farms.
- Standardizing the disinfections procedures for sustainable poultry production.
- Standardizing the sanitary and phyto sanitary measures for safe production of eggs and broilers.
- Prevention and control of toxin, pesticides and antibiotic residues in egg and meat.
- Value added egg and poultry meat products program
- Development of fast foods by utilizing poultry egg and meat.
- Development and standardization of designer eggs and low fat high protein poultry meat.
- Preservation, storage, packaging of value added egg and meat products and their standardization.
- Reduction of pollution from poultry farms and processing plants.
- Profitable utilization of Poultry waste and manure.
- Development and standardization of organic poultry farming and standards for phyto sanitary measures
- Standardization of managerial, nutritional methods and schedules for rearing turkeys, guinea fowls, geese, Japanese quails and domesticated ratites.
- Development of suitable varieties of turkeys and guinea fowl suitable for different agro climatic conditions.
- Development of suitable birds for backyard poultry.
- Poultry bio security measures in organized farms.
- Studies on diseases affecting turkeys, guinea fowl, Japanese quail and their preventive measures.
- Disease surveillance, forecasting and development of field level diagnostic kits.
Veterinary Clinical Subjects
Veterinary Gynecology & Obstetrics
Veterinary Medicine
Veterinary Surgery & Radiology
## Suggested list of specified minor subjects (departments)

<table>
<thead>
<tr>
<th>Major Subject</th>
<th>Minor Subjects*</th>
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<tbody>
<tr>
<td>Veterinary Gynecology and Obstetrics</td>
<td>Veterinary Surgery &amp; Radiology, Veterinary Physiology, Veterinary Biochemistry, Veterinary Medicine, Veterinary Biotechnology, Veterinary Pharmacology &amp; Toxicology, Animal Nutrition</td>
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<tr>
<td>Veterinary Medicine</td>
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<tr>
<td>Veterinary Surgery and Radiology</td>
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*The choice of minor courses other than those listed above, may be allowed on the recommendations of advisory committee, if essentially required as per the research problem with the concurrence of the Head of the department and Dean.
## VETERINARY GYNAECOLOGY & OBSTETRICS
### Course Structure

<table>
<thead>
<tr>
<th>CODE</th>
<th>COURSE TITLE</th>
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<tbody>
<tr>
<td>VOG 601</td>
<td>GENERAL GYNAECOLOGY</td>
<td>3+1</td>
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<tr>
<td>VOG 602</td>
<td>FEMALE INFERTILITY</td>
<td>3+1</td>
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<tr>
<td>VOG 603</td>
<td>VETERINARY OBSTETRICS</td>
<td>2+2</td>
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<tr>
<td>VOG 604</td>
<td>ANDROLOGY &amp; MALE INFERTILITY</td>
<td>3+1</td>
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<tr>
<td>VOG 605</td>
<td>SEMEN PRESERVATION AND ARTIFICIAL INSEMINATION</td>
<td>2+1</td>
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<td>VOG 606</td>
<td>REPRODUCTIVE BIOTECHNOLOGY</td>
<td>2+1</td>
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<td>VOG 607</td>
<td>CLINICAL PRACTICE I</td>
<td>0+3</td>
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<td>VOG 608</td>
<td>CLINICAL PRACTICE II</td>
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<tr>
<td>VOG 691</td>
<td>MASTER’S SEMINAR</td>
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<tr>
<td>VOG 699</td>
<td>MASTER’S RESEARCH</td>
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<tr>
<td>VOG 701</td>
<td>ADVANCES IN GYNAECOLOGY</td>
<td>2+1</td>
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<tr>
<td>VOG 702</td>
<td>ADVANCES IN OBSTETRICS</td>
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<td>VOG 703</td>
<td>ADVANCES IN ANDROLOGY</td>
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<td>VOG 704</td>
<td>ADVANCES IN REPRODUCTIVE BIOTECHNOLOGY</td>
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<td>VOG 705</td>
<td>ADVANCES IN SEMEN PRESERVATION</td>
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<td>VOG 706</td>
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<td>VOG 707</td>
<td>CLINICAL PRACTICE II</td>
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<td>VOG 792</td>
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<tr>
<td>VOG 799</td>
<td>DOCTORAL RESEARCH</td>
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</tbody>
</table>
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

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

UNIT VII
Lactation and artificial induction of lactation.

Practical

Suggested Readings
VOG 602  
**FEMALE INFERTILITY**  
3+1

**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**  

**Suggested Readings**


VOG 603  
**VETERINARY OBSTETRICS**  
2+2

**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
Pelvimetry of different species of farm animals. Diagnosis and correction of abnormal fetal presentation, position and posture in phantom box.
Epidural anesthesia, ovariohysterectomy and caesarean operation.
Handling of clinical cases of dystocia.

Suggested Readings

VOG 604 ANDROLOGY AND MALE INFERTILITY 3+1

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

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

Suggested Readings

VOG 605 SEMEN PRESERVATION AND ARTIFICIAL INSEMINATION 2+1

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

Suggested Readings

VOG 606 REPRODUCTIVE BIOTECHNOLOGY 2+1

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

Suggested Readings
Gordon I. 2004. Reproductive Technologies in Farm Animals. CABI.

VOG 607 CLINICAL PRACTICE - I 0+3
Objective
Hands-on training on diagnosis and treatment of reproductive disorders in animals in TVCSC.
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

VOG 608 CLINICAL PRACTICE – II 0+3
Objective
Hands-on training on diagnosis and treatment of reproductive disorders in animals in TVCSC.
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

VOG 701 ADVANCES IN GYNAECOLOGY 2+1
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
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 VI
Diagnostic & therapeutic approaches in infertility: Principles of hormone therapy in reproductive disorders, Laparoscopy, 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

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 ovario-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.
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
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
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

Suggested Readings
Selected articles from journals.

VOG 705 ADVANCES IN SEMEN PRESERVATION 1+1

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

Suggested Readings
Selected articles from journals.
VOG 706  CLINICAL PRACTICE - I  0+3
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
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
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.
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.blackwellpublishing.com (International Journal of Andrology)
www.bioreprod.org (Biology of reproduction)
www.domesticanimalendo.com (Domestic Animal Androcrinology)
www.reproduction-online.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)
editorijar@yahoo.co.in (Indian Journal of Animal Reproduction)

Suggested Broad Topics for Master’s and Doctoral Research

Anoestrus: Endocrinological investigations
Reproductive biotechnology
Investigations into andrological problems
Management of obstetrical problems
## Veterinary Medicine
### Course Structure

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VETERINARY MEDICINE

Course Contents

VMD 601  RUMINANT CLINICAL MEDICINE - I  2+0

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

Theory
UNIT I
General systemic states.
UNIT II
Diseases of alimentary system, liver and urinary system.
UNIT III
Diseases of respiratory and nervous system.

Suggested Readings

VMD 602  RUMINANT CLINICAL MEDICINE - II  2+0

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

Theory
UNIT I
Diseases of cardiovascular system, blood and blood forming organs.
UNIT II
Diseases of musculoskeletal system and skin
UNIT III
Diseases of eyes, ears, nose

Suggested Readings
VMD 603  INFECTIONAL DISEASES OF RUMINANTS – I  2+1

Objective
To supplement cognitive learning with regard to recent progress made in the areas of etiology, pathogenesis, epidemiology, symptomatology, diagnosis, treatment and control of bacterial and fungal diseases of bovine, sheep and goats.

Theory
UNIT I
Mastitis, joint ill, ulcerative lymphangitis, anthrax, clostridal infections, black quarter, tetanus, bacillary haemoglobinuria, botulism, colibacillosis.
UNII T II
Pasteurellosis, listeriosis, compylobacteriosis, tuberculosis, Johne’s disease, braxy, enterotoxaemia, brucellosis, salmonellosis, leptospirosis.
UNIT III
Actinomycosis, actinobacillosis, ringworm, cutaneous streptothricosis, sporotrichosis, aspergillosis, coccidiodomycosis, rhinosporidiosis, mucormycosis, histoplasmosis, candidiasis, blastomycosis etc.

Practical
Application of latest diagnostic/serological tests and adoption of preventive measures for the control of various bacterial and fungal diseases of bovine, sheep and goats.

Suggested Readings

VMD 604  INFECTIONAL DISEASES OF RUMINANTS – II  2+1

Objective
To supplement cognitive learning with regard to recent progress made in the areas of etiology, pathogenesis, epidemiology, symptomatology, diagnosis, treatment and control of viral, rickettsial and parasitic diseases of bovine, sheep and goats.

Theory
UNIT I
Foot and mouth disease, vesicular stomatitis, vesicular exanthema, rinderpest, PPR, bovine viral diarrhea, mucosal disease, ephemeral fever, bovine herpes virus-1 induced syndromes, leucosia, viral pneumonia, pox diseases, infectious gastro-enteritis of viral etiology.
UNII T II
Bovine malignant head catarrh, rabies, scrapie, blue tongue, louping II, papillomatosis.
UNIT III
Bovine tropical theileriosis, babesiosis, anaplasmosis, trypanosomiasis, toxoplasmosis, coccidiosis.
UNIT IV
Sarcocystosis, fascioliosis, amphistomiosis, gastro-intestinal nematodiosis, schistosomiasis, verminous bronchitis, echino-cocciosis, coenurosis, tape worm infestations.

Practical
Application of latest diagnostic and serological tests for establishing disease diagnosis, designing preventive and control measures against major diseases of veterinary importance caused by viruses, rickettsiae, helminth parasites and blood protozoa.

Suggested Readings
Radostits OM, Gay CC, Blood DC & Hinchcliff KW. 2006. Veterinary Medicine, a
Objective
Study of diseases of various body systems of dogs and cats.

Theory
UNIT I
Specific needs of canine and felines, Pet psychology; pet behavior and adaptation needs; General systemic states.
UNIT II
Diseases of digestive system, liver and pancreas, cardiovascular system, blood and blood-forming organs.
UNIT III
Diseases of respiratory system, urogenital and nervous systems.
UNIT IV
Diseases of musculoskeletal system and skin.
UNIT V
Diseases of endocrine system, diseases of new born animals.

Suggested Books
Objective

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

Theory

UNIT I

Bacterial diseases: salmonellosis, campylobacteriosis, mycobacteriosis, actinomycosis, nocardiosis, streptococcosis, leptospirosis, borreliosis, tetanus, botulism. Viral diseases: canine-distemper, infectious caninehepatitis, parvovirus infection, rabies, infectious tracheo-bronchitis, corona virus infection.

UNIT II

Feline diseases: feline pan-leucopaenia, feline infectious peritonitis, feline herpesvirus, feline spongiform encephalopathy, feline calci virus, feline immuno-deficiency virus (FIV).

UNIT III

Toxoplasmosis, neosporosis, sarcoptic mange, demodectic mange, hookworm and toxocara canis infections, leishmaniasis, canine babesiosis, ehrlichiosis, hepatozoonosis.

Practical

Assignments, recent diagnostic/serological tests for the diagnosis of important diseases of dogs and cats. Vaccination schedule for various diseases. Collection of material from clinical cases.

Suggested Readings

UNIT III

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

Practical Postmortem examination of poultry birds, collection of material for isolation, antibiotic sensitivity assay, histopathology and demonstration of other routine diagnostic tests. Seromonitoring for important diseases and pullorum testing.


VMD 608 ZOO, WILD AND LABORATORY ANIMAL MEDICINE 2+0

Objective

Study of diseases and health management of zoo, wild and laboratory animals

Theory

UNIT I
Etiology, symptoms, diagnosis and management of various diseases of zoo, wild and laboratory animals.
Diseases of urinary system.

UNIT II
Diseases, restraint, feeding and health management of exotic animals kept as pets

Suggested Readings

Hafez ESE. (Ed.). Reproduction and Breeding Techniques for Laboratory Animals. Lea & Fabiger.
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

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

Suggested Readings
VMD 610       CLINICAL PRACTICE - I
Objective
Application of the theoretical concepts in practice
Practical
Diagnostic and therapeutic protocol application, specimen collection, examination and management of sick farm and companion animals.
Note: This course shall be conducted in TVCSC (College Clinics), where students shall participate in diagnosis and treatment of diseased animals.

VMD 611       CLINICAL PRACTICE - II
Objective
Application of the theoretical concepts in practice
Practical
Diagnostic and therapeutic protocol application, specimen collection, examination and management of sick farm and companion animals.
Note: This course shall be conducted in TVCSC (College Clinics), where students shall participate in diagnosis and treatment of diseased animals.

VMD 701       ADVANCES IN GASTROENTEROLOGY 2+1
Objective
Study of contemporary advancements 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.
Practical
Advanced clinical procedures for the diagnosis of diseases of gastrointestinal system and associated organs of farm and companion animals
Suggested Readings
Selected articles from journals.

VMD 702       ADVANCES IN CARDIOPULMONARY MEDICINE 2+0
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

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

Theory
UNIT I
Advances in diagnosis, therapy and control of diseases of nervous system
UNIT II
Advances in diagnosis, therapy and control of diseases of urogenital system
UNIT III
Advances in diagnosis, therapy and control of diseases of locomotor system

Suggested Readings
Selected articles from journals.

VMD 704 ADVANCES IN ENDOCRINE AND DERMATOLOGICAL DISORDERS 2+0

Objective
Study of recent advances in endocrine and dermatological disorders.

Theory
UNIT I
Advances in diagnosis, therapy and control of diseases of skin and integumentary system
UNIT II
Advances in diagnosis, therapy and control of diseases of endocrine system.

Suggested Readings
Selected articles from journals.

VMD 705 ADVANCES IN PREVENTION AND CONTROL OF INFECTIOUS DISEASES OF RUMINANTS 2+1

Objective
To understand advancements made in the field of etiology, pathogenesis, epidemiology, symptomatology, diagnosis, treatment and control of diseases of ruminants.

Theory
UNIT I
Bacterial diseases of economic importance in bovines, sheep and goats.
UNIT II
Viral diseases of economic importance in bovines, sheep and goats.
UNIT III
Fungal diseases of economic importance in bovines, sheep and goats.

UNIT IV
Blood protozoan and rickettsial diseases of economic importance in bovines, sheep and goats.

UNIT V
Parasitic diseases of economic importance in bovines, ovines and caprines.

Practical
Latest diagnostic and serological tests for establishing disease diagnosis, designing preventive and control measures for major diseases of veterinary importance caused by bacteria, viruses, fungi, rickettsiae, parasites and protozoa.

Suggested Readings

VMD 706 ADVANCES IN PREVENTION AND CONTROL OF DISEASE IN PET ANIMALS 2+1

Objective
To get students acquainted with advancements made in the field of prevention and control of important infectious diseases of pet animals.

Theory
UNIT I
Bacterial diseases of economic importance in pet animals.

UNIT II
Viral diseases of economic importance in pet animals.

UNIT III
Fungal diseases of economic importance in pet animals.

UNIT IV
Blood protozoan and rickettsial diseases of economic importance in pet animals.

UNIT V
Parasitic diseases of economic importance in pet animals.

Practical
Latest diagnostic and serological tests for establishing disease diagnosis, designing preventive and control measures against major diseases of pet animals caused by bacteria, viruses, fungi, rickettsiae, parasites and protozoa.

Suggested Readings
Selected articles from journals.

VMD 707 ADVANCES IN PRODUCTION DISEASES 2+0

Objective
Study of recent advances in production diseases.

Theory

UNIT I
Latest advances in diagnosis, therapy and prophylaxis of metabolic diseases of farm and companion animals.

UNIT II
Latest advances in diagnosis, therapy and prophylaxis of nutritional diseases of farm
and companion animals.

UNIT III

Latest advances in diagnosis and treatment of various poisonings and toxicities

Suggested Readings
Selected articles from journals

VMD 708 ADVANCES IN PAEDIATRICS AND GERIATRICS 1+0

Objective
Study of recent advances in paediatrics and geriatrics

Theory
UNIT I
Recent advances in diagnosis, therapy and control of diseases and management of emergencies of neonates
UNIT II
Recent advances in diagnosis, therapy and control of diseases and management of emergencies of geriatric animals

Suggested Readings
Selected articles from journals.

VMD 709 ADVANCES AND UPDATES IN THE DIAGNOSIS AND MANAGEMENT OF TOXICOLOGICAL CONDITIONS 1+1

Theory
Unit-I
Toxins and their sources (animals, environment, bacterial, plants and mycotoxins)

Unit-II
Toxicological conditions of Farm and companion animals and their management, pathophysiology, systemic effects and prevention protocols

Unit-III
An overview of chemicals, insecticides, herbicides, pesticides and Toxic residues

Practical
Diagnostic protocols recommended in toxicological conditions. Serological tests and advanced techniques in laboratory examination of clinical materials for toxic products, biological tests and residue analysis

VMD 710 ADVANCES IN PREVENTION AND CONTROL OF DISEASES IN POULTRY 2+1

Objective
To impart knowledge about latest advancements made in the field of prevention and control of important infectious diseases of poultry.

Theory
UNIT I
Bacterial diseases of economic importance in poultry.

UNIT II
Viral diseases of economic importance in poultry.

UNIT III
Fungal diseases of economic importance in poultry.

UNIT IV
Parasitic diseases of economic importance in poultry.
Practical

Latest diagnostic and serological tests for establishing disease diagnosis, designing preventive and control measures against major diseases of veterinary importance caused by bacteria, viruses, fungi and other parasites.

Suggested Readings

Selected articles from journals.

VMD-711 ADVANCES IN INFECTIOUS DISEASES OF LABORATORY AND ZOO ANIMALS

Objective

Learning of specific diseases of laboratory and zoo animals which will help in understanding, and managing them in good health and employing good sanitation and bio-security measures.

UNIT I

Specific diseases of laboratory animals caused by bacteria, viruses, fungi and parasites.

UNIT II

Specific diseases of zoo (captive) animals caused by bacteria, viruses, fungi and parasites.

Suggested Readings


VMD 712 EMERGING AND RE-EMERGING ANIMAL DISEASES

Objective

To create awareness about emerging and reemerging diseases and surveillance methods.

Theory

UNIT I

General concepts for emergence of new diseases and re-emergence of old diseases.

UNIT II

Epidemiology of globally and nationally important emerging/re-emerging diseases and designing of strategies for their prevention and control.

Suggested Readings

Selected articles from journals.
VMD 713 AADVANCES IN SWINE DISEASES  2+0

Objective
1. Learning of important infectious diseases of Swine.
2. Study of diseases of various body systems in Swine.

Theory
UNIT I
Important diseases of different systems including skin and piglets.

UNIT II
Swine diseases: mange, mastitis, metritis, agalactia, swine influenza, Hog cholera, African swine fever, swine pox, vesicular exanthema, Vesicular stomatitis, rabies

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

Suggested Readings

VMD 714 AADVANCES IN EQUINE DISEASES  2+0

Objective
Learning of important infectious diseases of equines, their diagnosis, prevention and control.

Theory
UNIT I
Important diseases of different body systems.

UNIT II
Tetanus, Strangles, glanders, clostridial infections.

UNIT III
African horse sickness, equine infectious anaemia, equine influenza, rabies, Equine encephalomyelitis, ulcerative lymphangitis.

UNIT IV
Trypanosomiasis, babesiosis

Suggested Readings

VMD 715 ADVANCED CLINICAL PRACTICE – I  0+2

Objective
Application of the theoretical concepts in practice

Practical
Diagnostic and therapeutic protocol application, specimen collection, examination and management of sick farm and companion animals. Note: This course shall be conducted in TVCSC where students shall participate in diagnosis and treatment of diseased animals).
VMD 716 ADVANCED CLINICAL PRACTICE – II 0+2
Objective
Application of the theoretical concepts in practice
Practical
Diagnostic and therapeutic protocol application, specimen
collection, examination and management of sick farm and
companion animals. Note: This course shall be conducted in
TVCSC (College Clinics), where students shall participate in
diagnosis and treatment of diseased animals).

VMD 717 ADVANCED CLINICAL PRACTICE – III 0+2
Objective
Application of the theoretical concepts in practice.
Practical
Diagnostic and therapeutic protocol application, specimen
collection, examination and management of sick farm and
companion animals. Note: This course shall be conducted in
TVCSC (College Clinics), where students shall participate in
diagnosis and treatment of diseased animals).

VMD 790 SPECIAL PROBLEM 0+2
Objective
To Provide expertise in handling practical research problems
Practical:
Short research problems involving contemporary issues and
research techniques.

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 Clinia
- Veterinary Record
- Veterinary Research Communications
- Indian Journal of comparative Microbiology, Immunology and Infectious diseases
- Infection and Immunity
- Infection and Immunity
- Journal of General Virology
- Journal of Poultry Science
- Quarterly Bulletin of O.I.E.
- Avian Diseases
• Avian pathology
• British Poultry Science
• Tropical Animal Health and Production
• Veterinary Microbiology
• British Veterinary Journal
• Epidemiology and Infection
• World Animal Health
• World Poultry Science Journal

e-Resources

www.uni-sz.bg/bjvm/bjvm.htm (Bulgarian Journal of Veterinary Medicine)
Isrvma.org/journal.htm. (Israel Journal of Veterinary Medicine)
www.medwellonline.net/java/jp.html (Journal of Animal & Veterinary Advances)
www.jstage.jst.go.jp/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)
vetmed.vri.cz (Veterinary Medicine)
http://calvados.c3sl.ufpr.br/ojs2/index.php/veterinary/ (Archives of Veterinary 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://vetmed.vri.cz/ (Veterinarni Medicina)
http://www.jstage.jst.go.jp/browse/jpestics (Journal of Pesticide Science)
http://journals.tubitak.gov.tr/veterinary/index.php (Turkish Journal of Veterinary and Animal Sciences)

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
• Molecular epidemiological studies on infectious diseases of livestock
• Molecular epidemiological studies on infectious diseases of poultry
• Surveillance of economically important diseases of farm animals
• Surveillance of economically important diseases of 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.
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VETERINARY SURGERY AND RADIOLOGY
Course Contents

VSR 601 PRINCIPLES OF SURGERY 240

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

UNIT III

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

VSR 602 CLINICAL PRACTICE - I 0+3

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 surgical cases, surgical facilities, equipments, disaster management.

Suggested Readings

VSR 603 CLINICAL PRACTICE - II 0+3

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 surgical cases, surgical facilities, equipments and personnel, disaster management.

Suggested Readings

VSR 604 SMALL ANIMAL ANAESTHESIA 2+1
Objective
To impart the basic and practical knowledge of principles of companion 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
Thurmon JC, Tranquilli WJ & Benson JG. (Eds.). 1996. Lumb and Jone’s Veterinary Anaesthesia. Williams & Wilkins.

VSR 605 LARGE ANIMAL ANAESTHESIA 2+1
Objective
To impart the basic and practical knowledge of principles of farm 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
Thurmon JC, Tranquilli WJ & Benson JG. (Eds.). 1996. Lumb and Jone’s Veterinary Anaesthesia. Williams & Wilkins.

VSR 606 DIAGNOSTIC IMAGING TECHNIQUES 2+1
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
Goddard PJ. (Ed.). 1995. Veterinary Ultrasonography. CABI.

VSR 607 VETERINARY OPHTHALMOLOGY AND DENTISTRY 1+1

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 conjunctiva, cornea, sclera, iris, orbit, lens, vitreous and aqueous humor, retina and optic nerve.

UNIT V
Ocular manifestation of systemic diseases.
UNIT VI

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 paracentesis, flushing of naso-lacrimal duct, iridectomy, lens extraction/implantation. Dentistry instrumentation, dental radiography, teeth cleaning, tooth extraction.

Suggested Readings
Tyagi RPS & Singh J. (Eds.). 1993. Ruminant Surgery. CBS.

VSR 608 SMALL ANIMAL SOFT TISSUE SURGERY 2+1
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

VSR 609 LARGE ANIMAL SOFT TISSUE SURGERY 2+1
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.
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
Tyagi RPS & Singh J. (Eds.). 1993. Ruminant Surgery. CBS.
database management, attending surgical cases, surgical facilities, equipments and personnel.

VSR 702 CLINICAL SURGICAL PRACTICE - II 0+3
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+3
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
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
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

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  

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  

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
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
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.
List of Journals

American Journal of Veterinary Research
Canadian Veterinary Journal
Compendium of continuing Education for the practicing Veterinarian
Cornell Veterinarian
Equine Practice
Indian Journal of Veterinary Surgery
Journal of American Veterinary Medical Association
Journal of American Animal Hospital Association
Journal of Bone and Joint Surgery – A & B
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.blackwellpublishing.com/journalasp (Veterinary Surgery)
www.blackwellpublishing.com/summit.asp (Veterinary anaesthesia and Analgesia)
www.blackwellpublishing.com/journalasp (Veterinary Radiology and Ultrasound)
www.blackwellpublishing.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 animals
Management of pain in animals
Surgical Management of gastrointestinal tract disorders in bovines
Management of fractures in animals
Ultrasonography of soft organs of large and small animals
### VETERINARY BIOTECHNOLOGY

#### Course Structure – at a Glance

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* Courses may also be taken as Minor/Supporting

** Compulsory for Master’s Programme

Minor Subjects (In addition to listed ones above*):
- Vety.Biochemistry, Vety.Physiology, Vety.Microbiology, Animal Genetics and Breeding, LPT
VETERINARY BIOTECHNOLOGY
Course Contents

VBT 601 BASIC AND APPLIED BIOTECHNOLOGY 3+0

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


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

Theory

UNIT I

UNIT II
Cytoskeleton: Mechanism of muscle contraction, actin filaments and cell cortex, ciliary movements and cytoplasmic microtubules and intermediate filaments. Cell signaling: Endocrine, exocrine and synaptic signaling molecules, surface and intracellular receptors, G proteins and generation of secondary 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

Suggested Readings
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
i. Extraction of DNA and RNA.
ii. Polyacrylamide gel electrophoresis (PAGE).
iii. Agarose gel electrophoresis.
iv. Restriction endonuclease analysis of DNA.
v. Isolation and purification of plasmid.
vi. Polymerase chain reaction.
viii. Expression of cloned gene.
ix. Purification of recombinant protein.
x. Blotting
xi. RFLP
xii. RAPD.

Suggested Readings
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

i. Packing and sterilization of glass and plastic wares for cell culture.
ii. Preparation of reagents and media for cell culture.
iii. Primer culture technique chicken embryo fibroblast.
iv. Secondary culture of chicken embryo fibroblast.
v. Cultivation of continuous cell lines.
vi. Quantification of cells by trypan blue exclusion dye.
vii. Isolation of lymphocytes and cultivation of lymphocytes.
viii. Study of effect of toxic chemicals on cultured mammalian cells.
ix. Study of effect of virus on mammalian cells.
x. Suspension culture technique.
xi. Cryopreservation of cell primary cultures and cell lines.
xii. Effect of viruses on cultured mammalian cells.

Suggested Readings

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

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

Suggested Readings

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 sub-unit vaccines, synthetic vaccines, DNA vaccines, virus like particles, recombinant vaccines, edible vaccines, Nano particles in vaccine delivery systems, etc.

UNIT IV
Introduction to pharmacopeial 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
i. Inoculation of embryonated chicken eggs for cultivation of virus.
ii. Harvesting of virus from inoculated embryos.
iii. Inactivation of harvested viruses.
iv. Safety and sterility testing of inactivated vaccine.
v. Inoculation of tissue culture for propagation of virus.
vi. Harvesting and production of inactivated virus vaccine.
vii. Isolation and cloning of genes encoding immunogenic proteins.
viii. Expression of cloned gene.
ix. Purification of recombinant immunogenic protein.
x. Immunogenecity studies of recombinant protein
xi. Immunization of laboratory animals.
xii. Titration of antibodies against the recombinant protein.

Suggested Readings
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
i. Immunodiffusion.
ii. Immunoelectrophoresis.
iii. Fluorescent antibody test.
iv. Enzyme immunoassays including ELISA.
v. Immunoblotting.
vi. Affinity chromatography,
vii. Bioinformatics tools for immunological research.
viii. Cultivation of normal lymphocytes and myeloma cell line.
ix. Somatic cell hybridization and production of hybridoma.
x. Screening of hybrids for production of monoclonal antibodies.

Suggested Readings

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

i. Usage of NCBI resources
ii. Retrival of sequence/structure from databases
iii. Visualization of structures
iv. Docking of ligand receptors
v. BLAST exercises.

Suggested Readings

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
i. Chromosome preparation (normal karyotyping, different types of banding) in farm animals.
ii. Isolation and purification of animal genomic DNA from blood lymphocytes.
iii. Analysis of DNA by agarose or polyacrylamide gel electrophoresis.
iv. Checking the quality and quantity of genomic DNA.
v. Restriction digestion and analysis.
vi. Southern hybridization
vii. DNA fingerprinting.
viii. Techniques for revealing polymorphism-DNA fingerprinting, RFLP, SSCP, AFLP, STRP etc.
ix. Genomic DNA cloning or cDNA cloning.
x. Differentiation of tissues of different species by mitochondrial genome analysis.

Suggested Readings
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 III


Practical

i. Synchronization and superovulation protocols.
ii. Collection of embryos using non-surgical procedures.
iii. Transferring embryos using non-surgical procedures.
iv. Embryo freezing protocols.
v. Oocyte collection and evaluation from slaughterhouse ovaries.
vi. In vitro fertilization protocols.
vii. Micromanipulation of early embryos.

Suggested Readings

Gordon I. 2003. Laboratory Production of Cattle Embryos. CABI.
Gordon I. 2005. Reproductive Techniques in Farm Animals. CABI.
Objective

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

Practical

UNIT I

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

UNIT II

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

UNIT III

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

UNIT IV

Cloning of bacterial and viral genes into 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

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

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 fingerprinting, 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 III

Mass spectroscopy, protein detections methods, immunological techniques including ELISA, immunoelectrophoresis and immunofluorence.

Practical

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

Suggested Readings

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

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

Theory

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

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

UNIT III
Structure of sperms and ovum, cryopreservation of sperms and ova of livestock, artificial insemination, super ovulation, in vitro fertilization, culture of embryos, cryopreservation of embryos, embryo transfer, embryo-splitting, embryo sexing, transgenic manipulation of animal embryos, different applications of transgenic animal technology, animal viral vectors, animal cloning basic concept, cloning from- embryonic cells and adult cells, cloning of different animals, cloning for conservation for conservation 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.
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

i. Preparation of vector.
ii. Restriction enzyme digestion of vector.
iii. Purification of DNA.
iv. DNA ligation.
v. Transformation.
vi. Calculation of transformation efficiency.
vii. Preparation of electro competent cells.
viii. Screening by PCR.
ix. Cloning of PCR products in vectors.
x. Induction of expressed protein
xi. PAGE and western bloting.

Suggested Readings

Objective

Understanding gene expression at different conditions/organs.

Theory

UNIT I

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

UNIT II

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

UNIT III

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

UNIT IV

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

Practical

i. Northern blotting
ii. Quantitative PCR.
iii. Design of microarray experiments.
iv. Microarray image processing.
v. Basic statistical methods.
vi. Clustering methods to study gene expression.
vii. Analytical software related to genomics and proteomics

Suggested Readings

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 and development of stem cells, transfection of gene in embryonic blastomeres.

UNIT IV

Stem cell therapeutics, social, ethical religious and regulatory issues.

Practical

i. Embryo micromanipulation.
ii. Microinjection.
iii. Intra-cytoplasmic sperm injection.
iv. ICSI Embryo biopsy for PGD and sexing.
v. Culture of embryonic stem cell.
vi. Characterization of embryonic stem cells.

Suggested Readings

Selected articles from journals.
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, idioype 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

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

Suggested Readings

Selected articles from journals.
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

i. Primary and secondary mammalian cell culture.
ii. Development of transformed cell lines.
iii. Characterization of cell lines.
iv. Transfection of cells with recombinant DNA.
v. Expression of recombinant proteins.
vi. Scaling-up of cultures.

Suggested Readings

Selected articles from journals.
Objective

Understanding the latest developments in transgenic technology.

Theory

UNIT I

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

UNIT II

Suitable promoters for expression of transgenes, eukaryotic expression vectors, detection of transgenes in the new born.

UNIT III

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

UNIT IV

Social, ethical, religious, environmental and other regulatory issues related to transgenic animal technology.

Suggested Readings

Selected articles from journals.
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.biotechinstitute.org/programs/t_leader_program.html
www.accessxcellence.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/currsSci/dec252006/1594
www.cccoe.k12.ca.us/stsvcs/newteacher/rop/curr_rop_links2.html
www.sunysb.edu/ligase/Forstudents/BiotechTeachingCenter/biotechcenter.html
www.ca.uky.edu/agc/pubs/brei/breipl/breipl.htm
www.aggie-horticulture.tamu.edu/tisscult/biotech/biotechteach.html
www.ejbiotechnology.info/content/vol6/issue2/issues/2/index.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
COMPULSORY NON-CREDIT COURSES
(Compulsory for Master’s programme in all disciplines; Optional for Ph.D. scholars)

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<td>PGS 601</td>
<td>LIBRARY AND INFORMATION SERVICES</td>
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Course Contents

PGS 601 LIBRARY AND INFORMATION SERVICES 0+1
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 602 TECHNICAL WRITING AND COMMUNICATIONS SKILLS 0+1
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

PGS 603 INTELLECTUAL PROPERTY AND ITS MANAGEMENT 1+0

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 animal varieties and farmers’ rights and biodiversity 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

Technology Generation and IPR Issues, Academic Foundation.

PGS 606  DISASTER MANAGEMENT  1+0
(e-Course)

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
SRI VENKATESWARA VETERINARY UNIVERSITY

TIRUPATI – 517 502

FACULTY OF VETERINARY SCIENCE

MANUAL

FOR

COMPULSORY ROTATING INTERNSHIP TRAINING PROGRAMME

SVVU UNDERGRADUATE (B.V.Sc. & A.H) REGULATIONS, 2016
PREFACE

The Veterinary Council of India has framed the Minimum Standards of Veterinary Education - (B.V.Sc & AH- Degree Course ) Regulations , 2016 in supersession of the Veterinary Council of India - Minimum Standards of Veterinary Education-Degree course (B.V.Sc & AH) Regulations, 2008 . According to the VCI - MSVE(B.V.Sc & AH- Degree Course ) Regulations, 2016 the Veterinary curriculum shall have Core Courses and Internship including Entrepreneurial Training.

The University has implemented the Veterinary Council of India Minimum Standards of Veterinary Education- (B.V.Sc & AH -Degree Course) Regulations , 2016 from the Academic year 2016-17 onwards and accordingly Manual for Compulsory Rotating Internship Training Programme as per Undergraduate (B.V.Sc. & A.H ) Regulations, 2016is brought to provide the relevant information to the students, teachers and other officials of the University.

The A.P.Agricultural university implemented the internship Programme from 1973 onwards and an internship manual was finalized in the year 1988. The programme was reviewed and revised during the year 1993 and a manual was released during the year 1995. Sri Venkateswara Veterinary University has implemented the VCI –MSVE Regulations, 2008 from the Academic year 2009-10 onwards and accordingly the revised Manual of Internship Training Programme was brought out to provide the relevant information to the students, teachers and other officials of the University and implemented from 2013-14 onwards.

J.V.RAMANA
CONTROLLER OF EXAMINATIONS

T.S.CHANDRASEKHARA RAO
DEAN, FACULTY OF VETERINARY SCIENCE
# PRACTICAL MANUAL FOR COMPULSORY ROTATIONAL INTERNSHIP PROGRAMME

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1. INTRODUCTION:

The animal health care service for the millions of livestock farmers in Urban and Rural areas in the country are rendered by the Veterinary Assistant Surgeons of the State Animal Husbandry Departments. As such majority of the Veterinary graduates are being employed as Veterinary Assistant surgeons in the State Animal Husbandry Department while only few enter the A.P.D.D.C., Banking Services, Private Dairies, poultry etc. These new entrants are usually posted to the rural parts of Andhra Pradesh and are expected to get involved in the treatment & health care of diseased livestock, carry out A.I. and Animal Husbandry developmental activities such as promoting dairy, poultry and piggery farms. The purpose of internship programme is to make the fresh graduates to work independently under the supervision of experienced Veterinarians under field conditions. Keeping this in view the Internship programme was started in APAU during the year 1978 for the 1973-74 admitted batch students which are probably foremost in the country. Internship is spread over six months with emphasis on clinical, animal production and livestock technology services training.

Every student of Bachelor of Veterinary Science and Animal Husbandry degree course shall be required after passing the fourth professional examination to undergo compulsory rotating internship to the satisfaction of the University for a minimum period of twelve calendar months so as to be eligible for the award of the degree of Bachelor of Veterinary Science and Animal Husbandry and full registration with the council.

Compulsory rotating internship shall include a full time training in Veterinary and Animal Husbandry services (including emergencies and night duties, Sundays and holidays) and the intern shall devote whole time to the training and shall not be allowed to accept a whole time or part time appointment paid or otherwise.

Internship shall be undertaken only after completion of all credit requirements of Veterinary curriculum including Remount Veterinary Squadron or National Cadet Corp or National Social Service or Sports and games. The University shall issue a provisional course completion certificate of having passed all the professional examinations and having successfully completed prescribed course work.

The State Veterinary Council shall grant provisional registration to the candidate on production of provisional Bachelor of Veterinary Science and Animal Husbandry course completion certificate and the provisional registration shall be valid for a minimum period of twelve months and maximum of sixteen months. After provisional registration with the State Veterinary Council, the candidate shall register for internship of twelve calendar months. Interns shall be actively involved in rendering veterinary service under the supervision of an experienced teacher.

The intern shall assist the teacher or in-charge in all activities of the units they are posted in. The internship programme shall be monitored by a Committee consisting of Associate
Dean, in-charge of Veterinary Clinical Complex, in-charge of Livestock Farm Complex and Associate Professor (Internship) of Veterinary Clinical Complex and Assistant Professor (Internship & Entrepreneurialship) of Livestock Farm Complex as members and this Committee shall monitor effective implementation of the internship training programme from time to time and shall be required to inspect the internship programme at different intervals of time randomly.

Details of day to day work, posting and duration needs to be worked out by the Veterinary Institution as per its needs and infrastructure facilities and the activities of interns shall be regulated by an Associate Professor (Internship) posted in Veterinary Clinical Complex and Assistant Professor (Internship and Entrepreneurialship) posted in Livestock Farm Complex.

The training shall be supplemented by fortnightly sessions of clinical conference, farm operation and data analysis, preparation of feasibility reports, project report, campaigns or discussions in clinical training, Farm Training and Technology.

The intern shall maintain a log book of day to day work which shall be verified and certified by the supervisor under whom he or she works and in addition, the interns shall prepare a brief project report on the basis of his or her case study or case analysis, survey reports etc. and shall be based on his or her own study during the internship and such reports be supervised by more than one teacher, if required and the interns shall present such report in seminar organized for the purpose.

After successful completion of Internship, the Associate Dean shall then issue the certificate of satisfactory completion of internship training as prescribed by the Veterinary Council of India. A candidate shall become eligible for registration with State Veterinary Council only on the award of the B.V.Sc and A.H. degree or production of a provisional degree certificate by the University.

1.1 **Title:** The practical training programme which the B.V.Sc. & A.H. students have to undertake at various Veterinary Clinical Complex/ Veterinary Hospital/Veterinary Polyclinics, livestock farms, poultry farms etc. after completion of the course work will be termed as "Compulsory Rotational Internship Programme for B.V.Sc. & A.H. students".

1.2 **Duration:** The duration of internship is for a minimum period of one year The compulsory rotating internship shall be in the following areas, namely:-

(i) Posting in Veterinary Clinical Complex of other constituent veterinary colleges of university / Veterinary Hospital/Veterinary Polyclinic etc., for Clinical training covering veterinary medicine, surgery and radiology, gynaecology and obstetrics, clinical emergencies, indoor ward care, lab diagnosis, ambulatory, hospital management, record keeping etc; (6½ Months)

(ii) Posting at Veterinary Clinical Complex of Veterinary College of other state in India with provision of rent free accommodation; (15 Days)

(iii) Posting in any four of Zoo or wild life centre or National Parks, Meat Plant or Abattoirs, Milk Plants, Field Hospital, Animal Welfare Organization, Vaccine Institute, Remount Veterinary Corps, Pharmaceutical, Feed Industry for hands on training in each establishment etc.; (1 Month)
Entrepreneurial training and management covering farm routines of cattle and buffalo farms, piggery or rabbitry, sheep and goat farms and equine or camel unit etc. Poultry production and management covering layer and broiler production, hatchery and chick management and learning farm practices like record keeping and other related activities in LFC of other constituent colleges of university/Livestock research stations of the university (LRS, Garividi, BRS, VR Gudem, LRS, Palamner, LRS, Guntur, LRS, Siddaramapuram etc. (4 Months i.e Poultry -35 days, Cattle-55 days, Sheep -20 Days, Swine and Rabbitry - 10 days)

Each intern shall submit a Project Report on completion of entrepreneurial training and this training is aimed at developing entrepreneurial skill for self-employment and the university or college shall provide interest free loans, technical support and infrastructure for these activities. Inputs, day-to-day work and financial accounting shall be undertaken by the students;

One of the following entrepreneurial trainings shall be implemented to all students in batches at Livestock research stations of the university/LFC of other constituent colleges of University during internship training programme.

1) Ram lamb rearing
2) Swine production
3) Broiler production
4) Quail production
5) Milch cattle rearing
6) Meat and egg products processing
7) Milk and milk products processing
8) Feed production
9) Mineral mixture preparation

The profits, if any, shall be kept by the students, provided, in case of loss, the Associate Dean of the college through the Entrepreneurial Committee consisting of four faculty members (at least one subject matter specialist) may evaluate the reasons of such loss and provide compensation in case it is found that the loss has been inadvertent;

The In-charge or nominee of each posting shall regulate the training of such interns and submit the evaluation report of each intern out of 20 marks which shall be accounted at the time of final evaluation;

The remaining days shall be utilized for the final assessment of interns with the objective of having achieved core competency:-

1.3 Credits: Internship is a composite training for 12 calendar months. It is a non-credit compulsory programme which has to be satisfactory completed for the award of B.V.Sc. & A.H. Degree.

2. OBJECTIVES AND SCOPE:
- To provide an opportunity to the internees to handle medical, surgical and gynaecological cases independently under the supervision of registered Veterinarians.
- To accompany the Veterinarians in Ambulatory clinic for visit of villages.
- To attend mass vaccination programme and outbreaks if any during the period of training.
To collect and process the materials from the ailing animals.
To communicate freely with the livestock owners and farmers both at hospitals and at the door step of farmers.
To acquaint about the recent livestock developmental programmes such as calf rearing, I.C.D.P, D.P.A.P., D.R.D.A, DWACRA etc., launched in the state.
To work in the livestock and Poultry farms and Zoological parks.
To work in the milk collection, chilling and meat processing centers.
To acquaint with the various departmental procedures for effective working.
To render professional veterinary service, skill and knowledge under supervision and guidance of a registered veterinary practitioner/teacher working in the approved Veterinary Institution.

The intern shall have the following functions, responsibilities and duties namely:

(i) Participation with clinical faculty in the hospital practice;
(ii) To Share the emergency and night duties on rotation in the large and small animal hospitals including Sundays and holidays;
(iii) Participation with staff of the place of posting in Veterinary Practice, Production or Technology;
(iv) Hands-on diagnostic and treatment procedures for hospitalized cases under the supervision of the attending veterinarian;
(v) To administer primary care to emergency cases and participate in service such as anesthesia, radiology, ultrasonography, endoscopy, laboratory and diagnostic procedures. Medicine, Gynaecology and Surgery rounds are held periodically allowing the interns to present cases and participate in topic discussion.

3. ELIGIBILITY

3.1. Minimum requirement: Every B.V.Sc. & A.H. student is required after passing the fourth Professional B.V.Sc.&A.H examination to undergo compulsory rotational internship programme to the satisfaction of the University for a minimum period of 12 calendar months so as to be eligible for the award of Degree of B.V.Sc. & A.H. Every student has to obtain a provisional registration certificate from the Andhra Pradesh Veterinary Council in order to become eligible for registration of internship programme.

3.2. Registration: Every student shall register for this internship programme at his / her College on passing the fourth Professional Examination.

4. Place of Posting:
The B.V.Sc. & A.H. students (internees) have to undergo internship in the following Veterinary hospitals / Veterinary polyclinics/Veterinary Clinical complex, Livestock Farms, Slaughter house, Milk Plant, Zoo, Feed plant as per the postings made by the concerned Associate Dean of the Colleges. The students are generally posted to the districts neighbouring to their home districts except in case of girl students who are posted as per suitability and availability of accommodation. The Associate Deans shall take a decision to post the boy students in their native districts after taking into account the requirements of the Girl students and availability of facilities and feasibility. The students are posted in groups of usually 4-8 at a particular hospital/unit.

4.1. Posting for students of Colleges of Veterinary Science, Tirupati

II. Clinical training in the VCC of Veterinary College of other state: 15 days - places as decided by university.

III. Livestock and poultry Production & Management training including entrepreneurial training: 4 months - in LFC of other constituent veterinary colleges of university/ Livestock research stations of the university - LRS, Garividi, BRS Venkataramannagudem, LRS, Guntur, LRS, Palamner, LRS Siddaramapuram etc.

*Poultry - 35 days, Cattle - 55 days, Sheep - 20 Days, Swine and Rabbitry - 10 days*


 ADDL - 15 Days, Vaccine Institute - 2 days, Zoo - 3 days, Slaughter House - 4 days, Milk plant and Feed plant - 6 days

**4.2. Posting for students of Colleges of Veterinary Science, Gannavaram**

I. Clinical Training in the state: 6½ Months: VCC of other constituent veterinary colleges of university/Veterinary Polyclinics/Veterinary Hospitals of Guntur, Vizag, Kakinada, SIAH, Tanuku, Gudivada, Ongole, Srikakulam, Vizianagaram.

II. Clinical training in the VCC of Veterinary College of other state: 15 days - places as decided by university.

III. Livestock and poultry Production & Management training including entrepreneurial training: 4 months - in LFC of other constituent veterinary colleges of university/ Livestock research stations of the university - LRS, Garividi, BRS Venkataramannagudem, LRS, Guntur, LRS, Palamner, LRS Siddaramapuram etc.

*Poultry - 35 days, Cattle - 55 days, Sheep - 20 Days, Swine and Rabbitry - 10 days*

IV. Zoo, Meat plant/slaughter house, Milk Plant, Vaccine institute & ADDL, Feed industry training: 1 month - ADDL: Guntur, Vizag, Kakinada, Ongole, Srikakulam, Vizianagaram, Vijayawada, SIAH, Tanuku, Visakha Dairy, Sangam Dairy, Guntur, Vijaya Dairy, Vijayawada, VBRI, Samalkot, Indira Gandhi Zoological Park, Visakhapatnam
ADDL-15 Days, Vaccine Institute-2 days, Zoo-3 days, Slaughter House-4 days, Milk plant and/Feed plant -6 days

4.3. Posting for students of Colleges of Veterinary Science, Proddatur

I. Clinical training in the state: : 6½ Months – VCC of other constituent veterinary colleges of university/Veterinary Polyclinics/Veterinary Hospitals of Nellore, Chittoor, Cuddapah, Nandyal, Kurnool, Anantapur, Hindupur, Madanapalle

II. Clinical training in the VCC of Veterinary College of other state: 15 days—places as decided by university

III. Livestock and poultry Production & Management training including entrepreneurial training : 4 months— in LFC of other constituent veterinary colleges of university/ Livestock research stations of the university— LRS, Garividi, BRS Venkataramannagudem, LRS, Guntur, LRS, Palamner, LRS Siddaramapuram etc.

Poultry -35 days, Cattle-55 days, Sheep -20 Days, Swine and Rabbitry -10 days

IV. Zoo, Meat plant/slaughter house, Milk Plant, Vaccine institute & ADDL, Feed industry training :1 month :ADDL:Nellore, Chittoor, Cuddapah, Nandyal, Kurnool, Anantapur, Madanapalle, SV Zoological Park, Tirupati, IVPMT, Rani, APDDCF, Anantapur, Kurnool Dairy, MPF, Nandyal, Heritage, Chittoor

ADDL-15 Days, Vaccine Institute-2 days, Zoo-3 days, Slaughter House-4 days, Milk plant and/Feed plant -6 days

The Associate Deans may allot any other centre in consultation with officials of AH department/concerned officers of university/State Government/organization. The officials of AH department concerned to allotted clinical training centre may direct the internees to attend any other centre nearby depending on the need and number of cases.

5. ALLOWANCES: All the students undergoing internship training programme will be paid a monthly allowance of Rs.7000/- or as applicable from time to time throughout the training. A travel grant of Rs.500/- is paid to each student towards the journey undertaken by the student during the entire internship programme. The conduct and character of the student should be good during the training period. Internship allowance shall be paid only for twelve calendar months and no internship allowance shall be paid for the period of absence or unsatisfactory performance or extended period or re-registration period.

6. ATTENDANCE: The intern shall be entitled for fifteen days casual leave and the leave cannot be claimed as a matter of right until and unless the sanctioning authority sanctions it and an intern willfully absenting from the training programme even if for part of a day or during off hours duty (including Sundays and holidays) he or she may be treated absent for that day and the candidate shall be required to undergo training for the additional days in
lieu of the absence period and internship allowance shall not be paid for these additional days. No exemption on sports/games/NCC or any other grounds is allowed.

7. EVALUATION

The competence in veterinary skills examination shall be based on an evaluation of core competence in professional skills as detailed below:

- Restraint of cow, sheep, horse, dog and pig. Haltering, snaring, muzzling, tail switch, bandaging of horse for exercise and stable bandaging
- Animal identification, Dentition and ageing of animals
- Housing layout/requirements of livestock and poultry
- Computation of ration of livestock of different breeds and age groups in health and disease.
- Fodder management and interpretation of feed quality evaluation
- Physical evaluation of livestock health parameters (auscultation, percussion, recording of temperature, pulse, heart rate, respiration rate etc.)
- Recording and interpretation of cardiovascular response
- Testing of milk and milk products for quality, clean milk production
- Carcass quality evaluation (ante-mortem & post-mortem examination)
- Specific diagnostic tests for zoonotic diseases
- Sample collection, handling and dispatch of biological materials for laboratory examination
- Staining techniques for routine clinico-pathological examinations
- Relating post-mortem lesions to major livestock diseases
- Hematological evaluation (total leukocyte count, differential leukocyte count, hemoglobin, packed cell volume, erythrocyte sedimentation rate etc.) and interpretation
- Tests and their interpretation for haemoproteozoa diseases
- Body fluids collection, examination and interpretation as an aid to diagnosis
- Urine evaluation procedures and interpretation as indicators for diagnosis of diseases
- Fecal examination – procedures and interpretation
- Examination of skin scrapings and interpretation
- Interpretation of blood chemistry profile in diseases
- Deworming procedures and doses for different species of animals/birds
- Managing and outbreak of infectious/contagious disease
- Approach to diagnosis of a given disease condition
- Pre-anesthetic administration and induction, maintenance of general anesthesia and dealing with anesthetic emergencies
- Local anesthetic administration
- Nerve blocks-sites, functional application
- Suture material, suture pattern and tying knots
- Common surgical procedure including dehorning, docking, caesarian section, ovario-hysterectomy, castration, rumenotomy
- Application of plaster cast/splint for fracture immobilization and other bandaging procedure in large and small animals.
- Soundness in horses
- Rectal examination – palpation of pelvic/abdominal organs in cattle/horses/buffaloes,
- Detection of estrus, artificial insemination, pregnancy diagnosis,
• Management of vaginal/uterine prolapse and dystocia
• Andrological examination of bull, handling, preservation and evaluation of semen
• Vaccination procedures, vaccination schedules and vaccine types for different diseases
• Handling of radiograph, interpretation of a given radiograph of large and small animals
• Client management
• Managing a clinical practice, ambulatory van, transporting a sick animal requirements, etc.
• Dosage regimens of important drugs
• Drug administration techniques in different species of animals-oral, parenteral, rectal, intra-peritoneal and intra-uterine
• Identification of major livestock/ poultry breeds
• Measuring climatic parameters and their interpretation
• Communication technology tools

The assessment of each intern shall be based upon the evaluation of log book or project report, his or her performance reports from all the minimum prescribed training postings, entrepreneurial output, clinical case reports and their presentation, viva and comprehensive examination in core competence in veterinary skills through a written test by an Evaluation Committee comprising of the faculty representing the concerned departments appointed by the Associate Dean for this purpose and the distribution of marks for various components of assessment shall be as under, namely:-

<table>
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<th>Component</th>
<th>Marks</th>
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<td>Log book or Project Report</td>
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<tr>
<td>Performance in different postings:</td>
<td>20</td>
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<td>Entrepreneurial output:</td>
<td>20</td>
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<tr>
<td>Case Reports or Presentation</td>
<td>10</td>
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<tr>
<td>Written test</td>
<td>30</td>
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<tr>
<td>Viva</td>
<td>10</td>
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<tr>
<td>Total</td>
<td>100</td>
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The minimum pass marks in internship assessment shall be 50 out of 100.

In case of unsatisfactory work or performance or shortage of attendance or both the period of compulsory rotating internship shall be extended by two months and the student shall be reevaluated, if again found unsatisfactory or is unable to secure 50 marks, he shall be given one more chance after another two months and if he still is found unsatisfactory due to any reason, the intern has to re-register afresh for internship programme for entire twelve calendar months including registration with the State Veterinary Council.

Every intern shall be evaluated as ‘Satisfactory’ (A/B/C/D) or as ‘Unsatisfactory’ (I) based on the evaluation of this examination. In case of overall unsatisfactory performance in the examination, the candidate has to repeat the entire internship programme. Candidates obtaining unsatisfactory (I) evaluation have to repeat the Internship Training Programme.

Based on the recommendation of "Satisfactory" result by the Evaluation Committee, the Associate Dean shall issue a Certificate of completion of Internship following which the University shall award B.V.Sc. & A.H. Degree to the successful candidate(s). Candidates obtaining unsatisfactory (I) grade have to repeat the Internship Training Programme.
The Internees are evaluated by evaluation committee as follows - Satisfactory (A): 80% and above, Satisfactory (B): 70% to 79.9%, Satisfactory (C): 60% to 69.9%, Satisfactory (D): 50% to 59.9%, Unsatisfactory (I): Less than 50%.

The successful completion of each posting shall be decided on the basis of regularity and minimum expected performance including maintenance of log book of day to day work which will be verified and certified by the Supervisor in-charge of the unit of his/ her posting. Evaluation of intern will also be on the basis of his/ her skill knowledge and attitude. In addition the intern is required to prepare a small right up on the basis of his/her case study/case analysis, survey report, feasibility study, follow-up work. This preferably must be based on his own study/ workshop during internship. This shall be on any subject of his choice but on a topic in which he was directly involved.

Such studies may be in the form of a scientific journal/ submission, based on available literature, recorded observations and with an emphasis on an applied aspect:

a) Compilation of clinical case reports on a specific condition;
b) Survey reports/ incidence of a particular disease/ deformity/ behavioral pattern;
c) Monitoring or follow-up of a service delivery programme/ development programme;
d) Study of the use of a indigenous material/ method for housing, or a use of an ethnic systems in management.
e) Experience/ observations (field study) on the use of or substitution of material as feed, feed supplement, scarcity fodder;
f) Evaluation of a method of animal product technology, food production, storage from public health point of view;
g) Economic study of a method of production of animal product or a study of animal/ animal product market or market trend;
h) A study/ trial of a co-product or byproduct or animal waste management;
i) A evaluation of an awareness campaign, its media planning or dissipation technology
j) Ethograms of animals in captivity or free life.

The candidate will become eligible for registration with State Veterinary Council only on the award of the B.V.Sc & A.H degree or production of a provisional degree certificate by the University.

8. EVALUATION COMMITTEE:
All the internees who have put up the required attendance and completed training at different places as specified shall be examined by a committee at the concerned College under the supervision of the Associate Dean consisting of
1. One Assistant Director involved in the internship training from Veterinary Hospital nominated by the Department of Animal Husbandry, Govt. of A.P.
2. Four teachers to be nominated by the Associate Dean, one each from VCC, Para-clinical Departments, LFC and LPT of the concerned College.


- The Internship training shall be supplemented by weekly sessions of clinical conference, farm operation and data analysis, preparation of feasibility reports, project report, campaigns/ discussions in clinical training, farm training and technology services.
• Each Internee shall prepare a brief write up on case study, case analysis, survey reports, feasibility study, follow-up work on a topic in which he/she was directly involved or where he/she had been supporting a study of his supervisor. The interns shall present such work in a seminar organized for the purpose at the place of training. The topics may include, Compilation of clinical case reports on a specific condition; Survey reports / incidence of a particular disease / deformity / behavioural pattern, Monitoring or follow-up of a service delivery programme /development programme, Study of the use of a indigenous material/method for housing, or a use of an ethnic systems in management; Experience/observation (field study) on the use of or substitution of material as feed, feed supplement, scarcity fodder, Evaluation of a method of animal product technology, food product or a study of animal /animal product market or market trend, An study/trial of a co-product or by-product or animal waste management, An evaluation of a awareness campaign, its media planning or dissipation technology, Ethograms of animals in captivity or free life, Economic study of a method of production of animal product or a study of animal /animal product market or market trend.

• Every Internee shall have to submit an Entrepreneurial Project certified by concerned officer in charge of Training centre to the evaluation committee.

• The intern shall maintain a log book of day to day work for all the units which shall be verified & certified by the supervisor under whom he/she works and same shall be submitted at the time of examination.

The evaluation shall be based upon the evaluation of log book, Case record, entrepreneurial project report, performance reports from all the prescribed training postings (certificate of satisfactory completion of postings) and comprehensive examination (viva) in core competence in veterinary skills conducted at the end of the programme by an Evaluation Committee appointed by the Associate Dean for this purpose. The evaluation report of Internship Training Programme only shall be submitted to University for declaration of results strictly in prescribed format as detailed below.

### EVALUATION OF INTERNSHIP TRAINING PROGRAMME

<table>
<thead>
<tr>
<th>S. No</th>
<th>ID No.</th>
<th>Name</th>
<th>Written Test</th>
<th>Log Book/project report</th>
<th>Case Reports/presentation</th>
<th>Entrepreneurial output</th>
<th>Viva</th>
<th>Performance in differed postings</th>
<th>Total</th>
<th>Grade</th>
<th>Satisfactory (A/B/C/D)/ Unsatisfactory (I)*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>30 marks</td>
<td>10 Marks</td>
<td>10 marks</td>
<td>20 marks</td>
<td>10 marks</td>
<td>20 marks</td>
<td>100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Signatures of Committee Members

Nominee of AH Dept. | Member from VCC Dept. | Member from Para Clinical Dept.

Member from LFC | Member from LPT Department | Associate Dean

The written test shall be subjective type conducted for 1 hour duration and the total marks shall be for 60 (reduced to 30) out of which clinical subjects shall cover for 30 marks (Veterinary Surgery and Radiology-10 marks, Veterinary Medicine-10 marks,
Veterinary Gynaecology and Obstetrics-10 marks), Diagnostics, Zoo, Slaughter House, Milk plant-10 marks, Ruminant Production-10 marks, Poultry and Pig Production-10 marks

10. PROGRAMME OF WORK: The Interns are required to collect the history, make detailed examination of the cases and reach to a tentative diagnosis. They should discuss with the doctors on duty for carrying out treatment and same case they should follow till it recovers or otherwise. Each Intern should submit at least 20 such case records at the time of examination or earlier.

The internees are required to make a note of the details of day to day work as directed by the in-charge of the training programme. The internee will be entrusted with clinical responsibilities and his work will be supervised by a Veterinary Officer of a Veterinary Hospital. However, a representative of the College and the in charge of the hospital will regulate the training programme.

The Internee should maintain a log book of day work which may be verified and certified by the supervisor in charge of the unit of his/her posting. The intern would prepare a small write up on the basis of case study/case analysis, survey report, feasibility study, follow-up work on a topic in which he/she was directly involved or where he/she had been supporting a study of his supervisor or a resident / PG Student working under the supervisor provided that the intern had a direct involvement. Such studies may be in the form of a journal/ submission based on available literature, recorded observations and with an emphasis on an applied aspect. The topics may include.

a). Compilation of clinical case reports on a specific condition;
b). Survey reports / incidence of a particular disease / deformity / behavioural pattern;
c). Monitoring or follow-up of a service delivery programme / development programme;
d). Study of the use of a indigenous material/method for housing, or a use of an ethnic systems in management;
e). Experience/observation (field study) on the use of or substitution of material as feed, feed supplement, scarcity fodder;
f). Evaluation of a method of animal product technology, food product or a study of animal/animal product market or market trend;
g). An study/trial of a co-product or by-product or animal waste management;
h). An evaluation of a awareness campaign, its media planning or dissipation technology;
i). Ethograms of animals in captivity or free life.

10.1. VETERINARY MEDICINE

The Interns are required to record the data in case sheet, collect history and conduct preliminary general clinical and systemic examinations of various livestock and pet animals brought to the clinic for treatment of various systemic and infectious diseases. They should visit the villages wherever Ambulatory clinic is available and attend outbreaks if any.

CLINICAL CASE RECORDING

10.1.1 Case sheet for medical cases:

The candidate is required to submit 20 different medical cases in the proforma given here for each of the outpatient and 10 inpatient cases as a separate booklet.
Clinician (Name) ______________________________________

Unit_________________________ Medical ______________________________

CaseNo.________________________________ Date___________________________

Description of Animal Species: ________________ Breed: ________________

Colour: ________________________ Sex: __________________

Age: ______________

Owner's name and address: _______________________________________________

10.1.2 History:

a) Previous illness
   i. Number of animals affected
   ii. Whether protected against specific diseases

b) Present illness
   i. Duration
   ii. Food given
   iii. Symptoms noticed by owner

10.1.3 Diagnosis:
   1. Tentative
   2. Final
   3. Results

10.1.3.1 Physical Examination (circle and explain in detail below);

<table>
<thead>
<tr>
<th>General appearance</th>
<th>Normal</th>
<th>Abnormal</th>
<th>Abnormal</th>
<th>Normal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skin</td>
<td>N</td>
<td>A</td>
<td>Thorax (Gen. appear)</td>
<td>A</td>
</tr>
<tr>
<td>Head (Gen. appear)</td>
<td>N</td>
<td>A</td>
<td>Lung</td>
<td>A</td>
</tr>
<tr>
<td>Eyes</td>
<td>N</td>
<td>A</td>
<td>Heart</td>
<td>A</td>
</tr>
<tr>
<td>Ears</td>
<td>N</td>
<td>A</td>
<td>Other</td>
<td>A</td>
</tr>
<tr>
<td>Mouth</td>
<td>N</td>
<td>A</td>
<td>Abdomen-pelvis (Gen. appear)</td>
<td>A</td>
</tr>
<tr>
<td>Mucous membranes</td>
<td>N</td>
<td>A</td>
<td>Urinary and genital tract</td>
<td>A</td>
</tr>
<tr>
<td>Teeth</td>
<td>N</td>
<td>A</td>
<td>Mammary glands</td>
<td>A</td>
</tr>
<tr>
<td>Pharynx</td>
<td>N</td>
<td>A</td>
<td>Palpation</td>
<td>A</td>
</tr>
<tr>
<td>Palpation</td>
<td>N</td>
<td>A</td>
<td>Other</td>
<td>A</td>
</tr>
<tr>
<td>Nose</td>
<td>N</td>
<td>A</td>
<td>Limbs (specify)</td>
<td>A</td>
</tr>
<tr>
<td>Lymph nodes</td>
<td>N</td>
<td>A</td>
<td>RF, IF, LH, RH</td>
<td>A</td>
</tr>
</tbody>
</table>

Temperature: Pulse: Respiration:

Note: Explain in detail any area in which abnormal (A) is encircled.
10.1.3.2 Laboratory investigations done with results:
a) Blood  
 b) Faeces  
c) Urine  
d) Milk  
e) Skin scrapings  
f) ECG  
g) X-Ray  
h) Other investigations

10.1.3.3 Treatment:

<table>
<thead>
<tr>
<th>Date</th>
<th>Clinical Observations</th>
<th>Treatment</th>
</tr>
</thead>
</table>

10.1.3.4 Undertaking:

It is expressly understood and agreed that the clinic and its authorized personnel shall have, and are hereby given, authority and permission to prescribe or treat upon the above described animal. The clinic and its authorized personnel shall be held free from liability for any damage to escape or destruction of, or injury caused by, the above described animal provided that the clinic and its authorized personnel shall exercise ordinary professional care in the treatment and care of the animal. Seven (7) days after written notice mailed to the above address to remove the animal from the clinic, the clinic may consider the animal abandoned and may dispose of such animal in any manner deemed reasonable. Should the said animal perish while under the care and keep of the clinic in order to know the cause a necropsy to be performed upon the body and may dispose of body of the animal as the circumstances may require. I hereby expressly agree to pay all costs of care, keep and treatment, not withstanding death or abandonment, of the above described animal.

Animals will be received or discharged during clinic"hours. All accounts must be settled when animals are discharged.

Telephone No. (Owner)  (Authorized agent)

Owner's signature

Date of admission: Date of discharge:

Details of clinical information, Haematological, Biochemical parameters and features of reproduction of different domestic animals are given in Tables 1 to 4.

**Table 1:** Clinical Information

<table>
<thead>
<tr>
<th>Species</th>
<th>Temperature (Average) in degrees F</th>
<th>Pulse (Range) Beats / Min</th>
<th>Respiration (Range) Rate / Minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cattle</td>
<td>101.0</td>
<td>60-70</td>
<td>16-30</td>
</tr>
<tr>
<td>Buffalo</td>
<td>100.0</td>
<td>50-70</td>
<td>30-40</td>
</tr>
<tr>
<td>Sheep</td>
<td>102.0</td>
<td>70-90</td>
<td>20-30</td>
</tr>
<tr>
<td>Goat</td>
<td>102.0</td>
<td>70-90</td>
<td>20-30</td>
</tr>
<tr>
<td>Dog</td>
<td>103.0</td>
<td>100-130</td>
<td>15-30</td>
</tr>
<tr>
<td>Cat</td>
<td>103.0</td>
<td>110-140</td>
<td>20-30</td>
</tr>
<tr>
<td>Species</td>
<td>Hb%</td>
<td>PCV%</td>
<td>Total erythrocyte count (TEC)</td>
</tr>
<tr>
<td>---------</td>
<td>------</td>
<td>------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td>Cattle</td>
<td>8.5-13.5 (11.2)</td>
<td>28.3-42.3</td>
<td>5.9-9.0 (7.3)</td>
</tr>
<tr>
<td>Buffalo</td>
<td>11.0-15.2 (13.0)</td>
<td>26.0-34.0</td>
<td>6.0-8.0</td>
</tr>
<tr>
<td>Sheep</td>
<td>9.3-14.8 (11.5)</td>
<td>27.3-43.0</td>
<td>8.0-13.5 (10.5)</td>
</tr>
<tr>
<td>Goat</td>
<td>8.8-13.8 (11.3)</td>
<td>25.0-40.0</td>
<td>10.5-20.0 (14.3)</td>
</tr>
<tr>
<td>Dog</td>
<td>11.7-16.9 (14.3)</td>
<td>36.6-51.6</td>
<td>5.0-8.5 (6.5)</td>
</tr>
<tr>
<td>Cat</td>
<td>8.1-13.5 (11.2)</td>
<td>30.6-46.0</td>
<td>6.0-9.5 (7.5)</td>
</tr>
<tr>
<td>Pig</td>
<td>8.3-12.7 (10.4)</td>
<td>32.2-46.3</td>
<td>5.0-8.5 (6.8)</td>
</tr>
<tr>
<td>Horse</td>
<td>8.5-13.0 (11.0)</td>
<td>28.0-45.2</td>
<td>5.4-13.5 (8.5)</td>
</tr>
</tbody>
</table>

**Table 2:** Normal hematological Values in Domestic animals Differential leucocyte count%

**Table 3:** Normal values of biochemical constituents in Domestic Animals

<table>
<thead>
<tr>
<th>Species</th>
<th>Blood Glucose mg/dl</th>
<th>Calcium mg/dl</th>
<th>Magnesium mg/dl</th>
<th>Phosphorus mg/dl</th>
<th>BUN mg/100 ml</th>
<th>Total protein g/dl (plasma)</th>
<th>Albumin</th>
<th>ALT (SGPT) Frankal Units/ml</th>
<th>AST (SGOT) Units/ml</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cattle</td>
<td>45-75</td>
<td>8.0-10.5</td>
<td>1.2-3.5</td>
<td>4.0-7.0</td>
<td>5-20</td>
<td>5.7-8.1</td>
<td>0.84-0.94</td>
<td>7-35</td>
<td>45-110</td>
</tr>
<tr>
<td>Species</td>
<td>Females</td>
<td>Male</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Age at puberty (months)</td>
<td>Length of estrous cycle (days)</td>
<td>Duration of estrous (hrs)</td>
<td>Gestation period (days)</td>
<td>Age at puberty (months)</td>
<td>Volume of ejaculate ml (AV)</td>
<td>Spermatozoa millions / ml</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cattle</td>
<td>14-18 (CB) 24-36 (IB)</td>
<td>21-22</td>
<td>18-24</td>
<td>273-296</td>
<td>18 (CB) 24-30 (IB)</td>
<td>2-10 (4)</td>
<td>300-2000 (1000)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sheep</td>
<td>7-12</td>
<td>16-17</td>
<td>24-36</td>
<td>140-155</td>
<td>6-8</td>
<td>0.7-2(1)</td>
<td>2000-5000 (3000)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Goat</td>
<td>4-8</td>
<td>21</td>
<td>32-40</td>
<td>148-156</td>
<td>6-8</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Swine</td>
<td>4-9</td>
<td>19-20</td>
<td>48-72</td>
<td>102-128</td>
<td>5-8</td>
<td>150-500 (250)</td>
<td>25-300 (100)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Horse</td>
<td>10-24</td>
<td>19-25</td>
<td>4-8 Days</td>
<td>327-357</td>
<td>18</td>
<td>30-300 (70)</td>
<td>30-800 (120)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dog</td>
<td>6-12</td>
<td>-</td>
<td>4-14 Days</td>
<td>60-63</td>
<td>7-10</td>
<td>2-16 (6)</td>
<td>10-200 (65)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cat</td>
<td>6-15</td>
<td>15-21</td>
<td>9-10 days</td>
<td>56-65</td>
<td>8-10</td>
<td>0.01-0.2 (.05)</td>
<td>96-5100 (1730)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table 4:** Features of reproduction in domestic animals

10.2 VETERINARY SURGERY AND RADIOLOGY:

10.2.1 Surgery case sheet:

The candidate is required to submit 20 surgical cases in the proforma given below as a separate booklet / practical note book

Veterinary hospital / dispensary
Place: ________________________    Date: _______________________    

Surgeon    Student    (Date of admission)    

Assistant    Operation fixed on:    
Operation performed on    
Date of discharge    
Out-patient / In-patient    

Case No.    
Serial No.    

Description of the animal    Species _________ Breed ___________    
Sex _______________ Age _______________ Colour _______________    

Owner's name and address:_________________________________________________    

Tentative Diagnosis: ___________________________________    
Final Diagnosis: ___________________________________    

<table>
<thead>
<tr>
<th>Date</th>
<th>Observation</th>
<th>Treatment</th>
</tr>
</thead>
</table>

10.2.2 Undertaking:    
It is expressly understood and agreed that the clinic and its authorized personnel shall have, and are, hereby given authority and permission to perform surgery upon the above described animal. The clinic and its authorized personnel shall be held free from liability for any damage to, escape, or destruction of, or injury caused by the above described animal provided that the clinic and its authorized personnel shall exercise ordinary professional care in the treatment and care of the animal. Seven (7) days after written notice mailed to the above address, to remove the animal from the clinic, the clinic may consider the animal abandoned and may dispose of such animal in any manner deemed reasonable. Should the said animal perish while under the care and keep of the clinic necropsy has to be performed upon the body and, may dispose of the body of the animal as the circumstances may require. I hereby expressly agree to pay all costs of care, keep the treatment, not withstanding death or abandonment of the above described animal.    

Animals will be received or discharged during clinic hours. All accounts must be settled when animals are discharged.    

Telephone No.    

Owner's signature    

Address    

The data regarding the patients brought to the medical clinic are recorded in the prescribed format called case sheet. It includes following aspects.    

19
1) Patients data which includes:

   a) Name of the owner  
   b) Address  
   c) Age  
   d) Sex  
   e) Species  
   f) Breed

First the detailed history of the animal viz; actual problem, duration of illness, managemental practices, prior treatment is recorded.

General clinical examination is conducted and all details are recorded including, recording of temperature, pulse, respiration, condition of muzzle, colour of visible mucous membrane and ruminal motility.

For laboratory examination clinical material viz., skin scrapings, blood, faecal and urine samples and discharges etc are collected.

Diagnosis is made based on above aspects and treatment given is recorded and the procedure is followed subsequently till the case is discharged.

Anamnesis (History)

<table>
<thead>
<tr>
<th>Past history:</th>
<th>Present history:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental factors: indoor/outdoor</td>
<td>Present disease</td>
</tr>
<tr>
<td>Climate, transport</td>
<td>Location of illness</td>
</tr>
<tr>
<td>Managemental practices</td>
<td>Nature of infection / disease</td>
</tr>
<tr>
<td></td>
<td>Reproductive management</td>
</tr>
<tr>
<td></td>
<td>Prophylactic &amp; control measures</td>
</tr>
</tbody>
</table>

Past History: History of previous illness and details regarding clinical symptoms, diagnosis and treatment should be obtained. Such information may assist in diagnosing i.e. it indicates the presence of acquired weakness that render the animal more susceptible to disease.

Introduction of new animal into the herd may also aids in infection (FMD). History regarding past treatment is also essential for diagnosis ex. faulty drenching results in aspiration pneumonia, faulty passing of stomach tube results in oesophagitis, improper trocarization of rumen to relieve tympany causes peritonitis.

A. Environmental: There is a possible relationship between environmental factors and disease incidence. It is of two types.

(i) Indoor environment: It includes environment created inside the rooms/sheds due to inadequate ventilation, inadequate water supply, dampness of floor, which predispose for certain illness. Ex: Stall fed animals are very much prone to ketosis.

(ii) Outdoor environment: It includes topography and soil type of grazing areas. Ex. marshy lands predispose for tick borne infections (Trypanosomiasis). Stagnant water areas facilitate the propagation of fluke infestation.

Stocking rate - overcrowding is also a common predisposing factor for several diseases. Grazing pasture, and land water are sometimes contaminated with various toxic chemicals from industrial wastes.

Ex: Lush legume pasture consumption can cause tympanic problems. Fluorine rich water consumption leads to fluorosis.

Improper disposal of dead animals may be one of the important factors in the spread of certain diseases.

B. Present History: The present history deals with the present problems and its associated events. While collecting present history following points are to be considered.
(i) Present disease: To gather information regarding the present disease it is essential to note the changes in behavior and physiological functions such as 1) Appetite, 2) Milk yield, 3) Growth, 4) Defecation, 5) Respiration, 6) Urination 7) Sweating, 8) Posture, 9) Gait, 10) Voice

(ii) Location of illness: Digestive system abnormalities include suspended rumination, tympany, colic, enteritis, displacement of abomasum etc. Coughing, sneezing, nasal discharges, respiratory distress indicates that the illness is concerned to respiratory system. Lameness, incoordination of gait and paralysis may reveal that the disease pertains to nervous or locomotor system. Nature of the disease may be assessed basing on morbidity rate and mortality rate.

(iii) Prior treatment: Details of the preparations given and their dosage aid, in eliminating, some diagnostic possibilities.

(iv) Prophylactic and control measures: Include vaccination, changes in nutrition, maintenance of hygiene, introduction of A.I to control venereal diseases.

GENERAL EXAMINATION

It includes identification of animal for its species, breed, age, sex and any differentiating points and general inspection and other physical methods of examination.

1) General Inspection: It includes examination of the patient for following points;
   a) General appearance, b) Behaviour or demeanour, c) Voice, d) Eating or prehension e) Defaecation f) Urination, g) Posture, h) Gait, i) Condition of the body, j) Skin and Coat examination.

   a) General appearance: To assess the confirmation of appearance of the animal, it is quite essential to gather experience about the normal body status of different species of animals. Healthy animal should have bright eyes, alert and responding ears, glossy skin with hair laying evenly over the body coat. The muzzle of cattle should look moist with dew drop like appearance over it.

Abnormalities include:
- Swelling of the joints is observed in case of polyarthritis
- Bending of long bones as a consequence of rickets
- Enlargement of abdomen is frequently considered as gross abnormality due to a) excess food / feed b) excess fluid (ascites) c) fat d) foetus e) tympany.
- In some animals with prolonged illness and malnutrition abdominal tunic may be narrowed considerably. This type of appearance is known as "Tucked up" condition of the abdomen.
- Animal may look very much run down in appearance due to long standing wasting diseases, excessive malnutrition and dehydration.
- Animal may look very much run down in appearance due to long standing wasting diseases, excessive malnutrition and dehydration.
- In tetanus the body of the animal becomes rigid, head and neck extended along with prolapse of 3rd eyelid.
- A cow suffering from milk fever may show kinking of neck or '5' shape 'curvature of the neck (or) the head may rest on the flank.

b) Behaviour or Demeanour:
   Both beginning and during the course of the clinical examination, the general demeanour of the animal should be noted. In the case of animals in a heard (or) flock separation of an individual animal may be an indication of disease. Hence the demeanour or behaviour is also a reflection of the animals health.

Types of demeanour: 1) Bright, 2) Dull or apathetic, 3) Excitation.
1) Bright: If the patient responds normally to external stimuli, such as sound, it is classified as bright.

2) Dullness: If the reactions are sluggish and the animal exhibits relative indifference to normal stimuli, it is said to be dull or apathetic. The animal remains standing and it is able to move but does not respond to all external stimuli which is referred to as the "dummy syndrome". Dummy syndrome occurs in following disease conditions.
   - Hepatic cirrhosis, encephalomyelitis - in case of horses
   - Listeriosis, lead poisoning and ketosis - in case of cattle

   The most advanced degree of apathy is coma, in which the animal is unconscious and fails to respond to even painful stimuli.

3) Excitation: Three forms: a) Mildest form, b) More severe form, c) Extreme degree of excited demeanour
   a) Mildest form: Here the animal is alert and looks around constantly but normal in its movement. Such behaviour is usually expressive of moderate to constant pain or other abnormal sensations as in early parturient paresis.
   b) More severe manifestation: is that of restlessness in which the animal lies down and gets up and may go through other abnormal movements such as looking at its flank, kicking at its belly, rolling and bellowing.
   c) Extreme degree of excited demeanour include mania and frenzy: In mania, the animal performs abnormal movements, with violent kicking at its own body (Pseudo rabies and ketosis) and pressing its head (Meningitis) to an object. In frenzy the reactions were so wild and uncontrollable and it is dangerous to approach them as seen in case of: conditions viz. acute lead poisoning, Hypo magnesemia tetany, Rabies, Nervous acetanemia, Abnormal behaviour: In many cases unusual behaviour arises from a pain stimulus. Abdominal pain is indicated by grunting, groaning, grinding the teeth and looking round at the flank.
      - In a mild attack the horse look round at the flank kicks at the abdomen, switches the tail and lies down for short periods with mild intestinal spasms (catarrhal enteritis).
      - In an attack of moderate to severity the horse is restless frequently lies down and occasionally roles, out gets up immediately (obstruction of large colon and intestinal tympany)
      - In a severe attack the animal behaves recklessly, rolls, frequently, remains lying on its back for variable periods runs against the wall, walk aimlessly and dangerous to approach.
         (Intestinal volvulus, strangulated hernia and severe spasm of intestine).

   Involuntary movements are responsible for more or less changes in the normal behavioural patterns. They include tremors and convulsions. Tremor is persistent, repetitive twitching of a skeletal muscle. Convulsions may involve the whole or only a part of the body and consists of violent musculature contractions, which usually continue for short periods.

   c) Voice:
      Abnormality of the voice should be noted. It may be
      - Hoarse voice in dogs - Rabies
      - Weak in gut edema - lowering voice
      - Persistent bellowing - indicative of acute pain
      - Soundless bellowing and yawning is commonly seen in rabid cattle

   d) Eating or Prehension:
      In painful conditions of neck, osteomyelitis of cervical vertebrae, cerebellar ataxia, prehension of animal is reduced.
      In dummy syndrome animal shows periodic cessation of mastication, keeping feed in buccal cavity (space occupying lesions of cranium and encephalomyelitis.).
● In esophageal stenosis and paralysis of pharynx, animal makes attempts at swallowing followed by cough, regurgitation through nostrils and mouth (cud dropping).

● Quidding: partial masticated feed is dropped. When teeth are affected mastication may be incomplete and quidding occurs.

e) Defecation:
Involuntary defecation is noticed in closure of anal sphincter. When there is abdominal pain or laceration of mucocutaneous junction of the anus, straining may be noticed resulting in painful defecation.

f) Urination: Following points to be considered while examining urination.
Polyurea: chronic nephritis, diabetes mellitus, d. insipidus, hepatic insufficiency.
Dysurea: Painful urination observed in urolithiasis. Acute nephritis at terminal stages of renal diseases.
Anurea: complete absence of urine in severe dehydration, glomerular nephritis.
Urinary incontinence: Dribbling of urine drop by drop noticed in urolithiasis, urethritis and paralyzation of bladder.
Haematuria: In trypanosomiasis and sweet clover poisoning
Haemoglobinuria: Leptospirosis, Babesiosis, lead poisoning, adm. of phenothiazine derivatives.
Myoglobinuria: Coffee coloured urine, azoturia, Monday, morning sick nees, Male dogs urine in squating position.
g) Posture: Posture is the anatomical configuration of the animal during stationary phase. Abnormal posture not necessarily indicates a disease but when associated with other signs it indicates a disease condition.
Ex: Lateral kinking: Noticed in hypocalcaemia. In this case cow sits by resting its head on the flank with extended fore limbs. This is observed in inflammation of extensor tendon of carpal joint. Frog like posture with flexed hind legs in obturator nerve paralysis.

In downer cow syndrome animal is normal in feeding, rumination and defecation but sternal recumbent position is noted.
Abducted elbow with extension of head and neck and brisket edema in cattle indicates traumatic reticulo-pericarditis.
An animal standing with arched back condition with tensed abdomen is an indication of peritonitis.
A calf in lateral recumbent with head holding in opisthotonous along with tonoclonic contractions of limbs indicates hypomagnesemia tetany.
Horse adopting dog sitting posture is an indication of acute gastric distension.
A cow with stiffness of forelimbs extended from the body with lock jaw condition and rigidity of ears is an indication of tetanus.

Kyphosis: Is dorsal bending of spinal cord: observed in acute nephritis, polio, encephalomyelitis and thiamine deficiency.
Torticollis is abnormal twisting of neck; seen in deformities of cervical vertebral, muscles, tendons and nerves.

Lordosis: Ventral bending of spinal cord Scoliosis: Lateral bending of spinal cord.
h) Gait: It indicates locomotor process of individuals, which is judged basing on walking movements. Some of the abnormal gaits in relation to diseases are:
● High stepping gait with septicaemia in black quarter.
● Slow wobbling gait seen in all febrile and septicaemic condition.
● stiff gait with in coordination in azoturia.
● Stumbling gait in encephalitis, laminitis and narcotic poisoning.
● Walking in circles is seen in otitis, and listeriosis. Ataxia (in co-ordination of gait) noticed in cerebello vestibular diseases.
● Animal taking off its hind legs from the ground suddenly with jerky movements and brings its back rapidly string halt (or) luxation of patella (anatomical deformity).
● Goose stepping gait: Noticed in pantothenic acid deficiency.

i) Condition of the body: Condition of the animal may be recognised by looking at its gait and can be judged by thorough inspection and physical palpation. From patho physiological and nutrition point the physical condition of animal may be differentiated as
● Normal: In this case animal's body is well built with well covered bony prominences by muscle and with symmetrical confirmation of body.
● Obesity: Pathological deposition of fat. Mainly due to hereditary, excessive feeding with out exercise makes an animal obese. Diseases of thyroid and pituitary glands also causes obesity. Similarly castration and spaying may result in this condition.
● Lean: A state of health where the animal shows bony prominences.
   Physiological thinness is observed in some breeds like jersey. Thinness is of primary and secondary. Primary thinness is due to inadequate feeding both in quality and quantity. Secondary due to illness affecting appetite (or) interruption in the process of mastication, deglutition, digestion etc.
● Emaciation: In this state of health there is wasting (or) atrophy of muscles which is due to insufficient .consumption of feed (or) due to anorexia caused by impaction / intoxication / disorders of endocrine function.
● Hide bound condition: Prolonged emaciation makes the animallustreless with dry leathery skin with loss of elasticity usually noticed in chronic wasting diseases. Ex. TB, JD, Para TB, Fascioliasis and other deficiency diseases.
● Cachexia/cachetic: Advanced case of emaciation seen in old age animals as senile atrophy is also noticed in heavy parasitic infection and chronic wasting diseases.

j) Skin and Coat Examination:
   Skin is the anatomical and physiological barrier between body and environment. Body condition and skin coat indicates state of health. In healthy and well cared animal the hair coat is fine, lustrous, shiny and smooth. In febrile conditions hair become erect, rough, lustreless coarse and dry.
   Alopecia: is a condition where there is a loss of hair from some (or) entire part. Seen in scabies, ring worm, eczema, iodine deficiency, deficiency of vit. A and hypothyroidism. Rough hairs are commonly seen in :
   ii) Non-infectious conditions: Mineral deficiency (Co, Cu, Mn, P) vitamin A deficiency, pantothenic acid, nicotinic acid, pyridoxine deficiency.
   Condition of skin: Skin of healthy animal, provided with a surface fat and is elastic, smooth and soft.
   Asteatosis (loss of fat): noticed in endoparasitic infections like mange, wasting diseases,. elasticity is lost in chronic wasting diseases.
   Colour of skin: In conditions like jaundice, anaemia, cyanosis, discoloration of skin is noticed. Depigmented areas are noticed as a sequelae to certain inflammatory disease.
   Sweating of skin: Healthy animal has dry skin. But after exercise or heavy work perspiration is noticed. Sweating is common in horses but in certain diseases it is well marked Le., in conditions like H.5., colic, azoturia excessive sweating is noticed (hyper hydrosis-excessive sweating).
II) Palpation: It is the art of gaining information through the sense of touch as to consistency, extent, and sensitivity of a part. Ex: palpation of heart. It is done to access the
strength and extent of cardiac pulse, it is carried out by placing the hand or tip of the finger at the exact site of cardiac impulse. The action of heart can be felt with finger tips by placing the left hand flat against the chest inside the left elbow at the 4\textsuperscript{th} intercostal space. Similarly palpations of pulse can also be carried out by placing hand at the respective sites.

III) Percussion: It is carried out for assessing the structure of the organ with help of the sounds, emitted due to vibrations. It is of; a) immediate percussion - it is generally practiced in small animals. It is carried out by using fingers, striking upon a part. b) Mediate percussion - it is usually carried out in large animals. For this plexor and pleximeter are used.

<table>
<thead>
<tr>
<th>Immediate percussion</th>
<th>mediate percussion</th>
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<tbody>
<tr>
<td>Acoustic percussion</td>
<td>Pain seeking percussion</td>
</tr>
<tr>
<td>Over lung area</td>
<td>Over reticular area and</td>
</tr>
<tr>
<td>Over reticulum and</td>
<td>over the abomasal area</td>
</tr>
<tr>
<td>Over omasum and caecal area</td>
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</tbody>
</table>

IV) Auscultation: It is the procedure of listening the sounds generated in the organ. It is of 2 methods. Immediate auscultation - sounds can be listened by placing ear directly against the chest wall. Mediate auscultation listening of sounds using an instrument. For this usually phonendoscope and stethoscope are used. Auscultation can be carried out for Heart, Trachea, Bronchi, Lungs, Rumen, Reticulum, Omasum, Abomasum and intestines.

**GENERAL CLINICAL EXAMINATION OF LARGE AND SMALL ANIMALS**

It includes recording of temperature, pulse, respiration and examination of visible mucous membrane.

**TEMPERATURE:** Normally the temperature is taken per rectum when this is impossible the thermometer should be inserted into the vagina. Ensure that the mercury column is shaken down, moisten the bulb to facilitate entry and if the anus is flaccid (or) the rectum is full of hard faeces, insert a finger also to ensure that the thermometer bulb is held against the mucosa. As a general rule the thermometer should be left in place for 2 minutes. If there is doubt as to the accuracy of the recording, the temperature should again be taken. The normal average temperature range for the various species at average environmental temperature is as follows.

<table>
<thead>
<tr>
<th>Large Animals</th>
<th>Normal (°F)</th>
<th>Critical point (°F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cattle</td>
<td>101.5</td>
<td>103.0</td>
</tr>
<tr>
<td>Bovines</td>
<td>99</td>
<td>101.0</td>
</tr>
<tr>
<td>Horses</td>
<td>100.5</td>
<td>102.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Small Animals</th>
<th>Normal (°F)</th>
<th>Critical point (°F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sheep</td>
<td>102.0</td>
<td>104.0</td>
</tr>
<tr>
<td>Goat</td>
<td>103.0</td>
<td>105.0</td>
</tr>
<tr>
<td>Pig</td>
<td>102.0</td>
<td>103.5</td>
</tr>
<tr>
<td>Dog</td>
<td>101.5</td>
<td>101.5</td>
</tr>
</tbody>
</table>

To convert °F to °C; \[ C = \frac{(F-32) \times 5}{9} \]

Rise in temperature is termed as Hyperthermia. Rise in temperature with metabolic disturbance is termed as "Fever".

Types of Fever:
2. Remittent fever: The temperature rises and falls by more than i.e. at short and irregular intervals.
3. Intermittent fever: There are short attacks of fever lasting for 2-3 days interspersed with non-febrile intervals, usually forming a regular pattern.

**PULSE:** The pulse should be taken at the middle coccygeal or facial artery in cattle, the facial artery in horse, and femoral artery in sheep and goats. In case of dogs also femoral artery is preferred. With careful observation a number of characters may be determined including rate, rhythm, amplitude, tone of pulse, pressure, and the form of the arterial pulse.

**Rate:**

The pulse rate is dependent on the heart alone and is not directly affected by changes in the peripheral vascular system. Normal resting rates (Per minute) for various species:

- Cattle: 60-80
- Horse: 30-40
- Foals up to one year: 70-80
- Calves: 100-120
- Sheep & Goat: 70-96
- Dog: 62-80
- Cat: 110-130

**Amplitude:** The amplitude of the pulse is determined by the amount of digital pressure required to obliterate the pulse wave.

**Rhythm:** The rhythm may be regular or irregular. There are 2 components of the rhythm namely, the time between peaks of pulse waves and the amplitude of the waves. Most of the irregularities except that due to atrial fibrillation disappear with exercise.

**Waves of pulse:**
1. Normal pulse - It is regular in sequence, amplitude and strength.
2. Dropped pulse - A normal pulse interrupted with pause frequently
3. Large bounding pulse - An abnormal pulse with high amplitude and strength.

The changes in normal qualities of pulse may be caused by structural or functional disease of the heart or by abnormalities of the blood vessels (arterial thrombosis and embolism) which only have a local or indirect influence on the pulse.

**RESPIRATION:** The respiration rate may be counted by observation of rib or nostril movements, by feeling the nasal movements or by auscultation of the thorax or trachea. A significant rise in environmental temperature or humidity may double the normal respiratory rate. Animals, which are acclimatized to cold outdoor temperature are susceptible to heatstroke/stress, when exposed suddenly to warmer temperatures. When brought indoors the respiratory rate may increase to six or eight times the normal and panting/open mouth breathing may be evident. Respiratory rate in different species:

- Horses: 8-10/min
- Cattle: 10-30/min
- Sheep: 10-20/min
- Pigs: 10-20/min
- Goats: 25-35/min
- Dog: 14-30/min
- Cat: 20-30/min
- Buffaloes: 10-25/min
**Visible Mucous Membrane:** It is a good indicator of the state of the peripheral vascular system. Ex: Pale colour indicates Anaemia, Yellow coloration indicate Jaundice. In general visible mucous membrane includes:

1. Conjunctival
2. Nasal
3. Buccal
4. Vaginal
5. Urethral
6. Rectal mucous membrane

While carrying out examination of the visible membranes the tissues surrounding the orifice by means of which the particular mucosa communicates with the surface of the body should be included. Changes in these tissues are often closely associated with the disease of the related mucous membrane.

Conjunctival mucous membrane: It is of palpebral and bulbar mucous membrane

i) Palpebral mucous membrane covers inner surface of eye lid.

ii) Bulbar mucous membrane covers eye balls

Inspection of conjunctival mucous membrane assists in the diagnosis of disease which produces changes in the colour of mucosa in general.

Ex: Jaundice: Yellow color; Arsenic poisoning - Brick red; Anaemia - pale .and watery; Viral infections Hyperemia; shock - Pale and dry

Conjunctivitis occurs in association with inflammatory changes in other eye structures. (Infectious kerato conjunctivitis and contagious ophthamia).

In a condition called chemosis, the swelling of the palpebral conjunctiva is very extensive so that the mucous membrane protrudes beyond the free margin of eye lid.

Nasal mucous membrane: Can be inspected adequately in equine sp because of wider and flexible nostrils so that the anterior third of the nasal cavities are visible to direct visual examination. The important changes affecting the nasal m.m. include pale (anaemic), injection (allergic rhinitis), petechiation (purpura haemorrhagica and dicoumarel poisoning) Erosion and ulcerations, CRP, Malignant catarrhal fever.

Buccal mucous membrane: Its abnormalities include changes in colour and a local/general distribution such as jaundice; cyanosis, anaemic (Pale) hyperaemic which are clinical features of diseases with an inflammatory or allergic origin.

For examining the vaginal or rectal mucous membrane an appropriate speculum is used. The concealed mucous membrane (Pharynx, larynx, trachea, stomach, bladder) may be inspected with endoscopic instruments. Any discharges on the mucous membrane may be secretion of a gland (mucous, lacrimal, anal) or the product of inflammation (exudate) or the result of venous congestion (Transudate) or of vascular trauma (Haemorrhage).

**REGIONAL EXAMINATION**

**CLINICAL EXAMINATION OF HEAD NECK, EYE BALLS, CONJUNCTIVA**

HEAD: Facial expression of an animal indicates its mental state. Ex: anxious expression, muscular stimulation, dilatation of nostrils and prolapse of nictitating membrane is indication of tetanus.

1. In rabies and lead poisoning the facial expression is maniacal in nature.
2. In congenital achondroplasia and inherited chondroplastic dwarfism in calves bulging of frontal region is seen.
3. Symmetrical enlargement of mandibles and maxillae occurs in osteo dystrophia fibrosa.
4. In actinomycosis, asymmetrical enlargement of maxillae and mandible is characteristic feature. The condition is called 'Lumpy jaw'.
5. In actinobacillosis unilateral / bilateral swelling of cheeks is noticed. Condition is 'Wooden tongue'.
6. The soft tissues of nose and face are swollen in necrotic rhinitis of young pigs.
7. Rotation of head occur in otitis media and Listeriosis.

Neck:
1. Examination is carried out to rule out affections of jugular furrow.
2. Normal and healthy animal will have jugular pulse of small magnitude.
3. Enlargement of jugular vein may be due to obstruction of veins by compression / constriction.
4. In oesophageal diverticulum and paralysis of esophagus local/general enlargement of esophagus is noticed.
5. In TRP prominent jugular pulse is a characteristic symptom.

EYE BALLS: The deeper structures of eye i.e. Iris, fundus and lens can be examined by ophthalmoscope. Some affections of eye balls are:

- **Hyphaema:** Blood in ant. chamber of eye.
- **Hypopyan:** Pus in ant. chamber of eye.
- **Mydriasis:** Term to describe dilatation of pupil noticed in strychnine, arsenic poisoning due to paralysis of oculomotor nerve.
- **Myosis:** Constriction of pupil due to stimulation of parasympathetic nerves.
- **Macro phthalmus:** Larger eye ball than normal size.
- **Exophthalmus:** Protrusion of eye ball seen in Hyper parathyroidism
- **Anophtalmus:** Retraction of eye balls seen in cachetic and dehydrated conditions.
- **Lagophtalmus:** Incomplete closure of eye balls noticed in exophthalmia and macrophthalmia
- **Panophtalmus:** Generalised inflammatory condition of the eye.
- **Cataract:** Opacity of lens usually noticed in aged animals. In conditions like trypanosomiasis - Bilateral cataract is characteristic symptom in dogs.
- **Total Blindness:** Amaurosis
- **Partial blindness:** amblyopia

Eye lids:
- Excessive blinking is seen in painful conditions such as keratitis, conjunctivitis, damaged nervous condition, encephalitis, lead poison, hypo magnesemia tetany. In gross swelling of eyelids as in local oedema due to photosensitization, allergy (or) purpureahaemorrhagica eye lids will be kept closed. Prolapse of nictitating membrane is common in horses suffering with tetanus. In cats it indicates debilitated condition. Prolapse is due to contraction of retractor bulbi muscle.
- **Strabismus (Squint).** Lateral, upward and down ward squint are seen.

Etiology: Congenital or acquired.

Acquired Causes: Paralysis of 3 nerves i.e Trochlear,Abducent,Occulomotor nerve

Abnormalities of eye lids:
- **Entropian:** Inversion of palpebral border
- **Ectropion:** Eversion of palpebral border
- **Trichiasis:** Abnormal deviation of eye lashes
- **Distichiasis:** Two rows of eye lashes. Common in Dog and Sheep
- **Nystagmus:** Abnormal movement of eye balls due to paralysis of acoustic nerve

**EXAMINATION OF CONJUNCTIVAL MUCUS MEMBRANE:**

Normal:
- **Cattle:** Pink/Rose
- **Buffaloes:** Red
- **Dog, cat, sheep and goat:** Pink

Abnormal:
- In anaemic - Pale and moist
- Shock: Pale and dry
- **Arsenic Poisoning:** - Brick red
Jaundice - Yellowish
Hypoxic - Bluish/cyanotic
Acute viral infection Hyperemic.
CHEMOSIS: Swelling of palpebral conjunctive to a greater extent so that the m.m.
protrudes beyond the margin of eye lid.
Photo phobia: A condition in which eyelids are kept closed in normal light of day time Pain
noticed in cataract, conjunctivitis.
Blepharospasm : Spasms of eye lids.
Blepharitis: Inflammation of eye lids.
Inflammation of cornea is keratitis. It is examined with keratoscope.

REGIONAL EXAMINATION

CLINICAL EXAMINATION OF NOSTRILS, FRONTAL SINUS, BUCCAL
CAVITY AND SUB MAXILLARY LYMPH NODES

Examination of nostrils: While examining nostrils following points are to be considered.
Nostrils and surrounding tissue are examined for any lesions, vesicles, pustules, scabs and
tumours.

Movement of nostrils: Distension of external nares involving movement of alunasi is
voluntary in healthy animals, which is prominent in horse and rabbits. Inspiratory dyspnoea
causes distinct involuntary dilation of nostrils. It is observed in pulmonary emphysema,
bronchitis, pneumonia, rupture of diaphragm, oedema of larynx.

Respiratory sounds: Abnormal audible sounds of inspiration are called stridors. Stridor
sounds arising from partial construction of respiratory passages may be caused by swelling
of nasal mucous membrane, presence of excessive mucus, inflammatory oedema, neoplasia,
paralysis of nasals etc. In laryngeal paralysis the sounds are audible during inspiration. In
fracture of nasal bones, these are audible during both inspiration and expiration.
Due to congenitally elongated vulva in brachycephalic breeds - snoring sounds are
normally heard.
Sneezing: Reflex action created by stimulation of sensory nerve endings due to irritation in
nasal passages expressed by forceful expiration of air.

Hiccough: Due to stimulation of phrenic nerves.
Expired air: In healthy animals it is equal in strength from both the nostrils. In ketosis the
expired air has sweet smell. In uraemia, urea smell and pungent odour in conditions having,
putrefactive lesions in nasal cavities. Nasal discharge may be unilateral or bilateral.
Unilateral: In necrosis of turbinate bones and estrous ovis infestation in sheep the
discharges are unilateral.
Bilateral: Conditions affecting nasal cavity, atrophic-rhinitis, strangles and glanders.
Epistaxis: Due to warfarin and sweet clover poisoning.
Nasal mucous membrane: Pale in anaemic and shock, hyperaemic in allergic rhinitis, in
purpuraea haemorrhagica and in dicoumoral poisoning. It is necrotic and ulcerated in RP &
malignant catarrhal fever. Frontal sinusitis occurs as an extension and inflammation from
nasal cavity and seen in malignant catarrhal fever.

EXAMINATION OF BUCCAL CAVITY: Inflammation of oral mucosa is called stomatitis
which includes gingivitis; glossitis and lampas. In bacterial stomatitis lesions are necrotic in
nature (oral necro bacillosis). In viral stomatitis lesions are vesicular, ulcerative and proliferative in nature. (FMD, vesicular stomatitis).

Mycotic stomatitis: Lesions are whitish, patchy in nature caused by Monilia & Candida sp.

SALIVATION: Secretion of parotid, sub maxillary and sublingual glands produced in response to neural and hormonal stimuli. In conditions of dehydration (Where there is excessive loss of body fluids) nephritis, diabetes insipidus, etc., and in acute febrile condition salivation decreases and the oral mucosa becomes dry. Foreign body penetration in soft tissues and in conditions like FMD, RP, Mucosal diseases, salivation is increased and is termed as ptyalism which is also noticed in poisoning conditions.

Abnormalities of sub-maxillary region includes enlargement of lymph nodes due to local foci of infection, Sic edema, local cellulites, enlargement of salivary glands and guttural pouch distension in horse. In bovine malignant catarrhal fever and in bovine viral diarrhoea sloughing and gangrenous lesions in muzzle with scab formation is noticed. In sheep these lesions are seen in blue tongue, ecthyma and in vesicular exanthema swine Vesicular diseases and FMD.

EXAMINATION OF THORAX FOR DIFFERENT TYPES OF RESPIRATION
Resonant: (or) ringing indicates large vol. of air/gas beneath the site of percussion, (pulmonary emphysema, pneumothorax).

Dull sounds: When there is no air and also occurs when there is increase in density of pulmonary tissue as a result of congestion, neo-plasia and hydro thorax.

Tympanic: associated with pneumonia, pneumo-thorax, characterized by musical ring (Kettle drum)

Normal respiratory sounds/Breath sounds:
Vesicular Sounds: Resembles the sound produced when letter 'V' is whispered softly. Indicates healthy lung, clearly heard during inspiration. During expiration it may change its character and resemble 'f' sound. In conditions like pneumonia, Pulmonary oedema and collapse of lung these are absent. In T.B. and Bronchopneumonia these are interrupted.

Bronchial sounds: These sounds resemble a long drawn out guttural 'Ch' which commences and terminates abruptly. Audible over larynx, trachea, and also bronchial area where the larger bronchi are relatively near the surface of the body.

Abnormal Sounds: Originate from diseases of lungs, bronchi, pleura and diaphragm. It includes rales, emphysematous, frictional and peristaltic sounds.

Rales: Indicate the presence of secretions or fluid in bronchi and bronchioles (The fluids may be transudate or exudate). Rales are two types - Moist and Dry.

Moist Rales : Appears when there is mucus of low viscosity, and they set in motion by air passing through it. These are heard in broncho pneumonia.

Dry Rales: Heard when air is passed through bronchial tubes which are partially constricted by swelling of mucous membrane, heard as humming sounds, cracking sound, (heard in T.B., spasms of bronchi, bronchitis of early stages).

Emphysematous sounds: Harsh or crackling sounds heard during, whole inspiration phase. This sound resembles that sound produced when a sheet of paper is crushed into a ball. Occurs in chronic alveolar emphysema.

Frictional: When two opposing surfaces, that is visceral and coastal pleura are dry and roughened the rasping or scraping sounds appear (as in early stages of pericarditis and pleurisy).

Succussion Sounds: Heard in pneumo-thorax. These are splashing sounds caused by agitation of fluid which has free surface at which movement can take place.

TYPES OF RESPIRATION
1. Biots respiration: Characterized by pauses in ordinary respiration i.e., series of respiratory movements are foll. by a long pause. Polypnoea followed by pause; observed in meningitis, encephalitis, medullary lesions and poisoning.

2. Chyne stokes: Characterized by gradual ascending type of respiration which will reach maximum followed by gradual shallow respiration ending in pause. Observed in pulmonary insufficiency, chronic nephritis, embolism and anaemia.

3. Syncopic type of respiration: Characterized by pause followed by immediate take over by a deep breathing (hyperpnoea) which successively becomes shallow till proceeded by apnoea. Prognosis is grave in this. Observed in irreversible damage of respiratory system of respiratory acidosis.

4. Kussmauls type of respiration: (Air Hunger)
   The respirations are forceful and irregular with unaffected expirations. Observed in terminal stages of renal diseases of diabetic keto acidosis.

EXAMINATION OF ABDOMEN

Abdomen examination includes external examination comprising
a) Inspection
b) Palpation
c) Percussion and internal examination include recta) exploration, exploratory puncture, radiography and peritoneoscopy. An increase in size of abdomen occurs from various causes, which include advanced pregnancy, flatulence (wind" wave like appearance) distension of rumen, tumours, retention of urine, ascites. Edematous swelling of ventral abdomen occurs in congestive heart failure, acute gangrenous mastitis, equine infectious anaemia, rupture of penile urethra and in hydropneumonia. Decrease in circumference of abdomen resulting in tucked up as observed in prolonged malnutrition and in diseases associated with severe dehydration. - A pain reaction is elicited over the abdomen in peritonitis and over the upper half of the last 2 or 3 ribs on right side in acute hepatitis.

In TRP the existence of painful, lesions can often be demonstrated by applying firm upward pressure in the hypogastric region where upon the animal arches its back, slightly moves sideways.

Undulation (wind wave) can be noticed when the peritoneal cavity contains large vol. of fluid as in ascites, exudative peritonitis and rupture of urinary and gall bladder. Dull sounds of abdomen is observed over the impacted stomach over intestine, over spleen, liver and over neoplasms - suspended rumination is observed in ruminal atony, impaction of rumen, TRP, vagus indigestion, abomasal displacement, impaction of omasum. In vagus indigestion the nerve supply to stomach components may be impaired resulting in paralysis and is characterized clinically by ruminal distension, anorexia, retarded passage of ingesta and evacuation of soft faeces in large animals.

ABNORMALITIES OF ABDOMEN
1. Distension of left paralumbar fosa indicates acute tympany
2. Oval shaped swelling of left flank behind last rib indicates left side abomasal displacement.
3. Marked bilateral displacement indicates acute tympanitis.
4. Distension of lower right quarter indicates abomasal impaction.
5. Cylindrical enlargement of right side indicates abomasal volvulus.
Consistency of abdomen is determined as :
Doughy: Indicates edematous nature. Finger impressions are left on applying pressure.
Resilient: Organ gets its normal shape (or) size after removal of external pressure (ascites)
Hard dull: Fluid wave appearance (Ascites).

SPECIAL EXAMINATION

COLLECTION AND EXAMINATION OF RUMEN FLUID

Rumen fluid can be collected by the following methods:
1. Paracentesis Rumenocentesis
2. From slaughter house
3. From Fistulated animals
4. Stomach tube aspiration method.

Stomach tube aspiration method:
1. The animal is restrained properly and head is secured tightly.
2. Holding the head and tongue, introduce slowly the stomach tube, which is already lubricated with liquid paraffin.
3. Care should be taken to see that undue force is avoided. When proximal end of tube reaches the cardia, mild resistance is appreciated. This is overcome by a gentle moving of the tube towards the interior.
4. The other end of the stomach tube is attached to collection bottle which in-turn is connected to the aspirator pump.
5. Gently the pump is worked out and as much as 500 ml of rumen fluid is collected and subjected for immediate analysis.

Tests to be used:
Colour: It depends on the feeding. Green colour is seen in animals, which are grazing and fed with green fodder. In animals fed with concentrates colour will be brown. If the animals are fed with paddy straw the colour will be light yellow or light brown. Abnormal colour includes milky grey in acid indigestion, greenish black in alkaline indigestion and putrefaction.

Odour: Observed by smelling the contents. Normally aromatic due to volatile fatty acids abnormal odours are musty, foul odour of protein decomposition penetrating acid odour in lactic acidosis and reflex of abnormal abomasal contents into rumen in pyloric stenosis.
Consistency: It is appreciated by feeling the contents. Normally, it is slightly viscous. Salivary contamination will lead to extreme viscous samples. Watery rumen fluid is suggestive of inactive rumen flora. In frothy bloat the viscosity of rumen fluid is increased.

pH :This is measured by pH strips or by pH meter. Normal pH of rumen fluids varies from 6.0 to 7.0 pH below 5.5 is considered acidic (in acidic indigestion). pH above 7.5 to 8.0 is considered alkaline (alkaline indigestion).

Protozoal Motility:Take a drop of freshly collected rumen fluid onto a clean glass slide and apply coverslip over that. Examine under low power..
- No motility/dead
+ Sluggish
++ Moderate
+++ Vigorous

Concentration of Protozoa:
The density of protozoa is indicated as follows:

<table>
<thead>
<tr>
<th>Density</th>
<th>Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>+++</td>
<td>20 and above / L.P.F.</td>
</tr>
<tr>
<td>++</td>
<td>10-20 / LPF</td>
</tr>
<tr>
<td>+</td>
<td>upto 10 / LPF</td>
</tr>
</tbody>
</table>
Protozoal inactivity.

Iodophilic Activity: Take a drop of Lugol's Iodine on slide and add 2 or 3 drops of rumen liquor. Examine under microscope. Depending on starch content it will take colour. It is indicated as +, ++, +++.

Methylene Blue Reduction Test (MBR1):
1. Take 20 ml of freshly drawn rumen fluid in a test tube
2. Add one ml 0.03% Methylene blue solution to this and mix.
3. Initially there is bluish discoloration of rumen fluid.
4. The time taken for the disappearance of blue colour is noted as M.B.R. Time.
5. It is 3 minutes in animals fed with balanced rations, 3-6 minutes in animals given straw alone and prolonged M.B.R.T. in gross microbial inactivity.

Sedimentation Activity Time (SAT)
1. Freshly drawn rumen liquor is taken in a clean cylindrical flask.
2. It is allowed to settle.
3. The larger and more fibrous particles are carried to the top while the dense particles settle at bottom.

The time required for the complete sedimentation and floatation is measured and is referred to as SAT.

Healthy cattle: 4 - 8 mts.
Prolonged SAT: Inactive rumen microflora.

TRANSFUSION OF BLOOD IN ANIMALS

Blood transfusion is a life saving measure in certain critical cases such as acute blood loss or severe anaemia with a very low haemoglobin and PCV levels. Acute blood loss may result from any spontaneous haemorrhage as in case of accidents or during or after any major surgery in animals with coagulation defects. Severe anemia may be seen in conditions like chronic bleeding ulcers of gastro intestinal tract, massive hook worm or Fasciola hepatica infestation, heavy ectoparasitic infestation, heavy parasitemia with Theileria, Babesia and Trypanosomal organisms and nutritional haemoglobinuria. Blood transfusion is also given to restore normal maturation of erythrocytes in certain idiopathic anaemias by temporarily giving rest to erythropoisis. Ex: clover poisoning. A haemoglobin level of less than 6g% may be the indication for blood transfusion.

Selection of a donor: For Collection the donor selected should be apparently healthy and preferably from the same breed as that of a recipient. Its blood smear should be screened for haemoprotozoa. It should also have a normal haemoglobin level. In large animal practice donors are usually, readily available. In canine practice little difficulty may be experienced for procuring a donor. Hence it is ideal to maintain a few donor dogs in Veterinary Hospitals so that there can be of disease free status of the animal.

Compatibility of blood: The blood of donor and recipient must be checked for compatibility which in turn depends upon blood typing, cross matching and previous transfusion history. Under clinical conditions cross matching is preferred while going for blood typing is generally difficult. A simple matching is done as follows. Two drops of donor blood are mixed with 2 001 of 3.85% sod citrate or normal saline. Two drops of this dilute donor's blood are added to two drops of the recipient's serum on a glass slide and is gently mixed. On the other slide two drops of normal saline and is gently mixed which acts as a control. Any agglutination by way of clumps seen under a microscope shows the incompatibility. On the contrary clear dispersion of R.B.C.s indicates the compatible nature.
of two blood samples. The control should always show the uniform distribution of R.B.C.s without any signs of agglutination.

Collection of blood:
1. 3.85% Sodium citrate solution - this can be used @ 10 ml for collection of blood.
2. ACD solution, which consists sodium citrate 2.2 gm, citric acid 0.73 gm, dextrose 2.45 mg and distilled water 100 ml. This solution can be used @ 15 ml/100 ml of blood to be collected.
3. Blood can also be collected into CPO plastic bags with a negative pressure and containing citric acid 0.327g, tri-sodium citrate 2.63g dextrose (2.55 g) sodium hydrogen phosphate 0.22 g. This anticoagulant solution can be used @ 70 ml/500 ml blood to be collected.

Blood can be collected from jugular vein using 12 or 14 gauge needle in large animals. In dogs blood can be collected @ 10-15 ml / kg body weight from healthy donors by open mouth method into the bottle containing sterilised anticoagulant solution or into the plastics bags through the tube provided along with the bag. During collection, the blood may be mixed with the anticoagulant thoroughly and gently to avoid clot formation.

Method of transfusion: Blood suitable for transfusion may be transfused as early as possible after collection. However in case of need, blood stored properly up to a fortnight can also be transfused. In case of pure emergency blood may be given without any cross matching for the first time as transfusion reactions are relatively rare in animals. But in all other cases cross matching is an essential thing.

Blood should be administered through an infusion set containing the in-built filter and specifically meant for blood transfusion @ 10-15 ml/kg. Body weight. In large animals blood can be administered through the jugular vein at a speed of 50-60 ml per minute. The dog's blood can be administered through external saphenous or cephalic vein @ 5 ml per minute for the first fifteen minutes and then @ 40-50 ml per minute. As administration of excess quantities of anticoagulant causes hypocalcaemia, in case of such doubtful conditions calcium borogluconate can be given intravenously following blood transfusion. In case of a need a 2nd transfusion may be given preferably before 4 days of 1st transfusion to avoid transfusion reaction.

Transfusion reaction: During transfusion the animal should be monitored for signs of incompatibility which most commonly occur during the first 10 minutes of transfusion. The reactions are characterized first by hiccup, followed by dyspnoea, muscle tremor, salivation, frequent coughing, lacrimation, fever and in some cases ruminal tympany. Haemoglobinuria and abortion may also occur. Such reactions are more common and severe when repeated transfusions from the same donor are given more than a week after the initial transfusion.

Treatment of adverse reactions: Soon after the onset of symptoms the transfusion should immediately be stopped. About 4-5 ml of 1:1000 adrenaline hydrochloride should be injected intramuscularly and within 3-4 minutes the favourable effect will be seen. This can be followed by antihistamines and corticosteroids in appropriate doses.

10.3 VETERINARY GYNAECOLOGY AND OBSTETRICS:

During clinical practice they have to examine gynaecological cases for various disorders like anestrum, repeater, endometritis, Retained placenta, etc., and note the details in the case sheets regarding observations, treatment and diagnosis. They should also examine cases of heat, inseminate and make pregnancy diagnosis. If they happened to work
in livestock farms where bulls are stationed, they have to examine the semen quality and conception rate of bulls. They must collect data available at hospital or livestock farms, regarding the incidence and treatment of various reproductive disorders in male or female.

Clinical case record (Gynaecology):

Each candidate is required to submit 20 clinical cases in the following proforma as a separate booklet or in a practical note book.

RECORD THE FOLLOWING OBSERVATIONS FOR THE MUCUS SAMPLE

1. Physical examination
   a. Colour                              Transparent / turbid /cloudy
   b. Consistency                        Watery / Thin / Viscous
   c. Nature                             Ropy /Serous/Mucoid /Mucourulent/Purulent
   d. Presence of blood                  Yes/No

2. Microscopic examination:
   a. Fern pattern                       Present/Absent
      If present                          Typical/ Atypical
   b. R.B.C                               Present/Absent
   c. Protozoa                            Present/Absent
      If present, species                 Trichomonas/other
   d. Cytology                           Neutrophils & Abnormal cellular patterns if any

3. Bacteriological examination
   a. Culture
   b. ABST

REMARKS

RECORD OBSERVATIONS FOR BREEDING SOUNDNESS EXAMINATION

Name/ Number of animal ______________________
Identification marks _______________________
D.O.B/Age _______________________
Species / Breed _______________________
Owner __________________________
Dam No./ Name __________________________
Sire No./ Name __________________________
History:
Production:
Cow yield __________________ kg in ______ days
Dam’s yield __________________ kg in ______ days
Sire’s dam’s yield __________________ kg in ______ days
Dam’s dam’s yield __________________ kg in ______ days
Lactation length _______ days
Dry period _______ days
Parity: Nullipara/ Primipara/ Pluripara
Reproductive status Cyclic / Pregnant / Non-pregnant / Infertile
Age at 1st calving _______ months
Inter-calving period _______ days/months
Cyclic history:
Length: Normal / Short/ Long cycle( ____ days)
Regular/ Irregular

Estrus:
Duration & behaviour

Infertility

Calving particulars:
Date & Time
Nature Normal / abnormal, if abnormal details
Calf sex M / F
Calf weight ________kg
Foetal membranes Normally expelled / retained
Duration ________ hours
Other complications, if any
Method of estrus detection
Breeding NS / A.I
Stage of Pregnancy: FT / ST / TT

Feeding and managemental practices: _______________________________
___________________________________________________________________

Previous treatment (If any) ____________________________________________
____________________________________________________________________

Vaccination:

General Physical Examination:
Condition: Good / Fair / Poor
BCS
Alertness Alert/ Dull
Vision Normal / Defective
Gait
Skin coat Smooth and Shiny/ Dull / Rough
Body weight Optimum / Overweight / under weight
RLC Desirable / Faulty
Udder conformation
Any other findings ____________________________

Examination of Organ Systems:
Digestive system:

Urinary system:

Cardiovascular system:
Respiratory system:

Special Examination of Reproductive system:
I. Physical examination

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vulva (size, form mm)</td>
<td>________________</td>
</tr>
<tr>
<td>Perineum</td>
<td>________________</td>
</tr>
<tr>
<td>(Croup, pelvic diaphragm,</td>
<td></td>
</tr>
<tr>
<td>thighs &amp; buttocks, tail</td>
<td></td>
</tr>
<tr>
<td>and etc.,)</td>
<td></td>
</tr>
<tr>
<td>Vagina</td>
<td>________________</td>
</tr>
<tr>
<td>(Vaginoscopy / Speculum)</td>
<td></td>
</tr>
</tbody>
</table>

II. Per rectal examination

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cervix</td>
<td>________________</td>
</tr>
<tr>
<td>(Location, size, form,</td>
<td></td>
</tr>
<tr>
<td>consistency etc.,)</td>
<td></td>
</tr>
<tr>
<td>Uterus</td>
<td>________________</td>
</tr>
<tr>
<td>(Location, size, diameter,</td>
<td></td>
</tr>
<tr>
<td>consistency, turgidity,</td>
<td></td>
</tr>
<tr>
<td>symmetry, asymmetry, heavy,</td>
<td></td>
</tr>
<tr>
<td>doughy and signs of</td>
<td></td>
</tr>
<tr>
<td>pregnancy)</td>
<td></td>
</tr>
<tr>
<td>Broad ligament</td>
<td>________________</td>
</tr>
<tr>
<td>Inter corneal ligaments</td>
<td>________________</td>
</tr>
<tr>
<td>Uterine inflammation</td>
<td>________________</td>
</tr>
<tr>
<td>Uterine adhesion</td>
<td>________________</td>
</tr>
<tr>
<td>Fallopian tube</td>
<td>________________</td>
</tr>
<tr>
<td>Any other finding</td>
<td>________________</td>
</tr>
</tbody>
</table>

Ovaries: LO RO

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shape</td>
<td></td>
</tr>
<tr>
<td>Follicle</td>
<td></td>
</tr>
<tr>
<td>Corpus luteum</td>
<td></td>
</tr>
<tr>
<td>Ovarian cyst</td>
<td></td>
</tr>
<tr>
<td>Ovarian tumors</td>
<td></td>
</tr>
<tr>
<td>Ovarian bursa</td>
<td></td>
</tr>
</tbody>
</table>

Results of the Investigations Carried out:

<table>
<thead>
<tr>
<th>Investigation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cytology</td>
<td></td>
</tr>
<tr>
<td>Bacteriology</td>
<td></td>
</tr>
<tr>
<td>Serology</td>
<td></td>
</tr>
<tr>
<td>Histopathology</td>
<td></td>
</tr>
</tbody>
</table>

OBSTETRICAL CASE SHEET
CASE NO. : DATE: KIND OF ANIMAL:
BREED: AGE:
CLINICIAN:

I. HISTORY

1) Is the birth premature or overdue YES/ NO
2) Has the cow given birth before? Pluriparous/ primiparous.
3) Were there any previous problems at birth? YES/ NO
4) If so, what were they, how they were resolved and what was the outcome?
5) What is known about the sire of present pregnancy? YES/ NO
6) Was it used last time? YES/ NO
7) Is there a large disparity in body size between sire and dam? YES/ NO
8) Have any other animal pregnant to the same sire suffered dystocia recently YES/ NO
9) Has the cow suffered any illness or accident during pregnancy YES/ NO
10) If so what were the details
11) Had the animals been straining YES/ NO
12) If so when did it start and how vigorous has it been?
13) Have there been any vaginal discharges and what was its nature? YES/ NO
14) Have any fetal membranes, fetal fluids or fetal parts been seen at the vulva YES/ NO
15) Has any person already attempted to assist the animal YES/ NO
16) Has any of the litter been born YES/ NO
17) Were they live or dead? YES/ NO

GYNAECOLOGICAL EXAMINATION

General appearances and the condition of the animals: Excellent/ Good/Fair/Poor

1) Is the animal emaciated: YES/ NO
2) Is she able to stand and walk? YES/ NO
3) Is she recumbent? YES/ NO
4) Temperature Pulse Respiration
5) Are any fetal parts being seen at the vulva? YES/ NO
6) Are they exposed or covered by fetal membranes? YES/ NO
7) Are the parts dry? YES/ NO
8) Is there any vaginal discharge? YES/ NO
9) Type of discharge
10) Is there any evidence of fetal life? YES/ NO
11) Can any exposed fetal parts be seen to be moving spontaneously YES/ NO

VAGINAL EXAMINATION
1.) Whether the cervix is dilated
2.) Whether any fetuses are present,
3.) Presentation of fetus
4.) Position of fetus
5.) Posture of fetus
6.) Whether dystocia is present,
7.) Whether vaginal delivery is likely to be possible.
   NO
8.) Any other abnormality
9) DIAGNOSIS:

10) TREATMENT:

<table>
<thead>
<tr>
<th>DATE</th>
<th>OBSERVATION</th>
<th>TREATMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</table>

10.4 HOSPITAL MANAGEMENT & RECORD KEEPING

In addition to the routine clinical examination and treatment internees must gain a thorough knowledge of Hospital management and record keeping.

Management of Hospital is a broad term, which includes cleanliness, hygiene, discipline among staff and proper disposal of cases with maximum client satisfaction. Proper management will be carried out by electing some committees like farmers committee. Any problems can be focused into the committee and suggestions can be followed to maintain congenial hospital atmosphere.

Because of non-availability of ministerial staff in most of the Veterinary dispensaries it is the duty of the Veterinarian to look after some records. So in order to take care of this one must get acquainted with the records that are to be maintained in hospital among that some important records include.

1. Patient Register: a) Outpatient and b) In-patient
2. Biological Product Register
3. Vaccination Register
4. Specimen Register
5. Medicines Records
   a) Stock entry register, b) Expendable article register
6. Operation Register
7. Castration Register
8. A.I. Register: a) Cows, b) Buffaloes
9. Calf born Register
10. Post-Mortem Register
11. Fodder Register

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Besides these, some financial registers like Pay bill Register, Acquaintance roll register, Treasury bill register, T.A. Bill Register should be maintained and verified regularly whenever necessary by making regular entries.

10.5 LIVESTOCK PRODUCTION MANAGEMENT

10.5.1 Dairy farm:

Study of dairy farm routine
Calf management:
Care of new born calf
Colostrum feeding
Pail feeding
Feeding of calf between 0-3 months
Calf starter and milk replacer
Identification of calves: tattooing, ear tagging etc.,
Dehorning (Dis-budding)
Deworming : Selection of drug, calculation of dose, administration
Feeding of calf between 3-6 months
Feeding of calf above 6 months
Housing of calves: Study of housing requirements
Castration of bull calves
Recording of birth weight and fortnightly body weights Separation of male calves
Management practices for buffalo calves winter management of calves
Culling of calves
Heifer management:
Growth pattern of heifers
Feeding practices for heifers
Housing requirements
Control of external and internal parasites
Vaccination of heifers
Branding of heifers
Heat detection in heifers
Care and feeding of pregnant heifers
Management of dairy cows/buffaloes:
Feeding management in early lactation
Milking methods
Clean milk production
Demonstration of machine milking
Study of economic traits of dairy cattle/ buffaloes
  ● Age at first heat/maturity
  ● Service period
  ● Lactation period
  ● Dry period
  ● Calving interval
  ● Peak yield
  ● Breeding efficiency
  ● Services per conception

Dry cow management:
Care and management of cow before, at and after parturition
Housing of cattle: Selection of site, layout plan for dairy cattle farm of different sizes
Sanitation: cleanliness/bathing of animals
Cleaning and disinfection of animal houses
Environmental friendly disposal of animal wastes
Care and management of bio-gas unit
Economics of dairy farming (organized / unorganized farming)
Cost of milk production
Summer management of cross bred cattle and buffaloes
Selection, culling and judging of animals for milk production
Weighing of animals
Record keeping
Marketing - products, by-products, live animals
Fodder production
Nutritive value of different fodder crops Formulation of rations
Use of unconventional feed ingredients Pellet feeds
Cost of cultivation of fodder crops
Importance of leguminous fodder in animal feeding
Recording of different fodder grown/extent yield, package of practices.
Preservation of fodder - Hay making and silage making

DAIRY FARM INVENTORY

Name of the farm : 
Objectives: 
Total area of the farm (acres) : 
a. Buildings : 
b. Unconstructed area : 
Livestock (Number) : 
a. Milch cattle / buffaloes : 
b. Dry (pregnant) cattle / buffaloes : 
c. Dry (non-pregnant) cattle /buffaloes : 
d. Heifers : 
e. Young calves : 
  Males : 
  Females : 
  Male female ratio : 
f. Breeding bulls : 
g. Teaser bulls : 
h. Work cattle : 
Breeds maintained in the farm : 

Total land available for fodder cultivation : 
a. Irrigated land : 
  Legumes : 
  Non-legumes : 
b. Non-irrigated land : 
  Legumes : 
  Non-legumes : 

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c. Varieties of fodders cultivated:
   - Legumes:
   - Non-legumes:
d. Fodder yield/acre:
   - Legumes:
   - Non-legumes:
e. Cost of fodder production / tone:
   - Legumes:
   - Non-legumes:
f. Quantity of Silage prepared (tonnes) per annum:
g. Quantity of hay produced (tonnes) per annum:
Concentrate feed: (Farm prepared / purchased)
Composition:

PRODUCTION AND REPRODUCTION TRAITS: (farm average)
Breeding method: Natural service / Artificial insemination
Conception rate:
No of inseminations per conception:
Birth weight (kg):
Mortality rate (%):
Weight at 1 month (kg):
Weight at 3 month (kg):
Weight at 6 month (kg):
Weight at 1 year (kg):
Weight at maturity (kg):
Age at maturity (Months):
Age at first service (months):
Service period (days):
Lactation length (days):
Dry period (days):
Inter-calving period (calving interval) (months):
Milk yield per day per animal (kg):
Lactational milk yield for 305 days/animal (kg):
Peak yield (kg):
Stage of lactation at which peak yield attained (weeks):
Breeding efficiency or reproductive efficiency:
Cost of milk production per kg:
Quantity of dung produced per annum (tonnes):
Net profit / animal / year:
Any other information:

10.5.2 Sheep & Goat farm

Routine sheep farm operations
Handling of sheep / goat
Identification of sheep and goat: ear tagging, tattooing etc., Care of lambs/kids
Creep feeding
Docking
Management of weaners, hoggets
Management of adult stock
Dipping operation: Management of dipping pond, calculation of dose, Spraying
Examination for external and internal parasites
Vaccination schedule
Detection of heat, use of teaser rams Mating of sheep, identification of pregnant sheep
Care of pregnant animals
Judging sheep for wool and mutton
Judging goats for chevon and milk
Practical housing of sheep and goats
Winter management of lambs
Feeding / grazing of sheep and goat
Least cost rations in sheep and goat feeding
Determination of age of sheep
Sheep farm record maintenance
Layout plan for sheep and goat farms of different sizes
Economics of sheep / goat rearing
Study of breeding records and economic traits
Age at maturity :
Weight at maturity :
Age at first tupping :
Age at first lambing :
Lambing percentage :
Percentage of twining :
Dressing percentage in sheep and goat
Formulation of economic rations for sheep / goat
Shearing and grading of wool.
Structure of wool and its differentiation from hair fibre.
Determination of staple length, crimps, diameter and strength of wool fibre
Marketing of products
SHEEP / GOAT FARM INVENTORY

Name of the farm:
Objectives of the farm:
Area of the farm (acres):
a) Buildings :
b) Unconstructed area :
Total area available for fodder cultivation (acres) :
a. Irrigated
   Legumes :
   Non-legumes :
Number of fodder trees in. the farm :
Area available for grazing (acres) :
Fodder produced per acre (tonnes) :
Cost of fodder production / tone :
   Legumes :
   Non-legumes :
Composition of concentrate mixture : Farm prepared / purchased
Cost of concentrate mixture per kg :
Total no. of animals :
a. Rams/bucks :
b. Ewes/does :
Pregnant : 
Non-pregnant : 
c. Hoggests : 
d. Lambs/kids : 

BREEDS MAINTAINED

PRODUCTION / REPRODUCTION TRAITS :
LAMBING / KIDDING RATE (%):
Mortality rate :
  Adults :
  Young ones :
  Birth weight :
  Weaning weight :
  Slaughter weight :
  Feed conversion rate :
  Wool production / annum :
  Dressing percentage :

Milk production per lactation per doe: (if goats):

10.5.3. Piggery

Routine swine farm operations
Characteristics and identification of native pig and exotic swine breeds
Selection of gilt
Selection of boar
Culling of sows
Handling of pigs
Selection of site and housing of pigs
Care and management of sow during and after farrowing
Care and management of piglets
Recording of birth weight and fortnightly body weights
Weaning of piglets, care and their management
Vaccination schedule of pigs
Feeding of piglets
Feeding of growing pigs
Feeding of adult pigs
Feed ingredients composition, formulation of feeds for breeders, pregnant and lactating sow
Formulating rations for starter, grower and finisher pigs
Least cost rations in pig feeding
Control of parasitic diseases in swine
Deworming: Selection of drug, calculation of dose, administration
Methods of removal of needle teeth
Cleanliness and disinfection of pig farm
Detection of heat in sows
Identification of pregnant sows
Management of pregnant sows Culling of pigs
Castration of pigs
Use of wallowing during summer
Maintenance of swine farm records
Economics of pig rearing

PIGGERY FARM INVENTORY
Name of the Firm : 
Objectives of the farm : 
Area of the farm : (acres) : 
Total no. of animals maintained : 
  Adults : 
    Male : 
    Female : 
    Pregnant : 
    Non-pregnant : 
  Piglets: 
    Male : 
    Female : 
Breeds maintained : 
  Litter rate : 
  Mortality rate : 
  Birth weight : 
  Weight at weaning : 
  Weight at slaughter : 
  Dressing percentage (%) : 
Feeding schedule : 
  Composition of concentrate feed
  Creeper ration    Grower ratio    Finisher ration
  Cost of different rations per kg
  Feed conversion ratio
  Weight gain per day
  Culling rate
  Any other information

10.5.4 Rabbitry

Routine farm operations of Rabbitry
Handling of rabbits
Housing of rabbits
Care and management of doe during and after kindling
Feeding and watering of rabbits
Reproduction management of rabbits
Care and management of bunnies and weaning
Slaughtering and skinning of rabbits
Economics of rabbit keeping
Health management of rabbits
Pet animal management and care
Handling and restraining of pets for examination
Routine care and management of pets brushing, bathing, exercise, deticking, deworming, nail and tooth care
Detection of heat in bitches, mating of dogs
Vaccination schedule of dogs
Clipping of dogs, hygiene of pens, and equipment
Training of pets for obedience
Preparation of pets for shows
Selection
Fish production and management
Routine farm operation in fish rearing
Selection of site for fish culture
Fish pond construction
Management of ecology of fish pond water, soil quality, food chain and productivity
Management of nursery, rearing and stocking of ponds
Management and culture of air breathing fishes
Preparation of farming systems - Agriculture with fish
Management of prawn culture
Economics of fish and prawn culture

10.6 Poultry Production & Management

10.6.1 Layer & Broiler Production

A. Layer Production:

Lighting schedule for growers

As the poultry houses in our country are mostly open sided poultry houses, the natural (Sun) light cannot be controlled. No artificial light is provided from 8 to 20 weeks. Only natural day light is available.

From 20th week onwards step-up lighting programme need to be followed as shown below:

<table>
<thead>
<tr>
<th>Week</th>
<th>Light Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>21st</td>
<td>13 hrs. light</td>
</tr>
<tr>
<td>22nd</td>
<td>13 ½ hrs. light</td>
</tr>
<tr>
<td>23rd</td>
<td>14 hrs. light</td>
</tr>
<tr>
<td>24th</td>
<td>14 ½ hrs. light</td>
</tr>
<tr>
<td>25th</td>
<td>15 hrs. light</td>
</tr>
<tr>
<td>26th</td>
<td>15 ½ hrs. light</td>
</tr>
<tr>
<td>27th</td>
<td>16 hrs. light</td>
</tr>
<tr>
<td>28th</td>
<td>16 ½ hrs light</td>
</tr>
<tr>
<td>29th</td>
<td>17 hrs. light</td>
</tr>
</tbody>
</table>

The artificial light can be provided at a stretch after Sun-set or it can be divided into 2 equal halves and can be given one half after Sun-set and the other half in the morning hours before Sun-rise.

In some incidences restricted feeding is also followed during growing stage of pullets (8-20 weeks of age) i.e., 70-80% of the full fed (20-30% of restriction).

Second debeaking is done at 16th week before the pullets are being transferred from grower house to layer house.

Deworming is also done during 17th week before the pullets are being transferred to layer house. At 18th week R2B vaccination against Ranikhet disease is done. Transfer the pullets at 19th week from grower house to layer house. Arrange nest boxes if the layers are being reared in deep litter system.

Model rations:

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Grower</th>
<th>Layer</th>
<th>Breeder</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maize</td>
<td>42</td>
<td>46</td>
<td>46</td>
</tr>
<tr>
<td>D.O.B.</td>
<td>35</td>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td>G.N.C.</td>
<td>12</td>
<td>18</td>
<td>18</td>
</tr>
</tbody>
</table>
### Table

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Min.</th>
<th>Mixture</th>
<th>Vit. A, B2, D3</th>
<th>Coccidiostat</th>
<th>Antibiotic</th>
<th>C.P.%</th>
<th>M.E. (K Cal /kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fish meal</td>
<td>8</td>
<td>10</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Min-mixture</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shell grit</td>
<td>-</td>
<td>5</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vit. A, B2, D3</td>
<td>25 gms</td>
<td>25 gms</td>
<td>25 gms</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coccidiostat</td>
<td>50 gms</td>
<td>50 gms</td>
<td>50 gms</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Antibiotic</td>
<td>50 gms</td>
<td>50 gms</td>
<td>50 gms</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C.P.%</td>
<td>16.0</td>
<td>18.0</td>
<td>18.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M.E. (K Cal /kg)</td>
<td>2500</td>
<td>2600</td>
<td>2600</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The student needs to formulate rations for grower, layer and breeder with locally available ingredients and show the calculations for C.P. and M.E. as per BIS standards.

The student needs to mix the above formulated ration with his own hands (at least 500 kgs, for each type of ration).

### Characteristics of Good and Poor Layers

<table>
<thead>
<tr>
<th>Character</th>
<th>Good layer</th>
<th>Poor layer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comb and wattles</td>
<td>Large, red, glossy and warm</td>
<td>Small, pale, dry and shrunken</td>
</tr>
<tr>
<td>Eye</td>
<td>Full, bright and prominent</td>
<td>Dull and shrunken</td>
</tr>
<tr>
<td>Abdominal capacity</td>
<td>Full, soft and fliable, 4-5 fingers space</td>
<td>Contracted, hard and rubbery, 2-3 fingers space</td>
</tr>
<tr>
<td></td>
<td>between tip of keel bone and pubic bones</td>
<td>between tip of keel bone and pubic bones</td>
</tr>
<tr>
<td>Pubic bones</td>
<td>Thin and flexible, 3 fingers space between</td>
<td>Thick and rigid, 1-2 fingers space between</td>
</tr>
<tr>
<td></td>
<td>pubic bones</td>
<td>pubic bones</td>
</tr>
<tr>
<td>Vent</td>
<td>Large, dilated, of long and moist</td>
<td>Small, contracted, dry and puckred</td>
</tr>
<tr>
<td>Feathers</td>
<td>Soiled and broken</td>
<td>Clean and shiny and unbroken</td>
</tr>
<tr>
<td>Pigmentation</td>
<td>Evidence of bleaching</td>
<td>Presence of yellow pigment on beak and shanks.</td>
</tr>
</tbody>
</table>

### Breeder Management

**Collection of semen from the cocks**

The cocks need to be prepared by clipping the feathers around the vent region and need to be trained for semen collection 1-2 weeks before actual A 1 work. The cocks can be milked (semen collection) on alternate days without any physiological stress. The average semen yield per ejaculation from a cock would be about 0.5 ml.

**Inseminating the hen**

The dosage of undiluted semen per insemination into each hen is 0.05 ml. The insemination should be done in the evening hours from 4 P.M. onwards.

- Demonstration by the teacher and practice by the student.

The student needs to practice semen collection and insemination.

### B. Broiler production

Some of the commercial broiler stocks available in the market are

1. Vencobb
2. Hubbard
3. Hubchix
4. Pearl bro samrat
7. Indian River      8. Tegel

The floor space go be given from 0-4 weeks is ½ sq.ft per bird and from 0-8 weeks is about 1 sq.ft per bird.

Vaccination Schedule
Day old  - Marek's vaccine (0.2 ml. Sic neck)
5-7 days - Lasota vaccine or F, (one drop in eye)
10 days  - Gumboro-I mild strain (one drop in eye)
17th day - Gumboro II Intermediate strain (one drop in eye)
28th day - Lasota (one drop in eye/drinkin water)

<table>
<thead>
<tr>
<th>Feed ingredients</th>
<th>Broiler starter (0-4 weeks) %</th>
<th>Broiler Finisher (5-8 weeks) %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maize</td>
<td>55</td>
<td>60</td>
</tr>
<tr>
<td>DOB</td>
<td>-</td>
<td>7</td>
</tr>
<tr>
<td>GNC</td>
<td>30</td>
<td>20</td>
</tr>
<tr>
<td>Fish meal</td>
<td>12</td>
<td>10</td>
</tr>
<tr>
<td>Min. mixture</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>C.P %</td>
<td>23</td>
<td>20</td>
</tr>
<tr>
<td>M.E. (K.Cal/kg)</td>
<td>2800</td>
<td>2900</td>
</tr>
</tbody>
</table>

* The student should record the dry bulb and wet bulb reading for recording the temperature and humidity respectively at 2 hourly intervals.

Summer Management of Poultry:
1. The height of the poultry house should be at least 7-8' at the sides so that there is more cross ventilation.
2. The width of the house should not be more than 25'. The roof of the house can be covered with thatch material during summer months.
3. Sprinklers can be arranged on the roof of the poultry house for cooling.
4. Foggers can be arranged inside the poultry house for cooling.
5. Fans can be fixed inside the poultry house.
6. Painting outside the roof with white paint to reflect back the sun-rays and inside of the roof with black paint to absorb heat from the poultry house.
7. Reduce the litter thickness to 2" in deep litter system.
8. Spraying on the birds and inside the poultry house on the walls and roof at hourly or 2 hourly intervals in day time.
9. Growing of shady trees and grass around poultry house.
10. Wetting of soil around the poultry house.

10.6.2 Chick & hatchery management

Hatchery sanitation: The removable fittings of the incubator like setting trays and hatching trays need to be taken out from the setter and hatcher and thoroughly cleaned with some disinfectant solution. Then they should be dried and fixed back in the setter and hatcher before fumigation.
Fumigation: The inside measurements of the setter and hatcher need to be taken in order to calculate the quantum of chemicals required for fumigation. For every 100 cubic feet of incubator space 20 g of potassium permanganate and 40 ml. of formalin is required. The required quantity of potassium permanganate need to be taken in a shallow enamel pan and the required quantity of formalin in a measuring cylinder. The setter and hatcher need to be switched on and waited till the normal temperature and humidity are attained. Open the door of the setter and hatcher and keep the enamel panel that contains potassium permanganate near the fan and pour formalin quickly which is already taken in a measuring cylinder and close the door quickly. Allow the incubator to run for 3 hours. Then open the outlet slowly for the residual formaldehyde gas to escape. Then open the door for loading the eggs in the setter.

Optimum conditions of incubation

<table>
<thead>
<tr>
<th>Factor</th>
<th>Setter</th>
<th>Hatcher</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>99 – 100°F</td>
<td>98 – 99 °F</td>
</tr>
<tr>
<td>Relative Humidity</td>
<td>60%</td>
<td>70%</td>
</tr>
<tr>
<td>(Wet bulb)</td>
<td>(87 – 90°F of wet bulb reading)</td>
<td>(90 – 92 °F of wet bulb reading)</td>
</tr>
<tr>
<td>Turnings</td>
<td>6 – 8 times per day</td>
<td>No turning is required</td>
</tr>
<tr>
<td>Position of eggs</td>
<td>Broaden up</td>
<td>Flat</td>
</tr>
<tr>
<td>Ventilation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>O₂ tension</td>
<td>21%</td>
<td>21%</td>
</tr>
<tr>
<td>CO₂ tension</td>
<td>Less than 0.5%</td>
<td>Less than 0.5%</td>
</tr>
</tbody>
</table>

* The student should record the dry bulb and wet bulb reading for recording the temperature and humidity respectively at 2 hourly intervals.

Selection of hatching eggs: The eggs should be of medium size, oval shape, with sound shell, without blood and meat spots on candling.

Care of hatching eggs: The eggs should be stored at 50-55°F with a relative humidity of 70-80% and with broad end up. The hatching eggs are normally stored for one week. Turnings are required if the storage of hatching eggs does not exceed one week. The eggs should not be set in incubator within 24 hours after lay.

Candling of eggs during incubation: The first candling of incubated chicken eggs is done at 7th day to remove the infertile eggs and on 18th day at the time of transfer to hatcher to remove dead germs. The student should incubate certain number of eggs and record the percentage of fertility and hatchability on total eggs set and also on fertile eggs.

Sexing of day old chicks

Methods of Sexing
1. Japanese method of vent sexing
2. Auto sexing (Feather sexing)
3. Demonstration of sexing to a student by the teacher in the hatcher.

Wing banding

Demonstration of wing banding and practicing of wing banding by student for identification of individual chicks in the breeding programme and also for other experimental purposes.

Vaccination schedule for chicks
<table>
<thead>
<tr>
<th>Type of vaccine</th>
<th>Age</th>
<th>Diluent</th>
<th>Dose</th>
<th>Method of Administration</th>
</tr>
</thead>
<tbody>
<tr>
<td>HVT Marek's</td>
<td>Day old</td>
<td>Special diluent</td>
<td>0.2 ml</td>
<td>Eye drop</td>
</tr>
<tr>
<td>Lasota</td>
<td>5-7th day</td>
<td>Normal saline</td>
<td>One drop</td>
<td>Eye drop</td>
</tr>
<tr>
<td>Gumboro</td>
<td>Second week</td>
<td>Special diluent</td>
<td>One drop</td>
<td>Eye drop</td>
</tr>
<tr>
<td>Gumboro</td>
<td>Third week</td>
<td>Special diluent</td>
<td>0.5 ml</td>
<td>Eye drop</td>
</tr>
<tr>
<td>R2B</td>
<td>Eighth week</td>
<td>Normal saline</td>
<td>One drop</td>
<td>s/c in the wing web</td>
</tr>
<tr>
<td>Fowl Pox</td>
<td>Tenth week</td>
<td>50% glycerine saline solution</td>
<td></td>
<td>Prick method</td>
</tr>
</tbody>
</table>

* The student has to practice vaccination and Debeaking.

Debeaking is done with the help of an electric debeaker. The upper beak is cut midway between the tip of the beak and nostril. The lower beak is touched to the hot blade to reduce the sharpness.

**BROODING ARRANGEMENTS**

Cleaning and disinfection of brooder house and equipment:
1. Removal of old litter, dust and debris
2. Washing with fresh water
3. Washing with disinfectant solution
4. Blow lamping
5. White washing
6. Spreading of litter (2” thickness)
7. Spreading of old News papers
8. Cleaning and disinfection of chick feeders, chick waterers, chick guards and brooders.
9. Arranging of brooders and testing of power points for electric supply
10. Arranging of waterers and feeders in a cart wheel mariner
11. Sprinkling of ground maize
12. Counting of chicks in the boxes and leaving them under the brooder.

**Chick ration**

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>Quantity</th>
<th>C.P %</th>
<th>ME, K.cal / Kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maize (9.0, 3300)</td>
<td>42</td>
<td>3.781386</td>
<td></td>
</tr>
<tr>
<td>GNC (40.0, 2600)</td>
<td>25</td>
<td>10.00</td>
<td>650</td>
</tr>
<tr>
<td>Fish meal (43.1, 2500)</td>
<td>10</td>
<td>43.1250</td>
<td></td>
</tr>
<tr>
<td>Mineral mixture</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>100 Kg</td>
<td>20.91</td>
<td>2686</td>
</tr>
</tbody>
</table>

- The students need to prepare a chick ration with the locally available feed ingredients as per BIS requirements.

**10.6.3 Duck, Quail & Turkey Production**

Management of ducks

Breeds of ducks

Layer breeds: Campbell and India Runner


In layer type of ducks the average annual egg production will be 250. The average egg size is around 70 grams. Ducks lay their eggs between 3.00 and 9.00 A.M.
Floor space requirements (sq. ft)

<table>
<thead>
<tr>
<th>Age in weeks</th>
<th>Wire Floor</th>
<th>Solid floor</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 1</td>
<td>¼</td>
<td>½</td>
</tr>
<tr>
<td>1 – 2</td>
<td>1 / 3</td>
<td>3 / 4</td>
</tr>
<tr>
<td>2 – 3</td>
<td>½</td>
<td>1</td>
</tr>
<tr>
<td>3 – 7</td>
<td>13 / 4 – 2</td>
<td>2-2 ¾</td>
</tr>
<tr>
<td>Adults</td>
<td>-</td>
<td>4 - 5</td>
</tr>
</tbody>
</table>

Feeding

<table>
<thead>
<tr>
<th>Nutrients</th>
<th>Starter 0 – 2 Wks</th>
<th>Grower 3 – 8 Week</th>
<th>Grower 9 – 20 Week</th>
<th>Layer / Breeder</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein %</td>
<td>20</td>
<td>18</td>
<td>15</td>
<td>18</td>
</tr>
<tr>
<td>ME, KCal / Kg</td>
<td>2750</td>
<td>2750</td>
<td>2700</td>
<td>2659</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Ducklings</th>
<th>Grower</th>
<th>Layer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maize</td>
<td>41</td>
<td>42</td>
<td>46</td>
</tr>
<tr>
<td>Soya</td>
<td>18</td>
<td>12</td>
<td>18</td>
</tr>
<tr>
<td>DORB</td>
<td>30</td>
<td>35</td>
<td>18</td>
</tr>
<tr>
<td>Fish meal</td>
<td>8</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>Mineral mix</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Shell grit</td>
<td>s-</td>
<td>-</td>
<td>5</td>
</tr>
<tr>
<td>A.B₂, D₃</td>
<td>25 gm</td>
<td>25 gm</td>
<td>25 gm</td>
</tr>
<tr>
<td>Antibiotic</td>
<td>50 gm</td>
<td>50 gm</td>
<td>50 m</td>
</tr>
</tbody>
</table>

* The student has to formulate duck rations by himself. The feed should not contain groundnut cake.

Sex differentiation in ducks

1. Sexing of day old ducklings is done by vent method of sexing. In day old drakelet the male eminence is like a pinkish root tip. Sexing of day old ducklings is more easier when compared with sexing of day old chicks.

2. In some breeds of ducks the sexes can be distinguished morphologically when ducklings are 4 week old and onwards. For example in Khaki Campbell the drakelets begin to show a darker shade on the head and neck at an early age.

3. In all breeds of ducks the sexes can be recognized from 6 weeks of age by their voices. Females make lot of quacking sound while males have hoarse hissing.

4. The characteristic curled-up tail feathers of a drake except in Muscovy ducks appear at 4-5 months of age.

Diseases in ducks

A. Viral diseases
   1. Duck viral Hepatitis
   2. Duck plague

B. Bacterial diseases
   1. Salmonellosis
   2. Pasteurellosis (Duck cholera)
   3. Infectious serositis (Duck septicaemia)

C. Fungal diseases
   1. Aspergillosis
Management of Quails

The layer and meat type strains were developed at CARL. The female quail begins to lay at 6-7 weeks of age. The rate of egg production rises quickly reaching 50% production by 8 weeks of age and peak production (80%) is attained by 10 weeks of age. The quails lay their eggs in the afternoon. Nearly 75% of the daily production is laid between 3-6 P.M. and the remaining eggs are laid during night. The annual average egg production is 250 eggs. The average egg weight is around 10 g. The day old quail chick weight around 7 g. The shell colour vary from almost white to brown with dark coloured mottlings on it. Sex differentiation in quails: Sex can conveniently be identified at 3-4 weeks of age by difference in the plumage colour pattern. The males will have brown red feathers under the neck and the females will have grey feathers with black shackles under the neck. The adult female quails are heavier than the males. The adult body weight of males will be around 150 g and females will be around 200 g.

Many preparations can be made from eggs and the quail meat is a delicacy. As the quails are small in size it is very convenient to prepare quail egg pickles and also pickles can be prepared from quail meat.

Daily feed requirements of Quails at different ages

<table>
<thead>
<tr>
<th>Age (Weeks)</th>
<th>Feed consumed per day (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>12</td>
</tr>
<tr>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td>4</td>
<td>16</td>
</tr>
<tr>
<td>5</td>
<td>20</td>
</tr>
<tr>
<td>Above 5 weeks</td>
<td>25</td>
</tr>
</tbody>
</table>

* The student has to formulate one ration for each age group of quails.

Nutrient | Starter (0-3 weeks) | Grower (4-5 weeks) | Adults (6 weeks and above) |
----------|---------------------|---------------------|-----------------------------|
Management of Turkeys: Turkeys are not classified into breeds like chicken or ducks. The American standard of perfection recognizes several varieties of Turkeys, which include Black, Bronze, Naragansett, Slate and White Holland. All of which were admitted to the standard in 1974.

There are only 3 subsequent admissions to the Standard of Perfection and they are
1. Borboun Red
2. Beltsville Small White
3. Royal Palm (Admitted in 1971)

Indigenous and Non-descriptive Turkeys are found in small numbers in and around Mirzapur and Allahabad districts of eastern U.P. and in some parts of southern India.

Differences Between males and females:
- Males are usually heavier than females
- Matured males of all varieties have conspicuous black beards attached to the skin of upper breast region.
- Dewbill or snood, a fleshy protuberance near the base of the upper beak is relatively large, plump and elastic in males. It is relatively small, thin and non-elastic in females.
- Male poults strut even at day old stage and continued to do this throughout lifetime. Struting is not seen in female poults.

The average age at first egg is around 30 weeks. Turkey hens lay about 100 eggs after sexual maturity in the first 24 weeks. The average egg weight is 85 g. In our country turkey poults weighing around 4 kg. are in great demand. By proper management turkeys weight 4 kg. at 12-14 weeks of age.

Floor space requirement:

<table>
<thead>
<tr>
<th>Age in weeks</th>
<th>Floor space (square feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hens</td>
</tr>
<tr>
<td>0 – 8</td>
<td>0.6</td>
</tr>
<tr>
<td>8 – 12</td>
<td>1.5</td>
</tr>
<tr>
<td>12 – 16</td>
<td>2.0</td>
</tr>
<tr>
<td>16 – 20</td>
<td>2.5</td>
</tr>
<tr>
<td>20 – 24</td>
<td>3.0</td>
</tr>
<tr>
<td>Above 24</td>
<td>4.0</td>
</tr>
</tbody>
</table>

Protein and energy requirements for Turkeys

<table>
<thead>
<tr>
<th>Age in weeks</th>
<th>Protein %</th>
<th>M.E (K.Cal / Kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males</td>
<td>Females</td>
<td></td>
</tr>
<tr>
<td>0 – 4</td>
<td>0 – 4</td>
<td>28</td>
</tr>
<tr>
<td>4 – 8</td>
<td>4 – 8</td>
<td>26</td>
</tr>
<tr>
<td>8 – 12</td>
<td>8 – 11</td>
<td>22</td>
</tr>
<tr>
<td>12 – 16</td>
<td>11 – 14</td>
<td>19</td>
</tr>
<tr>
<td>16 – 20</td>
<td>14 – 17</td>
<td>17</td>
</tr>
<tr>
<td>20 – 24</td>
<td>17 – 20</td>
<td>14</td>
</tr>
<tr>
<td>Adults</td>
<td>Adults</td>
<td>14</td>
</tr>
</tbody>
</table>

Model ration

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>Grower</th>
<th>Adult</th>
</tr>
</thead>
</table>
The student has to formulate a ration for adults by themselves and mix.

<table>
<thead>
<tr>
<th>Maize</th>
<th>55</th>
<th>75</th>
</tr>
</thead>
<tbody>
<tr>
<td>GNC</td>
<td>32</td>
<td>10</td>
</tr>
<tr>
<td>Fish meal</td>
<td>10</td>
<td>8</td>
</tr>
<tr>
<td>Min. Mixture</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Shell</td>
<td>-</td>
<td>5</td>
</tr>
<tr>
<td>A, B₂, D₃, Vit. Mix</td>
<td>25 gm</td>
<td>25 gm</td>
</tr>
<tr>
<td>Antibiotics</td>
<td>50 gm</td>
<td>50 gm</td>
</tr>
</tbody>
</table>

- The student has to formulate a ration for adults by themselves and mix.

### Mating Ratio

<table>
<thead>
<tr>
<th>Type of turkey</th>
<th>Single male mating</th>
<th>Flock mating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large type turkeys</td>
<td>1:16</td>
<td>1:10</td>
</tr>
<tr>
<td>Medium type turkeys</td>
<td>1:18</td>
<td>1:12</td>
</tr>
<tr>
<td>Small type turkeys</td>
<td>1:20</td>
<td>1:14</td>
</tr>
</tbody>
</table>

### Artificial Insemination

The semen collection can be done from tom turkey at 2 or 3 days intervals. The average semen yield per ejaculation is 0.4 mt. The recommended volume of semen per insemination is 0.05 mt.

- First insemination: 5 days after first egg or at 5% production
- Second insemination: 3 to 4 days following first insemination
- Third insemination: 2 weeks after first insemination
- Fourth and remaining: At 2 weeks intervals.

### 10.7 LIVESTOCK TECHNOLOGY & SERVICES

#### 10.7.1 Disease Investigation

**Collection of Materials for Diagnosis of Disease**

History: First observe the temperature, then symptoms and palpation of different parts of the body. Based on that collect different specimens for diagnosis. In case of ailing animals collect the materials like blood, external secretions, dung and pus sample. These are to be dispatched to the laboratory as early as possible.

In dead animals Post-Mortem should be done as early as possible. Generally, carried out within 2-4 hours after death otherwise post-mortem invaders, which are normal inhabitants of intestine invade tissues and reach different organs. In case the post-mortem after 2-24 hours of death materials are not much useful because post-mortem invaders gain entry into different tissues and when we make attempt to culture they interfere. In order to avoid P.M. invaders, give preference to heart blood (there it takes more time to invade heart).

After collection, samples should be properly labelled. The label should denote:
- Name of the owner
- Species from which the sample is collected
- Age of the animal
- Case number
- Brief history
- Note about symptoms observed and tentative diagnosis
- Kind of specimens collected
- Type of preservative used.
The specimen should be sent to the laboratory for further processing with a special messenger. We should see that the specimen reach laboratory on the same day. Send the samples by a special messenger, if it is not possible send by post.

Before dispatching the specimen to the laboratory, the collected specimens should be properly packed in a leak proof plastic containers, which should be kept in ice or ice in combination with sawdust and dispatched to the laboratory. Materials should be packed in sterile containers. Normal requirements of sterile containers are:

1. Sterile swabs: Prepare the swab with thick broom stick and absorbent cotton. The swab is placed in a tube plugged with cotton plug which is wrapped in a paper properly and then sterilized in hot air oven.
2. Penicillin vials: For storing tissues.
3. Sterile test tubes
4. Petri dishes
5. Plastic bags, which are leak-proof
6. Slides

Label these and pack them in ice or sawdust or containers are filled with brine solution and are kept in deep freeze and low temperature (around 4°C) are maintained for 24 hours packed materials are to be sent to lab as early as possible by special messenger / post.

Materials to be collected

1. Organs or Tissues: In most septicaemic infections organisms get localised in different visceral organs. So in P.M. collect different visceral organs based on requirements like liver, kidney, spleen, lungs, brain, spinal cord etc. Eg: In H.S. - liver, spleen, kidneys Anthrax - liver, spleen. Materials should be properly packed in leak proof plastic containers which should be kept in ice pack or ice + sawdust and dispatched to the laboratory. No preservative is added in case of tissues. If we are not in a position to immediately analyse the material, it should be preserved in the refrigerator at 4°C. Preferably, the material is processed as early as possible in order to have better chance of isolation of organisms.

2. Blood: It is one of the important materials for isolating the organisms without much contamination, especially in diseases where organisms cause Septicaemia or Bacteremia.

   Bacteremia: Simple presence of bacteria in blood
   Septicaemia: Organisms have ability to multiply in blood collect blood when animals are suffering from high fever, collect the blood by using - Sterile syringe with an anticoagulant – Heparin / EDTA / Citrate
   In case of ailing animals: Collect peripheral blood
   In case of dead animals: Collect heart blood and store at 4°C.

   1. Serum: To demonstrate antibodies which gives evidence of recent and chronic infection of Brucellosis.
   Material: Sterile syringe & tubes.
   Collect the blood with the help of sterile syringe
   For large animals - 16-18 gauze needle
   For large cattle - 16 gauze needle
   For large sheep - 18 gauze needle
   For Poultry - 22 gauze needle
   For Mice - 24 gauze needle

   Blood should be collect from Jugular vein in case of cattle, sheep, goats, horses
   Heart / Ear vein - Pig
   Heart / Inner canthus of eye - Small animals
   Heat., wing vein - Birds / poultry
Blood is collected to separate serum to study antibody titre in recovered animals. We should collect a paired serum sample (serum samples with a difference of time). Suppose if there is an abortion we suspect for Brucella @ or campylobacter. So collect blood (serum) immediately after abortion 2nd serum sample after 2-3 weeks from the same animal and both the samples are processed for abortions. If the animal is positive first sample gives low titre 1:40 (or) 1:80 the second sample increases to 1:150 (or) 1:320 if it is Brucella.

Collect the blood in to a test tube and place the tube in such a way that it has maximum slant and keep for 5-10 minutes to allow the blood to clot. (Do not add anticoagulant). Blood clots. Now transfer the tubes into refrigerator at 4°C for 8-12 hours. Clot shrinks, serum oozes our. Separate the serum in to other small containers, some traces of RBC also will come. These RBCs are eliminated by centrifugation at 2000-3000 rpm for 10-20 minutes. RBCs settle down and clear supernatant serum transferred into another tube. Neither the container nor syringe should have moisture while collecting blood, when blood comes in contact with water RBC haemolyse and serum acquires red/pink colour which interfere with serological tests. Good serum will not have any red tinge. It will be slight golden yellow in colour. Now add the preservative before it is dispatched to the lab. Preservative prevents contamination by inhibiting the growth of contaminant.Preservative usually added is Merthiolate (or) Thiomersol 1 in 10,000 (or) Sodium azide and stored at -20°C until used.

2. a. Pus
b. Sputum
c. Uterine discharges
d. Exudate & other body fluids
e. Nasal & throat discharges.

All these should be collected in sterile containers. Usually no preservative is added and stored at 4°C.

Pus: From abscess, wound/pyaemic infection in Penicillin vials

Sputum: More important in human beings. In T.B., sputum always contain organisms.

In animals sputum is swallowed and hence difficult to collect.

50 gastric lavage is collected.

Uterine Discharges: In aborted cow repeat breeders etc.

Nasal and throat discharges are collected in certain disease.

Exudates & other body fluids.

In some of the bacterial infections there will be accumulation of edematous fluid which can also be used as material for isolation of organisms.

Eg: 1. Incase of H.S. Edema at neck region.

2. B.Q: Swelling in deep muscular area especially in hind legs or shoulders thus swelling will have clear fibrinous fluid accumulated between muscular tissue which is good source of organisms. This material is to be collected with sterile precautions and transferred into sterile containers, label and dispatch.

5. Blood smears: More useful in diagnosing ailing as well as dead animals that have suffered due to Bacterial infections Eg. H.S., B.Q. Anthrax. In ailing animal peripheral blood smear should be sent to lab (collect from tip of the ear).

Heart blood smear in dead animals: These blood smears are stained by Leishman stain/Giemsa stain and organisms are demonstrated under microscope. If animal has died quite a long time ago even in heart blood smear we find post-mortem invaders. Hence it should be done as early as possible after death.
6. Tissue smears: Liver, Lung, Kidney, Impression smears can also be sent to lab for diagnosis stained with Leishman stain to demonstrate organisms. Eg: Liver impression smears stained with Leishman stain to demonstrate B.Q. organisms. Label them and pack in a paper and send to laboratory for further examination.

In some cases, piece of intestine, intestinal contents, stomach contents, meconium can be sent to lab. Eg. A loop of small intestine ligating at the two ends to diagnose Enterotoxaemia, send it in a Ice pack. Sometimes intestinal contents are sent to lab by preserving in chelz & preserve the degradation of toxins. Here intestinal contents are dissolved in PBS to separate toxins in order to estimate enterotoxins. Stomach contents of foetus – Brucella, Campylobacter.

7. Milk: Milk is generally sent to diagnose mastitis. While collecting the sample, udder should be cleaned with flowing water including teats, then mope with dry cloth and dip the teat in Iodine solution or 70% alcohol in order to eliminate external contamination. Allow it to dry. First let out 4-5 strips of milk, then collect the milk. The milk from each quarter should be collected in a different container and sent to laboratory to estimate the mastitis infection. No preservative is added and stored at 4°C.

Milk smear can also be used for the purpose of diagnosis. Treat the slide with chloroform to remove fat globules before staining with Giemsa stain.

8. Urine: Generally urine is collected in case of those infections where organism is localized in kidney and excreted through urine. One of the best example is leptospira which is excreted intermittently through urine. Collect urine in a container and immediately dilute with equal volume of PBS (pH 7.4) in order to reduce the toxicity due to the presence of urates and uric acid. Label, dispatch in Ice at 4°C.

Faecal sample: Most important specimen for the diagnosis of Parasitic diseases, sometimes Bacterial and viral diseases are also diagnosed.

Parasites: Most of the parasites of digestive system, biliary tract, eggs/Larvae/cysts are excreted in the faeces. In some respiratory infections the eggs / larvae are coughed, ingested and are observed in faecal sample. In some of the ectoparasitic infections by licking and biting of the animal they are ingested. Occasionally, they are also seen in faecal sample. So faecal sample is important in diagnosis of many parasitic diseases.

Some organic material like pollen grain fungal spores, grains and undigested fibres imitate the morphology of larvae/egg/parasite itself so they should be differentiated.

For bacteriological purpose collect them in small containers and send to the lab. In case of virus isolation of poultry dropping in EDS, and in parvo virus infection collected faeces should be diluted with nearly 10% in 50% glycerine saline (Glycerine prevents growth of bacteria) for parasitic examination simply collect and send to the lab.

Collection of sample: Generally fresh faecal sample should be collected in optimum quantity. If it is kept at room temperature it dries up and examination becomes difficult. As it is stored for long time, the ova/oocyst, they will disintegrate and their identification becomes difficult, so it should be examined immediately. If it necessary to store, it should be stored in 10% formal saline adding equal volume. The sample may be stored at 4°C for long time. The sample should be collected in optimum quantity in proper sterile container (wide mouth) labelled and sent to lab. (In parvovirus infection, collect faeces in buffered saline).

SKIN SCRAPINGS: Can be generally collected in order to study the ectoparasitic and fungal infections. To collect skin scrapings select dermo mycotic lesions or affected part
and cleaned with antiseptic lotion (70% alcohol). Mop with dry cloth. (Alcohol eliminates bacterial presence on the surface of the skin). Take a sterile scalpel, scrape the skin surface or scrub over the infected site gently to get the top layer of the skin (collect the material until becomes reddened or traces of blood oozing out). Pack in a paper dispatch to lab after labelling.

Note: In viral diseases specimens should be collected and preserved in 50% glycerine PBS which inhibits the growth of bacteria and preserves the viability of viruses. Mostly tissues should be collected in 50% Buffered glycerine saline. In case of R.P. Glycerol saline should not be used, tissues should be sent in Ice to the lab.

**MATERIALS TO BE COLLECTED IN VIRAL DISEASES**

1. **FMD**
   - Vesicular fluid (vesicular)
   - Nasal discharge
   - Swab from Buccal.Mucosa
   - Blood (Febrile)

   After death
   - Heart muscle (from dead calf)

   Preserved in
   - Lymphnode
   Buffer Glycerine saline PH 7.2
   - Thyroid
   - Adrenals
   - Kidneys

2. **R.P.**
   - Blood (febrile)
   - Collect blood in Heparin (or) EDTA (citrate should not be used). Collected blood stored at 4°C
   - Faeces (Diarrhoea)
   - Nasal secretions
   - Serum to estimate antibodies

   After death
   - Mesenteric L.N.: Collect in buffered saline Spleen
   - or
   - Bone marrow (BM): (or) Preserved in Hanks balance salt store solution without glycerine at 20°C

3. **Malignant Catarrhal fever**
   - Blood (Best source)
   - Occular to Nasal discharges
   - Urine (excreted in urine)
   - Small intestine, abomasum

   After P.M.
   - Liver, Kidney
   - Lymph nodes spleen
   - Brain

4. **Bovine viral diarrhoea**
   - Blood & Serum
   - Nasal & ocular discharges, faecal sample (respiratory symptoms)

   P.M.
   - Liver, L.N. Spleen, Kidney, Lungs etc.
3. Vesicular Stomatitis
   Live
   - Vesicular fluid
   - Blood, Serum
   - Epithelial cells from tongue
   P.M. Scrapings from tongue

6. Rabies
   Live
   - 1. Saliva (best source)
   - 2. Discharges from eyes
   P.M.
   - Piece of salivary glands
   Piece of Brain and spinal cord

7. Infectious bovine rhinotracheitis
   - Blood (fever)
   - Serum to estimate antibodies
   - Nasal discharge and ocular discharge (respiratory symptoms)
   - Collect turbinate bones
   - In abortions collect
   - Vaginal discharges
   - Swabs from pustules on vagina
   - Foetal cotyledons placenta
   - Foetal liver, spleen, lungs, stomach contents.

8. Bovine Ephermeral Fever - Blood (best source (fever) serum
   - Nasal discharges - swabs
   - Tonsils, Lymph nodes, Spleen

9. Pseudo rabies
   - Nasal discharges (respiratory signs)
   - Swab from pruritic area (Itching)
   - Abortion placenta foetal stomach, liver

10. Sheep Pox and Goat Pox
    Live
    - Pus from pustules
    - Material from scab
    - Serum samples
    Dead
    - Skin, Spleen, Liver

11. Japanese Encephalities
    - Blood during viremia
    - After death collect Brain and Spinal cord stored in PBS with 2% calf serum

12. Bovine Leukemia - Blood (Leucocytes have organisms)
    - Bone marrow (BM) : L.N's and RES are involved
    - Thymus, skin

13. Rota Viruses - Neonatal Diarrhoea
    Live
    - Faecal sample (Diarrhoea)
    - Intestinal epithelium (Diarrhoea)
    Dead
    - Mesenteric L.N.
14. Entero viruses
   Live
   - Faecal samples (Diarrhoea)
   - Rectal sample (Diarrhoea)
   - Nasal discharges (Respiratory symptoms)
   - Intestines (Diarrhoea)
   Dead
   - Nasal discharges (symptoms)

15. African Horse Sickness
   - Blood,
   - Nasal discharge
   - Accumulated fluid in pericardial region
   - Piece of heart, lungs, mediastinal L.N’s.

16. Equine Infectious Anaemia
    Live
    - Blood, serum
    - Spleen, Liver, B.M.
    - Intestinal epithelium, Mesenteric L.N.

17. Blue Tongue
   - Collect blood with anticoagulant
   - Swabs from Erosion and Ulcers
   - Paired serum samples to estimate antibiotics
   - Spleen L.N & Intestines in 10% formal saline
   - Collect spleen L.N. in Ice
   - Faecal sample in Buffers saline

18. Paro Virus
    Live
    - Faecal sample (Diarrhoea)
    - Serum for antibodies (read Ab levels)
    Dead
    - Intestinal Epithelium (Gastroenteritis)
    - Heart muscle (Myocarditis)

19. Canine Distemper
    Live
    - Blood - (Biphasic fever) (leucoytes for organisms)
    - Nasal & ocular discharge
    Dead
    - Visceral organs for demonstration of Inclusion bodies
    - Pieces of lung, urinary bladder, liver, trachea, stomach
    & Brain in 10% formal saline for histo-pathological studies
    - Impression smears form liver
    - Pieces of spleen, liver in Ice

20. Infectious Canine Hepatitis
    - Canines
    - Liver, Gall bladder and kidney in 10% formal saline
    - Spleen, L.N. & liver in sterile containers in Ice.

POULTRY VIRUSES
1. New Castle Disease
   Live
   - Nasal discharge faecal sample (respiratory signs)
Dead - Spleen, liver, lungs, trachea in 50% glycerine
- Collect proventriculus in 10% formal saline

2. Fowl Pox - Materials from pox lesions

3. I.B.D.
   Live - Faecal sample
   Dead - Bursa Fabricius, Kidneys and spleen in 10% formalin and thymus HPE and in 50% glycerine saline for isolation

4. I.B
   - Swabs from exceed ate
   - Paired sera samples
   - Spleen liver and _________ for isolation 50% saline

5. M.D. : Feather tips
   (Feather follicles) - Paired sera samples
   - Portions of peripheral nerves, liver, kidney, spleen & thymus in 10% formaline and in 50% glycerine saline

4. I.L.T.
   - Tracheal swabs
   - Nasal discharges, Spleen, lung, Trachea

5. Lymphoid leucosis - Blood
   - Fluid from Tumours

FUNGAL DISEASES

1. Ring worm infection - Collect skin scrapings in a sterile container.

2. Candidiasis - Collect liver (produces Turkey towel like lesions)
   - Collect Heart blood
   - Collect spleen, intestinal contents

3. Aflatoxicosis - Respiratory discharges
   - Piece of lung

MATERIALS TO BE COLLECTED IN BACTERIAL DISEASES

1. Anthrax: Do no open the carcass in field condition
   a. Collect, blood from tip of ear i.e. blood swab and blood smear
   b. Collect blood smear from the carcass i.e. from Oozed blood
   c. Small piece of ear and Muzzle
   d. Edematous fluid in case of swellings
   e. Heart blood & Spleen can be sent to lab if carcass is opened.

2. H.S.
   Live - Peripheral blood smear at high temperature
   - Nasal discharge
   - Fluid from swellings & neck region
   - Heart blood
   Dead - Piece of lung, liver, spleen, mesenteric L.N. etc.
3. B.Q.
Live
- Edematous fluid from lesions
- Impression smears from fluid and muscle.
- Visceral organs like liver, spleen
Dead
- Piece of affected muscle
- Skin

4. J.D.
Live
- Faecal sample
- Rectal pinch
- Spleen enlarged LN.
Dead
- Corrugations

5. Leptospirosis
- Blood in febrile state
- Urine in case of Jaundice
- Aborted materials like foetal membranes etc. in case of abortion.
- Serum sample to estimate bilirubin level

6. T.B.
Live
- Blood to estimate ESR level (EST)
- Sputum
- Milk samples
- Collect mucus & dung
Dead
- L.N. and
- T.B. nodule

7. Calf scours
Live
- Faecal sample (Diarrhoea)
- Blood (Leukocytes).
Dead
- Heart blood, liver, spleen
- Intestinal contents

8. Enterotoxaemia
Live
- Faecal sample
- Heart blood smear
- Loop of small intestine
- Intestinal contents
Dead
- Visceral organs like liver, spleen & Kidney

9. Actinobacillosis
Live
- Pus (pus granules) best sample
- Scrapings from the lesions
- Swabs from infected area
Dead
- Infected tissues and
- Live, spleen, scrapings from the lesion in 10% formalin for HPE and in Ice for isolation.

10. Actinomycosis
- Pus granules
- Pieces of necrosed bone and swab from infected area are both in formalin and ice.

11. Brucellosis
- Collect aborted material
- Dirty, Yellowish grey coloured cotyledons
- Congested and necrosed placenta
- Foetal – stomach contents heart blood, spleen, liver, meconium
- Aborted cows: Vaginal discharge
- Uterine discharge
- Milk
- Paired serum samples
- Bull – Semen, Preputial washings

12. Vibriosis – similar to Brucellosis

13. Bacillary white diarrhoea
   Live - Faecal sample (Diarrhoea)
   Dead - Heart blood, liver, spleen, (Vertical transmission)
   Ovum of different stages

14. Fowl Typhoid
   Live - Faecal swab
   - Heart blood
   Dead - Liver, spleen

15. Salmonellosis
   Live - Faeces
   - Heart blood
   Dead - Liver, spleen

16. Fowl Cholera
   Live - Peripheral blood smear at high temperature
   - Long bone packed in charcoal
   - Heart blood smear swab
   Dead - Pieces of liver & spleen

17. Listeriosis
   Live - Faeces
   - Nasal discharge
   - Blood (septicaemia)
   - Brain (Meningitis & Encephalitis)
   Dead - Heart blood
   - Spleen liver
   Aborted material - Placenta, Cotyledons
   Foetal - Liver, Stomach Contents, Spleen, Heart.

18. Foot rot

19. Diphtheria
   - Throat swabs

20. Cholera / Shigella dysentery
   - Faecal sample

21. CRD in birds
   - Nasal discharge, throat swab
   - Piece of lung
   - Suppurative inflammatory fluid from trachea

22. Coryza
   - Respiratory tract material

23. Black disease
   - Piece of necrosed liver, spleen, kidney both in ice & formalin
24. Botulism
   a. Feed consumed for presence of toxins
   b. Loop of small intestine
   c. Intestinal contents

25. Pleuro pneumonia (CBPP & CCPP)
   a. Swabs from upper respiratory tract
   b. Nasal exudate
   c. Mucus secretions in trachea
   d. Piece of lung

26. Tetanus
   a. Blood (Septicaemia)
   b. Kidney, liver
   c. Nasal m.m, cloaca

MASS TESTING OF HERD
BRUCELLOSIS RING TEST (ABRT)
Common for routine testing of herds.

To 9ml of Milk add 1 ml of coloured Antigen Mix, Keep at room temperature for one hour. Milk has antibodies so antibodies interact with coloured antigen and clumps are formed which raise along with fat globules to the surface. Remaining milk is clear white If milk has no antibodies Antigen is evenly present in milk and whole milk is coloured moderately.

<table>
<thead>
<tr>
<th>Cream</th>
<th>Milk</th>
<th>Grade</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highly coloured</td>
<td>White</td>
<td>4+</td>
<td>+ve</td>
</tr>
<tr>
<td>Moderately coloured</td>
<td>Slightly coloured</td>
<td>3+</td>
<td>+ve</td>
</tr>
<tr>
<td>Equally coloured</td>
<td></td>
<td>2+</td>
<td>Doubt</td>
</tr>
<tr>
<td>Fat clear white</td>
<td>Milk evenly coloured</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ANTIBIOTIC SENSITIVITY TEST (ABST): Drug resistance is a plasmid borne factor when we use drugs at low concentration. The organisms somehow overcome its effect and try to accommodate itself and survive. Eg: Penicillin sensitive bacteria produce an enzyme penicillinase, which is going to destroy the action of penicillin.

Penicillin inhibits the cell wall synthesis preventing the cross linking and some bacteria overcome this action by choosing some other pathway. When we go on using antibiotic frequently at a low dose it becomes a hazard to use. In many cases it is advisable to use ABST especially in urinary tract infections. In mastitis for the isolates before starting the treatment.

Urine samples with complaint that frequent micturition with burning sensation, first collect urine sample and subject to ABST. The sample should be processed for isolation and go for drug sensitivity test.

For collection of urine sample take a sterile tube and container. In village conditions boil for 1 ½ Hr. and invert it to drain off water. This process should be done 1 hour before collection. Immediately after getting red urine should be collected. First few drops should not be collected. Collect the mid-stream and plug it tightly and try to dispatch to lab as early as possible. If not possible store at 4°C.
There will be small amount of turbidity and in severe case white precipitate is found. In some cases RBC also comes through urine. The sample should be centrifuged at 3000-5000 rpm for 10-20 mt. The supernatant is collected in a separate container and discard the remnants. For immediate results take a sterile swab and take swab full of and take desirable agar medium plate (ABST Medium or Glucose Agar Medium or BHI Agar Medium). Taking the swab prepare material. Culture by rotating plate and rubbing with swab.

Routinely, the sediment should be inoculated in glucose broth or ABST broth or BHI broth medium. Allow organisms to grow for 24 Hrs and next day put the material culture, if there is any growth of the organisms. If there is no growth then sample is sterile. After preparing a smear and staining it demonstrate the organisms where there is growth. Put different types of antibiotic discs. For every test minimum of 10 discs and proper distance between the discs. Keep this plate at 12°C for 1 hour. During the 1 Hr the antibiotic present in disc gets diffused into medium in all directions. Then incubate at 37°C for overnight. Suppose antibiotic is capable of inhibiting the growth of organisms then organisms cannot grow in the medium around the disc. If bacteria is resistant for particular antibiotic. Even in the presence of antibiotic bacteria will luxuriously grow. Depending on zone of inhibition, the required quantity of antibiotic for destruction of organisms can be denoted as 4+, 3+, 2+ 1+ etc. It is always advisable to combine more than one antibiotic and maintain proper dosage.

WHOLE BLOOD PLATE AGGLUTINATION TEST: This is employed to screen the blood (sera) within a short period for preliminary testing.

MATERIALS: Salmonella Pullorum coloured Antigen, suspected blood sample, glass slide.

PROCEDURE:
1. Place one loopful of the suspected blood and one loopful of salmonella pullorum coloured antigen adjacent to each other on a glass slide.
2. Mix the reagents with an inoculation loop and rotate the slide while tilting the sides slowly. Watch for the agglutination reaction.
3. Check the antigen for auto-agglutination replacing the blood with a loopful of saline.

STANDARD PLATE AGGLUTINATION TEST - BRUCELLOSIS

This is employed to screen the sera within a short period for preliminary testing.

MATERIALS: Brucella abortus coloured Antigen
Suspected serum
Glass slide.

PROCEDURE:
1. Place on loopful of the suspected serum and one loopful of Brucella abortus coloured Antigen adjacent to each other on a glass slide.
2. Mix the reagents with an inoculation loop and rotate the slide while tilting the slides slowly.
3. Watch for Agglutination reaction.
4. Check the Antigen for auto-agglutination replacing serum with a loopful of saline.

Prophylactic calendar for cattle and buffaloes

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Disease</th>
<th>Vaccine</th>
<th>Age</th>
<th>Dose</th>
<th>Booster</th>
<th>Interval</th>
<th>Season</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>
### Foot and Mouth Disease

**Vaccine:** Foot and Mouth Disease Vaccine

**Dosage:** 6-8 Wks

**Route:** 10 ml s/c

**Interval:** 6, 9 or 12 month

**Season:** Preferably November, December

### Rinderpest

**Vaccine:** Rinderpest freeze dried goat tissue vaccine (FDGTV) Rinderpest avianised vaccine Rinderpest Lapinized vaccine Rinderpest Tissue culture vaccine

**Dosage:** All age 1 ml s/c

**Interval:** Every year

**Season:** Preferable in Winter month

### Anthrax

**Vaccine:** Anthrax spore vaccine

**Dosage:** All ages 1 ml s/c

**Interval:** 6 month

**Season:** Annual

### Black quarter

**Vaccine:** Polyvalent B.Q. vaccine

**Dosage:** All ages 5 ml s/c

**Interval:** 6 month

**Season:** Annual

### Haemorrhagic septicaemia

**Vaccine:** Haemorrhagic septicaemia adjuvant vaccine

**Dosage:** All age 3 ml s/c

**Interval:** 6 month

**Season:** Annual

### Prophylactic calendar for Goats

<table>
<thead>
<tr>
<th>Months</th>
<th>Vaccine</th>
<th>Adult Goat</th>
<th>Kids (above 6 months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>Contagious Pleuro pneumonia (C.C. P.P)</td>
<td>0.2 ml i/dermal</td>
<td>0.2 ml i/dermal</td>
</tr>
<tr>
<td>March</td>
<td>Haemorrhagic septicaemia (H.S) Goat Pox</td>
<td>5 ml s/c Scratch method</td>
<td>2.5 ml S/c Scratch method</td>
</tr>
<tr>
<td>April</td>
<td>Enterotoxaemia</td>
<td>5 ml S/c</td>
<td>2.5 ml S/c</td>
</tr>
<tr>
<td>May</td>
<td>F.M.D. Rinderpest</td>
<td>5 ml S/c</td>
<td>5 ml S/c</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 ml S/c</td>
<td>1 ml S/c</td>
</tr>
<tr>
<td>June</td>
<td>Black quarter</td>
<td>5 ml S/c</td>
<td>2.5 ml S/c</td>
</tr>
<tr>
<td>July</td>
<td>F.M.D.</td>
<td>5 ml S/c</td>
<td>0.5 ml S/c</td>
</tr>
<tr>
<td>August</td>
<td>Enterotoxaemia</td>
<td>5 ml S/c</td>
<td>2.5 ml S/c</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Prophylactic calendar for Sheep

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Disease</th>
<th>Vaccine</th>
<th>Age</th>
<th>Dose</th>
<th>Booster</th>
<th>Interval</th>
<th>Season</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Foot and Mouth disease</td>
<td>Foot and Mouth Disease Vaccine</td>
<td>Adult</td>
<td>5 ml S/c</td>
<td>-</td>
<td>Annual</td>
<td>Preferably Winter / Autumn</td>
</tr>
<tr>
<td>2.</td>
<td>Rinderpest</td>
<td>Rinderpest Tissue culture vaccine</td>
<td>-</td>
<td>1 ml S/c</td>
<td>6 months</td>
<td>Annual</td>
<td>Winter</td>
</tr>
<tr>
<td>3.</td>
<td>Black disease</td>
<td>Black disease vaccine</td>
<td>-</td>
<td>2 ml S/c</td>
<td>-</td>
<td>Annual</td>
<td>All seasons</td>
</tr>
<tr>
<td>Sl. No.</td>
<td>Vaccine</td>
<td>Type of vaccine</td>
<td>Age</td>
<td>Booster</td>
<td>Repeat</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------</td>
<td>--------------------------------</td>
<td>--------------------------</td>
<td>----------------</td>
<td>---------------</td>
<td>--------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Lamb dysentery vaccine</td>
<td>Lamb</td>
<td>2 ml S/c</td>
<td>-</td>
<td>Annual</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Black quarter vaccine (Polyvalent)</td>
<td>Lamb Adult</td>
<td>2 ml S/c 3 ml S/c</td>
<td>-</td>
<td>Annual</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Enterotoxaemia vaccine</td>
<td>Lamb Adult</td>
<td>2.5 to 5 ml S/c 2 ml S/c</td>
<td>7-19 days</td>
<td>Annual</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Haemorrhagic septicaemia vaccine</td>
<td>Adult</td>
<td>2 ml S/c</td>
<td>-</td>
<td>Annual</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sheep pox vaccine</td>
<td>Lamb Sheep</td>
<td>3 ml S/c 5 ml S/c</td>
<td>Repeat at 6 month Repeat annually</td>
<td>December / March</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lung worm vaccine</td>
<td>Lamb Month's Age</td>
<td>1000 Larvae First dose</td>
<td>One month later 2000 larvae</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Some commercial vaccines as available in the market are

1. Candur DH
2. Nobivac-DHLP
3. Rabisin
4. Rabguard
5. Duramune
6. Raksha rab
7. Pentadog
8. Caniffa
9. Vanguard
10. Rabisyva
11. Parvocine
12. Nobi-vac DHL
13. Nobi-vac Rabies
14. Animune
15. Vanguard CPV

Prophylactic calendar for Cat
<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Vaccine</th>
<th>Type of vaccine</th>
<th>Age</th>
<th>Booster</th>
<th>Repeat</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Feline Panleukopaenia (FPL)</td>
<td>Modified live virus vaccine</td>
<td>8 to 9 weeks</td>
<td>12 to 16 weeks</td>
<td>Annual</td>
</tr>
<tr>
<td>2.</td>
<td>Feline viral rhinotracheitis (FVR)</td>
<td>Modified live virus vaccine</td>
<td>8 to 9 weeks</td>
<td>12 to 16 weeks</td>
<td>Annual</td>
</tr>
<tr>
<td>3.</td>
<td>Rabies</td>
<td>Modified live or inactivated</td>
<td>12 weeks</td>
<td>-</td>
<td>Annual</td>
</tr>
</tbody>
</table>


10.7.1.1. VETERINARY PATHOLOGY

POST-MORTEM EXAMINATION

The object of post-mortem examination is to ascertain the cause of death and time of death. There are several occasions viz. outbreaks of diseases insured animals, experimental animals and vetero-legal cases in which P.M. examination become necessary. A Systematic method of P.M. should be followed, so that all organs can be examined thoroughly. Before start of examination date and time of examination, species, breed, sex, age, distinguishing marks owners name and name & designation of authority who had sent the dead body for examination are noted and also detailed history including symptoms, course, morbidity, mortality treatment etc. should be collected P.M. is done in day time preferably and avoided in artificial light.

P.M. EXAMINATION OF CARCASS IS DIVIDED INTO TWO (1) EXTERNAL EXAMINATION (2) INTERNAL EXAMINATION

1. External Examination:
The following steps should be followed for external examination
   a. Note the general condition of the carcass.
   b. Note the species, age and sex of the animal
   c. Examine the body 'surface for injuries, burns, swelling etc.
   d. Examine mouth, gum, tooth, tongue buccal cavity and nasal cavity.
   e. Look for the discharges from the natural orifices.
   f. Examine the visible mucus membranes.
   g. Examine the External genitalia
   h. All the bones should be carefully examined for presence of fractures and joints for dislocation. Note the presence of rigger mortis to know the time of death.

2. Internal Examination: For the Internal examination of carcass the systematic examination should be done. To open abdominal cavity, incise through the midline from pubis to xiphoid cartilage then from pubis to lumbar region. All the abdominal organs should be examined on by one. After examination of abdominal organs, the organs of thoracic cavity and pelvic cavity should be examined.

Materials for Bacteriological, parasitological and chemical examination are removed and properly preserved for further laboratory tests.

REPORT FOR POST MORTEM EXAMINATION

1. P.M. No ___________________ Date ___________________
2. By whom sent for examination and reason if any
3. Date & hour of death and P.M. examination
4. History
5. External appearance and on removal of skin
6. Mouth and pharynx
7. Nasal cavities
8. Larynx and trachea
9. Oesophagus
10. Pleural cavity and lungs
11. Pericardium and heart
12. Liver and gall bladder
13. Spleen
14. Stomach and small intestine
15. Urinary organs
16. Genital organs
17. Brain and spinal cord
18. Lymph glands in general
19. Diagnosis on the basis of above examination
20. Remarks state if viscera and tissues are sent for chemical, bacteriological, histopathological and parasitological examination
21. Results of microscopic examination of blood etc.
22. Place where P.M. examination was made

Date
Signature of Autopsist
Designation

POST MORTEM TECHNIQUES OF DIFFERENT ANIMALS

The technique adopted for P.M. examination in different animals are given below

Cattle:
1. Before proceeding to post mortem take a blood smear from the ear to rule out Anthrax.
   In positive cases the carcass should not be opened.
2. The body is supported on its back in inclined towards its left side.
3. Make a long skin incision from the middle of lower jaw upto pubic bone.
4. The skin incision is extended along the medial aspect of fore and hind limbs so that the skin may be removed. The hind limbs are abducted by cutting through the medial thigh muscles.
5. In females the udder is removed. In case of males the penis and prepuce drawn backwards to avoid damage when abdominal wall is incised.
6. The abdomen wall is opened by an incision running along the linea alba from the xiphoid cartilage backwards to the pelvis.
7. The abdominal wall is reflected by incisions along costal arch
8. Inspect the contents of abdominal cavity.
9. The omentum is freed along the incision to the lateral grooves of rumen and from the duodenum and spleen is left attached to rumen.
10. The fore stomach and abomasum are removed; the duodenum is sectioned between two
ligatures at pylorus. Then the rumen is freed from its attachments to the dorsal
abdominal wall while pulling it to the left side of the body.
11. The oesophagus is cut through and the fore stomach and abomasum freed from their
remaining attachments and removed to left side of the body.
12. The intestinal tract except the duodenum is removed by cutting the duodenum after
ligating it in its posterior third. The rectum is then freed ligated and divided the
intestines are removed in one piece by cutting the mesentery at its attachment and lifted
out of the abdomen. The duodenum and pancreas are allowed to remain in abdomen to
be removed together with the liver subsequently.
13. The liver, duodenum and pancreas are removed together.
14. The urogenital organs are removed together by cutting the pubic bone. The kidney from
the abdominal wall along with adrenals.
15. The diaphragm is cut through along its incision
16. The pericardial sac is freed from the sternum by the hand
17. An incision is made on either side of the tongue along the borders of mandible and the
tongue is grasped and drawn backwards the soft palate is cut free by incisions from each
side which runs forwards and medially to meet in the mid line. The hyoid bone is
divided at the joint between the main branch and the thyroid branch. The knife is placed
at this junction with sharp side upwards and by single sharp jerk separates the bones.
Then the pharyngeal structures are freed. The trachea and oesophagus are freed to half
way down the neck and cut through.
18. Inserting two fingers through a short transverse incision between two cartilage rings
gives a good grip on the trachea so that the trachea and oesophagus pushed into the
thoracic cavity. The left hand is then inserted into the thoracic cavity from the abdomen
and trachea drawn backwards and thoracic organs are freed from the dorsal thoracic
wall by cutting through mediastinum.
19. The head with salivary glands attachment is removed by cutting through atlanto
occipital joints.
20. The body lymph-nodes are then examined i.e prescapular axillary, cubital, popliteal
lymphnodes etc.
21. All the joints are opened on the medial surface and beginning distally on the limbs.
22. The skeletal musculature is inspected by several incisions.
23. The spinal cord is exposed by removing the dorsal arches of the vertebrae if
examination is warranted.
Small Ruminants: The technique is similar to that in large ruminants except that the
sternum is removed by cutting through the costochondral junction. The neck and thoracic
organs are then removed together that is without cutting of the trachea and oesophagus
anterior to the thoracic aperture.
Carnivores: In carnivores the liver, stomach, pancreas duodenum are removed together. The
neck and thoracic organs are removed together as in small ruminants. Here also the sternum
is removed by cutting the costochondral junction.
Pigs: In pigs to remove the intestinal tract begin at the tip of the colonic spiral and free the
entire intestinal tract along the mesenteric attachments. In large pigs the stomach is
removed separately where as in smaller animals the stomach is removed together with liver,
duodenum and pancreas.
Post-Mortem examination of horse: In the case of equines the body should be inclined
towards its right side and evisceration of abdominal and thoracic cavities should be
performed from right side and other procedure is same as described above except for the
removal of intestine. In this animal after the abdomen is opened, the great colon lifted out
of the abdomen to the right side of the body. The small intestine is freed along its mesenteric attachment beginning with the duodenum at the duodenum and the large intestine at the termination of the right dorsal great colon and beginning of the small colon. The small intestine is divided between two ligatures and then is freed along the mesenteric attachment as far back as the ileum where it is divided again between ligatures. During removal of the small intestine the assistant should stand on the left side of the body and help by drawing out the intestine and tending the mesentery.

The rectum small and great colon and caecum are removed together. The rectum is divided in the pelvis and the intestines are freed along their mesenteric attachment as far forward as the right dorsal great colon. In this region the pancreas lies between the intestine and the sub-lumbar musculature and part of it lies under the intestinal serosa. Since the pancreas is to be left in the abdominal cavity (its removed later together with the liver and duodenum). It is necessary to free the great colon from the pancreas and the dorsal abdominal wall by blunt dissection or by careful use of the knife in places. At this point only the branches of mesenteric blood vessels connect the great and small colon, caecum and rectum to the body. These blood vessels are freed as far out as possible and then cut close to the intestinal wall. The large intestines are completely freed and can be lifted out to the right side of the body. The spleen and omentum are removed. The stomach is removed the duodenum is divided between two ligatures immediately posterior to the pylorus. Then a short longitudinal incision is made through the serosa covering the portion of oesophagus which extends into the abdominal cavity and the oesophagus is then freed of its ligaments and removed from the body.

Fowl: The legs are abducted by cutting or breaking open the hip joints. The abdomen is opened and the sternum is freed by lateral incisions through the ribs. The crop is then freed by blunt dissection from its attachments along the thoracic aperture to avoid being damaged when the heavy anterior osseous attachments of the sternum (the coracoid and the davide) are clipped through with bone cutter on each side to join the lateral incisions through the ribs.

The liver is removed separately, avoiding damage to the gall bladder, the spleen is removed separately, and the stomach and intestinal canal are removed in one piece after cutting through the oesophagus just anterior to the pro-ventriculus. In sexually mature females, the ovary is removed at its base and the oviduct is first extended by cutting through its dorsal and ventral mesenteric attachments and then removed by cutting through the cloaca.

The pericardial sac is incised and the chamber of heart opened in situ by incising the wall of the right ventricle near the apex and continuing the incision anteriorly up through the pulmonary artery and laterally through the right atrium. The procedure is repeated for the left ventricle extending an incision at the apex up through the aorta and up through the left atrium. The heat is then removed by cutting through its base.

The lungs are freed by blunt dissection from the thoracic walls cutting through the dorsal attachment (dorsal to the thoracic oesophagus and aorta) and then removed by cutting through the trachea immediately anterior to the syrinx. The upper beak is cut transversely at its base to expose the nasal cavities and then mouth is opened by cutting through one corner (the right is more convenient) and the incision continued through the pharynx and down to oesophagus to open the crop. The trachea is then opened along its whole length.

The brachial plexus and sciatic nerve are exposed on both the sides (for ALC). The major joints are also examined. Now the organs are inspected in detail one after the other.

EXAMINATION OF ORGANS
(APPLICABLE TO ALL SPECIES)

Lungs:
1. The Lungs and associated lymph nodes should be inspected closely.
2. Open the trachea and its branches
3. Make generous incisions through the different lobes
4. Squeeze the cut edges and examine for pus, blood or oedematous fluid.
5. Examine diaphragmatic lobes for any parasites.

Heart:
1. Examine the pericardium pericardial fluid and epicardium
2. Remove the pericardium
3. Locate the septum and open the right ventricle by an incision adjacent to the septum.
4. Pass the knife under the tricuspid value into the pulmonary artery and open it.
5. A similar procedure carried out on left side.
6. Open the pulmonary vein by passing knife through the bicuspid valve.
7. Examine the heart valves, vessels, endocardium, myocardium and epicardium

Brain
1. Disarticulate the head at atlanto occipital joint
2. The skin and muscles are stripped off
3. Make a transverse cut behind the posterior margin of the orbit
4. Lateral cuts are made at an angle of 34-40° from a sagittal plane along the dorsal aspect of the cranium.
5. The lateral cuts should meet anteriorly and posteriorly
6. Try up the calvarium and remove with the help of a chisel
7. Severe the olfactory and optic nerves
8. The brain is lifted up from the front and removed
9. Examine the various parts of the brain for the presence of tumours, cysts, abscess parasites, haemorrhages etc.

Digestive Tract
1. Open the digestive tract by enterotomy at various parts
2. Examine the bowel, bowel contents and mucus membrane for abnormalities
3. Examine mesenteric lymph nodes also
4. In Ruminants, the rumen, reticulum and omasum are opened in situ
5. Remove the contents and examine for parasites and lesions
6. Examine the reticulum for any foreign body.

Parenchymatous organs
1. Examine the liver, spleen, kidneys, testes and adrenals
2. Incision is made in order to determine the inner character of the organs.
3. Examine various lymph nodes associated with these organs
4. The uterus is examined in situ.

Genital Tract
A. Female
1. Separate the female genital tract from rectum and take it out.
2. Open the tract from vulva to the tips of the cornua
3. Open the fallopian tubes and examine
4. Incise the ovaries length wise

B. Male
1. Make an incision from the neck of the bladder to the urethra
2. Open the urethra by a slender pointed knife
COLLECTION OF CLINICAL MATERIAL FOR LABORATORY EXAMINATION

Various clinical materials are collected routinely for the diagnosis of diseases. These materials are collected from living or dead animals and send to the nearest laboratory for examination. So that preventive measures can be taken. Also the samples must be as fresh as possible and preserve in correct manner while sending to the laboratory.

Blood: Blood examination is performed as a screening procedure to assess general health as an adjunct to patient evaluation or to diagnosis of a disease, to assess the body ability to fight infection and to evaluate the progress of certain disease status. Venous blood is usually collected from jugular vein in cattle, sheep and goats from anterior vena cava in pigs and cephalic vein in dogs and ear veins in cats. Haematologic examination requires blood in liquid form. For this purpose, blood is collected into a vial containing an appropriate anti-coagulant. EDTA is the anticoagulant of choice for most hematologic and biochemical analysis. A 5001 volume of blood is adequate for routine blood study but in cats and small dogs the volume is limited to 2001. Immediately after withdrawal, blood must be thoroughly mixed with the anticoagulant to prevent clotting. Blood can be kept at room temperature for an hour or two. However if blood examination is to be postponed for several hours or overnight, make blood films immediately perform ESR and then refrigerate the sample leave blood films at room temperature. An ice box or cold packs should be used to transport or dispatch blood samples to distant lab. The blood films should be made immediately from fresh blood and as soon as possible from anti-coagulated blood preferably within an hour of sampling. It can be prepared on a slide or a cover slip.

Blood for bacteriological examination is collected in sterile pipettes from the heart of a dead body. The surface of heart is sterilized with hot iron spatula. The sealed end of pipette is broken and is inserted inside the heart and blood is sucked, it is then properly packed and dispatched.

Serum

1. Collect blood sample and keep the bottle in a cool place without agitation.
2. Keep the bottle at an angle of 20° from the horizontal plane.
3. Clotting will take place in an hour or two
4. When it has clotted, turn over the bottle
5. Serum separation depends upon the temperature and it is separated in about 2 to 24 hours and a clear serum appears in the bottle.

Submit about 2 ml of serum to the lab in clean, sterile screw caped container.

Faecal samples: Faecal samples should be collected direct from the rectum or a quantity for freshly passed faeces may be collected from the floor. The sample is placed in a screw-capped container which has been thoroughly cleaned and then dispatched. If long delays sampling and examination are likely to occur, a little 10% formalin can be mixed with the sample to prevent embryonation.

Milk samples: Milk should be collected direct from the mammary gland into clean, water tight glass or plastic containers. If bacteriological examination is required the container must be sterile and external contamination of the sample should be avoided by cleaning the teats with alcohol prior to sampling. Examinations should be performed as soon as possible in warm weather but if a delay is unavoidable the milk should be refrigerated.

HISTOPATHOLOGICAL SAMPLES

1. The materials for histopathological examination should be collected soon after death. The portion representing the characteristic lesion should be selected and 1/2” sq. and not more than 1/5” thick be cut.
2. After removal it should be kept in a fixative preferably in 10% formal saline, which should be 20-24 times more than the volume of tissue.

3. Place the samples in a wide-necked bottle as samples are difficult to remove from narrow-necked containers once they have become hardened by the fixative.

Urine Samples: These are collected either during micturition or after catheterization. The catheters must be sterile and not lubricated excessively with liquid paraffin otherwise 'fat' will appear in the sample, sterile water-tight glass or plastic containers should be used to hold the samples. Mid flow urine samples give the most reliable results, especially for bacteriological purpose, as the risk of sample contamination from prepuce is reduced. Samples should not be stored at room temperature for more than a few hours especially if culture is to be undertaken.

PRESERVATION OF MATERIALS IN CASES OF SUSPECTED POISONING

The entire alimentary canal should be opened and its contents inspected for suspicious looking substances. If any suspicious looking substances are detected in the alimentary canal, they should be packed in a separate vessel and spirit should not be added unless necessary for its preservation. In case of suspected poisoning the following viscera should be preserved for chemical analysis in white, wide mouthed glass bottles using rectified spirit.

1. The stomach and its contents
2. A portion of liver
3. Portions of kidneys, spleen and lungs
4. Upper parts of intestine with its contents
5. Urine and faeces
6. Portions of heart and brain
7. Blood sample from the heart
8. A portion of skin where the poison was suspected to have been administered by subcutaneous route.
9. Portion of long bones in cases of chronic poisoning by arsenic and antimony.
10. Some quantity of hair in case of chronic mineral poisoning.

10.7.1.2 PARASITOLOGY

EXERCISE: 1
COLLECTION, FIXATION AND PRESERVATION OF HELMINTHS

Collection:
1. Helminthes parasites at times, as adults or immature forms are passed along with faeces. These worms should be recovered after washing in normal saline solution.
2. At post-mortem, collect the worms, found in various regions, organs and the body cavity separately. Every portion of the body must be searched and the worms should be picked up.
3. Worms from the clean situations like subcutaneous tissue, peritoneal cavity and eyes etc., can straight away be fixed in hot 5% formalin or 70% alcohol before preservation.
4. Worms from liver and intestines should be collected, washed in normal saline and then fixed.
5. If the worms are adhering to the gut wall, pieces of intestine should be placed in warm normal saline and after detachment from the wall, they are collected.
6. Worms and larvae from nodules in the intestines or in any other organs are collected by cutting open, teasing and exposing them.
7. Bile duct, alveoli of lungs or if the worms are embedded in any organ, parallel cuts are made and after applying gentle pressure, they are exposed, then collect, wash in normal saline, fix and preserve them.

8. In case of minute worms, the intestinal contents or washings from organs should be collected in a basin containing water or using flasks and allowed to stand. Then decant the supernatant fluid and subject the bottom sediment suspension to washing with NSS and collect the worms.

9. Gastro-intestinal mucosa should be scrapped into normal saline, examine for worms and larval stages and collect them accordingly.

10. Cestodes should be collected with heads. Cut pieces of intestines, cut out the attachment and place in warm NSS at 40°C along with worms in a dish. They detach, extend and die within 30 minutes to 1 hour.

11. In bovines, the nasal, portal and mesenteric veins should be examined for the presence of schistosomes. They are collected by vein puncture using a pin, using gentle pressure.

12. Eggs can be concentrated and collected from dung samples, for detecting gastro-intestinal parasites, Urine sediment for eggs of Schistosoma haematobium, Stephenurus dentatus, Diocto-phyma renale, nasal washings - for eggs of S. nasale, Sputum for eggs of Paragonimus westermani and Syngamus trachea should be examined.

Fixation
1. Platyhelminthes should be fixed in hot 10% formalin or 70% alcohol.
2. Cestode and trematodes are subjected to a process of flattening between two slides using optimum pressure with rubber bands or thread. Then only they should be fixed.
3. Nemathelminths should be fixed in steaming mixture of 95 ml of alcohol + 5 ml of glycerine or warm 10% formalin.
4. Tissues / organs infected with platy helminthes or Nemathelminths should be fixed in anyone of following fixatives for histological studies.
   i) Zenkers fluid   (ii) Bouin's fluid   (iii) Manns' fluid

Preservation:
1. Small cestodes and nematodes are usually preserved in 70% alcohol with glycerine to an extent of 5%. If fixed in 70% alcohol, preserve them in alcohol glycerine mixture.
2. Large nematodes should be preserved in 5% formalin after fixation. Organs infected with parasites can be preserved in 10% formalin solution.
3. Small pieces of organs, tissues fixed in Zenkers fluid, Bouins fluid or Manns fluid can be preserved in 70% alcohol.
4. In order to retain the natural colours of specimens/organs/tissues with helminthes in situ and to indicate the changes brought about, Kaiserling solution can be used.
5. Trematode and cestodes also can be preserved by preparing permanent mounts with DPX mount after staining with acetic alum caramine or borax caramine stain solution.
6. Similarly nematodes also can be preserved by making glycerol permanent mounts or in DPX on slides after dehydrating and clearing the worms.

Collection, fixation and preservation of protozoa
1. Faecal material containing cysts and trophozoites can be collected by concentration methods and preserved by adding 10% formalin solution, double the quantity of faecal material.
2. Coccidiosis positive material can be preserved in 2.5% potassium dichromate solution, which helps for sporulation of coccidial oocysts and also acts as a preservative.
3. In case of amoebae and intestinal flagellates faecal smears are made on glass slides / cover slips to which smear a small amount of egg albumin as adhesive. Fix in Schadinns fixative for 15-20 minutes (Sat. solution of HgCl₂ - 2 vols, ethyl alcohol 1 vol. glacial
acetic acid to an extent of 5%) transfer to 50% alcohol/ alcohol-iodine solution, 70% alcohol (5 minutes each) and then absolute alcohol for 1 hour preserve in 70% alcohol until subjected to further staining.

4. Blood films - Prepare thick smears on clean glass slides for detecting extra cellular blood protozoans and thin films for intracellular parasites. Dry them at 37°C and fix them in methyl alcohol or methanol. Unstained films can be kept in polythene paper wrapped and stored in the refrigerator at 4°C Before staining, remove them from refrigerator and keep them at room temperature for about half an hour, remove the wrapper and then stain the slides.

5. Stained blood smears – After examination under oil immersion add one drop of Canada balsam and cover it with cover slip, label and store in the slide cabinet.

6. Tissues / organs infected with protozoan parasites can be preserved in 10% formalin solution.

7. Histological study - tissues/organs can be fixed in (a) Zenkers fluid for 24 hours(b) Bouins fluid for 18 hours (c) Mann's fluid for 24 hours, washed in 70% alcohol and preserved in the same alcoholic solution.

8. To retain the natural colour of specimens/organs and tissues and to indicate the changes brought about, fix them in Kaiserling’s solution-I, treat with Kaiserling's solution-II and preserve in Kaiserling's solution-III.

9. Arthropods, containing protozoa can be fixed in Cornoys fluid for 12-24 hours. This fixative consists of absolute alcohol 6 parts, chloroform-3 parts and glacial acetic acid 1 part.

10. Biopsy material for diagnosis of protozoan infection (including other parasitic infections).
   i. Lymph glands - Trypanosomiasis, Leishmaniasis
   Theileriasis & toxoplasmosis
   ii. Splenic puncture - Leishmaniasis
   iii Sternal puncture material
   iv Lumbar puncture fluid - Trypanosomiasis
   v Skin biopsy - Dermal leishmaniasis, onchocercosis, microfilariae in stephenofilariasis and mange infestation.
   vi Rectal/proctal biopsy - Amoebiasis, schistosomiasis
   vii Muscle biopsy - Cysticercosis, Trichinosis, sarcocystosis
   viii Liver biopsy - Amoebiasis, Schistosomiasis
   ix. Aspiration materials - Amoebic liver abscess, hydatid fluid for Echinococcus infection, Hydrocoel fluid for microfilariae.
   x Nasal growth - Rhinosporidiosis and schistosomiasis

   Biopsy material / exudate from infected organs/tissues should be examined afresh for living parasites. In other cases prepare the smears and treat in the same way as that of blood smear, stain and examine

11. Impression smears can be made from tissues containing protozoa and subjected for staining with Giemsa / Leishman stain for demonstration of organisms.

12. Sections of infected organs with protozoa, after processing should be stained with haematoxylin / Giemsa's stain, cover by cover slip with DPX mountant and preserve them.

13. Genital tract may be examined for Trichomoniasis. For this purpose, collect preputial / vaginal washings in normal saline solution concentrate by centrifugation and examine the sediment-afresh or after staining.
14. Urine also should be examined in a similar way for Trichomoniasis.
15. Exudate from skin lesions or impression smears may be examined for T.equiperdum infection after fixing, staining and can be preserved for ever after covering by a cover slip with DPX mountant.

COLLECTION OF ARTHROPODS

Most of the parasites lead an ectoparasitic life while a few become endoparasitic during their developmental phase. Some of these ecto-parasites are permanently attached, on to the skin of the host, a few live on the skin of the host itself (Permanent ectoparasites). Eg., lice, keds, mites, etc. while a great majority are found in and around animal houses either flying about or hidding in holes and orifices, often visiting the host for their food (temporary ecto-parasites) Eg. Flies, ticks, etc.

Collection and preservation of insects, mites and ticks: An accurate identification of any insect, mite or tick can be made only after the specimen has been captured and prepared for the examination. The specimen is also preserved and stored with data giving the name of the host, locality, date of collection, collector's name and any other information of importance.

Collection:
1. Winged insects may be captured in an entomological net and then carefully tubed, care must be taken not to damage them while tubing.
2. Biting species may also be captured in glass tubes which are carefully placed over them while they are feeding.
3. Insects like lice and fleas must be carefully brushed on to a white paper or linen and collected.
4. Bugs must be searched in crevices and holes of animal house.
5. Ticks may be collected, from their hosts by smearing them with a thin oil, waiting 10-15 minutes and detaching them with a slow gentle pull, provided they have not fallen off in the meantime or from the animal house. They may also be collected from pastures by dragging a piece of white cotton cloth about one yard square over the vegetation.
6. Soft ticks, which are nocturnal in habit, should be collected from the host at night or from cracks, crevices, barks of trees or holes in walls during day time:
7. Unattached species of mites such as scrub itch mites, red mites etc., can be collected with small brush dipped in 70% alcohol.
8. Mites which live in the skin can be collected by making deep scrapings of the affected lesion.
9. Foul smelling wound will be invariably harbouring the dipterous larvae, which must be either mechanically pulled out or making them come out by repellent dressings.
10. Nasal discharges should be collected for the eggs of tongue worm infection in dogs.

KILLING AND PRESERVATION OF ARTHROPODS
1. Adult dipterous flies are specially killed in cyanide bottles.
2. Chloroform/Benzene are some times used for killing. For this purpose, these are applied on cotton wool / at the bottom of bottle.
3. Mount the insects on entomological pins and store in glass tubes with wooden corks or in display cases which are provided at corners with moth boll or cotton felt dipped in a mixture of chloroform, naphtha line and creosote (1:0-75:2)
4. Small insects can be mounted on small triangular piece of white cardboard with gum (gum arabica 60 parts, sugar 50 parts, carbolic acid 2 parts, 95% alcohol 8 parts and water 45 parts).

5. Mouth parts or whole insects can be preserved in 70% alcohol, whereas larvae and pupae are killed in hot 70% alcohol and preserved in the same or in 10% formalin solution.

6. Ticks may be stored in 70% alcohol temporarily, but in order to preserve their natural colour, they are best placed in chloroform saturated with 10% formalin.

7. Mites are satisfactorily preserved in 90% alcohol.

8. Small insects / fleas, lice un-engorged larvae, nymph, ticks and mites can be mounted on slides permanently after processing them and preserved forever.

9. Mouth parts and posterior spiracles of dipterous larvae are also similarly processed for preparation of permanent mounts on slides for preservation purpose.

10. Temporary mounts of lice, fleas, ticks, mites and other insects can be done in lactophenol (Lactic acid-1 part, carbolic acid-I. part, glycerine 2 parts and water 1 part) after boiling in 10% KOH, solution and washing with water and dehydrated by using ascending grades of alcohol. This is useful for immediate identification of the specimens and afterwards they are preserved in 5% formalin after washing with alcohol.

EXERCISE – 2

FAECAL EXAMINATION TECHNIQUES

A) Gross Examination of Faeces: Gross examination should always proceed microscopic examination. Before examination of fresh faecal sample, it is advisable to know to what class of animal the sample belongs. The dung of a herbivore is dark greenish yellow with peculiar aromatic smell, contains lot of vegetable fibres, pollen grains, plant hairs, mould spores and animal debris that resemble parasitic forms (Pseudo parasites) whereas faeces of a carnivore is soft, pasty, dark yellowish devoid of fibres and having unpleasant smell.

Gross examination of faeces may reveal round worms, tapeworm segments and immature forms of parasites. In addition, colour, consistency, presence of epithelial casts, blood, deviation of faeces from normal appearance, intensity of infection if present can be known by this gross examination of faeces.

B) Microscopic examination of faeces: Microscopic examination of faeces provides an evidence of parasites inhabiting the alimentary canal of the host. Eggs of certain parasites inhabiting respiratory tract may also be seen in faeces because of swallowing of sputum and passing of it through alimentary tract and then passed out through faeces. Parasitic eggs or cysts of one species may be found in faeces of another species of host as a result of coprophage (spurious parasites). Microscopic examination of faeces can be done in two ways - (i) Direct examination (ii) Concentration methods consisting of sedimentation and flotation techniques.

i) Direct smear examination

1. Take a small quantity of pin-head size faecal material to be examined on a clean glass slide.

2. Add 2-3 drops of water to it.

3. Emulsify thoroughly with a glass rod or needle.

4. Spread it evenly in the form of a thin layer.

5. Cover it with a cover slip.

6. Examine under low power and confirm under high power if it contains any parasitic objects.
Advantages
1. Heavy infections can be detected very easily
2. It is a spot test consuming less time.

Disadvantages
1. It is difficult to detect light infections.
2. It is not an accurate and not a confirmatory test.
3. If negative, the sample should be subjected to any one of the concentration methods of examination for confirmation.

OBSERVATIONS
ii) Concentration methods
   By these methods parasitic objects can be concentrated.
   a. Sedimentation method
      1. Take small quantity of faeces about 1 gm. into specimen tube or small bowel
      2. Add 10-15 ml of water or N.S.S.
      3. Mix it thoroughly with a glass rod till all pellets are dissolved forming an emulsion.
      4. Sieve the emulsion in to a bowel through a strainer to remove coarser particles and debris.
      5. Pour the filtrate into a centrifuge tube just below it brim.
      6. Centrifuge at 2000 revolutions per minute for 2 minutes or until the supernatant fluid is clear.
      7. Pour off the supernatant fluid leaving 0.5-1 ml above the sediment.
      8. Mix the sediment suspension in the tube.
      9. Take one or two drops of this faecal suspension on to a slide, cover it with a cover slip avoiding air bubbles.
      10. Examine under low power, and if positive, then under high power to note the morphological characters.

Advantages
1. It is a routine and reliable test for all types of eggs / cysts or larval forms.
2. Number of faecal samples can be examined at case.

OBSERVATIONS

EXERCISE - 3

FLOATATION TECHNIQUE
   This method is useful for detecting intestinal nematode and protozoan infections only since ova of trematodes and cestodes cannot be floated up easily. The principle is to use a heavier specific gravity media than that of parasitic objects, so that they rise to the surface and they can be skimmed out from top most layer for examination. The common floatation fluids or leviating media in use are;
   a. Saturated solution of sodium chloride having specific gravity 1.18.
   b. Saturated solution of sugar -SP Gravity 1.25
   c. 33.3 % solution of Zinc sulphate sp. gravity 1.18.
   d. Sodium nitrate
   e. Commercial glycerine
   I. Willi's technique
1. Fill up to 1/3 of Willis tube with faecal emulsion.
2. Add saturated solution of sodium chloride in small quantities with a pipette and simultaneously mixing at each time, up to its brim.
3. Keep the tube at a place undisturbed.
4. Add few more drops of the salt solution to the tube until a surface is formed.
5. Allow it to stand for 30 minutes.
6. Transfer the top most layer of the fluid on to a slide with pipette or glass rod.
7. Cover it with a cover slip.
8. Examine under low power and then high power of microscope.

II. Lanes Process (Centrifugal floatation method)
1 to 6 The procedural steps mentioned from 1 to 6 as in sedimentation method are to be followed here also.
7. Pour off the supernatant fluid and then add saturated solution of sodium chloride up to the brim of centrifuge tube, mixing well at each stage with the sediment.
9. Take the scum or topmost layer on to a slide with a pipette or glass rod.
10. Cover it with a cover slip and examine immediately under low power and then under high power of a microscope.

Advantages
1. Scanty or light infections can be detected by this method
2. Parasitic objects can be found clearly, devoid of most of the faecal debris.

Disadvantages
1. Examination should be done immediately without any delay otherwise salt crystals are formed, with shiny parasitic objects, which render them undiagnosable.
2. Requires some skill in taking the top most layer from the tubes.
3. Chemical solutions are used and hence slightly expensive when compared to sedimentation method.
4. Mostly useful for nematode infection only as trematode and cestode eggs will not float with the usual solutions used.

OBSERVATIONS

EXERCISE - 4
Faecal examination for gastro intestinal protozoan parasites

Method of Application of Iodine and eosine solutions
1 to 6. The procedural steps mentioned from 1 to 6 as in sedimentation method are to be followed here also.
7. Pour off the supernatant fluid and then place 2 drops of faecal suspension on to a slide separately.
8. Add a drop of Lugols iodine or D. Anthonis iodine solution one drop or 2% Aqueous eosine solution one drop to another drop of faecal suspension on the slide.
9. Mix and spread them separately with a glass rod using its different ends.
10. Cover them with cover slips and examine under low power and then high power of the microscope.
i. Iodine solution
1. Iodine solution stains the faecal material and protozoa also.
2. It permits the identification and differentiation of protozoa.
3. With the iodine solution, the protoplasm of protozoa appear as lemon yellow colour. Nuclear membrane and Karyosome appear brighter and refractile where as glycogen mass assumes dark brown colour.
4. Iodine solution kills the protozoa and hence they cannot be seen in living condition.
ii. Eosine preparation
1. Eosine solution has the property of staining everything in the faeces except living protozoa which appears colorless.
2. Protozoa can be observed under pink background.
3. Dead protozoa are also stained pink and hence serves as a test for viability
4. Eosine solution does not kill the protozoa hence can be seen in living condition.
   a. Lugols iodine
      Iodine - 2G
      Postassium iodide - 4G
      Dist. water - 100 ml.
   b. 2% aqueous solution of eosine
      Eosin aqueous - 2G
      Dist. water - 100 ml.

OBSERVATION

EXERCISE: 5

QUANTITATIVE ESTIMATION OF FAECAL SAMPLES
Egg/Cyst counting techniques
i. Stoll's method
1. Take 1 gm of faecal material into a measuring cylinder.
2. Add water or NSS up to 15ml mark in the cylinder.
3. Transfer the material into bowel and mix well with a glass rod to form a uniform suspension.
4. Sieve the faecal material through a strainer to remove coarser particles without any wastage of the material.
5. Agitate and take 0.15 ml of faecal suspension with a measuring pipette on to a slide in the form of 2 to 3 drops.
6. Cover them with cover slips.
7. Count number of eggs/cysts present under each cover slip
8. Different species of eggs or cysts present in the measured quantity of faecal suspension should be counted separately.
9. Calculate the eggs per gram of faeces (EPG) or cysts per gram of faeces (CPG).
10. This is useful to know the worm burden and severity of the infection.
   Calculation:
   \[ 0.15 \text{ ml of faecal suspension contain } X \text{ - eggs.} \]
   \[ 15 \text{ ml of faecal suspension contain } = \frac{X \times 15}{0.15} = X \times 100 \]
   \[ 15 \cdot \text{ml of faecal suspension is prepared out of } 1 \text{ gm of faeces.} \]
   So 1 gm of faeces contains \( x \) 100 eggs
   Eggs per gram (EPG) or cysts per gram (CPG) = 100\( x \).

Observation:

ii. Mc. Masters Method
   In this method Mc. Masters chamber is used.
Two Chambers are present on each slide, each of which is divided into 6 longitudinal compartments. Each chamber 1 cm length, 1 cm width and 1.5 mm width.

Hence volume is 1 cm x 1 cm x 0.15 cm = 0.15 cubic cm i.e., it holds 0.15 cc of solution.

Eggs/cysts present in 2 chambers should be counted i.e. 0.15 cc + 0.5 cc = 0.3 cc.

1. In this method take 1 gm of faeces
2. Add 30 ml of saturated sodium chloride solution, mix well
3. Charge the 2 chambers on the slide with this faecal suspension with a pipette.
4. Count all the eggs/cysts present in both the chambers.
5. Count different species of eggs/cysts separately.
6. Calculate EPG/CPG of each species of parasite.

Calculation

No. of eggs / cysts present in the 2 chambers = X
Volume of faecal suspension in the 2 chambers = 0.3 ml.
So, 0.3 ml contain = X eggs
30 ml of faecal suspension contains = \(\frac{X \times 30}{0.3} = X \times 100\)
30 ml of suspension is prepared out of 1 gm of faeces.
One gram of faeces contains = X x 100 eggs
Eggs per gram (EPG) or Cysts per gram (CPG) - 100 x

Observation:

**EXERCISE - 6**

**PARASITIC CULTURES**

A. Culturing of nematode eggs

Specific diagnosis of certain nematode infections can be done by examination of larvae obtained through faecal cultures.

i. Petri dish method:

This method is useful for migrating/motile larval forms.

1. Take a lump of suspected faecal sample into a watch glass.
2. The sample should be semi-solid. If it is too liquid, add sterile charcoal/dung powder and if it is too solid, add sterile water to get it into the required consistency.
3. Place the watch glass in a Petri dish.
4. Add water into the Petri dish till the brim of the watch glass and cover with another Petri dish.
5. Keep it in dark at room temperature for about a week.
6. After this period, take a drop of water in the Petri dish surrounding the watch glass on a slide.
7. Cover it with a cover slip and examine under microscope.
8. If the infection is right, take about 5 -10 ml of water surrounding watch glass into a centrifuge tube.
9. Centrifuge at 2000 R.P.M. for 2 minutes and examine the sediment for larval form.
10. Study the morphology of larval forms and identify them.

OBSERVATIONS
ii. Baermann’s apparatus

   This method is useful for lethargic and non-migrating larval forms.
   1. Baermann apparatus consists of a funnel, wire gauge linen or cheese cloth, rubber tubing with a clamp cock at the end. These are arranged as shown in the figure.
   2. Place a lump faecal material, which was incubated previously, on the linen cloth over the wire gauge in the funnel.
   3. Pour warm water at 40° C into the funnel to the level of wire gauge touching its bottom.
   4. Within 1 to 2 hours, the non-migrating larvae come down by gravitation to the water medium and settle at the bottom.
   5. Collect bottom portion of water by opening clamp into a beaker or Petri dish.
   6. Take 1 or 2 drops on a slide.
   7. Cover it with a cover slip and examine under microscope.
   8. Study the morphology of larval forms and identify them.

OBSERVATIONS

B. Culturing of oocysts:
   This is useful for specific diagnosis of coccidia.
   1. Subject the suspected material to sedimentation method of examination.
   2. Examine sediment for the presence of coccidial oocysts.
   3. Transfer the positive material, contained in the sediment, into a petri dish.
   4. Add 2.5% of potassium dichromate solution, to form a thin layer.
   5. Dichromate solution inhibits bacteria and promotes sporulation.
   6. Examine after 24 hours for sporulation of oocysts.
   7. Take a drop of oocystic material on a slide
   8. Cover it with a cover slip.
   9. Examine under microscope
   10. Study the morphology of oocysts and identify them.

OBSERVATIONS

EXERCISE: 7

PREPARATION OF PERMANENT MOUNTS OF PLATYHELMINTH
(Staining of Trematodes and cestodes)

1. Collection: Collect the worms in normal saline and wash them in water.
2. Flattening: Flatten the platyhelminth between the two slides using optimum pressure with a thread or rubber bands.
3. Fixation: Fix such flattened specimens in 5% formalin solution for 24 hours.
4. Washing: Remove the specimens from the slides without damage and wash them well in water to remove the fixative.
5. Treatment: Transfer the washed specimen into a cavity block/watch glass, add 70% alcohol. Keep for about 5-10 minutes for easy penetration of stain.
6. Staining: Remove the alcohol and add dilute acetic alum carmine / Boraxcarmine stain solution. Allow it to stand for 24 hours. Preparation of stain solution - Boil excess of carmine stain powder in saturated solution of potassium for 15 minutes. Then add glacial acetic acid to an extent to 10% allow to stand for a week, filter and store. Dilute the stain with distilled water till it attains a port wine colour.
7. Differentiation: Destain the over stained specimens with 1 % acid alcohol (1 ml of HCl in 99 ml of 70% alcohol) till optimum differentiation is obtained.

EXERCISE - 8

I. Examination of nasal washings for diagnosis of nasal Schistosomiasis
   1. Collect the nasal growths and discharges with a scoup into a test tube containing Normal saline solution.
   2. Add 5 ml of 5% KOH or NaOH solution
   3. Allow to stand for about 10 minutes.
   4. Mix well with a glass rod till mucus and granular growths are uniformly dispersed and dissolved.
   5. Centrifuge this mucus suspension at 2000 R.P.M. for 2 minutes.
   6. Pour off the supernatant fluid
   7. Mix the sediment suspension and take a drop of it on to a slide.
   8. Spread it with a glass rod as a thin layer
   9. Cover it with a cover slip
   10. Examine under low power and study the morphological features of S.nasale eggs under high power of microscope.

II. Preparation of temporary mount of nematode
   1. Take the nematode worm as a whole (when it is slender and small like Haemonchus sp.) or cut and separate the head and tail ends (when it is a large nematode like Ascaris sp.) in to watch glass containing water.
   2. Wash the specimen thoroughly well with distilled water.
   3. Dehydrate in ascending grades of alcohol (70%, 90% and absolute) keeping in each for 2-5 mts. depending on the size of the specimen.
   4. Add clearing agent, like lactophenol for small nematodes or carbolic acid for large nematodes, into the watch glass.
   5. Keep the clearing agent in contact with the specimen for 3-5 mts. or till structures are clearly visible.
   6. Take 1-2 drops of the same clearing agent on a slide.
   7. Transfer the nematodes into the clearing agent on the slide with the help of a needle.
   8. Cover it with a cover slip, avoiding air bubbles.
   9. Examine under low and high powers of the microscope and study the morphology.
   10. Identify the specimen, depicting with characteristic diagrams of head and tail ends of nematode worm.

EXERCISE: 9
PREPARATION OF BLOOD SMEARS AND STAINING

Collection of blood: Clip the hair at the tip of the ear and clean it with spirit, prick with a fine, sterile needle and collect a drop of blood on a clean glass slide.

Preparation of Smears: Place another slide in a slant position touching blood drop on the slide and smear. Air dry it. Thick smears are required for examination of extra cellular parasites like microfilaria Trypanosomes and thin smears are preferred for intracellular parasites like Babesia, Theileria and Anaplasma organisms.

Fixation: Fix the smear with methyl alcohol or methanol for 3 minutes.

Staining:

i. Staining of blood smears with Leishman's stain solution
   1. Ascertain the right side of the film on the slide.
   2. Keep the slide on the rack with the film upwards.
   3. Filter the stain solution with a filter paper and add few drops of this Leishman's stain till it covers the whole film on the slide.
   4. Allow it to act for one minute.
   5. Then dilute the stain on the slide by adding double the quantity of distilled water.
   6. Mix it by blowing air or with a pipette.
   7. Allow it to act for 12-15 minutes
   8. Pour off the stain and wash with distilled water.
   9. Add again few drops of neutral distilled water on stained film and keep for about a minute for differentiation and removing excess of stain.
   10. Pour off, flood and wash with water.
   11. Air dry it
   12. Examine under oil immersion objective lens of the microscope.
   13. Detect the infection and study the morphology of parasites if any.

OBSERVATIONS:

ii. Staining of blood smears with Giemsa stain solution
   The steps 1 and 2 in the above method are to be followed.
   3. Dilute the stain (1 part of Giemsa stain solution 19 parts of neutral distilled water) and filter with a filter paper
   4. Fix the smear with methanol/methyl alcohol for 3 minutes.
   5. Air dry it and flood the smear with the diluted and filtered stain solution.
   6. Allow it to act for about 20 minutes.
   7. The steps 8 to 13 as in the Leishman's method of staining are to be followed.

OBSERVATION
EXERCISE - 10

PREPARATION OF PERMANENT MOUNTS OF ARTHROPODS

i. Mouth parts mounting
   1. Take a fresh or formalin preserved specimen (Musca species) in to a watch glass. If formalin preserved, wash it in water.
   2. Separate the head with a blade.
   3. Place the separated head in to a boiling test tube and add about 5ml of 10% sodium or potassium hydroxide solution.
   4. Boil gently, till chitinous structures are softened or for about 5-10 minutes, taking care hot to spurt out the specimen.
   5. Allow it to cool and transfer into a watch glass.
   6. Wash thoroughly with water to remove the hydroxide solution.
   7. Dehydrate in ascending grades of alcohol (70%, 90% and absolute) keeping in each for 5-8 minutes.
   8. Clear the specimen in carbolic acid or lacto phenol till all the structure become transparent and clearly visible.
   9. Take one or two drops of D.P.X. mountant or Canada balsam on a slide and transfer the cleared specimen into the mounting medium on the slide. Cover it with a cover slip avoiding air bubbles.

EXERCISE - 11

EXAMINATION OF SKIN SCRAPINGS FOR DETECTION OF MANGE MITES

1. Take skin scrapings into a boiling test tube
2. Add 5 ml of 10% NaOH or KoH solution
3. Boil the scrapings till a homogenous suspension is obtained.
4. Transfer the scrapings suspension into a centrifuge tube.
5. Centrifuge at 2000 R.P.M. for 2-3 minutes
6. Pour off the supernatant fluid leaving 0.5 to 1 ml fluid over the sediment.
7. Mix the sediment well and take one crop of sediment suspension on to a slide.
8. Spread it in the form of a thin layer
9. Cover it with a cover slip, avoiding air bubbles.
10. Examine under low power and study the morphological feature under high power of microscope.

OBSERVATION:

II. DESPATCH OF PARASITES AND PARASITIC MATERIALS FOR LABORATORY EXAMINATION

1. Faecal sample: Faeces from suspected animals should be preserved in 1 or 2 drops of commercial formalin and has to be sent in a clean glass container or plastic container. For coccidiosis, faeces should be sent in 2% potassium dichromate solution.
2. Trematodes and cestodes : The worms are to be washed with water or normal saline. Flattened between two slides kept in 10% formalin in glass container.
3. Nematodes: Worms are to be washed in normal saline. Fix in hot 70% alcohol or 10% formalin for few minutes so that the worms are fixed in extended condition. These can be sent either in 70% alcohol (slender and small worms) or 10% formalin (large worms) in clean glass containers.
4. Tissues or organ pieces: Containing parasites like liver piece, oesophagus nodules, pimply gut intestines are sent in 10% formalin.
5. Intermediate hosts like snails: The live snails are packed in moist cotton, kept in a glass tube and dispatched.
6. Skin scrapings: Take deep scrapings from the skin with blunt scalpel and sent in clean glass containers.
7. Insects (winged): These are pinned (Entomological pins) through meso-thorax and kept at the inner surface of the cork of a specimen tube.
8. Ticks: Preserve in 70% alcohol. Live ticks can also be sent in a specimen tube containing moist filter paper at the base.
9. Blood films: Fix in alcohol and can be stored at refrigeration temperature for few days. Blood smear should be very thin.

10.7.1.3 MICROBIOLOGY

Method of Bacterial Examination
Specimens to be examined
   Serum for serological examination
   Tissue samples for pathological (in 10% formalin solution) examination
   Samples for Virology, Parasitology and Biochemistry (freezing)
   Smears for staining (Giemsa, Gram and Methylene blue stains)
Enrichment culture in fluid media
   Nutrient broth
   Selenite broth
   Mycoplasma broth

Isolation on solid nutrient media
   Anaerobic culture
   GAM agar
   Blood agar
   pure culture identification
   - Morphology
   - Serology
   - Biochemistry
   - Drug sensitivity

CO₂ culture
   Bloodagar
   Mycoplasma agar
   Medium for Haemophilus sp.
Aerobic culture
   110 agar
   MacConkeyagar
   Blood agar
   Nutrient agar
Inoculation to chickens
Method of Virological Examination (General)

Specimens to be examined
   Serological examination
   Sampling for pathology (in 10% formalin solution)
   Sampling for Bacteriology, Parasitology and biochemistry (freezing)
Smear for staining (Giemsa, Gram and Methylene blue stains)

Virological examination

Death
Embryo inoculation  Abnormal growth
Bacterial contamination check-Pock observation

<table>
<thead>
<tr>
<th>Cell culture</th>
<th>CPE</th>
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<td>CK cells</td>
<td>Round or fusion - FA, HAd - EM</td>
</tr>
<tr>
<td>CF cells</td>
<td>Stain</td>
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<tr>
<td></td>
<td>Inclusion body - Cytoplastic or intranuclear</td>
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</tbody>
</table>

Cell culture fluid  HA and HI

METHODS FOR EMBRYO INOCULATION

Material

1) Embryo: SPF chicken embryos
2) 1-2 ml syringe with 22G / 24G x l’ needle
3) 70% alcohol or tincture of iodine
4) Small gimlet
5) Dental drill or small file
6) Vaseline-Paraffin (1:9, VP)
7) Liquid paraffin (LP)
8) Cellophane adhesive tape (Cello tape)

Yolk sac inoculation

1) Embryos : 5-7 days old
2) Candle and mark with pencil at the point of embryo and edge of air cell.
3) Sterilize the surface shell of air cell with 70% alcohol sol. or tincture of iodine.
4) Puncture the surface shell of air cell with small gimlet.
5) Inoculate 0.5 ml of specimen
6) Fill up the hole in shell with sterilized VP
7) Candle every day and observe for 7-10 days after inoculation

Chorio-allantoic cavity inoculation

1) Embryos : 11-12 days old
2) Sterilize the surface shell of air cell
3) Cut off the shell and open small window in air cell.
4) Drop small amount of LP on air cell and make clear the shell membrane
5) Inoculate 0.1 ml of specimen.
6) Cover the window with cello tape.

3. Allantoic cavity inoculation

1) Embryos: 10-11 days old
2) Candle and mark with pencil at the edge of air cell and blood vessel
3) Puncture with a gimlet at a point 3-5 mm apart from air cell edge for inoculation and the surface shell or air cell for exhaustion.
4) Sterilize the shell surface of inoculation and exhaust parts.
5) Inoculate 0.2-0.5 ml of specimen.
6) Fill up the holes in shell with sterilized VP
4. Intravenous inoculation
   1) Embryos 11-14 days old
   2) Candle and mark with pencil at the edge of air cell and most thick blood vessel.
   3) Sterilise the mark point and cut a square shell on the blood vessel without damaging the shell membrane.
   4) Take off the square shell
   5) Drop small amount of LP on shell membrane and make clear
   6) Inoculate 0.1 ml of specimen.
   7) Cover the hole with cellophane tape.

STAINING TECHNIQUES
A. GRAM’S STAIN
   Procedure
   1) Prepare bacterial smears and fix over flame.
   2) Pour Ammonium oxalate crystal violet stain and allow it to act for 1 min.
   3) Wash with tap water.
   4) Add Gram's iodine to act for 1 min
   5) Decolourise with 95% ethyl alcohol for about 30 sec. gently agitating the slide till no colour comes out from the smear.
   6) Counter stain for about 10 to 20 sec with Safranin solution or dilute Carbol fuchsin solution
   7) Wash with tap water, blot it dry and examine
   Interpretation
   Gram positive organisms will be deep violet and gram negative pink.

B. STAIN FOR METACHROMATIC GRANULES
   Bacterial cytoplasm is not homogeneous and structure less substance but contains various chemically different cytoplasmic granules. Metachromatic granules are very characteristic in the organisms of the genus Corynebacterium.
   Procedure
   1) Prepare a smear, dry and fix over flame.
   2) Flood with Methylene blue stain and allow it to act for 3 to 4 min.
   3) Wash with water
   4) Dry in air and examine under oil immersion lens.
   Interpretation
   Metachromatic granules will be stained deep red and the rest of the cell' light blue.

C. CAPSULE STAIN
   Capsule, when present, is the outermost structure in bacteria. Its thickness varies greatly in different species of bacteria. Pneumococci and Klebsiella organisms possess thick capsule. Among pathogenic organisms, the presence of the capsule is considered an indication of their virulence which may be absent in a virulent forms due to constant subculture. Capsule is antigenic in nature and except in one case (B.anthracis) where it is polypeptide in nature, the chemical nature of capsule of most other bacteria is polysaccharide in nature. The composition of the medium in which the capsulated organisms are grown may influence the size of the capsule. The Hiss copper sulphate method of capsule staining is commonly used.
   Procedure
1) Prepare the smears in serum, air dry and fix by gentle heating.

2) Apply gentian violet stain and heat gently until steam rises. Allow the dye to act for 15 to 20 seconds.

3) Wash the dye with 20% copper sulphate solution, applying several changes.

4) Do not wash with water. Blot it dry and examine under oil immersion lens.

Interpretation: The capsule appears as a faint blue halo around the dark purple cell body against a faint purple background.

D. FLAGELLA STAIN

Typical motile bacteria possess very thin thread-like appendages, which are known as flagella. Flagella are antigenic in nature and originate from the cell cytoplasm. They are locomotive organs for the motile organisms. The length of flagella is usually several times that of the cell size. Flagella probably by alternate contraction and relaxation produce a wave-like motion, which pull or push the organism and cause bacteria to move. The arrangement of flagella on the cell body is helpful in their identification. They can be stained by special techniques. Leifson's staining technique is usually employed for flagellar staining.

Procedure

1) Gently wash the cells twice in centrifuge with distilled water at 3000 r.p.m. for about five minutes, each time discarding the supernatant.

2) Gently re-suspend the cells in distilled water to give a visible turbid and incubate at 37°C for about 10 minutes. Check motility by hanging drop method.

3) Pick up a perfectly clean slide, flame for few seconds and before it cools, mark a heavily defined band around an area of about 1 x 1.5 sq. inch on the flamed slide with a grease pencil.

4) Incline the slide and place a loop full of the washed bacterial suspension at two points at one end of the enclosed area and allow them to run to the second end. Allow the slide to dry in air.

5) Place the slide on the staining rack. Thoroughly shake the staining bottle and slowly add about one ml basic fuchsin stain with a pipette into the marked area without soiling the grease pencil marks.

6) Allow the stain to act till there is formation of a fine precipitate in the stain. Precipitate formation is detected by the appearance of rust coloured cloud, which generally starts along one side of the stain and quickly spreads throughout the staining solution. This is the end of staining period (about 10 to 30 minutes).

7) Flood the stain off the slide with a gentle stream of water.

8) Counter stain for 1 minute with 1 per cent aqueous methylene blue.

9) Wash with water; air dry and examine under oil immersion lens.

E. SPORE STAIN:

Under certain unfavourable circumstances, spore forming bacteria (e.g., species of Bacillus and Clostridium genera) develop into spores, which are refractile bodies that are resistant to various physical and chemical agents. Bacterial spores are not devices of multiplication. They simply resist adverse conditions and germinate under favourable conditions. Most of the vegetative cells sporulating transform into a single spore. Spores may be spherical or oval and may be central, sub-terminal or terminal in position within the cell. Shape, size and position of the spore in the cell are useful for the identification of sporulated organisms. Spores are difficult to stain and when once stained, they are difficult to de-colourize. With Gram's stain, mature spores remain unstained bodies. Following is the modified Ziehl-Neelsen's method of staining of spores.

Procedure
1) Make smears and fix over flame.
2) Stain with concentrated carbol fuchsin and steam for 3 to 4 minutes.
3) Wash with tap water.
4) Decolourise with 0.5% sulphuric acid.
5) Wash with water.
6) Counter stain with Loeffler's methylene blue for 2 minutes.
7) Wash with water, dry and examine.

Interpretation

The spores will stain pink and vegetative cells blue.

F.ZIEHL - NEELSEN'S STAIN

Species belonging to the genus Mycobacterium do not stain readily by simple staining procedures. Their staining is facilitated by heat. Once stained they retain the colour of the dye even when treated with a suitable decolourising agent. These organisms are designated as acid fast. The organisms which are decolourised, take counter stain and are non-acid fast. Organisms causing tuberculosis in animals and Johne's disease (JD) are acid-fast.

Procedure

1. Cut a piece of the tuberculosis lung, or pinch of intestine suspected for JD, press and spread evenly on the slide. Dry the smear and fix over the flame.
2. Flood the smear with concentrated carbol fuchsin and steam for 3 to 5 min. Do not boil or char the stain. Stain should not dry on the slide.
3. Wash with water.
4. Decolourise with acid alcohol until the preparation is faint pink or colourless (about 15 to 20 seconds).
5. Wash with water.
6. Counter stain with Loeffler's methylene blue for about 1-2 minutes.
7. Wash with water, blot carefully and dry before examination.

Interpretation

Acid fast bacteria will stain red and pink and non-acid fast and tissue debris blue.

TESTING CULTURES FOR ANTIBIOTIC SENSITIVITY

Determination of the sensitivity of microbial isolates to antimicrobial agents is one of the most important tasks of the clinical microbiologist. The sensitivity of a culture can be most easily determined by an agar diffusion method. The recommended procedure is called the Kirby-Bauer method. A plate of suitable culture medium is inoculated by spreading a sample of culture evenly across the agar surface. Filter paper discs containing known concentrations of different antimicrobial agents are then placed on plate. The concentration of each agent on the disc is specified, so that the zone diameter of appropriate size will develop to indicate sensitivity or resistance. After incubation, the presence zones of inhibition around discs of the different agents is noted. (Table presents typical zone sizes for several antibiotics) Zones observed on the plate are measured and compared with standard data, to determine if the isolate is truly sensitive to a given antibiotic or not.

<table>
<thead>
<tr>
<th>Antibiotic</th>
<th>Amount on disc</th>
<th>Inhibition zone diameter (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Resistant</td>
</tr>
<tr>
<td>Ampicillin&lt;sup&gt;b&lt;/sup&gt;</td>
<td>10 µg</td>
<td>11 or less</td>
</tr>
</tbody>
</table>

91
<table>
<thead>
<tr>
<th>Drug</th>
<th>Concentration</th>
<th>MIC Range</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ampicillin</td>
<td>10 µg</td>
<td>28 or less</td>
<td>29 or more</td>
</tr>
<tr>
<td>Cephoxin</td>
<td>30 µg</td>
<td>14 or less</td>
<td>15 – 17</td>
</tr>
<tr>
<td>Cephalothin</td>
<td>30 µg</td>
<td>14 or less</td>
<td>15 – 17</td>
</tr>
<tr>
<td>Chloramphenicol</td>
<td>30 µg</td>
<td>12 or less</td>
<td>13 – 17</td>
</tr>
<tr>
<td>Clindamycin</td>
<td>2 µg</td>
<td>13 or less</td>
<td>15 – 16</td>
</tr>
<tr>
<td>Erythromycin</td>
<td>15 µg</td>
<td>12 or less</td>
<td>14 – 17</td>
</tr>
<tr>
<td>Gentamycin</td>
<td>10 µg</td>
<td>13 or less</td>
<td>13 – 14</td>
</tr>
<tr>
<td>Methicillin</td>
<td>30 µg</td>
<td>9 or less</td>
<td>10 – 13</td>
</tr>
<tr>
<td>Neomycin</td>
<td>300 µg</td>
<td>12 or less</td>
<td>13 – 16</td>
</tr>
<tr>
<td>Nitrofurantoin</td>
<td>10 units</td>
<td>14 or less</td>
<td>15 – 16</td>
</tr>
<tr>
<td>Penicillin G</td>
<td>10 units</td>
<td>28 or less</td>
<td>17 or more</td>
</tr>
<tr>
<td>Penicillin G</td>
<td>10 µg</td>
<td>11 or less</td>
<td>12 – 21</td>
</tr>
<tr>
<td>Polymyxin B</td>
<td>10 µg</td>
<td>8 or less</td>
<td>9 – 11</td>
</tr>
<tr>
<td>Streptomycin</td>
<td>30 µg</td>
<td>11 or less</td>
<td>12 – 14</td>
</tr>
<tr>
<td>Tetracycline</td>
<td>1.25 / 23.75 µg</td>
<td>14 or less</td>
<td>15 – 18</td>
</tr>
<tr>
<td>Trimethoprim</td>
<td>10 µg</td>
<td>10 or less</td>
<td>11 – 15</td>
</tr>
<tr>
<td>Tobramycin</td>
<td>10 µg</td>
<td>12 or less</td>
<td>13 – 14</td>
</tr>
</tbody>
</table>

b - For gram negative organisms and enterococci  
c - For Staphylococci and highly penicillin sensitive organisms.  
d - For Staphylococci  
e - For organisms other than Staphylococci - include organisms such as enterococci and some gram negative rods that may cause systemic infections treatable by high doses of Penicillin G.

**Important Clinical Diagnostic Tests for Bacteria**

<table>
<thead>
<tr>
<th>Test</th>
<th>Principal</th>
<th>Procedure</th>
<th>Most common use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbohydrate fermentation</td>
<td>Acid and / or gas during fermentative growth with sugars or sugar alcohols</td>
<td>Broth medium with carbohydrate and phenol red as pH indicator; inverted Durham's tube for gas</td>
<td>Enteric bacteria differentiation (also several other species separations with some individual sugars)</td>
</tr>
<tr>
<td>Test</td>
<td>Description</td>
<td>Procedure</td>
<td>Result</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Catalase</td>
<td>Enzyme decomposes hydrogen peroxide H₂O₂</td>
<td>Add drop of H₂O₂ to dense culture and look for bubbles (O₂)</td>
<td>Bacillus (+) from Clostridium(-); streptococcus (-) from Micrococcus / Staphylococcus (+)</td>
</tr>
<tr>
<td>Citrate utilization</td>
<td>Utilization of citrate as sole carbon source results in alkalinisation</td>
<td>Citrate medium with bromthymol blue as pH indicator, look for intense blue colour</td>
<td>Klebsiella-Enterobacter (+) from Escherichia (-), Edward siella (-)</td>
</tr>
<tr>
<td>Coagulate</td>
<td>Enzyme causes clotting of blood plasma</td>
<td>Mix dense liquid suspension of bacteria with rabbit plasma (1:5), incubate, and look for clot</td>
<td>Staphylococcus aurius (+) from S.epidermis (-)</td>
</tr>
<tr>
<td>Decarboxylases</td>
<td>Decarboxylation of amine acid (lysine, ornithine, arginine) releases CO₂ and Amine</td>
<td>Medium enriched with amino acid Bromocresol purple pH indicator. Alkafine pH if enzyme action, indicator becomes purple</td>
<td>Aid in determining bacterial group among the enteric bacteria</td>
</tr>
<tr>
<td>B-Galactoidase (ONPG) test</td>
<td>Orthonitrophenyl-B galactoside (ONPG) is an artificial substrate for the enzyme, when hydrolyzed, nitrophenol (yellow) is formed</td>
<td>Incubate heavy suspension of lysed culture with ONPG, look for yellow color</td>
<td>Citrobacter a, I Arizona (+) From Salmonella (-) Identifying some shigella and pseudomonas species</td>
</tr>
<tr>
<td>Gelatin liquefaction</td>
<td>May proteases hydrolyze gelatin and destroy the gel</td>
<td>Incubate in broth with 12% gelatin. Cool to check for gel formation. If gelatin hydrolyzed, tube, remains liquid upon cooling</td>
<td>To aid in identification of Serratia, Pseudomonas, Flavobacterium, Clostridium</td>
</tr>
<tr>
<td>Hydrogen sulphide (H₂S)</td>
<td>(H₂S) produced by breakdown of sulfur amino acids or reduction of thiosulfate</td>
<td>H₂S detected in iron-rich medium from formation of black ferrous sulfide (many variants Kliger's iron agar, also detect carbohydrate fermentation)</td>
<td>In enteric bacteria, to aid in identifying Salmonella, arizona Edwasdiella and Proteus.</td>
</tr>
<tr>
<td>Indole test</td>
<td>Tryptophan from proteins converted to indole</td>
<td>Detect indole in culture medium with dimethyl-aminobenz-aldehyde (red color)</td>
<td>To distinguish Escherichia (+) from Klebsiellaa Edwardseilla (+) from salmonella (-)</td>
</tr>
<tr>
<td>Methyl red test</td>
<td>Mixed-acid fermenters produce sufficient</td>
<td>Glucose-broth medium Add methyl red indicator to a sample after incubation</td>
<td>To differentiate, Escherichia (+ , culture red) from Klebsiellaa - (Usually-, culture yellow)</td>
</tr>
<tr>
<td>Nitrate</td>
<td>Nitrate as alternate</td>
<td>Broth with nitrate. After</td>
<td>To aid in identification</td>
</tr>
</tbody>
</table>
reduction electron acceptor, reduced to NO₂ or N₂ incubation, detect nitrite with - naphthalamine-sulphanilic acid (red color). If negative, confirm that NO₃, still present by adding zinc due to reduction of NO₃ to NO₂. If no colour after zinc, then NO₃ - N₂.
of enteric bacteria (usually +)

10.7.2 MEAT PLANT

The students will attend the slaughter house/Meat plant for 10 days at the district Head Quarters, where the student is undergoing Internship programme. During the period, the students have to do ante-mortem and post-mortem examination of the animals and note the details of different abnormalities observed. They should also note how animals are grouped into various categories based on ante-mortem and post-mortem examination.

DATA TO COLLECT

The students must collect following data at the slaughter house.
1. Slaughter date
2. Number of animals slaughtered on working days/Sundays/Festival days
3. Species, age, sex
4. Marketing of live animals-determination of live animal cost and basis for it.
5. Fees collected for different animals.
6. Type of transport used.
7. Condition of the animals after transport, in lairage and before slaughter
8. a. Lairage and lairage management (availability of facilities like shelter, Feed, fodder, arid water)
   b. Number of animals died;
9. Holding time
10. a. Antemortem inspection
    b. Number of animals condemned: Judgment of live animals fit for slaughter or not. If not, reasons
11. Stunning
12. Slaughter procedure
13. a. Post-mortem examination
    b. Number of carcasses rejected
14. Reasons for condemning the carcass
15. Disposal of condemned carcasses
16. Processing of meat & Meat products
17. Storage of meat & Meat products
18. Marketing (local or export) of meat
19. Transportation of dressed carcasses
20. Average yield (%)
21. Constraints, type and nature of improvement required
22. Registers maintained - purpose and proforma
23. By-products produced - mode of disposal
24. Personal hygiene

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25. Effluent disposal
   If possible, the students may be asked to visit Bacon Factory, Gannavaram and/or Alkabeer Slaughter House and note the various steps involved in slaughter of different species.

10.7.3. MILK PLANT
   The students have to collect information on the following aspects of the dairy plant allotted and are expected to have operational knowledge of the Dairy Plant.

A. About Dairy Plant
   1. Year of Starting:
   2. Full capacity of the plant:
   3. Present handling:
      a. Maximum:
      b. Average:
      c. Minimum:
   4. Source of procurement:
      a. Number of routes:
      b. Name of routes:
      c. Qualities procured:
      d. Direct procurement:
   5. Staff:
      a. Supervisors:
      b. Technical:
      c. Administration:
      d. Labour:

B. Dairy routine
   i. Reception of Raw Milk (RMRD)
      a. Time of Reception - Morning and evening
      b. Quantity received - Morning and evening
      c. Mode of transportation and quantity received in each mode - cans, tankers etc.
      d. Temperature of milk at reception and visual appearance of milk
      e. Tests done at the places of reception:
         1. Organoleptic test
         2. COB - Test
         3. Acidity test
      f. Condition of sanitation in the reception dock
      g. Quality and disposal of substandard milk
      h. List of equipment available in RMRD
   ii. Chilling of Raw Milk
      a. Capacity of the chiller
      b. Temperature of chilled milk
   iii Storage of Milk
      a. Storage of raw milk
         Number of tanks, type and maximum time of retention
      b. Type of agitation
      c. Cleaning system for storage
   iv. Processing
a. Capacity of Pasteurizers, total number of units, number of units in operation.
   b. Time of operation
   c. Details of ghee preparation
   d. Number of Units, capacity.
   e. Number of workers in the section
   f. Cleaning and sanitation
   g. Records maintained.

v. Preparation and processing -of toned, double toned and standardised milk
   a. Quality made
   b. Formulae of cooperation
   c. Standards maintained equipment, capacity and study of operation
   d. Labour involved
   e. Processing and storage
   f. Cleaning

vi. Products Manufacture (for each product)
   a. Name and component of product manufactured
   b. Quantity produced per day/shift
   c. Raw material used
   d. Machinery used, capacity, cost
   e. Processes involved in manufacture, detailed study of operation
   f. Preparing the equipment, cleaning, sanitation
   g. Packing of the product
   h. Labourers requirement
   i. By-products obtained and their disposal
   j. Sale price of products
   k. Project loss from the product

C. Quality Control
   a. Details of the laboratory, equipment, staff etc.,
   b. Stages of sampling for milk, products, water detergents etc.,
   c. Test, place, farm, laboratory
   d. Standards fixed for milk, products etc.
   e. Number samples tested daily
   f. Quality control at the procurement
   g. Quality control at the distribution level
   h. Special tests done, frequency and details of the test as procedures
   i. Bacteriological examination
      1. Raw milk
      2. Pasteurized milk
      3. Milk products
      4. Equipment

D. Visit to Collection Centre
   a. Number of suppliers:
   b. Time of supply: From _______________ To ____________________
   c. Method of weighing sampling recording
   d. Total collection -Cows and buffaloes
      Morning, evening and seasonal fluctuations.
   e. Tests taken
   f. Type of building, plant, area, rented etc.
   g. Distance of collection from centre to processing dairy
h. Mode of transportation from centre to dairy
i. Mode of payment at the dairy centre

E. Visit to Chilling Centre
   a. Location
   b. Number of collection centres
   c. Number of routes
   d. Total collection
      Morning: Cow: Buffalo:
      Evening: Cow: Buffalo
   e. Time collection starts
   f. Time collection ends.
   g. Equipment present
   h. Testing of milk
   i. Time of sending milk to dairy
   j. Records maintained
   k. Staff pattern
   l. Cleaning.

10.7.4 TRAINING IN ZOO / WILD LIFE CENTRE
   ● Familiarization with various bio-diversity programmes, that are observed in zoo/sanctuary.
   ● Familiarization of various captive animals present in zoo/sanctuary
   ● Housing of captive animals: housing conditions, types of houses, enclosures for animals in zoo. Feeding schedule of wild animals: Feeding practices for Herbivores, Carnivores, aquatic animals and birds.
   ● Acquaintance of general sanitation measures practised in zoo
   ● Isolation and quarantine of wild animals under captivity
   ● Restraint, handling of wild animals-familiarization with various restraint equipment such as guns, dart guns etc.
   ● Care and management of sick animals in zoo
   ● Identification of poisoning and non-poisoning snakes
   ● Familiarization with zoo records and keeping
   ● Cleanliness, disinfection of animals premises, enclosures
   ● Identification and familiarization with wildlife values.

Zoo / Sanctuary inventory

Name of the zoo/sanctuary : 
No. of animals : 
No. of species maintained : 
Species maintained : 
Total area of zoo/sanctuary : 
No. of visitors per annum : 
Dimensions of different animal enclosures : 
Feeding schedule
   Carnivores
   Herbivores
   Birds
   Any other animals
Mortality pattern : 

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Birth rate of individual species : 
Total annual income of zoo : 
Total expenditure per annum : 
No. of Veterinarians working in zoo : 
No. of animal keepers in zoo : 

10.7.5 TOXICOLOGICAL STUDIES

MODE OF COLLECTION AND DESPATCH OF TOXICOLOGICAL SPECIMENS FOR DIAGNOSIS OF POISONING

There are two types of poisoning in farm animals (1) Accidental and (2) Malicious poisoning. The necropsy of the animals and the rapid diagnosis is helpful in the treatment of other affected accidental poisoning. In case of malicious poisoning which may turn up into medico-legal case, the identification of poison is a must to establish the cause of death. In all poisonous cases chemical analysis of the biological specimens is essential to know the cause of death or illness. Therefore, every veterinarian should know the salient points in collection and dispatch of toxicological specimens to a laboratory.

History of the case is of great Importance in the diagnosis of poisoning. This includes the number of animals in the farm, number of affected, method of feeding, regularity of feeding, recent changes in the rations or attendants. Whether pastures have been sprayed with pesticides or fertilizers, if rodenticides have been used and remnants of the bait removed and disposed properly, storage of the poisonous substances, access to poisonous plants, etc. Inspect the surroundings for empty pesticides or paint containers that are not really empty, presence of poisonous plants in the farm environment. Also, the possibility of industries effluents coming in contact with grazing/watering sources should be given thought of.

POST MORTEM PROPER

Necropsy by routine procedure is to be performed as soon as possible after the death of animal. Examine the animal externally and note incisions. Snake poisoning Snake bite on the skin or in the m.m. Examine the oral cavity for corrosive lesions (acids/alkali) or changes in colour of m.m. (Nitrate poisoning). As most of the toxins gain entry through GI tract, examination of GI mucosa, the contents, their smell, pH and colour is a valuable guide in diagnosing toxicoses. Poisoning by salts of heavy metals produce significant PM lesions but alkaloids like strychnine produce very feeble lesions. The Natural orifices, subcutaneous fat tissue, muscles, bones and teeth (in fluorine poisoning) body cavities and internal organs should be examined. The stomach should be punctured rather than cut open for organoleptic examination to note the character of smell. Puncture ensures greater accuracy and a longer time smell. Some of the poisons which emit characteristic smell are bitter almond in hydrogen cyanide, garlic smell in phosphorus, selenium-rotten garlic smell or horse radish smell, zinc phosphide, acetylene, ammonia smell in urea and petroleum smell in petro product poisoning. The pH of the gastric contents is to be analyzed. Acidic pH (normal in herbivores) - acid ingestion decreases pH. Alkali/urea ingestion increases pH. The colour of stomach contents also indicate the cause of poisoning Copper salts impart a greenish blue colour to the contents, picric acid, nitric acid impart yellow colour. Acid/alkali: char the contents. The contents of the stomach vary from traces to flakes of paints or lead objects, grains or baits, seeds etc., like wise small and large intestine should be examined. The contents of stomach phosphoresce in dark in phosphorus poisoning. Blood should be examined for its colour and clotting characters.
Poison - Colour
Cyanide - cherry red colour.
Arsenic - rose red colour.
Hydrogen sulphide - dark.
Carbon monoxide - pink and
Nitrate poisoning - blood is brown in colour.

In abrus and cyanide poisoning, blood remains fluid after death.

Examination of other visceral organs should be done in relation to their size, colour etc. Ex: spleen size is decreased and colour is changed to dark brown or black in copper poisoning and spleen size is increased in T2 mycotoxicosis. Lymph nodes are swollen, hemorrhagic, Edematous and dark upon radiation exposure. Bone marrow becomes pale and gelatinous with yellowish tint. The description of morphological changes should be noted clearly and absence of changes should be notified. The most important lesions found should be underlined.

<table>
<thead>
<tr>
<th>Kind of sample</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole Blood</td>
<td>10-20 ml</td>
</tr>
<tr>
<td>Serum</td>
<td>10-20 ml</td>
</tr>
<tr>
<td>Milk</td>
<td>50-100 ml</td>
</tr>
<tr>
<td>Urine</td>
<td>50-100 ml</td>
</tr>
<tr>
<td>Water</td>
<td>200 ml</td>
</tr>
<tr>
<td>Feces</td>
<td>50 gms</td>
</tr>
</tbody>
</table>

In case of small animals (poultry, small dogs, lab animals) the cadavers are sent as it is. But in case of large animals the stomach contents are collected from the vicinity of pathognomic changes in the gastric mm. If there are no changes a representative sample is collected.

COLLECTION OF SAMPLES FOR ANALYSIS

A sample feed/suspected bait is collected to establish source of Poisoning. Rumen contents/vomitus to establish that the toxin has been ingested. Liver, spleen and blood to establish absorption. Kidney, urine, milk to establish excretion.

Always collect paired samples. Send one and keep the other set for future reference.

Poison - Colour of Urine
Picric acid - yellow,
Chlorophenol/ nitrophenol (wood preservatives) - greenish yellow
Phenothiazine - red.

In medium sized animals the stomach is tied at esophageal and duodenal ends and intestine is tied at both ends, bladder is tied at the neck and sent separately. All the specimens are to be taken in separate containers (polythene jars/ covers), properly labeled with particulars of date, case No., organ collected, species, name of the preservative used etc. A sample of the preservative used should be included for reference. A brief history of the case and treatment particulars should be given. It is always preferable to send the specimens through a special messenger. In vetero-legal cases, the specimens should be sealed in the presence of a witness.

Mode of preservation
1. Ice/72 hrs
2. Alcohol (95% ethyl alcohol) 1 ml/gm of tissue is the ideal preservative for toxicological specimens. Formalin should never be used as it hardens the tissue without giving scope for scraping and interferes in the analysis.

Blood and serum should be refrigerated and never frozen,

3. Saturated salt solution can also be used, except in case of salt poisoning.

Type of poison Organs to be collected

<table>
<thead>
<tr>
<th>Type of Poison</th>
<th>Organs to Collect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arsenic (Acute)</td>
<td>Liver, kidney, feed, stomach contents, urine.</td>
</tr>
<tr>
<td>Lead</td>
<td>Bone, blood, stomach contents.</td>
</tr>
<tr>
<td>Fluoride</td>
<td>Urine, stomach contents, forage and water sample</td>
</tr>
<tr>
<td>Arsenic (Chronic)</td>
<td>Hair, liver, Urine, Spleen</td>
</tr>
<tr>
<td>Lead (Chronic)</td>
<td>Hair, liver, Bone, feces, kidney</td>
</tr>
<tr>
<td>Nitrate</td>
<td>Water, forage, silage, whole blood, plant material frozen and sent without chopping in a polythene cover</td>
</tr>
<tr>
<td>Copper</td>
<td>Kidney, liver, whole blood, feces</td>
</tr>
<tr>
<td>Cyanide</td>
<td>Blood, liver, forage, stomach contents in 1 % mercuric chloride and refrigerated.</td>
</tr>
<tr>
<td>Organo phosphorus Pesticides</td>
<td>Body fat, stomach contents, blood (heparinized) Urine, feed</td>
</tr>
<tr>
<td>Organochlorine Pesticides</td>
<td>Fat, stomach contents, liver, kidney, whole blood Carbon monoxide - Blood</td>
</tr>
<tr>
<td>Urea</td>
<td>Rumen Liquor</td>
</tr>
<tr>
<td>Salt</td>
<td>Liver, brain, feed, water, urine sample.</td>
</tr>
</tbody>
</table>

11. HANDS – ON – SKILLS IMPARTING PROGRAMME

The transfer of technology from developed to developing nations has grown vastly within the last three decades. Traditional economic analysis can be dangerously misleading in the study of technology transfer. The problem arises because the term involves two complex and multidimensional concepts: 'technology' and 'transfer'. A broad definition of transfer of technology is 'the process by which science and technology are diffused throughout human activity. On the other hand, educating the people about the various aspects of scientific management of their resources and time, where 'Lab to Land' programme turns out to be most important and as felt by many the same is most neglected.

In the above context, a practically viable activity entitled as 'Hands-on-Skills Imparting Programme' embodies various extension tools and techniques, which shape out the students with more proficient in several aspects of animal husbandry activities and in turn helps out them to perform better in their future endeavors.

SOCIAL SURVEY: The survey word was derived from the Latin words 'sur /sor' means 'over' and 'veer / veoir' means 'see' i.e. means to 'look over or to see over'. As state by Mark Abrams, social survey is a process by which quantitative facts are collected about the social aspects of a community's composition and activities. In other words, it is a fact-finding study dealing with nature and problems of the community.

Purpose of social survey
1. To obtain the facts regarding social aspects of the community.
2. To study social problems and economic conditions of farmers and factors responsible for these conditions.
3. To evaluate the programme and assess the benefits desired from it. All together social survey helps in bringing about social welfare and betterment of the people.
Steps in social survey

- Selecting the problem
- Definition of aim
- Determination of scope
- Definition of time limit
- Examination of means of sources of information
- Determination of unit of survey
- Determination of the amount of refinement
- Preparedness of the respondents
- Construction of tools for data collection
- Field work and data collection
- Processing and analysis of collected data
- Interpretation and report writing

Types of social survey: Social survey is classified into various types according to subject matter, technique of data collection, area covered and regularity etc.

General survey: When a survey is conducted for collecting general information about any population, institution or any phenomenon without any objectives is known as general survey. The Government institutions for getting regular data on many socio-economic problems undertake such survey. For example, census survey of population conducted for every 10 years.

Specific survey: These are conducted for specific purposes or problems for testing the validity of some theory. These surveys are naturally more pinpointed for specific purpose. For example, survey conducted to assess the rate of mortality among livestock affected with a particular disease, hygienic milk production, calf management etc.

Regular survey: Some surveys are regular in nature and must be repeated at regular intervals. Such survey is undertaken when continuous data are required to study the trend and effect of time upon the phenomenon. For example, collecting data regularly to assess the impact of AI in improvement of local cattle or census survey of population conducted for every 10 years.

Ad Hoc survey: These surveys are undertaken once for all. They are also conducted in phases when the area of investigation is large. The whole process of survey can be completed in one or two installments. This could not be termed as regular or repetitive survey unless the same information is collected over and over again. Ad Hoc survey are undertaken mostly for supplementing some information with regard to any research problem. For example, survey to assess the causes of calf mortality in a particular area.

Preliminary survey: Also known as pilot study and is forerunner of the final survey. The purpose of this survey is to get first hand knowledge of the universe and population to be surveyed. It assists the researcher to get acquainted with problems and nature of respondents from whom the information is to be collected. It is very useful in preparing a schedule or questionnaire and organizing the survey on proper lines.

Final survey: Final survey is made only after the pilot study is completed.

Census survey: In census survey every single unit of universe is contacted and information is collected.

Sample survey: In sample survey, a portion of the universe is contacted and the information is collected. This sample represents the entire population and is called as sample survey. These surveys are becoming popular because of its convenience, time saving and low cost etc.

Direct or Indirect survey: In case of direct survey quantification is possible whereas in indirect survey quantitative description is not possible. For example, Direct survey - Demographic survey and Indirect survey - Health and Nutritional status survey.
Primary survey: In the primary survey, the task of survey is taken up afresh and the surveyor himself sets the goals and collects relevant facts.

Secondary survey: If the facts are already available and there is no need to examine them afresh by a new survey then the survey is called secondary survey. Primary survey is far more reliable than the secondary survey.

Initial and Repetitive survey: If the survey is being made for the first time it is called as initial survey and if it is being made second or third time it is called as repetitive survey.

Public survey: Survey, which is not highly personal in nature and accordingly no secrecy, is maintained in the collection of data or publication of results is known as public survey.

Confidential survey: If the nature of survey is such that the information collected is not to be revealed to public, then it is known as confidential survey.

Postal and Personal survey: When the data is collected through dispatch of questionnaires by post it is known as postal survey, where as if the information is collected through direct interview of the respondents usually through schedule, it is known as personal survey.

Benchmark or Baseline survey: The survey conducted to know the resources and traditional methods of farming of the people. The usual method for studying the existing situation of the clientele is the Benchmark or baseline survey. "The survey conducted in extension programmes based upon the needs and interests of the people is known as benchmark or baseline survey.

Utility of social survey:
- Survey is the only practical way to collect any type of information.
- Survey facilitates drawing generalization about large population.
- Survey helps the researcher to find out the new problems.
- Survey helps to construct plan for the development of the society.
- A social survey helps the extension worker to come in contact with the rural people.
- This method permits greater objectivity, as the data collected is not influenced by one-man views and beliefs.
- It helps the extension worker to find out the extent at which the rural people are affected with a particular problem.
- Based on the problem that emerged from social survey it helps the extension worker to come out with suitable solutions.

SAMPLING AND SAMPLING METHODS:

There are some important sampling concepts that need to be clarified before sampling techniques can be understood. Population: A population or Universe is defined as an entire group of persons I things I events having at least one characteristic in common. For example, Livestock farmers, Rural people, Veterinary students etc.

Sample: A sample is defined as a small part of population selected by some rule / plan. For example, Among 1000 livestock farmers of a region taking few farmers as a sample of study. Thus a sample is a part of population. We select the sample, measure the sample and from these, we can make inferences about the population.

Sampling: The process of choosing the units of the target from the universe which are to be included in the study.

Reasons for sampling
- In many cases, a complete coverage of the population is not possible.
- Complete coverage may not offer substantial advantage over a sample survey.
- Sampling provides a better option, since it addresses the survey population in a short period of time and produces equally valid results.
- Studies based on samples require less time and produce quicker results.
- Samples provide more detailed information and a high degree of accuracy because they deal with relatively small number of units.
Principles of sampling

Samples are to be chosen by means of sound methodological principles.

- Sample units must be chosen in a systematic and objective manner.
- Sample units must be easily identifiable and clearly defined.
- Sample units must be independent of each other, uniform and of the same size and should appear only once in the population.
- Sample units are not interchangeable; the same units should be used throughout the study.
- Once selected, units cannot be discarded and
- Selection process of units should avoid errors and bias

Sampling methods are classified as either probability or non-probability. In probability samples, each member of the population has a known non-zero probability of being selected. Probability methods include Simple Random sampling, systematic sampling, stratified sampling, multi-stage sampling and cluster sampling. In non-probability sampling, members are selected from the population in some non random manner. These include convenience sampling, Purposive sampling, judgment sampling, quota sampling, and snowball\' sampling. The advantage of probability sampling is that sampling error can be calculated. Sampling error is the degree to which a sample might differ from the population. When inferring to the population, results are reported plus or minus the sampling error. In non-probability sampling, the degree to which the sample differs from the population remains unknown.

METHODS OF DATA COLLECTION

Observation Method: According to Goode & Haft, science begins with observation and must ultimately return to observation for its final validation. Observation is probably the oldest method used by man in scientific investigation. The first knowledge of the universe around man begins with observation. In social research too the earliest method of investigation was probably the 'observation' method. This method involves a careful and systematic watching of facts as they occur in course of time. It could be considered as a basic method of collecting information about the world I phenomenon around us. Observation is important in social sciences including Animal Husbandry Extension as an independent method of research and as an auxiliary to other methods. It is an act of recognizing and noting some fact or occurrence. It is a methodical way of looking at the behavior of others in a specific situation and recording the same thoroughly in some form or the other. Observation method of data collection is the technique for gathering information without direct questioning on the part of the investigator.

Characteristics of Scientific Observation: The accurate and fruitful observation is an art and it demands training and practice, following are criteria of a good scientific observation:

- It must be specific but not haphazard
- It must be systematic but not by chance i.e. 'dropping in' on a situation
- It must be quantitative in nature and
- Scientific observation must be recorded immediately.

Kinds of observation: Observation can be classified into various categories, depending upon 'type of method' and 'type of control'

Depending on the type of method used observation is classified into
1. Participant observation:

When the observer participates with the activities of the group under study it is known as participant observation. Thus a participant observer makes himself a part of the group under study. The observer need not necessarily carry out all the activities as carried out by other members of the group, but his presence as an active member of the group is necessary. Behavior of the members of the group is observed under natural situation. During this, it is possible to get minute and hidden facts. Participant observer can easily learn a wide variety of intimate details to interpret his observation.

2. Non-participant observation: When the observer does not actively participate in the activities of the group, but simply observes the group from a distance it is known as non-participant observation. The observer will observe the group in a particular situation as an outsider by standing at a distance. It is a useful method, if an extension scientist wants to find out the real reaction of farmers. During this, it is possible to get complete, thorough, scientific & objective method of data collection is possible. Researcher behaves like a stranger and stands outside the group so the group may forget about the researcher and they behave in a natural way.

Depending on the type of control observation is classified into:

1. Non controlled observation:

When the observation is made in the natural surroundings and the activities are performed in their usual course without being influenced or guided by any external force it is known as non-controlled observation. The observation may be biased and colored by the views of the observer, because there is no check upon him. For example, observing the farmers when they are carrying out their farming activities in their fields.

3. Controlled observation:

Observing the people when they are working under some authority. The purpose of controlled observation is to check any bias due to faulty perception, inaccurate data and influence of outside factors on the particular incident. For example, studying the people working under some administration like in factories.

Guidelines for data collection through observation: While collecting data through observation method, following are the guiding points to be considered in the field of extension:

- Physical environment of the village such as rivers, valleys, hills, types of houses, building etc.
- Various centers of the community such as marketing center, recreation center, temples, educational institutions etc.
- Agricultural farming activities such as farming system, farming types, varieties of crops grown, species of animals reared, pattern of animal rearing, sources of irrigation, farm implements, etc.
- Religious activities such as beliefs, superstitious beliefs like why they do that?
- What are the beliefs associated with it?
- Relationship pattern among the livestock owners and with other community members.
- To whom more respect is given whether to high adopters or literates or wealthier persons.
- What are the different groups existing in the village? What are its different activities? What kind of relationship existing between and within the groups?
- What is the pattern of leadership existing in the community?
- What are the problems being faced by the livestock farmers?
Case Study Method: Case study research involves studying individual cases, often in their natural environment, and for a long period of time. The method of exploring and analyzing the situation in depth of any social unit is called as Case Study. It is studying 'everything about a single thing'. For example, study about any institution, any phenomena and about any successful persons.

Characteristics of Case study
- It studies the whole unit in totality.
- It often studies a single unit - one unit is one study.
- It perceives the respondent as an expert, but not as a source of data.
- It studies typical cases.
- It employs several methods primarily to avoid errors and distortions.

Steps in conducting Case study
- Introduction about the unit under study.
- Explanation about the existing situation.
- Course of events
- Cause and effect relationship.
- Validation of diagnosis.
- Follow up of case.
- Summary of findings.
- Conclusion and generalization.

Uses of Case study
- To gain more information about the structure, process and complexity of the research object especially when relevant information is not available or insufficient.
- When the research content is complex for survey studies and when the researcher is interested in the structure, process and outcome of a single unit.
- To assist with formulating hypothesis.
- To illustrate, explain and to offer more detail findings.
- To test the feasibility of quantitative studies.

Interview Method:

Interview is a technique of face-to-face contact used to watch the behavior of an individual to record the statements, to observe the concrete results, and group interactions. It may be regarded as a systematic method by which a person enters more or less imaginatively into the life of a comparative stranger. This method helps in securing special information by getting in contact with the respondents.

Purpose of the interview
- To bring the scientist and layman into direct contact, so that both may know and recognize the needs by each other.
- To gather first hand, factual, tactful and useful information.
- To provide chance for the extension worker to observe the behavior of livestock owners.
- To find out the views, reactions, attitudes and beliefs towards the livestock farming activities and various developmental programmes.

Kinds of Interviews
Structured interview: Also known as controlled, guided or direct interview. In this a complete schedule is used and the interviewer is asked to get the answers to those questions only. Interviewer generally doesn't add anything from his own side and does not even change the language. Interviewer can only interrupt or amplify the statement wherever necessary.

Unstructured interview: Also known as uncontrolled, unguided or undirected interview. No direct or predetermined questions are used in this type of interview and are generally held in the form of free discussion or narrative story type. The interviewee is asked to narrate the incidents of his life, his own feeling and reactions and the researcher has to draw his conclusions from it.

Focused interview: The interview generally focused on a particularly issue of social, economic, cultural, psychological aspects of the society. For example, study on reaction of livestock farmers towards an animal husbandry programme broadcasted in television. The researcher tries to focus his attention to the particular aspect of problem and tries to know his experiences, attitudes and emotional response regarding the situation under study. The interview is also in the form of free story or narrative type.

Repetitive interview: When it is desired to note the gradual influence of some social or psychological process Interview then, it is repetitive in nature. To know the social change that have a far-reaching influence upon the people and it is sometimes desired to know the effect of such factors in time sequence. For example, when veterinary college adopts a village, naturally it will have its own influence upon the livestock and farmers owning the livestock. There will be betterment in the production of livestock, and also in the economic status, and standard of living of farmers. In order to study this influence in time sequence the study can be conducted through repetitive interviews.

Guidelines for conducting an interview method: Conducting an interview is a technical matter & requires a thorough knowledge of the methods and the principles underlying it. Following are the different steps to be taken in conducting an interview.

- Establishing contact: Interviewer has to greet the respondent & introduce himself. He should explain the purpose of selecting him and also how the information supplied by him is going to benefit the farmers.

- Starting an interview: A beginning may be made from the general discussion of the problem. The interviewer should see that the respondent do most of the talking and the interviewer should listen to him attentively by guiding and directing the respondent towards the subject matter.

- Securing rapport: The interviewer should be tactful and expert in creating friendly atmosphere and gain confidence of the respondent.

- Recall: At times respondent is full of emotional feelings so that he drifts away from the main interview. Then after some narration he/she generally lapses into silence. In such a case the researcher should wait for some time, and should try to draw the attention of the respondent to the actual point carefully by probing some questions to continue again.
● Encouragement: The respondent has to be encouraged from time to time during the course of interview by complementing for his expressions and also by supporting him wherever necessary.

● Recording: The entire process of interview should be recorded which can be used for future references.

Participatory Rural Appraisal: PRA method has been considered the most appropriate to understand and analyze the local situations. This methodology has been developed as an alternative and to complement conventional sample survey methodology and hence should not be considered as a substitute for the survey research. PRA is a way of learning from and with villagers to investigate, analyze and evaluate constraints and opportunities. PRA is a most flexible and adaptable need assessment technique.

Features of PRA

1. Triangulation: This is form of cross-checking by changing the team composition, the sources of information and the techniques applied. There is need that each activity or phenomenon is considered from different viewpoints and studied using different techniques. The diversity in PRA scientist's team and also in villager group having different interest groups help in triangulation and thereby in higher reliability of information.

2. Learning in the community: PRA is an approach for learning from, with and through members of the local community. The PRA scientists' team should make all possible efforts to see the situation through the eyes of the affected people. To achieve this, the team members must become friendly to the villagers by taking part in their everyday activities and by listening from them.

3. Appropriate – Imprecision: In conventional survey, efforts are made to collect information on all possible aspects very exhaustively and most of the time only a part of it is used. On the contrary in PRA approach the information is generated only on the aspects which are directly required in accordance with the aims and objectives of the study. Further, an effort is made to avoid unnecessary precision during the process of collection and analysis of data.

4. Use of Appropriate tools / techniques: The selection of tools / techniques needs to be done carefully. Tools should be simple, clear, self evident and appropriate to local conditions. The team should also be ready for any modification in the technique that might be suggested by the residents of the study area. Appropriate means and local materials may be taken for describing quantities and qualities and setting up classification schemes.

5. On Site Analysis: The team should meet each evening to jointly discuss and analyze that day's findings and also to plan the work to be done on the following day. The repeated on the spot analysis enable them to understand the existing situation, concentrate on the problem areas and lead to growing understanding and accumulation of knowledge. The results should be evaluated by the team before departure from the area and should be publicly presented and discussed with members of the community.
6. Offer setting Biases, self-critical awareness: This process should try to have involvement - of those who would otherwise never get a chance to speak, the poorest people, women, disadvantaged groups in remote areas etc. still important is that the team must refrain from any value judgments about others.

7. Multi-disciplinary Team: The scientific team conducting PRA must have fairly broad base, meaning thereby inclusion of scientists of all important disciplines relevant to the area of study. It is also important to have female scientists in the team so that rural women could be effectively involved in the appraisal exercise.

Approach of PRA

L Listen to what they say
E Encourage them to join the discussion
A Ask question (do not make judgements)
R Review what has been discussed
N Note what has been discussed

Steps of PRA
1. Direct observation: Direct observation has no substitute to collect the reliable data from the primary source since it provides proof in itself. The team members, therefore, must always act as observer through out the PRA exercise. Valuable hints and information should be collected by critically observing the objects and acts right from entering into the area. Each observation must be recorded as early as possible. The critical analysis of these observations/notes will not only provide the additional information but will help in triangulation.

2. Rapport building: The first most requirement of PRA is rapport building and environment creation for free and frank interaction by the villagers. The best way to achieve this condition is that the team members during the study period stay and eat with local people. The team should listen and take part in every day activities.

3. DIY (Do-it-Yourself): The team members should make efforts to perform the activities that the villagers are doing such as sowing the seeds, transplanting, harvesting, threshing, feeding the animals, milking, chaffing the fodder etc. This helps not only in rapport building but provides practical ideas and feelings of complexities of activities.

1. SSI (Semi-Structured Interview): This is the most important and critical step of PRA process. The individuals are asked relevant but informal questions. No structured schedule or questionnaire is prepared for interviewing. Various roles, such as team leader, process recorder and environment controllers are divided among the members of PRA team and they should be well prepared before entering into the village.

2. Focus Group Interviews: Group interviews are always better than individual interview. It provides exhaustive information with all possible triangulation and does not leave any chance of missing information. Focus group interviews are arranged under special circumstances depending upon the specific objectives of the study. Focus group interviews provide specific and pointed data for the specific group without any intervention, hindrance and hesitation from other villagers not belonging to the focus group. Separate focus group interviews may be arranged for women, for weaker sections, for dairy farmers and so on.
Understanding Livestock owners by utilizing PRA tools: Four patterns are normally chosen to reveal the key functional relationship that determines the properties of an agro-ecosystem. These are space analysis, time analysis, seasonal analysis and matrix ranking. These analyses provide an understanding about the properties and the process of human management of agro-eco system.

Space Analysis: The spatial patterns are mostly revealed by maps and transects. The functional relationship can be depicted through various maps (social map, resource map, occupational map etc.), while transects are useful in defining a system boundaries and in identifying problem areas.

Transect Walk: A transect walk by PRA team across the village with Villagers help to develop a clear idea on the natural resources, land use, vegetation, topography, cropping pattern, livestock resources“ rearing patterns etc. It is a useful method to know rural ecological conditions. A walk from one point of the village to another enable the outsider to observe difficult aspects of rural ecology and to discuss with rural people about fodder crop, livestock, agro-ecological zones, water flows and water sheds etc.

Mapping Steps
● Ask the villagers to draw the map of their own village at a suitable place which is convenient for all the villagers (dry, visible and spacious place)
● Allow them to draw map in their own way and don't suggest.
● Don't interrupt from outside.
● More the participation of villagers better the quality of map.
● Triangulate the information indicated in the map. Ask some of the villagers to point out his/her house, crop field, orchards, etc. on the map.
● Ask others if they would like to add anything in the map.
● Transfer the map on a paper. Write down the names of all the participants.

Types of Mapping:

Social Map or Social Profile: The social map is made by the farmers to describe locations of different castes and communities in the village, the conditions of households, roads and rivers etc. The social map forms a useful base for identifying problems of different households, their number and their characteristics.

Resource Map or Land use Pattern: The resource map of a village can show different kinds of natural resources. In a resource amp, the villagers depict different kinds of rivers, ponds, trees, crop, animal species and the land utilization pattern. The problems can be discussed on the basis of a resource map. This can also form a basis for transect walk.

Occupational Map/Enterprise map: This map indicates the diversity of earnings. This type of map can be used for studying the income sources, expenditure pattern etc.

Time Analysis: It show the quantitative and qualitative changes overtime and can be used for many variables such as area and yields of different crops, livestock population, farming practices, variety, breeds, use of fertilizer and other inputs etc. In the method of time-line, elderly people are chosen as key informants. They narrate the history on different parameters. Triangulation may be done with the secondary data obtained from records.
Time line: Time line is a method of knowing history of major recollected events in a community. This method is also known as historical time-line of a community. Time-line illustrates diagrammatically the past events, which the member of a community remembers as being significant to their livelihood. The historical time-line is narrated by elderly villagers in details with respect to the major changes, that have taken place in' their society and has impact on their economic, social and agro-ecological life.

Steps:
- Develop rapport with elderly villagers by explaining them the objectives of visit clearly.
- Select the focus group from the village, which could give correct information.
- Ask the group about major significant events in various fields that have affected their life pattern in past.
- Ask the group about the impact of these events on their past and present life style.
- Arrange the narrated major events and its impact in logical sequences and in tabular form.
- Each of these events should be triangulated two or three other villagers.

Seasonal Analysis: It helps in understanding seasonal cyclic variations in the selected parameters such as rainfall, temperature, humidity, cropping systems, livestock rearing systems, crop rotations, labour availability, fodder availability, disease occurrence etc. Seasonal analysis may be done through drawing of seasonal diagrams through PRA. The community members are asked to draw the diagram for a given year, if required each month may be divided into two fort nights or four weeks. Each activity or event is shown with the help of a bar drawn across the month. The diagram drawn by the community members on the ground is then transferred on the papers. Seasonal analysis helps in drawing out the information about the months/seasons in a year when the villagers face the hardships/problems. Such analysis helps the researchers and policy makers in formulating the projects to solve the rural problems. The seasonal analysis can be done for rainfall, seasonality of diseases, season wise workload in agriculture and animal husbandry, season wise work fodder availability etc.

Steps:
- Brief the villagers or the focus group about the item with regard to which you require information. For instance, occurrence of livestock diseases and fodder availability in a calendar year.
- Do all necessary preparations required for drawing a diagram.
- Tell them to enlist the livestock disease that have affected in previous years.
- Prepare a table and write down the name of the diseases on the first column on different rows.
- Write down the names of each month/season on the first row in different columns.
- Show this table to the focus group and ask them to depict the months in which a particular disease occur in a year.

Time Trends: This tool of PRA is used for depicting quantitative changes over a time in different aspects of rural life. By applying this method one can see the increasing or decreasing trend of hardship in life of rural people.

Steps:
- Obtain data from the focus on a time frame about development in particular field
- Verify the provided data with other villagers
- Arrange these information in tabular form and analyze clearly the increasing or decreasing trend
- Draw the conclusion from the given data

Matrix Ranking: Matrix ranking helps in comparing two or more objects in respect of perceived attributes or criteria by the villagers. In this exercise, different attributes and criteria are listed which are ranked either on the basis of fixed scoring or free scoring according to their relative importance. It helps in understanding different criteria against which the villagers rank any particular object/item, ego livestock species, breeds of livestock, fodders and their varieties etc.

Steps:
- Decide the topic(s) on which you would like Villagers to score.
- Have an initial discussion with the interested villagers and set the climate for discussion.
- Ask the villagers to list different alternative objects / items such as breeds, varieties of species etc. Ask them to write on horizontal line to have columns.
- Ask them the possible criteria for ranking or preference and to write them on the left side column in vertical order to make rows.
- Draw the table of matrix by drawing horizontal lines dividing the possible criteria and vertical lines dividing the different objects / items.
- Start talking about the first criteria and ask them to score out of 10 for each object / item. The most preferred object may have the highest score on the criteria.
- Move to the next criteria and ask them to score each object against those criteria. Complete for all the listed criteria.
- Triangulate the information with other villagers.
- Also ask the villagers for their best choice of the object/item and record for its verification.
- Transfer the information on the sheet of paper
- Calculate the total score for each object / item and triangulate with the best choice of object by the villagers.

Livelihood analysis: Livelihood analysis helps in obtaining information about decisions and problems and also the coping strategies of different households in relation to socio-economic factors. This type of analysis can be used for studying the household size, composition, income and expenditure pattern, income from different sources etc.

Steps:
- Decide on the topic which respect to which livelihood analysis is to be carried out such as income and expenditure pattern for different types of household.
- Decide on the classification of household in terms of socio-economic categories, caste categories etc.
- Choose a representative household from different socio-economic categories.
- Ask the head of the chosen household for different socio-economic categories.
- Ask the head of the chosen household for different socio-economic categories.

Village Institution Linkage Map (Venn Diagram): Venn diagram is a visual method to represent the role and relationship of individuals and institutions, their degree of importance and relationship with other individuals and institutions. The individuals or institution are depicted by circles and their importance by the size of circles. The relationship is depicted
by connecting lines and distance of placement. Different aspects of decision making relationship can be studied by venn diagram. The villagers are asked to enumerate various institutions contributing to a specific action, project or decision - making. They are asked to place them in the form of circle, the size on the basis of importance and the distance indicating the relationship among each other.

Activities to be carried out by the Internees

1. Survey on 'Need Identification' of the livestock farmers
2. Case study on identified Institutions
3. Organize general meetings or group discussions to find out possible solutions for their problems
4. Employing any of the PRA tool during their internship period.