Livestock Production Technology & Products Management

- Animal Genetics & Breeding
- Animal Nutrition
- Livestock Production and Management
- Livestock Products Technology
- Poultry Science

Education Division
Indian Council of Agricultural Research
New Delhi
April 2009
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EXECUTIVE SUMMARY

I. The New Approach

The proposed course curricula and syllabi in animal science disciplines have been prepared in the light of PG programs in vogue at different veterinary colleges in India and contemporary developments in animal sciences. The guiding principle of the proposed new approach is to impart comprehensive and practical knowledge by covering all important aspects of the subject area of study at Master’s level. It is proposed that each M.Sc./MVSc student should register for all the courses offered by the major department, instead of opting for courses of 1 or 2 sub-disciplines only.

II. Credit Requirements

• Common academic regulations for post graduate education in SAUs, DUs and CAU as proposed in table 2 will be followed with slight adjustments to accommodate specific and special needs to build up and enhance the knowledge based competence of the animal science students as given below.

• The total course work of 40 credit hours has been proposed at M.Sc./M.V.Sc. level instead of minimum requirement 35 credit hours (Table 1), keeping the research credit hours (20) unchanged. Break up of the course work: Major subject (including 1 credit seminar) - 29 credits, minor subject (specified in table 1) and supporting subjects (as per requirement) together -11 credits.

• At Ph.D. level, it is proposed to keep course credit hours (30) and research credit hours (45) unchanged. However, break up of the course work: Major subject (including 2 credit seminars) - 19 credits, minor subject (specified in table 1) and supporting subjects (as per requirement) together-11 credits.

• Out of 11 credit hours for minor and supporting subjects, courses with a minimum of 6 credits should be taken from minor subject and course(s) with a minimum of 3 credit hours from supporting subject(s) 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.
• The credit hours for minor and supporting subjects both at Master’s and Doctoral level have been reduced to compensate partially for the increased credit load of courses of major subject.

• Besides, four general non-credit courses namely, Library and Information Services (0+1), Technical Writing and Communication Skills (0+1), Intellectual Property and its Management (1+0) and Disaster Management (1+0) are mandatory at Master’s level, and at Doctoral level, if not studied already.

• The undergraduate courses for B.V.Sc. & A.H. students, formulated and implemented uniformly in all veterinary colleges of India under statutory provisions of Veterinary Council of India, are up to 500 series. To avoid overlapping and confusion generated thereof, the numbering of courses is also revised i.e., 600 series for M.Sc./MVSc and 700 for Ph.D. programme.

Based upon the key issues that are assuming priority day by day, the areas which need to be strengthened in various disciplines, are outlined hereunder.

**Animal Genetics and Breeding**

Molecular techniques in animal breeding, biometrical techniques in animal breeding, conservation of animal genetic resources and bio-informatics in animal genetics and breeding.

**Animal Nutrition**

New concepts in feed technology, feed analysis and quality control, clinical animal nutrition, nutrition of companion and laboratory animals, nutrition of wild and captive animals, toxic constituents in animal feed stuffs, modern concepts in feeding of ruminants, monogastrics, rumen fermentation, micronutrients and nutrient-drug interaction.

**Livestock Products Technology**

Abattoir and slaughter technology, fresh and processed meat technology, animal by products processing, poultry other than chickens and broilers such as turkeys, ducks, geese, quails, emu and ostriches.

**Livestock Production and Management**

Shelter designs and engineering, climatology in relation to animal production, poultry farm and hatchery management, integrated livestock production systems, acts and regulations
relating to animal welfare, livestock business management, management of rabbits and intensive rearing of goats, sheep, swine and buffaloes for meat and milk.

**Poultry Science**

Commercial layer and broiler production, breeder flock and hatchery management, bio-security of flock management, poultry economics, micro-nutrients and amino acids in poultry nutrition, commercial aspects of marketing and integration.

Regarding certain specific suggestions made during the presentation of the draft report of this BSMA Committee, the following response by way of clarification may be worthwhile mentioning:

Animal Physiology is distinct from Veterinary Physiology deals with physiological aspects relating to production, such as body maintenance, growth, lactation and various other productive and reproductive traits. While the governing basic features of Physiology remain the same in both the streams, in Animal Physiology, the relationship with nutrition, breeding, management, climate and environment are given special emphasis.

Regarding the admission of B.Sc Agriculture and dairy science graduates to PG programmes in LPM, it can be considered by prescribing supplementary/pre-requisite courses, if need be, as per admission relations and concerned Advisory Committee Recommendations.
### BSMA Committee on Livestock Production Technology & Production Management

(Animal Sc./Animal Husb./Animal Bre./Animal Nutrition & AFT/LPM/APT/Poultry Sciences)

(Constituted by ICAR vide Office order No. F. No. 13 (1)/2007- EQR dated January 14, 2008)

<table>
<thead>
<tr>
<th>Name</th>
<th>Address</th>
<th>Specialization</th>
</tr>
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<tbody>
<tr>
<td><strong>Dr. N. Balaraman</strong></td>
<td>Tamil Nadu Univ. of Vety. &amp; Animal Science, Chennai</td>
<td>Animal Nutrition</td>
</tr>
<tr>
<td>Former Vice-</td>
<td></td>
<td></td>
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<tr>
<td>Chancellor Convener</td>
<td></td>
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<tr>
<td><strong>Dr. B. K. Joshi</strong></td>
<td>NBAGR, Karnal</td>
<td>Animal Breeding</td>
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<tr>
<td>Director</td>
<td></td>
<td></td>
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<tr>
<td><strong>Dr. S. K. Jindal</strong></td>
<td>Animal Physiology, CIRG, Makhdoom, Farh, Mathura (UP)</td>
<td>Animal Physiology</td>
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<tr>
<td>Principal Scientist</td>
<td></td>
<td></td>
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<tr>
<td><strong>Dr. B. T. Deshmukh</strong></td>
<td>Deptt. of Physiology &amp; Biochemistry, Bombay Vety. College, Parel, Bombay</td>
<td>Animal Physiology</td>
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<tr>
<td>Prof.&amp; Head</td>
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<tr>
<td><strong>Dr. Arjava Sharma</strong></td>
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<tr>
<td>Head</td>
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<td>LPT</td>
</tr>
<tr>
<td>Professor</td>
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<tr>
<td><strong>Dr. C. L. Marwah</strong></td>
<td>Dept. of LPM, COVS, CSKHPAU, Palampur</td>
<td>LPM</td>
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<tr>
<td>Professor</td>
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<tr>
<td><strong>Dr. R .S. Yadav</strong></td>
<td>Dept. of LPM, College of Animal Science, CCS HAU Hisar</td>
<td>LPM</td>
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<tr>
<td>Professor Member Secretary</td>
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PREAMBLE

Livestock sector has gained prominence during the past three decades owing to its impressive growth and increasing GDP contribution within the agricultural sector. Livestock rearing practices have dramatically changed in recent years from subsistence to commercial, subsidiary to main-occupational and unorganized to intensively organized systems. These achievements have taken place in spite of the limited priority and monetary allocations to this sector and the poor resources of the majority of the farmers who have contributed to this phenomenal transition. The high quality man power generated through the educational institutions dealing with veterinary and animal sciences has been mainly instrumental in fulfilling the technological backstopping needed at the field level, through scientific research and technology development. The farming community and the industry adopted latest innovations in production, processing, health and management, resulting in production and productivity enhancement and increased per capita availability of livestock products.

Today, India leads the world in milk production with around 100 million tonnes per annum. Over seventy per cent of the milk produced in India is contributed by semi-medium, small, marginal and landless farmers. Another significant feature of milk production is that over 56 per cent of it is derived from the buffalo, which is an animal species of pride to this country. Poultry sector has set the trend for other sub-sectors of livestock rearing by its intensive commercialization, high productivity level and technology adoption of a high order. Concerns of food and nutritional security are being adequately addressed through inclusion of food products of animal origin in the human diet, particularly the vulnerable sections of the society such as growing children, adolescents, pregnant and nursing mothers, senior citizens and convalescing patients.

Livestock sector is not only a sustainable livelihood option, but also an appropriate medium of socio-economic growth through educational empowerment, employment and entrepreneurship development and gender equity for millions of people in the country. Value addition at the farm level brings additional income to the producer and saves food products of animal origin from deterioration and wastage. Environmental protection through proper shelters, drainage, waste disposal and recycling has become all the more important when our country enters into the era of commercial and intensive production. There are several areas of untapped resources with large scope for development. In the meat sector, the sheep, goats and
swine need to be paid more attention. Buffalo meat production is gaining popularity with increased prospects of export. Emerging dimensions relating to phyto-sanitary monitoring and quality assurance are becoming immensely relevant at national and global levels.

It is imperative that, in tune with the change of times and modern needs, the large scale developments in science and technology in the field of livestock production and processing are appropriately incorporated into the proposed revised course curricula in respect of postgraduate and doctoral programmes. This task has been undertaken by the Broad Subject Matter Area (BSMA) Committee. The subject matter area has been identified as “Livestock Production Technology and Products Management”. This exercise has been the outcome of the initiative provided by the Education Division of Indian Council of Agricultural Research, which has constituted the 18 BSMA Committees to cover the entire area of agricultural sciences. The BSMA Committee on Livestock Production Technology and Products Management seriously deliberated upon the issues concerning animal science education in general, and livestock production technology and products management in particular. The curricula and syllabi of all the seven disciplines, viz., Animal Breeding, Animal Nutrition, Animal Physiology, Animal Products Technology, Livestock Production and Management, Meat Science and Poultry Science were discussed at length in the meetings and workshop convened by the BSMA Committee.

The key issues, which need to be specially addressed while contemplating on the revision of course curricula at PG and doctoral levels are: supply of high quality germplasm to farming community, compounded feed supply to intensive livestock production units, adoption of concepts such as total mixed rations, complete feeds, strategic bio-available micro-nutrient supplements, land use for intensive green fodder production, shelter designs for in-house livestock rearing amenable to automation and mechanization, clean milk production to be taken up as a national mission, phyto-sanitary measures for traceability and quality assurance of products of animal origin, onward linkages for processing and marketing of meat, particularly from small ruminants, swine and buffalo, cold chain infrastructure for meat, milk and eggs, entrepreneurship building and economic analysis of livestock production including pricing, insurance, credit, technological backstopping and assessment of economic losses associated with inadequate prioritization of the livestock enterprise.
The implementation of the new and restructured post graduate course curricula is expected to build knowledge and skill portfolio of the students so as to enhance their employability and marketability as multi-service providers with practical skills and comprehensive knowledge of the entire subject area after masters. The doctorates should, in turn, prove as specialists, in the field of their specialization. The valuable inputs received from the stake holders viz. eminent academicians, scientists, extension workers, pharmaceutical/dairy industry, leading veterinary practitioners, state animal husbandry department etc. have immensely helped in preparation of this document.

The BSMA Committee wishes to place on record the help rendered by Dr. Lalitha John, Dean, Madras Veterinary College, Faculty and Staff Members of TANUVAS especially Dr. T. Sivakumar and Dr. J. John Kirubaharan for coordinating teh various BSMA committee meetings and for their active participation, unstinted cooperation and assistance. The help rendered by National Core Group under the Chairmanship of Dr. J.C. Katyal, Vice-Chancellor, CCS Haryana Agricultural University, Hisar for providing guidance and regulations and format his greatfully acknowledged. The committee is also indebted to Dr. S.P. Tiwari, DDG (Education) and Dr. R.K. Mittal, ADG (EQR), ICAR for providing all administrative assistance. The critical inputs provided by Dr. Dharmeshwar Das (Member, NCG), Dr. B.K. Joshi, Dr. Arjava Sharma, Dr. N. Balaraman, Dr. V. Balakrishnan, Dr. B.T. Deshmukh, Dr. R.S. Yadav, Dr. T. Shivkumar, Dr. F.R. Sheriff, Dr. J.J. Robinson Abraham were helpful in designing this document. The basic document (1st draft) prepared by the faculty of Animal Sciences, CCS Haryana Agricultural University, Hisar, the efforts put in by the HAU faculty is highly appreciated.
ORGANIZATION OF COURSE CONTENTS
&
CREDIT REQUIREMENTS

Code Numbers
• All 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.
• Credit seminar for Master’s level is designated by code no. 691, and the two seminars for Doctoral level are coded as 791 and 792, respectively.
• Similarly, 699 and 799 codes have been given for Master’s research and Doctoral research, respectively.

Course Contents
The contents of each course have been organized into:
• Objective – to elucidate the basic purpose.
• Theory units – to facilitate uniform coverage of syllabus for paper setting.
• Suggested Readings – to recommend some standard books as reference material. This does not unequivocally exclude other such reference material that may be recommended according to the advancements and local requirements.
• A list of journals pertaining to the discipline is provided at the end which may be useful as study material for 600-series courses as well as research topics.
• E-Resources - for quick update on specific topics/events pertaining to the subject.
• Broad research topics provided at the end would facilitate the advisors for appropriate research directions to the PG students.

Minimum Credit Requirements

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<tr>
<th>Subject</th>
<th>Master’s programme</th>
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<td>Major</td>
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<td>17</td>
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<tr>
<td>Minor + Supporting (minimum 6 for minor &amp; 3 for supporting)</td>
<td>11</td>
<td>11</td>
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<tr>
<td>Seminar</td>
<td>01</td>
<td>02</td>
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<tr>
<td>Research</td>
<td>20</td>
<td>45</td>
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<tr>
<td><strong>Total Credits</strong></td>
<td><strong>60</strong></td>
<td><strong>75</strong></td>
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<tr>
<td>Compulsory Non Credit Courses</td>
<td>See relevant section</td>
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</tbody>
</table>

**Major subject:** The subject (department) in which the students takes admission
**Minor subject:** The subject closely related to students major subject. A suggested list of specified minor subjects is given below.
**Supporting subject:** The subject not related to the major subject. It could be any subject considered relevant for student’s research work.
**Non-Credit Compulsory Courses:** Please see the relevant section for details. Six courses (PGS 501-PGS 506) are of general nature and are compulsory for Master’s programme. Ph. D. students may be exempted from these courses if already studied during Master’s degree.
**Suggested list of specified minor subjects (departments)**

<table>
<thead>
<tr>
<th>Major Subjects</th>
<th>Minor Subjects</th>
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<tbody>
<tr>
<td>Livestock Production and Management</td>
<td>Animal Nutrition, Animal Genetics &amp; Breeding, Livestock Products Technology and Veterinary and Animal Husbandry Extension</td>
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<tr>
<td>Livestock Products and Technology</td>
<td>Food Science and technology, Biochemistry, Microbiology, veterinary public health, Poultry science, Livestock Production and Management</td>
</tr>
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</table>

**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 post graduate studies.
## ANIMAL GENETICS AND BREEDING

### Course Structure – at a Glance

<table>
<thead>
<tr>
<th>CODE</th>
<th>COURSE TITLE</th>
<th>CREDITS</th>
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<tr>
<td>AGB 601</td>
<td>ANIMAL CYTOGENETICS AND IMMUNOGENETICS</td>
<td>2+1</td>
</tr>
<tr>
<td>AGB 602</td>
<td>MOLECULAR GENETICS IN ANIMAL BREEDING</td>
<td>2+1</td>
</tr>
<tr>
<td>AGB 603</td>
<td>POPULATION AND QUANTITATIVE GENETICS IN ANIMAL BREEDING</td>
<td>2+1</td>
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<tr>
<td>AGB 604</td>
<td>SELECTION METHODS AND BREEDING SYSTEMS</td>
<td>3+1</td>
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<tr>
<td>AGB 605</td>
<td>BIOMETRICAL TECHNIQUES IN ANIMAL BREEDING</td>
<td>3+1</td>
</tr>
<tr>
<td>AGB 606</td>
<td>CONSERVATION OF ANIMAL GENETIC RESOURCES</td>
<td>2+0</td>
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<tr>
<td>AGB 607</td>
<td>CATTLE AND BUFFALO BREEDING</td>
<td>2+1</td>
</tr>
<tr>
<td>AGB 608</td>
<td>SMALL FARM ANIMAL BREEDING (SHEEP, GOAT, SWINE AND RABBIT)</td>
<td>2+0</td>
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<tr>
<td>AGB 609</td>
<td>POULTRY BREEDING</td>
<td>2+1</td>
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<tr>
<td>AGB 610</td>
<td>LABORATORY ANIMAL BREEDING</td>
<td>1+0</td>
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<tr>
<td>AGB 691</td>
<td>MASTER’S SEMINAR</td>
<td>1+0</td>
</tr>
<tr>
<td>AGB 699</td>
<td>MASTER’S RESEARCH</td>
<td>20</td>
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<tr>
<td>AGB 701</td>
<td>RECENT ADVANCES IN ANIMAL GENETICS</td>
<td>2+0</td>
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<tr>
<td>AGB 702</td>
<td>RECENT TRENDS IN ANIMAL BREEDING</td>
<td>2+0</td>
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<tr>
<td>AGB 703</td>
<td>ADVANCES IN BIOMETRICAL GENETICS</td>
<td>2+1</td>
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<tr>
<td>AGB 704</td>
<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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</tr>
<tr>
<td>AGB 706</td>
<td>ADVANCES IN MOLECULAR CYTOGENETICS</td>
<td>2+0</td>
</tr>
<tr>
<td>AGB 707</td>
<td>UTILISATION OF NON-ADDITIVE GENETIC VARIANCE IN FARM ANIMALS</td>
<td>2+1</td>
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<tr>
<td>AGB 791</td>
<td>DOCTORAL SEMINAR I</td>
<td>1+0</td>
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<tr>
<td>AGB 792</td>
<td>DOCTORAL SEMINAR II</td>
<td>1+0</td>
</tr>
<tr>
<td>AGB 799</td>
<td>DOCTORAL RESEARCH</td>
<td>45</td>
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</tbody>
</table>
ANIMAL GENETICS AND BREEDING
Course Contents

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
Individual verses population. Genetic Structure of population. Factors affecting changes in gene and genotypic frequencies and their effect on genetic structure of animal populations. Approach to equilibrium under different situations: Viz: Single autosomal locus with two alleles, single sex-linked locus, two pairs of autosomal linked and unlinked loci;

UNIT II
Small population: random genetic drift, effective popultion size, pedigreed populations, regular and irregular inbreeding systems.

UNIT III
Quantitative genetics-gene effects, population mean and variance and its partitioning, biometric relations between relatives.
UNIT IV
Genetic and phenotypic parameters-their methods of estimation, uses, possible biases and precision. Scale effects and threshold traits.

Practical

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 plateux 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
Computation of realized heritability and genetic correlation. Selection index: Computation, Accuracy and response in component traits. Estimation of heterosis for different types of crosses. Estimation of GCA and SCA.

**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 programme. 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
AGB 609  POULTRY BREEDING  2+1

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

AGB 610  LABORATORY ANIMAL BREEDING  1+0

Objective
To educate about the laboratory animal breeding principles.

Theory
UNIT I
Introduction to laboratory animal genetics – Breeding colonies of mice, rats, hamsters, guinea pigs and rabbits.

UNIT II
Selection and Mating methods/systems – monogamous, polygamous and others.
UNIT III
Development of genetically controlled laboratory animals – Rules for nomenclature, inbred strains, outbred stocks, mutant stocks, recombinant inbred strains, transgenic strains, gene targeting and production of ‘gene knock-out’ animals.

UNIT IV
Genetic control and monitoring – Record keeping – Ethics of laboratory animal use.

Suggested Readings

AGB 701 RECENT ADVANCES IN ANIMAL GENETICS 2+0
Objective
To impart knowledge about the latest tools and techniques of animal genetics and their uses in animal sciences.

Theory
UNIT I
Eukaryotic genome: Gene families, Pseudogenes SnRNPs, Gene conversion, tandemly repeated genes, Nuclear Organiser region, mRNA splicing, Minisatellites, Microsatellites and its usage.

UNIT II

UNIT III
Transgenic animals their benefits in livestock production, somatic cell nuclear transfer, transgenic animals in biomedical research, ethical consideration of transgenic animals; gene therapy and transgenic animal production. Pharming of Pharmaceutical.

UNIT IV
Radiation hybrid panels and their usage in livestock, microdissection of chromosomes, In-situ hybridization, chromosome painting, meiotic crossing over, genome selection; Structure and functions of major histocompatibility complex, T Cell receptor, CD4, Toll Like Receptors and their functions.

Suggested Readings
Selected articles from journals

AGB 702 RECENT TRENDS IN ANIMAL BREEDING 2+0
Objective
To acquaint with recent trends in animal breeding and designing of need-based breeding strategies.

Theory
UNIT I
Biometrical models and their analytical techniques on simulated and actual animal breeding data using computer application and use of programme in the field of animal breeding.
UNIT II
Formulation of detailed breeding plans ongoing breed improvement programmes and their impact analysis in various species of livestock under different situations.

UNIT III
Advanced techniques in genetic manipulation for multiplication and improvement of livestock species.

Suggested Readings
Selected articles from journals.

AGB 703  ADVANCES IN BIOMETRICAL GENETICS  2+1

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 BIOINFORMATICS IN ANIMAL GENETICS AND BREEDING 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.
ANIMAL GENETICS AND BREEDING

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
- Chromosoma
- Chromosome 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
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 – at a Glance

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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 monogastrics and utility.

UNIT IV

Suggested Readings
ANN 602  ANIMAL NUTRITION – MINERALS, VITAMINS AND FEED ADDITIVES

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**
ANN 604  FEED CONSERVATION, 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 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.
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
laboratory, wild and zoo animals. Natural dietary habits. Nutritional requirements of various species of animals.

UNIT II
Feeding standards and feeding habits of companion / laboratory animals. Importance of colostrum and feeding of neonates and growing animals. Feeding and care of nursing mothers. Feeding of sick and old animals. Post Surgical nutrition.

UNIT III
Ration formulation for captive animals. Artificial feeding and feeding during emergency. Nutritive characteristics of forages for wild animals. Adequacy of forage plants for wild and zoo animals. Diets used in captivity. Raising orphans. Nutritional melodies. Nutrition of semi wild and semi domestic animals like mithun and yak under special topography

UNIT IV
Composition, presentation, sterilization, palatability, assessment and storage of companion/laboratory animal diets. Companion food tables and their nutritional assessment. Mistakes and misleading information on companion food labels and labeling.

UNIT V
Nutraceuticals in companion / laboratory foods and animal foods. Nutritional deficiency diseases. Geriatric nutrition – corrective measures

Practical
Formulation and preparation of hygienic, balanced diets and feeding for companion/laboratory animals. Characteristics of ration formulation and feeding schedules wild and zoo animals. Feeding schedules for sick and orphan wild / zoo animals. Artificial and emerging feeding. General feeding habits and different feed constituents of wild and captive animals. Research methodology of companion/laboratory animals. Processing and storage of companion/laboratory diets. Visit to Zoological parks and wildlife sanctuary.

Suggested Readings
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 NON CONVENTIONAL FEEDSTUFFS AND TOXIC CONSTITUENTS/ANTIMETABOLITES IN ANIMAL FEEDSTUFF 2+1

Objective
To understand the importance of alternate feeds and their use in augmenting profit in livestock farm. Different toxins present in feedstuffs, 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 MODERN CONCEPTS OF FEEDING RUMINANTS AND FORAGE UTILIZATION**

**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 MODERN CONCEPTS OF FEEDING MONOGASTRIC ANIMALS 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 post natal development of livestock, recent concepts of rumen fermentation and its manipulation

Theory
UNIT I
Nutrient requirements for fertility and gestation, prenatal growth and foetal nutrition. Post-natal feeding, growth and developments – Body composition at prenatal and postnatal stages, abnormalities due to malnutrition.

UNIT II
Practical

Suggested Readings
Selected articles from journals.

ANN 704 ADVANCES IN MICRONUTRIENTS 1+0
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 1+2
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 \textit{in vitro} studies – Degradability of feeds by various techniques – rates of VFA and microbial production.

\textbf{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.

\textbf{Suggested Readings}
Selected articles from journals.

\textbf{ANN 706 ADVANCES IN FEED TECHNOLOGY} \hspace{1cm} 1+1

\textbf{Objective}
To impart knowledge on modern feed processing methods and automated feed plant layout

\textbf{Theory}
\textbf{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.

\textbf{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.

\textbf{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

\textbf{Suggested Readings}
Selected articles from journals.

\textbf{ANN 707 CLINICAL NUTRITION} \hspace{1cm} 1+1

\textbf{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.

\textbf{Theory}
\textbf{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 NEW FEED RESOURCES AND TOXICANTS IN ANIMAL FEEDING 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.
ANIMAL NUTRITION
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 AND MANAGEMENT

### Course Structure - at a Glance

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LIVESTOCK PRODUCTION AND MANAGEMENT

Course Contents

LPM 601 CATTLE AND BUFFALO PRODUCTION AND MANAGEMENT 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
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.

UNIT I
Introduction - Population structure and importance- Advantages and disadvantages of sheep farming under different systems of management – type of housing and equipments- Important sheep and goat breeds- Advantages and disadvantages of sheep and goat farming.

UNIT II
Breeding Management: Breeding seasons - fitness of purchase for first breeding - methods of detection of heat - Natural Service and artificial insemination - Care of the pregnant Animals - Breeding stock - Use of teaser - Culling.

UNIT III
Feeding Management: Feeding methods - Principles to be followed in feeding and watering- feeder space, waterer space, Designing feeders and waterers. - Range management - Stocking rate and pasture improvement and utilization; management under stall fed conditions, Transportation of sheep and goat.

UNIT IV
Disease Management: Role of management in the prevention and control of diseases. Special Management: Deworming - Dipping and spraying- shearing - Avoidance of goatry odour in milk, Tupping

UNIT V
Wool: Importance of wool - Fiber structure- Fleece characters - Goat 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.
Suggested Readings

LPM 603 SWINE PRODUCTION AND MANAGEMENT 1+1

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
LPM 604  LABORATORY ANIMAL PRODUCTION AND MANAGEMENT  1+1

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

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 - Micro climate modification in animal houses.
UNIT IV
Estimation of microclimatic conditions in Animal house - Measurement of Temperature, Relative humidity, Air Velocity and Mean temperature of the surrounding, measurement of intensity of light in animal houses - Construction of 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 managemental
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 2+1

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
LPM 611  EQUINE PRODUCTION AND MANAGEMENT  1+1

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.

LPM 612  WILDLIFE MANAGEMENT AND CONSERVATION  2+0

Objective
To acquaint students with the principles and concepts of wild life sanctuaries and national parks, classification of wild animals, role of authorities in conservation and management of wild animals in captivity.
Theory

UNIT I
Zoo and captive wild animals - Principles and concepts – Ecology of wild life sanctuaries and National parks- wild life legislation in India - Status of forest in India - Biological and ecological basis of management of wild life.

UNIT II
Voluntary organization on wild life - Rules and regulations of zoo authority of India -Wild life protection act - Zoological classification of wild animals - Funding agencies for wild life research and preparation of project. - Conservation of wild animals.

UNIT III
Wild life health control - Reproduction in zoos - Population analysis - Population manipulation - Habit analysis and design - The resources and its management - Distribution of important Indian animals - Zoo animals and birds - Breeding characteristics – Movements - Cover requirements - Food - Population density – Mortality - Nesting losses caused by predators, predator and prey relationship - Human interference - Refuge rehabilitation

UNIT IV
Restraints - Maps - Survey and plans of management systems - Principles, protective measures - Development and conservation of water supply- puberty - Breeding seasons - pregnancy - Parturition - Lactation postnatal survival of the young - Social factors among various species - Miscellaneous management procedures.

Suggested Readings
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
Advance 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.

LPM 702  ADVANCES IN SHEEP AND GOAT PRODUCTION AND MANAGEMENT  2+1

Objective
To educate the students on advances in sheep and goat farming for improving their productivity through different management practices.

Theory
UNIT I
Utility origin – Domestication - Numbers and distribution of meat and dual purpose breeds - Methods of rearing – Range sheep production –

UNIT II
The farm flock – Pure bred flock - Management during breeding season - The sexual seasons and its control - Puberty – Time of the year to breed – Flushing – Ram-Ewe ratio.

UNIT III
Advances in feeding management, Nutrient deficiencies in range forage, Feed to supplement range forage,General feeding practices, Feeding materials, Lamb feeding, Use of antibiotics and hormones, Hand feeding,Self feeding, Pellet feeding, Feeding lambs and ewes during lactation.

UNIT IV
Recent development in sheep and goat management and their relevance under Indian economic conditions, needs and possibilities for future research.

UNIT V
Role of sheep husbandry in dry farming in India, Present development programmes in sheep and goat production, Advances in reproduction, housing, feeding and watering, diseases, Shearing methods and culling of sheep and goat.
UNIT VI
Role of goat in animal agriculture, Goat farming in India, selection of Breeding stock, Breeding problems, Housing, Principles of feeding, Practices, Crops and crop residues for goats, Milking practices.

Practical
Study of population trend and structure - Visit to sheep and goat farms and critical analysis of various farm practices, Analysis of breeding, feeding, housing - Disease control management, management of young ones and maturing systems Estimation of fibre diameter medullation percentage crimps, tensile strength, Grease, pH and moisture content of wool - Score card and grading of wool.

Suggested Readings
Gupta JL. 2006. Sheep Production and Management. CBS.
Selected articles from journals.

LPM 703 ADVANCES IN SWINE PRODUCTION AND MANAGEMENT 2+1
Objective
To educate about the latest advances of swine farming in India, principles of housing, breeding, feeding and health care of pigs, management practices at different stages of swine.

Theory
UNIT I
The past, present and future of Swine production systems in India and production policies adopted in advanced countries.
UNIT II
Advances in breeding and selection – Prenatal and postnatal development - Growth reproduction and lactation - Economic traits of swine production.
UNIT III
Advances in feeding and nutrition in pigs; automatic feeding and watering techniques, Feed stuffs, Energy, protein, minerals and vitamin sources, metabolic and nutritional disorders – Toxic substances.
UNIT IV
Advances in housing of pigs, environmental physiology - Infectious diseases and parasitism, reduction in new born piglet mortality.

Practical
Marketing - Study of population trend and structure. Analysis of breeding, feeding, housing, health care, farrowing management, summer management and special management principles practiced.

Suggested Readings
Selected articles from journals.

LPM 704 ADVANCES IN LABORATORY ANIMAL PRODUCTION AND MANAGEMENT 1+0
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 CO₂ - 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 CO₂, air supply, dust particles and bacterial count in air - Visit to sewage treatment plant - Planning farm waste disposals - Physical chemical and bacteriological examination of water watering of farm animals.

Suggested Readings
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

Suggested Readings
Selected articles from journals.
LIVESTOCK PRODUCTION AND MANAGEMENT

List of Journals

- Asian Journal of Buffalo Production and Management
- Australian Journal of Animal Science
- British Poultry Science
- Canadian Journal of Animal Science
- Indian Dairyman
- Indian Journal of Animal Nutrition
- Indian Journal of Animal Production and Management
- Indian Journal of Animal Science
- Indian Journal of Dairy Science
- Indian Journal of 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 - at a Glance

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<td>POULTRY AND FISH PRODUCTS TECHNOLOGY</td>
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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

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.
Theory

UNIT I
Factors affecting fresh meat quality, ageing, basic principles of preservation, chilling, freezing, thermal processing, dehydration, irradiation and use of chemicals and antibiotics; meat curing and smoking.

UNIT II
Comminuted meat; preparation of various kinds of fresh and cooked meat products—Canning—Heat processing—Sausages—Ham, Bacon, Tandoori-Barbecueing of Poultry. Senses of taste and olfaction—factors influencing sensory measurements, physical and chemical properties related to sensory evaluation, types of sensory panels, discriminate and descriptive testing.

UNIT III
Meat adulteration and substitution—Different techniques for meat speciation—Agar gel immuno diffusion techniques—Démonstration of CIE, IEF, ELISA, PCR

UNIT IV
Principles of packaging—Product characteristics affecting packaging requirements; packaging material and their characteristics—different methods of packaging meat—Vacuum packaging—MAP—Retort pouch processing.

UNIT V
Marketing of meat, setting up of 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, subjective and objective method of sensory evaluations.

Suggested Readings

LPT 603 POULTRY AND FISH PRODUCTS TECHNOLOGY 2+1

Objective
To impart knowledge on structure, functional quality, microbiology, processing and preservation of poultry meat, eggs and fish.

Theory

UNIT I
History and development of poultry meat and egg processing industry. Different species of poultry and their production potentials—commonly occurring anti nutrients, and antibiotics in poultry feed ingredients and its
effect on egg and meat nutrition - Quality identification, quality maintenance, chemical, nutritional and microbiological quality of poultry meat. Preservation and packing techniques of shelled and liquid eggs. Quality identification of shell eggs and factors influencing the quality

UNIT II
Pre-slaughter care, transportation, resting, fasting, ante-mortem examination, methods of slaughter and slaughtering procedure-postmortem inspection-reasons for condemnation of carcass-yield and grading of dressed chicken,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 capaccity. 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**

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**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

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- paneer- 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

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-Estiamtion of Nitrate-Preparation of some noval meat products and studies on their shelf life-Total viable count and differential counts of meat and meat products-Visist of meat /poultry processing units.
Suggested Readings
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.
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.
LIVESTOCK PRODUCT TECHNOLOGY

List of Journals

- Advances in Food Research
- Beverage and Food World
- British Poultry Science
- Dairy Foods
- Dairy Indian
- Dairy Industries International
- Dairy Science Abstracts
- Flieshwirtschaft
- Food Processing
- Food Technology
- Food Technology
- Indian Dairy Man
- Indian Food Industry
- Indian Journal of Dairy Technology
- Indian Journal of Food Science and Technology
- Indian Journal of Poultry Science
- Indian Journal of Veterinary Research
- International Dairy Federation
- International Dairy Journal
- International Food Hygiene
- International Journal of Dairy Technology
- Journal of Animal Science
- Journal of Dairy Research
- Journal of Dairy Science
- Journal of Food Protection
- Journal of Food Science
- Journal of Meat Science
- Milk Industry
- Poultry Science
- Processed Food Industry
- Science of Food and Agriculture

E-Resources

- www.meatscience.org
- www.amis.org
- www.meatami.com
- www.mla.org.au
- www.FAO.org
- www.agresearch.co.nz/mirinz
- www.usa.gov
- www.fsis.usda.gov
- www.poultryhelp.com
- www.nddb.org
- www.ndri.res.in
- www.amul.com
- www.idfa.org
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
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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
Breeds 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 COMMERICAL 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
including feed microscopy – Estimation of carotenes, cholesterol and peroxides.
Quality control of functional poultry feeds – Preservation of feed quality from production to consumption.

**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 PRODUCTS 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.

PSC 706  POULTRY ECONOMICS, MARKETING AND INTEGRATION  2+1
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
POULTRY SCIENCE
List of Journals

- Avian Diseases
- Avian Pathology
- Avian Research
- British Poultry Science
- Indian Journal of Poultry Science
- International Poultry Production
- Japanese Poultry Science
- Journal of Applied Poultry Research
- Journal Avian Biology
- Poultry Abstract
- Poultry Science
- World Poultry Science Channel
- Tamilnadu Journal of Veterinary and Animal Sciences
- Indian Journal of Veterinary and Animal Sciences

e-Resources

- http://www.alabamapoultry.org
- http://www.eggcom.com
- http://www.dpichicken.com
- http://www.georgiaeggs.org
- http://www.anasc.purdue.edu/ISEB
- http://www.ag.anasc.purdue.edu/ISP
- http://www.MinnesotaTurkey.com
- http://www.nebraskapoultry.org
- http://www.ohiopoultry.org
- http://www.aeb.org
- http://www.afia.org
- http://www.albcsa.org
- http://www.amerpoultryassn.com
- http://www.avianresearch.co.uk
- http://www.canr.uconn.edu/anisci/
- http://www.anasc.cornell.edu
- http://www.castscience.org
- http://www.enline.org
- http://www.internationalegg.com
- http://www.eatchicken.com
- http://www.nmaonline.org
- http://www.eatturkey.com
- http://www.naga.org
- http://www.mtgplace.com
- http://www.poultryscience.org
- http://www.posc.tamu.edu/library/dother.html
- http://www.poultryegg.org
- http://www.usapeec.org
- http://www.wattpoultry.com
- http://www.afns.ualberta.ca
- http://www.poultryresearchcentre.ch
- http://www.poultryscience.uark.edu/poultry.html
- http://www.aes.ucdavis.edu
- http://animalscience.ucdavis.edu/
- http://animalscience.ucdavis.edu/extension
- http://www.calstate.edu
- http://www.csupomona.edu
- http://www.animalscience.calpoly.edu
- http://www.clemson.edu/avs/
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.
COMPULSORY NON-CREDIT COURSES
(Compulsory for Master’s programme in all disciplines; Optional for Ph.D. scholars)

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PGS 501  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 502  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 503 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


PGS 506 
( e-Course )

**DISASTER MANAGEMENT**

1+0

**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**

