ANNEXURE II

List of Major, Minor and Supporting courses

MAJOR COURSES (12 credits)			
1.	RPE 700	*Research and Publication ethics	1+1
2.	LPM 701	*Recent Developments in Large Ruminants Production Management	2+1
3.	LPM 702	*Recent Developments in Small Ruminants Production Management	2+1
4.	LPM 706	Recent development in welfare of farm animals	1+0
5.	ANN 701	Modern Concepts in Feeding of Ruminants	2+0
6.	ANN 703	Recent Concepts in Feeding of Non-Ruminants	1+0
7.	LPM 708	Precision Livestock Farming	1+1
8.	ANN 707	Advanced Techniques in Nutritional Research	1+1
9.	LPM 709	Recent Developments in Poultry Production Management	2+1
MINOR COURSES (6 credits)			
1.	LPM 705	Organic Livestock Production	1+0
2.	LPM 704	Livestock and Environment	1+0
3.	ANN 708	Advances in feed technology	1+0
4.	ANN 702	Forages in Animal Nutrition	1+0
5.	LPT 702	Advances in Meat Production and Fresh Meat Technology	1+1
6.	LPT 704	Current Trends in Processing of Milk and Milk Products	1+1
7.	LPT 708	Current Trends in Disposal and Utilization of Waste from Meat and Dairy Industry	1+1
8.	PSC 707	Diversified Poultry Production 2+1	2+1
9.	PSC 702	Recent Trends in Commercial Poultry Production 2+1	2+1
SUPPORTING COURSES (5 credits)			
1.	BCT 705	Recent trends in biochemical techniques and instrumentation	2+1
2.	VGO 604	Reproductive biotechnology 1+1	1+1
3.	BTY 702	Functional Genomics and Proteomics 3+0	3+0
4.	AGB 602	Molecular Genetics I	2+1
5.	STAT 511	Experimental Designs	2+1

6.	EXT 705	Educational Technology	2+1

REMEDIAL COURSES (32 credits)

1. LPM 111 Livestock Production Management 4+2=6 **(UG Syllabus)**
2. ANN 111 Animal Nutrition 3+1=4 **(UG Syllabus)**
3. AGB 111 Animal Genetics and Breeding 3+1=4 (**UG Syllabus)**
4. LPT 111 Livestock Products Technology 2+1=3 (**UG Syllabus)**
5. LPM 601Cattle and Buffalo Production Management 2+1
6. LPM 602 Sheep and Goat Production Management 2+1
7. LPM 603 Swine Production Management 1+1
8. ANN 604 Feed and Fodder Technology 1+1
9. LPT 603 Processing and Preservation of Meat 2+1
10. LPT 604 Processing of milk and milk products 1+1
11. BCT 604 Analytical Techniques and Instrumentation in Biochemistry 1+1
12. VGO 506 Basics of Reproductive Biotechnology 2+1
13. LPM 605 Behaviour and Welfare of Farm Animals 1+1

SEMINAR

Seminar I 1+0 =1

Seminar II 1+0 = 1

Total 2 credits

RESEARCH

75 credits

DETAILED SYLLABUS

MAJOR COURSES (12 credits)

1. RPE700-*Research and Publication Ethics (1+1)

Theory

Unit 01: Philosophy and Ethics

• Introduction to philosophy: definition, nature and scope, concept, branches

• Ethics: definition, moral philosophy, nature of moral judgements and reactions

Unit 02: Scientific Conduct

• Ethics with respect to science and research

• Intellectual honesty and research integrity

• Scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP)

• Redundant publications: duplicate and overlapping publications, salami slicing

• Selective reporting and misrepresentation of data

Unit 03: Publication Ethics

• Publication ethics: definition, introduction and importance

• Best practices/ standards setting initiatives and guidelines: COPE, WAME, etc.

• Conflicts of interest

• Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa, types

• Violation of publication ethics, authorship and contributorship

• Identification of publication misconduct, complaints and appeals

• Predatory publishers and journals

Practical

Unit 4: Open Access Publishing

• Open access publications and initiatives

• SHERPA/ RoMEO online resource to check publisher copyright and self-archiving policies

• Software tool to identify predatory publications developed by SPPU

• Journal finder/ journal suggestion tools, viz., JANE, Elsevier Journal Finder, Springer Journal Suggested, etc.

Unit 05: Publication Misconduct

A. Group Discussions• Subject specific ethical issues, FFP, authorship

• Conflicts of interest

• Complaints and appeals: examples and fraud from India and abroad

B. Software tools

• Use of plagiarism software like Tumitin, Urkund and other open-source software tools

Unit 06: Databases and Research Metrics

A. Databases

• Indexing databases

• Citation databases: Web of Science, Scopus, etc.

B. Research Metrics

• Impact Factor of journal as per Journal Citation Report, SNIP, SIR, IPP, Cite Score

• Metrics: h-index, g index, i10 index, altmetric

2. LPM 701-*Recent Developments in Large Ruminants Production Management (2+1)

Theory

Unit 01 (2 Lectures)

Present status of dairying in India *vis-à-vis* Global and south Asian scenarios, Production dynamics, Recent policy initiatives in dairy development. Conservation of indigenous germplasm

Unit 02 (4 Lectures)

Advances in housing management, viz., design, layout, construction materials, cost of construction suits to various agro-climatic zones of India. Low-cost houses for large ruminants. Ideal shelter management practices for better productivity, Advances in manure and waste disposal.

Unit 03 (6 Lectures)

Recent approaches in breeding and reproductive Management of dairy animals, Optimization of reproductive traits, Estrus synchronization, MOET, Sexed semen, Cloning and IVF.

Unit 04 (4 Lectures)

Recent approaches in Feeding, phased feeding, Transition period, Hydroponic fodder, Eco-feeding, standards for drinking water and water hygiene.

Unit 05 (4 Lectures)

Advances in health management of dairy animals, preventive measures for production-related diseases, bio-security measures, etc.

Unit 06 (4 Lectures)

Milking management, automation, Sanitary and phytosanitary standards for the production of quality milk, post-harvest processing.

Unit 07 (4 Lectures)

Establishing a Dairy Enterprise suitable for various economic strata with different sizes, SWOT analysis. Computerization of dairy enterprises, best management practices.

Unit 08 (4 Lectures)

Advances in herd management and data analysis, Advances in the management aspects of buffaloes, salvaging of buffalo calves, Advances in work animal management

Practical (14 Classes)

Critical analysis of various types of managerial practices at farms. Preparation of layout and designs for construction of sheds of various sizes in different agroclimatic zones. Cost analysis of dairy bovine housing. Organization of milking machines. Dairy Cattle and Buffalo judging – BCS. Farm record analysis. Project report preparation for commercial dairy farms.

Suggested Reading

1. Clarence HE. 2007. Dairy Cattle and Milk Production. Daya Publ. House.
2. Moran J and Chamberlain P. 2017. Blueprints For Tropical Dairy Farming: Milk Production in Developing Countries. CSIRPO Publishing.
3. Moran J. 2013. Tropical Dairy Farming: Feeding Management for Small Holder Dairy Farmers in the Humid Tropics. Landlinks Press.
4. Singh U, Kumar S, Kumar A, Deb R and Sharma A. 2013. Advances in Cattle Research. Satish Serial Publishing House, New Delhi.
5. Thomas CK, Sastry NSR and Ravi Kiran. 2012. Dairy Bovine Production, 2nd ed. Kalyani Publishers

3. LPM 702-*Recent Developments in Small Ruminants Production Management (2+1)

Theory

Unit 01 (4 Lectures)

Relevance of small ruminants in the Indian economy. Population and production dynamics of small ruminants. Systems of rearing. Needs and possibilities for research in future.

Unit 02 (8 Lectures)

Recent approaches in breeding and reproductive management. Management during the breeding season, Mating seasons and their control. Recent approaches in reproductive biotechnologies, MOET, Cloning, transgenic, genomics and accelerated lambing.

Unit 03 (6 Lectures)

Recent approaches in feeding management, Pasture and grazing management, Phase feeding, Feed resources and feeding techniques under different systems.

Unit 04 (6 Lectures)

Recent approaches in housing systems with reference to different agro-climatic zones and rearing systems.

Unit 05 (6 Lectures)

Prospects of management under stall-fed conditions, management of small ruminates during scarcity periods, Migratory pattern and flock management. Recent approaches in exploiting goat's, milk quality, safety and production aspects of dairy goats. Wool/fibre production and its quality.

Unit 06 (2 Lectures)

Recent approaches in health care management, Parasitic control in present ecological and environmental changes.

Practical (14 Classes)

Critical analysis of various farm practices, Preparation of layout and designs for construction of sheds of various sizes in different agro-climatic zones. Cost analysis of housing. Organization of shearing. Sheep and goat judging – BCS. Farm record analysis. Disease control management. Scorecard and grading of wool. Project report preparation for commercial sheep and goat units.

Suggested Reading

1. Devendra C and McLeroy GB. 1983. Goat and Sheep Production in the Tropics. Agrodok.
2. Gupta JL. 2006. Sheep Production and Management. CBS.
3. Jansen C and van den Burg K. 2004. Goat Production in the Tropics. 4th ed. Agromisa Foundation, Wageningen.
4. Karim SA. 2008. Small Ruminant Production in India. Satish Serial Publishing, New Delhi.
5. Sastry NSR. 2016. Livestock Production Under Diverse Constraints-Indian Experience in its Management. ISAPM Publication.
6. *Selected articles from journals*

4. LPM 706-Recent developments in welfare of farm animals (1+0)

Theory

Unit 01 (2 Lectures)

Ethology: species-specific behaviour, changing with the season, physiological condition of animals, as a guide to animal welfare; not driving animals beyond their natural capacity, for better performance;

Unit 02 (6 Lectures)

Amelioration of climatic stress and avoidance of unnecessary injury, pain and stress to animals in animal houses, during handling, before and during slaughter, carting bullocks, feeding, milking, shearing, transportation, etc., including deprivance of quality feeds and water; this being a common feature;

Unit 03 (4 Lectures)

Providing safety, healthcare, feed and water to unproductive animals let off to free roam and injured or orphaned pets, birds and others; monkeys being common –Good management of goshalas and safe shelters for such animals – Conversion of their wastes into VAP to meet part costs of running shelters; Education of the general public, especially children to avoid wanton harm to animals via *Lectures* in schools, TV and radio talks, leaflets, etc.

Unit 04 (4 Lectures)

Evaluation of animal welfare measures as an 'instrument' of good animal husbandry, production of quality products and enhanced income to farmers.

Suggested Reading

1. Animal Rights and Animal Welfare Publications 1896-2009. https://www.lib.ncsu.edu/findingaids/mc00440
2. Appleby MC, Mench JA, Anna Olsson I and Hughes BO. 2018. Animal Welfare. CABI.
3. AWBI. Animal Protection Laws, Newsletters, etc. of Animal Welfare Board of India; http:// www.awbi.org/section/4/publications/2
4. GoI Gazzete. Order on Animal Welfare-http://www.moef.nic.in/legis/awbi/awbi18.html
5. Phillips C. 2009. The Welfare of Animals: The Silent Majority. Springer.
6. Webster J. 2005. Animal Welfare: Limping Towards Eden. Blackwell Publishing.
7. Selected articles from journals

5. ANN 701-Modern Concepts in Feeding of Ruminants (2+0)

Theory

Unit 01 (20 Lectures)

Developments in ruminant digestive physiology. Advanced concepts in the determination of energy and protein requirements. Importance of energy and protein quality for milk and meat production. Recent concepts in protein and energy systems like CNCPS, net energy, metabolizable and available protein. Methods of estimation of energy and protein values of feeds for different physiological functions of livestock. Kinetics of nutrient metabolism. Hindgut fermentation. Efficiency of nutrient utilization for different production purposes. Hormonal regulation of nutrient partitioning.

Unit 02 (12 Lectures)

Concept of limiting amino acids for high yielders. Strategic feeding of high yielding dairy cows and meat-producing ruminants. Concept of phase feeding and precision feeding. Feeding during the transition period. Bypass nutrient technology. Rumen manipulation to optimize productivity and reduce methanogenesis.

Suggested Reading

1. D'Mello JPF. 2003. Amino Acids in Animal Nutrition, 2nd ed. CAB International.
2. McDonald P, Edwards RA, Greenhalgh JFD, Morgan CA, Sinclair LA and Wilkinson RG. 2011. Animal Nutrition, 7th ed. Benjamin Cummings.
3. McDowell RL. 2012. Nutrition of Grazing Ruminants in Warm Climates. Academic Press.
4. NRC. 2001. Nutrient Requirements of Dairy Cattle, 7th rev. ed. National Research Council. National Academies Press.
5. NRC. 2016. Nutrient Requirements of Beef Cattle, 8th rev. ed. National Academies of Sciences, Engineering, and Medicine. National Academies Press.

6. ANN 703-Recent Concepts in Feeding of Non-Ruminants (1+0)

Theory

Unit 01 (18 Lectures)

Latest concepts in nutrition and feeding in different phases of broiler, layer and breeder stocks. In-ovo and early chick nutrition. Nutritional disorders in modern poultry production and their amelioration. Nutritional factors affecting egg quality and hatchability in poultry. Feeding strategies for the production of designer egg sand meat. Omega fatty acids. Recent trends in amino acid nutrition. Advances in new generation feed and feed additives.

Unit 02 (14 Lectures)

Nutrition and feeding of pigs in various stages of production. Modern concepts in amino acids nutrition in swine production. Emerging concepts in feeds and feed additive for pigs. Role of vitamins and minerals in health and disease. Nutritional manipulation for lean meat and designer pork production. Carcass modifiers.

Suggested Reading

1. Chiba LI (Ed.). 2012. Sustainable Swine Nutrition. Wiley-Blackwell.
2. D'Mello JPF. 2003. Amino Acids in Animal Nutrition, 2nd ed. CAB International.
3. Hendriks WH, Verstegen MWA and Babinszky L. (Eds.). 2019. Poultry and Pig Nutrition: Challenges of the 21st Century. Wageningen Academic Publishers.
4. Leeson S and Summers JD. 2001. Scott's Nutrition of The Chicken, 4th ed. University Books.
5. Lewis AJ and Southern LL. 2000. Swine Nutrition, 2nd ed. CRC Press

7. LPM 708-Precision Livestock Farming (1+1)

Theory

Unit 01 (2 Lectures)

Concepts of Precision Livestock Farming-Scope and limitations. Utilities of Precision tools in Livestock Farming, the present level of usage of precision tools in India.

Unit 02 (6 Lectures)

Implementation of sensor systems and ICTs in animal health, productivity and welfare, Animal identification and tracking- Radio frequency identification (RFID), Livestock identification and traceback system (LITS), etc. Geo-tagging, Virtual fencing, GPS and GIS in the exploration of feeding resources and grasslands.

Unit 03 (6 Lectures)

Automation in water resource management. Development and evaluation of early warning and disease support systems for animal health and welfare.

Unit 04 (2 Lectures)

Use of software's for database creation of the livestock farms, computation and analysis.

Practical (14 Classes)

GPS/ GIS Application in the exploration of breeding tracts of livestock, forage and grassland profiles. Exposure visits to precision livestock farms with automation, use of tools in reproduction and health care, use of different software in farm routines.

Suggested Reading

1. Halachmi I. 2015. Precision Livestock Farming Applications. Wageningen Academic Pub.
2. Sastry NSR. 2016. Livestock Production Under Diverse Constraints-Indian Experience in its Management. ISAPM Publication.
3. *Selected articles from journals.*

8. ANN 707-Advanced Techniques in Nutritional Research (1+1)

Theory

Unit 01 (16 Lectures)

Good laboratory practices. Analytical equipment in animal nutrition research. Estimation of minerals using atomic absorption spectrophotometer and ICP. Principles and applications and of GC, HPLC, amino acid analyzer, SF6, and electron microscopy. Remote sensing and geographic information system (GIS) in animal nutrition research. Analysis of feeds and fodders using NIR. Faecal inoculum as an alternative to rumen liquor for *in-vitro* studies.

Practical (16 Classes)

RUSITEC. Estimation of minerals by atomic absorption spectrophotometer. Estimation of mycotoxins, oxalate, nitrates and tannin. Fatty acid analysis. Vitamin estimation.

Suggested Reading

1. Kaneko J, Harvey J, Bruss M.(Eds.) 2008. Clinical Biochemistry of Domestic Animals, 6th ed. Academic Press.
2. Krishna 2012. Livestock Nutrition- Analytical Techniques. New India Publishing Agency

9. LPM 709-Recent Developments in Poultry Production Management (2+1)

Theory

Unit 01 (8 Lectures)

Planning, organization, executive and management of poultry farms and hatcheries of various sizes - an alternative in poultry production

Unit 02 (4 Lectures)

Demand, supply, the present status of poultry production in India.

Unit 03 (10 Lectures)

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 04 (10 Lectures)

Poultry development policies and planning for higher production constraints in development and solutions, Ethology in relation to avian welfare in intensive poultry production.

Practical (14 Classes)

Planning and preparation of research and commercial projects on broiler and layer production management

Suggested Reading

1. DAHD. 2015. Poultry Farm Manual: A Reference Guide for Central and State Poultry Farms. 2014-15. Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture and Farmers Welfare, Government of India.
2. FAO. 2003. Live bird marketing. In: Egg Marketing-A Guide for the Production and Sale of Eggs. http://www.fao.org/3/Y4628E/y4628e09.htm#bm9
3. Sreenivasaiah PV. 2006. Scientific Poultry Production: A Unique Encyclopaedia. International Book Distribution Co.
4. *Selected articles from journals*

MINOR COURSES (6 credits)

1. LPM 705-Organic Livestock Production (1+0)

Theory

Unit 01 (2 Lectures)

Historical background and origin, Organic livestock farming vis-a-vis conventional livestock farming, the current status of organic farming in India and world- objective sand importance of organic livestock farming. Opportunities and Problems of organic livestock farming in India.

Unit 02 (6 Lectures)

Key consideration, selection of animals, housing, feeding, breeding, health care, record keeping, processing and labelling and marketing. Conversion of livestock farm into an organic farm. ITKs used in organic livestock production.

Unit 03 (4 Lectures)

Organic farming standards in India and the world. IFOAM basic standards, WHO/FAO Codex Alimentarius, NSOP of India, etc. Role of organic livestock farming in environmental Protection and biodiversity enhancement.

Unit 04 (4 Lectures)

Accreditation of inspection and certification agencies. Organic certification mark. Guidelines for organic certification of livestock modalities in the certification of organic products. The economic value of organic livestock products, pricing strategy and marketing of organic products.

Suggested Reading

1. Balasubramaniam R, Balakrishnan K and Sivasubramaniam K. 2013. Principles and Practices of Organic Farming. Satish Serial Publishing House, New Delhi.
2. ICAR. 2014. Handbook of Animal Husbandry. ICAR, New Delhi.
3. Paajanen T. 2011. The Complete Guide to Organic Livestock Farming. Atlantic Publishing Group Inc.
4. Katherine M. 2009 The Organic Dairy Handbook. Northeast Organic Farming Association.
5. Sastry NSR. 2016. Livestock Production Under Diverse Constraints-Indian Experience in its Management. ISAPM Publication.
6. Singh M, Sharma DK and Mishra UK. 2011. Organic Dairy Farming. Satish Serial Publishing House, New Delhi.

7. *Selected articles from journals*

2. LPM 704-Livestock and Environment (1+0)

Theory

Unit 01 (4 Lectures)

Effect of livestock on the environment- Role of ruminants in global warming, Slaughterhouse waste, Tannery waste, Stray and fallen animal impact. Strategies for mitigation of methane emission from the livestock sector, animal waste management. A life cycle assessment of the environmental impacts of livestock indifferent production systems.

Unit 02 (4 Lectures)

Effect of environment on livestock and quality of products: Heat and cold stress, Pollution, Heavy metals, Pesticide residues, etc., Management of micro and macro environment with respect to animal well-being,

Unit 03 (4 Lectures)

Concept of Water, Carbon footprints and carbon sequestration of farm animals and products. Thermal load indices, Livestock comfort zones. Carbon trading, mechanisms and opportunities in the livestock sector.

Unit 04 (4 Lectures)

Selection of breeds of livestock for hot climate. Recent advances in shelter management practices under the impending climate change scenario. Climate and reproduction. Environment and diseases.

Suggested Reading

1. Cheeke PR. 1993. Impacts of Livestock Production on Society, Diet/ health, and the Environment. Interstate Publishers.
2. FAO. 2009. Livestock in the Balance, FAO, Rome.
3. ICAR. 2014. Handbook of Animal Husbandry. ICAR, New Delhi.
4. Mudgal VD, Singhal KK and Sharma DD. 2003. Advances in Dairy Animal Production, 2nd ed. International Book Distributing Co.
5. Sastry NSR. 2016. Livestock Production Under Diverse Constraints-Indian Experience in its Management. ISAPM Publication.
6. Sejain V, Naqvi SMK, Ezeji T, Lakritz J and Lal R. 2012. Environmental Stress and Amelioration in Livestock Production. Springer
7. Sirohi SK, Walli TK, Singh B and Singh N. 2013. Livestock Greenhouse Gas: Emissions and Options For Mitigation. Satish Serial Publishing, New Delhi.

8. *Selected articles from journals*

3. ANN 708-Advances in feed technology (1+0)

Theory

Unit 01 (10 Lectures)

Good manufacturer practices (GMP) in feed plants. Planning and designing of feed plants of different capacities. Recent developments in feed processing: particle size reduction, pelleting, extrusion, expanding, conditioning, micronizing. Post pelleting applications. Automation in feed processing. Flow charts for preparation of feeds for various species. Mixer efficiency test, pellet durability test. Densification of bulk feeds. Silos of various capacity, silage preparation and silage additives. Laws and regulations of the feed manufacturing industry. Introduction to labour law sand standards, planning and production programme. Record-keeping.

Unit 02 (6 Lectures)

Roughage processing. Whole plant processing. Solid-state fermentation technology. Preparation of complete feeds and its processing. Formulation of premixes. Carriers and diluents. Liquid feed handling. Latest concepts in feed microscopy. Qualitative tests for rancidity.

Suggested Reading

1. Langham J. 2013. Recent Advances in Animal Feed Technology. Random Exports.
2. Moughan PJ and Hendricks WH. (Eds.). 2018. Feed Evaluation Science. Academic publishers.
3. Perry TW, Cullison AE and Lowrey RS. 2003. Feeds and Feeding, 6th ed. Pearson.
4. Schofield EK (Ed.). 2005. Feed Manufacturing Technology V. American Feed Industry Association, Arlington.

4. ANN 702-Forages in Animal Nutrition (1+0)

Theory

Unit 01 (10 Lectures)

Forages in ruminant production. Improvement in productivity of fodders and pasture: feed-food crops, silvi-pasture, horti-pasture, shrubs. Use of conserved forages in ruminant feeding. Factors affecting the nutritive value of cultivated and conserved forages. Hydroponics as an alternate to green fodder production. Top feeds, fodder trees and their effective utilization. Tree leaves as a source of condensed tannins: role in protein protection and GI parasite control.

Unit 02 (6 Lectures)

Methods in forage evaluation: calculated *in-vitro* DOMD and ME by using *in-vitro* gas production technique. Pasture consumption and evaluation studies.

Suggested Reading

1. Givens D, Axford R and Owen E. (Ed.). 2000. Forage Evaluation in Ruminant Nutrition. CAB International.
2. McDowell RL. 2012. Nutrition of Grazing Ruminants in Warm Climates. Academic Press.
3. Minson D. 1990. Forage in Ruminant Nutrition. Academic Press.
4. Shirley RL. 2012. Nitrogen and Energy Nutrition of Ruminants. Academic Press

5. LPT 702 Advances in Meat Production and Fresh Meat Technology (1+1)

Theory

Unit 01 (7 Lectures)

Current status of meat production trends in India-Government policies-economics and viability-Traceability in the meat industry-Strategies for augmenting meat production-Salvaging male buffalo calf-Non-conventional meat resources.

Unit 02 (10 Lectures)

Pre- and Post-natal development of Muscle fibres - Genetic, nutritional and physiological aspects of muscle development - Ultrastructure of skeletal muscle -Modern tools for fibre typing of muscle - Chemical and biochemical aspects of rigor mortis and fresh meat quality – Oduor, colour, water holding capacity – Texture profile - Artificial tenderization - Myofibrillar, sarcoplasmic and connective tissue proteins - Cytoskeletal proteins - Lipid profile - Meat in human nutrition – Meat and health issues.

Practical (17 Classes)

Economics of establishing commercial meat animal production Unit - Extraction of sarcoplasmic and myofibrillar proteins and their fractionation - Estimation of Collagen content of Meat - Histochemistry of muscle tissues - Muscle fibre typing- Meat tenderization techniques.

Suggested Reading

1. Aberle ED, Forest JC, Gerrard DE and Mills E. 2013. Principles of Meat Science, 5th ed. Kendall Hunt Publishing Company, Iowa.
2. Carlson CW, Greaser ML and Jones KW. 2001. The Meat We Eat, 14th ed. Interstate Publishers, Inc.

3. Jensen WK, Devine C and Dikeman M. 2004. Encyclopaedia of Meat Sciences, Vol. I, II and III, 1st ed. Elsevier Academic Press, UK.
4. Lawrie RA and Ledward DA. 2006. Lawrie's Meat Science, 7th ed. Woodhead Publishing Limited, Cambridge, England.
5. Pearson AM and Dutson TR. 1997. Advances in Meat Research. Healthy Production and Processing of Meat, Poultry and Fish Products, Vol. 11. Springer.
6. Swatland HJ. 2004. Meat Cuts and Muscle Foods. Nottingham Univ. Press.
7. *Selected articles from Journals.*

6. LPT 704-Current Trends in Processing of Milk and Milk Products (1+1)

Theory

Unit 01 (8 Lectures)

Principles and practices of production of quality raw milk - Advances in methods of chilling of milk - Thermal processing of milk – Principles and methods – types of UHT processing plants - Advances in the packaging of milk and milk products- Rheology of milk products - Preservatives, antioxidants, antibiotics and different toxic residues in milk - Advances in bacteriological and physico-chemical analysis of milk and milk product – Different legal and voluntary standards for milk and milk products - A1 and A2 milk and their significance.

Unit 02 (4 Lectures)

Bacteriological, physical, chemical and nutritional effects of processing on milk -New concepts in milk processing – radiation, microwave processing and conduction heating of milk – By-products from the dairy industry and their utilization.

Unit 03 (5 Lectures)

Innovative mechanization in the manufacture of Indigenous dairy products -Advances in the utilization of dairy by-products - preservation of milk products -Application of immobilized enzymes in dairy products – Latest trends in cleaning and sanitation of dairy plant

Practical (17 Classes)

Quality evaluation of milk and milk products - Preparation of novel and indigenous milk products and their economics of production, quality and sensory evaluation -Use of Starter cultures - Maintenance of cultures - Demonstration of membrane processing technology - Preparation of DPR for Dairy plants of different capacities.

Suggested Reading

1. Fuquay JW, Fox PF and McSweeney PLH. 2011. Encyclopaedia of Dairy Sciences, 2nd ed. Elsevier Academic Press, UK.

2. Herrington BL. 2000. Milk and Milk Processing. Green World Publishers.
3. Walstra P, Wouters JTM and Geurts, TJ. 2006. Dairy Science and Technology, 2nd ed. Taylor and Francis Group.
4. *Selected articles from Journals*

7. LPT 708-Current Trends in Disposal and Utilization of Waste from Meat and Dairy Industry (1+1)

Theory

Unit 01 (8 Lectures)

Terminologies used in solid and liquid waste management systems - Public health significance - Classification, composition, functional elements and sources of solid waste from Meat and Dairy Processing plants and their management - Aerobic and anaerobic systems of liquid waste management.

Unit 02 (9 Lectures)

Waste handling, separation, storage, processing and utilization of Solid waste -Common solid waste disposal methods like rendering, composting, deep burial and incineration - Scope for zero waste management - Properties of dried sludge and its utilisation as manure - Economical aspects of waste treatment and disposal -Utilization of meat and dairy processing wastes - Application of nanotechnology in waste management - State and Central Pollution Control Board norms.

Practical (17 Classes)

Visit Sewage and Effluent Treatment Plants - Estimation of pH, dissolved oxygen, TSS, BOD and COD - Estimation of micronutrients in treated effluents - Design and schematic layout of various solid and liquid waste treatment plants.

Suggested Reading

Selected articles from Journals. Through Interaction with personnel of Municipal Corporation and Pollution Control Board

8. PSC 707-Diversified Poultry Production (2+1)

Theory

Unit 01 (9 Lectures)

Commercial hybrid strains of ducks for egg and meat production – Feeding and management – Housing – Specific diseases of ducks, prevention and their control– Slaughter and processing

of ducks – Economics of production of ducks, indigenous duck production system including polythene duck pond.

Unit 02 (8 Lectures)

Varieties of Japanese quail for meat and egg production – Cage and deep litter system of rearing of quails – Feeding and management – Housing – Emerging diseases affecting Japanese quail – Nutritive value of Japanese quail meat and egg- Economics of production of Japanese quail.

Unit 03 (9 Lectures)

Varieties/ breeds of Turkey, Guinea fowl, Geese, Emu and Ostriches – System of rearing – Feeding and management – Housing – Emerging diseases and theirprevention – Nutritive value of Turkey, Geese and Guinea fowl – By-products of Geese, Emu and Ostriches.

Unit 04 (8 Lectures)

Scope and constraints in the marketing of diversified poultry products – Rearing and management of common pet birds and other birds of regional importance –Common diseases affecting pet birds and their prevention and treatment – Economics of production of different pet birds.

Practical (17 Classes)

Layout and design of housing for other species of poultry. Visit commercial Japanese quail, turkey and duck farms. Incubation and care of hatching eggs and young ones– Rearing practices followed for duck, quails and turkey farmers under field conditions – Designing of aviaries for pet birds - Different types of feed prepared for pet birds – Vaccination and medication for diversified poultry species – Preparing project reports for different species and calculating the cost of production

Suggested Reading

1. Cherry P and Morris T. 2011. Domestic Duck Production: Science and Practice. CAB International.
2. CPDO. Duck-Management Guide. Central Poultry Development Organization Publication (online resource)
3. CPDO. Turkey-Management Guide. Central Poultry Development Organization Publication (online resource)
4. Pathak N. 2013. Poultry and Ratite Nutrition. Narendra Publishing House.
5. Thiyagarajan D. 2012. Scientific Turkey Farming. SSPH, New Delhi.

9. **PSC 702-Recent Trends in Commercial poultry production (2+1)**

Theory

Unit 01

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 and chick quality – Use of artificial intelligence in poultry production.

Unit 02

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 - Behavioural patterns of poultry in different growing systems.

Unit 03

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

Unit 04

Factors influencing egg production in different species of poultry – Factors influencing growth rate and egg production - Automation in poultry production.

Unit 05

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. Advances in Biosecurity, welfare and waste management - Role of integration in poultry production.

Practical

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

Suggested Reading

1. Bell DD and Weaver WD, Jr. 2002. Commercial Chicken Meat and Egg Production, 5th ed. Kluwer Academic Publishers.

2. Sreenivasaiah PV. 2006. Scientific Poultry Production: A Unique Encyclopaedia. International Book Distributing Co.
3. Online sources of equipment manufacturers
4. *Selected articles from journals.*

SUPPORTING COURSES (5 credits)

1. BCT 705-Recent trends in biochemical techniques and instrumentation (2+1)

Theory

Basic components of the Instrument, principle and applications of the following analytical techniques:

Unit 01

Separation, purification and quantification of biomolecules: Gas Chromatography (GC) and High-performance liquid chromatography (HPLC)- Types of pumping systems and their essential features; Column packing; Normal and modified stationary phases; Detection systems; Blotting techniques (Western), 2-D gel electrophoresis – IPG-DALT, IEF-SDS PAGE

Unit 02

Structural elucidation of biomolecules and quantification: NMR spectrometry, X-ray crystallography, ESR Spectroscopy, CD Spectroscopy and Mass Spectrometry (LC/ MS, GC/ MS, MALDI-TOF, SELDI-TOF). Microscopy – Electron microscopy – SEM/ TEM/ STEM; Atomic force microscopy (AFM) or scanning force microscopy (SFM); Scanning Tunnelling Microscope (STM).

Unit 03

Other Analytical techniques: Radiotracer techniques: Radiotracers in study of biological processes. Tissue Culture: Setting up a cell culture laboratory; Principles of aseptic handling; Cell line derivation; Cell freezing and quantitation; Contamination control; Cell freezing and thawing; Cell culture media constituents and their functions; Designing serum-free medium. Techniques for short-term and long-term culture of organs. Any other current technique with relevance to biochemistry.

Practical

Demonstration of feasible techniques available at the department/ institute/ other institutes.

Suggested Reading

1. Burtis CA, Ashwood ER and Burns DE. 2014. Tietz Textbook of Clinical Biochemistry and Molecular Diagnostics. 5th Edition. Elsevier

2. Nelson DL and Cox MM. 2017. Lehninger's Principles of Biochemistry. 7th Ed. Freeman.
3. Garrity S. 1999. Experimental Biochemistry. 3rd Ed. Academic Press.
4. Gowenlock AH. 2002. Varley's Practical Clinical Biochemistry. 6th Ed. CBS.
5. George W Latimer Jr. 2016. Official Methods of Analysis of AOAC International, 20th Ed. AOAC International.
6. Holme DJ and Hazel P. 1998. Analytical Biochemistry. 3rd Ed. Longman.
7. Wilson K and Walker J. (Eds.). 2010. Principles and Techniques of Biochemistry and Molecular Biology. 7th Ed. Cambridge Univ. Press.
8. Willard et al. 1988. Instrumental Methods of Analysis. 7th Ed. Wadsworth Pub Co.
9. *Selected articles from standard journals.*

2. VGO 604-Reproductive biotechnology (1+1)

Theory

Unit 01

Assisted Reproductive Technology (ART), History, Role of biotechnology in ART, importance of assisted reproductive technology in human and animals

Unit 02

Multiple Ovulation Embryo Transfer (MOET), *in-vitro* fertilization, Micro assisted fertilization, Embryo culture, Micromanipulation of gametes and embryos, preservation of embryos and oocytes

Unit 03

Semen sexing technology, Embryo splitting, Different methods of embryo sexing, Transgenic animal production, Application, Limitation and regulatory issues

Unit 04

Somatic cell nuclear transfer of domestic animals and application. Isolation and characterization of embryonic stem cells. Different applications of embryonic stem cells

Practicals

• MOET protocols for domestic animals
• Oocyte and embryo freezing protocol
• Oocyte collection and evaluation from live and slaughter house animals
• *In-vitro* embryo production
• Embryo quality analysis
• Embryo biopsy and embryo sexing

Suggested Reading

1. Hafez ESE and B Hafez. 2013. Reproduction in Farm Animals. Wiley-Blackwell.
2. B Singh, SK Gautam and MS Chauhan. 2012. Textbook of Animal Biotechnology, Pearson Education.
3. Heiner Niemann, Christine Wrenzycki. 2018. Animal Biotechnology 1: Reproductive Biotechnologies. Springer.
4. Heiner Niemann, Christine Wrenzycki. 2018. Animal Biotechnology 2. Springer International Publishing AG.
5. Ian Gordon. 2017. Reproductive Technologies in Farm Animals. Wallingford, Oxfordshire CABI.
6. Troy L Ott, Zhihua Jiang. 2010. Reproductive Genomics in Domestic Animals. John Wiley.
7. Marcelo Marcondes Seneda, Katia Cristina Silva-Santos, LS Rafagnin Marinho. 2016. Biotechnology of Animal Reproduction, Nova Science Pub. Inc; UK Ed
8. Tacia Gomes Bergstein-Galan. 2018. Reproduction Biotechnology in farm animals. Avid Science.
9. *Selected articles from journals.*

4. BTY 702-Functional Genomics and Proteomics (3+0)

Theory

Unit 01

Overview of Mammalian Genome: Mitochondrial genome, Protein coding genes, RNA genes and repeat sequences, Variations in the mammalian genome, Expression of mammalian genome.

Unit 02

Overview of Mammalian Transcriptome: Different methods to study gene expression, Single gene analysis, Northern blots, Quantitative PCR, SAGE, MPSS and SSH, Introduction to basic microarray technology, Design of experiments, Types of microarrays.

Unit 03

Methods to study the mammalian Genome: Chromosome number evolution in mammalian species, Chromosome territory, Karyotyping, FISH and Spectral karyotyping, Next Generation sequencing platforms chemistries and their applications, Mutation detection methods for single gene and genome wide scale.

Unit 04

Databases such as NCBI, EBI, Nucleotide, Genome, SNP, Gene, Unigene, Homologene, Protein, etc. under NCBI. Service databases under EBI. Genome browsers, The concept of Comparative genomics, Genome BLAST and BLAT. Proteomics technology, Identification and analysis of proteins by 2D analysis, Mass spectrophotometry, Circular Dischorism, Fluorescence Spectroscopy, NMR and Xray crystallography, MALDI-TOF, Differential display proteomics, Protein -protein interaction, Yeast two hybrid system and phage display.

Suggested Reading

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

4. AGB 602-Molecular Genetics-I (2+1)

Theory

Unit 01 (8 Lectures)

Basic concepts in molecular genetics; Concepts of proteomics and genomics; Genesis and importance of molecular techniques; Genome organization: physical and genetic map, current status of genome maps of livestock; Gene expression and control.

Unit 02 (8 Lectures)

Molecular markers and their applications; RFLP, RAPD, Microsatellite/ Minisatellite markers, SNP marker, DNA fingerprinting.

Unit 03 (7 Lectures)

DNA sequencing; Genome sequencing; Genomic Library; Polymerase Chain Reaction (PCR) and its types (PCR-RFLP, AS-PCR, etc.) and applications; Transgenesis and methods of gene transfer; Recombinant DNA technology and applications.

Unit 04 (7 Lectures)

Analysis of molecular genetic data; Quantitative Trait Loci (QTL) mapping and its application in animal breeding: Genome scan, candidate gene approach.

Practical (15 Classes)

Extraction and purification of genomic DNA; Gel electrophoresis; Restriction enzyme digestion of DNA and analysis; PCR-RFLP; PCR-SSCP; Bioinformatics tool for DNA sequence analysis; Isolation of RNA; cDNA synthesis; Statistical methods for analyzing molecular genetic data

Suggested Reading

1. Akano IE. 1992. DNA Technology. IAP Academic Press.
2. Brown TA. 2006. Genome 3. Garland Science Publishers.
3. Clark D and Pazdernik N. 2012. Molecular Biology, 2nd ed. Elsevier.
4. Micklos DA, Fryer GA and Crotty DA. 2003. DNA Science. Cold Spring Harbor.
5. Setlow JK. 2006. Genetic Engineering-Principles and Methods, Springer

5. STAT 511-Experimental Designs (2+1)

This course is meant for students of agricultural and animal sciences other than Agricultural Statistics. Designing an experiment is an integrated component of research in almost all sciences. The students would be exposed to concepts of Design of Experiments so as to enable them to understand the concepts involved in planning, designing their experiments and analysis of experimental data.

Theory

Unit 01

Need for designing of experiments, characteristics of a good design. Basic principles of designs-randomization, replication and local control.

Unit 02

Uniformity trails, size and shape of plots and blocks, Analysis of variance, completely randomized design, randomized block design and Latin square design.

Unit 03

Factorial experiments, (symmetrical as well as asymmetrical), orthogonality and partitioning of degrees of freedom. Concept of confounding

Unit 04

Split plot and strip plot designs, analysis of covariance and missing plot techniques in randomized block and Latin square designs: Transformations, Balanced Incomplete Block Design, resolvable designs and their applications, Lattice design, alpha design – concepts, randomization procedure, analysis and interpretation of results. Response surfaces. Combined analysis. Augmented designs and its analysis.

Practical

– Uniformity trial data analysis, formation of plots and blocks, Fairfield Smith Law, Analysis of data obtained from CRD, RBD, LSD, Analysis of factorial experiments.

– Analysis with missing data

- Split plot and strip plot designs.

- Combined analysis and analysis of Augmented Designs.

6. EXT 705-Educational Technology (2+1)

Theory

Unit 01

Educational Technology – Meaning, Nature, Scope Concepts and Components of Educational Technology- Basics of Teaching and Learning- Theories of teaching and learning. Curriculum development at macro and micro levels. Formulation of instructional objectives. Teaching Competencies –Need and Importance in teaching – competency mapping and development.

Unit 02

Preparation of course outline for instructions, lesson planning. Designing instructions for theory and practical, Innovative Teaching Methods/ methodologies – Student Centric and Teacher Centric; Instructional tools and devices in class room instruction, computer aided learning. Understanding learner's behaviour, learning styles, motivating learners. Measurement of learning outcomes.

Unit 03

Students' counselling, guidance and mentoring – concepts, types and importance in higher education- Student evaluation – meaning and methods, construction of measuring instrument – question banking. Performance appraisal of teachers – meaning and methods, construction of assessment instruments. Use of library for effective learning.

Unit 04

Emerging Educational Technologies- Open and Distance Learning (ODL) for qualityVeterinary Education; Concepts of ODL – Implications to Veterinary Education. Online Education - Synchronous and Asynchronous learning – models – eLearning, Massive Open Online Courses – SWAYAM, Open Education Resources (OERs), RLOs, Digital Initiatives in Education, viz., Swayam Prabha, National Digital Library, National Academic Depository, E-Shodh Sindhu, E Acharya, EVidhwaan, Agriculture Education Portal, e-KrishiShiksha, KrishiKosh, CeRA, National Educational Alliance for Technology (NEAT) etc.

Practical

Preparation of lesson plans, Planning and preparation of instructional aids, Individual classroom instructional exercises, Micro Teaching Exercise, Development and testing of student evaluation instrument, Development of performance appraisal instrument for teachers., Critical analysis of different online education platforms

Suggested Reading

1. Aggarwal JC. 2000. Essential of Educational Technology: Teaching Learning Innovations in Education. New Delhi: Vikas Publishing House.
2. Alston, Antoine JW, Wade Millerand, David L Williams. 2003. The future role of instructional technology in agricultural education in North Carolina and Virginia. Journal of Agricultural Education, Volume 44, Number 2, 2003.
3. Breslow L, Pritchard DE, DeBore J, Stump GS, Ho AD, Seaton DT. 2013. Studying Learning in the Worldwide Classroom Research into edX's First MOOC.
4. Davies IK. 1971. The Management of Learning. New York: McGraw-Hill Publications.
5. Fred Percival and Phil Race. 2005. Handbook of Educational Technology 3rd Edition. New Jersey: Nichols Publishing Company.
6. Holz-Clause MS and Guntuku D. 2010. Global Agricultural Knowledge Initiative: Strengthening the global competence of students, faculty and extension agents.
7. Kumar KL. 2000. Educational Technology. New Delhi: New Age International Publishers.
8. Leith GO et al.1966. A Hand Book of Programmed Learning and Birmingham.
9. Mangal SK. 2002. Foundation of Educational Technology. Ludhiana: Tondan Publication. 137.
10. Mangal SK. 2006. Essentials of Educational Technology. New Delhi: Prentcile-Hall Publications.
11. Mithra, Shiv K. 1968. Proceeding of Symposium on Educational Technology. IPAL, NCERT. P.4.
12. Purabi Jain. March 1968. Educational Technology. New Delhi: Dominant Publishers and Distributers.
13. Sampath K, Panneerselvam A, Santhanam M. 2001. Introduction to Educational Technology. New Delhi: Sterling Publishers Pvt. Ltd.
14. Sharma RA. 2007. Educational Technology and Management. Agra: Vinod Pustak Mandir.

REMEDIAL COURSES (32 credits)

1.Livestock Production Management 4+2=6 (compulsory)

2. Animal Nutrition 3+1=4 (compulsory)

3. Livestock Products Technology 2+1=3

4. Animal Genetics and Breeding 3+1=4

5. LPM 601-Cattle and Buffalo Production Management (2+1)

Theory

Unit 01 (2 Lectures)

Development of dairy industry in India and the world. Present status and future prospects of dairying in India and the world. SWOT analysis of the dairy sector indifferent agro-climatic zones. Production systems in vogue under Indian conditions. Breeds of cattle and buffalo with more emphasis on breeds of economic importance.

Unit 02 (6 Lectures)

Housing/ Shelter management. Housing and equipment requirements for different classes of cattle and buffaloes. Layout plans and construction details for different sized farms in different climatic zones of India. Ventilation and lighting systems in dairy farms.

Unit 03 (8 Lectures)

Feed and fodder resources used for feeding cattle and buffaloes. Scientific technique and regimen of feeding and watering of different categories of cattle and buffaloes. Feed and fodder requirements of different categories of cattle and buffaloes. Supply of green fodder round the year. Enrichment of poor-quality roughages. Non-conventional feeding resources. Pasture management.

Unit 04 (8 Lectures)

Traits of economic importance and their inter-relationships. Selection and methods of breeding. Reproduction management - pre-natal and post-natal care and management of dams. Care of neonates and young calves. Management strategies for reducing mortality in calves, optimizing age at first calving and calving interval. Improving breeding efficiency of dairy animals.

Unit 05 (8 Lectures)

Farm management - Routine management practices and farm labour management. Milking management - Machine milking and hand milking. Clean milk production-Techniques of harvesting clean milk, cooling and transportation. Different laws and practices governing the dairy sector to produce quality products on par with international standards. Health management of dairy animals. Summer and winter management of dairy animals. Draught ability and management of draught animals.

Practical (14 Classes)

Visits to different sized dairy farms and assessment of routine managemental practices. Analysis of various farm records for economic evaluation. Computation of practical and economical rations. Layout plans and housing details. Housing, milking, calf, heifer and adult management. Dairy Cattle and Buffalo judging and body condition scoring (BCS). Project preparation for commercial farms.

Suggested Reading

1. Arora SP. 1997. Feeding of Dairy Cattle and Buffaloes. Kalyani Publication.
2. Dutta G. 1994. Care and Management of Dairy Cattle and Buffaloes, 3rd ed. ICAR.
3. Flanders F and Gillespie J. 2015. Modern Livestock and Poultry Production, 9th ed. Delmar Cengage Learning Edition.
4. Gupta PR. 2017. Dairy India-2017, 7th ed. Dairy India Yearbook, Thomson Press Ltd.
5. ICAR. Livestock Production and Management-CAR eCourse PDF eBook (online free).
6. Phillips CJC. 2011. Principles of Cattle Production. CABI Publishing.
7. Sastry NSR. 2016. Livestock Production Under Diverse Constraints-Indian Experience in its Management. ISAPM Publication.
8. Thomas CK, Sastry NSR and Ravikiran G. 2012. Dairy Bovine Production, 2nd ed. Kalyani Publishers.
9. Tyler HD and Ensminger ME. 2006. Dairy Cattle Science, Pearson Prentice Hall Publishing.
10. *Selected articles from journals*

6. LPM 602-Sheep and Goat Production Management (2+1)

Theory

Unit 01 (2 Lectures)

Population structure and importance. Sheep farming under different systems of management. Advantages and limitations of sheep and goat farming. Genetic resources of sheep and goats with special emphasis on breeds of economic importance.

Unit 02 (6 Lectures)

Shelter management. Housing and equipment requirements for different classes of sheep and goats. Designing feeders and waterers. Layout plans and construction details for different size farms in different agro-climatic zones of India.

Unit 03 (8 Lectures)

Feed and fodder resources for small ruminants. Common property resources (CPR's)and their management. Principles and systems of feeding and watering different categories of sheep and goat. Pasture utilization and improvement.

Unit 04 (8 Lectures)

Breeding Management, Traits of economic importance and their inter-relationship. Breeding seasons. Selection of breeding animals. Methods of detection of heat, use of teaser, flushing, tupping. Estrous synchronization, Natural Service, artificial insemination and off-season breeding in small ruminants. Care and management of pregnant animals and breeding stock. Culling.

Unit 05 (4 Lectures)

Disease Management. Prevention and control measures including vaccination, deworming, dipping and spraying, etc. Transportation of small ruminants.

Unit 06 (4 Lectures)

Meat, Methods of slaughter, dressing percentage. Wool: Shearing methods. Importance of wool, wool quality. Goat fibers: mohair, pashmina - Marketing of goat fibers/ wool. Milk, Milking, avoidance of goaty odour in milk, clean milk production and its therapeutic uses.

Practical (14 Classes)

Visits to modern sheep and goat farms and critical analysis of various managerial practices under different conditions. Study of practical housing management. Diseases control management. Shearing management. Record keeping and economics of sheep and goat farming for mutton/ chevon, wool/ fibre and milk. Preparation of project for commercial farming. Daily and periodical farm operations. Dipping and vaccination.

Suggested Reading

1. Bhat PN and Khan BU. 2009. Goat Production. Studium Press (India) Pvt. Ltd.
2. Bhatt PN and Arora CL. 2009. Sheep Production. Studium Press (India) Pvt. Ltd.
3. Devendra C and McLeroy GB. 1982. Goat and Sheep Production in Tropics. Longman.
4. Devendra C and Burns M. 1983. Goat Production in the Tropics. CABI Publishing.
5. Gupta JL. 2006. Sheep Production and Management. BS Publ.
6. ICAR. 2014. Handbook of Animal Husbandry, 3rd ed. ICAR.
7. Jindal SK. 2013. Goat Production and Health Management. New India Publishing Agency.
8. Kaushik SK. 2017. Sheep Production. ICAR Publ.

9. Peacock CP. 1996. Improving Goat Production in the Tropics: A Manual for Development Workers, OXFam, UK.
10. Sastry NSR. 2016. Livestock Production Under Diverse Constraints-Indian Experience in its Management. ISAPM Publication.
11. Solaiman SG. 2010. Goat Science and Production. Wiley-Blackwell.
12. *Selected articles from journals.*

7. LPM 603-Swine Production Management (1+1)

Theory

Unit 01 (2 Lectures)

Population dynamic, Economic contribution of pigs, Advantages and limitations of swine rearing, Systems of management. Breeds of economic importance.

Unit 02 (2 Lectures)

Housing and rearing systems. Housing and equipment requirements for different classes of swine, layout plans and construction for different sized farms.

Unit 03 (3 Lectures)

Feeding principles and nutritional requirement of different classes of swine. Feeding schedule for different classes of swine. Traditional and scientific methods of swine feeding.

Unit 04 (4 Lectures)

Traits of economic importance and their interrelationship. Selection of breeding stock. Reproductive parameters of swine. Methods for detection of heat. Mating systems. Care and management of pregnant sows, piglets, growers and boar. Summer management in swine.

Unit 05 (3 Lectures)

Health Management, Prevention and control measures including sanitation, vaccination, deworming, etc. Piglet anaemia and its management.

Unit 06 (2 Lectures)

Methods of slaughter, dressing percentage, Methods of marketing and transportation. Use of by-products from the swine industry.

Practical (14 Classes)

Visit modern piggeries and critical analysis of various types of managemental practices. Practical feeding and breeding management, disease control measures, Judging. Record-keeping. Economics of pig production. Formulation of economic rations for different classes of swine. Project formulation of commercial swine production.

Suggested Reading

1. Katingi E. 2012. Raising Pigs-Manuals and Other Useful Resources. ICARDA and ILRI Publications.
2. https://livestockfish.cgiar.org/2012/06/13/raising-pigs-manuals-and-other-useful-resources/
3. Selected articles from journals

8. ANN 604-Feed and Fodder Technology (1+1)

Theory

Unit 01 (4 Lectures)

Various feed mill equipment and their handling; layout and operations in feed mill (small, medium and large feed plants); automated feed mill: merits and demerits. Procurement of feed ingredients: specification and guidelines. Quality control of feed ingredients and finished feeds. BIS standard.

Unit 02 (4 Lectures)

Principles and process of material handling, weighing, grinding, mixing, pelleting, packaging and other major processing operations. Crumbling, flaking, popping and extrusion. Premixes. Codex Alimentarius, HACCP.

Unit 03 (4 Lectures)

Feed and fodder processing and preservation techniques. Densification, chemical and biological treatment of feeds/ fodders. Fodder conservation through hay and silages; Microbiological evaluation of processed and preserved feeds; Effect of preservation on the nutritional value of feed.

Unit 04 (4 Lectures)

Feed storage and God own management; goods sanitation and hygiene of go-down. Traditional and modern farm-level storage structures. Factors affecting feed stuffs during storage. Liquid feed ingredients. Storage losses; insect pests and rodents control measures; Mycotoxins in feedstuffs and its control measures.

Practical (16 Classes)

Quality control and inspection of feed materials. Qualitative tests for adulterants urea, urease, thiram. Identification of insect pests and fungi in stored products. Feed microscopy. Formulation and preparation premixes. Quality evaluation of silage and hay, Laboratory preparation of silage. Visit to feed plant: Hands-on training on preparation of feed and mineral

mixture. Preparation of project report on plant layout and design, problems related to feasibility, record-keeping in different sections of a feed mill.

Suggested Reading

1. Dryden G. 2008. Animal Nutrition Science. CAB International.
2. Kundu SS, Mahanta SK, Singh S and Pathak PS. 2016. Animal Feed Technology. Satish Publishers
3. Perry TW, Cullison AE and Lowrey RS. 2003. Feeds and Feeding, 6th ed. Pearson.
4. Pond WG, Church DB, Pond KR and Schoknecht PA. 2004. Basic Animal Nutrition and Feeding, 5th ed. Wiley.
5. Schofield EK (Ed.). 2005. Feed Manufacturing Technology V. American Feed Industry Association, Arlington

9. LPT 603-Processing and Preservation of Meat (2+1)

Theory

Unit 01 (8 Lectures)

Basic principles of meat preservation – dehydration, chilling, freezing, freeze-drying, thermal processing, direct microbial inhibition, irradiation, use of chemicals and antimicrobials - Curing and smoking - Hurdle technology concept.

Unit 02 (17 Lectures)

Principles of Meat Processing - Meat and non-meat ingredients and their roles -Additives - Processing techniques - comminution, chopping, blending, marination, massaging, tumbling, etc. - Cooking methods including microwaving – Development of meat products including ham, bacon, tandoori and barbeque - Emulsion formation– factors affecting emulsion formation - Emulsion based meat products - sausages, nuggets and patties - Enrobed, restructured, fermented and intermediate moisture meat products – Ready-to-cook, ready-to-eat and shelf-stable meat products – Canned and retort meat products – Traditional and ethnic meat products - Functional meat products.

Unit 03 (9 Lectures)

Sensory evaluation – Sensory physiology, types, methods, quality attributes – Factors influencing sensory measurements - Types of sensory panels - Selection of sensory panel lists- Sensory evaluation tests- Layout and designing of sensory evaluation laboratory.

Practicals (17 Classes)

Estimation of tyrosine value, nitrite content, TBARS value, peroxide value -Preparation of Meat Products - Minced meat products - Emulsion based meat products – sausages, nuggets

and patties - Ham and Bacon - Meat Pickles –Enrobed, restructured, fermented and shelf-stable meat products - Canned/ retorted Meat Products - Traditional and ethnic Meat Products - Kebabs - Sensory evaluation of meat products - Subjective and objective method of sensory evaluation -differential, descriptive, training tests, etc. – Test practices and training in the sensory lab - Determination of emulsion stability - cooking yield - Texture Profile Analysis.

Suggested Reading

1. Aberle ED, Forest JC, Gerrard DE and Mills E. 2013. Principles of Meat Science, 5th ed. Kendall Hunt Publishing Company, Iowa.
2. Amerine MA, Pangborn RM and Roessler EB. 1965. Principles of Sensory Evaluation of Food. Academic Press, New York.
3. Barbut S. 2005. Poultry Products Technology. CRC Press.
4. Carlson CW, Greaser ML and Jones KW. 2001. The Meat We Eat, 14th ed. Interstate Publishers, INC.
5. Kerry J, Kerry J and Ledward D. 2005. Meat Processing-Improving Quality. Woodhead Publishing Ltd., UK.
6. Lawless HT and Heymann H. 2010. Sensory Evaluation of Food-Principles and Practices, 2nd ed, Springer-Verlag, New York Inc.
7. Mountney GJ and Parkhurst CR. 2017. Poultry Products Technology, 3rd ed. Food Products Press, New York.
8. Pearson AM and Gillett TA. 1996. Processed Meats, 3rd ed. Chapman and Hall, Inc, New York.
9. Sharma BD, Wani S and Sharma N. 1997. Sensory Evaluation Manual for Meat and Meat Products. IVRI Publication.
10. Toldrá F. 2010. Handbook of Meat Processing. Wiley-Blackwell

10. LPT 604-Processing of milk and milk products (1+1)

Theory

Unit 01 (6 Lectures)

Basic concepts of dairy plant organization and operation - collection, chilling, transportation - Heat treatments of Milk - Cleaning and sanitization of Dairy plants - Composition, nutritional, physico-chemical and functional properties of milk - Standards for milk and milk products.

Unit 02 (7 Lectures)

Manufacture of milk products - Flavoured Milk - Drying of milk and milk products- Evaporated and condensed milk - Milk powders – Butter - Ice cream and other frozen desserts

- Manufacture of different fermented milk products – Manufacture of cheddar, mozzarella, cottage and processed cheese - Manufacture of indigenous milk products – paneer, channa, khoa, ghee, dahi and shrikh and - Rheology of milk products - Dairy by-products.

Unit 03 (4 Lectures)

Membrane filtration technology- principles and concepts - Manufacturing and functional properties of casein - Caseinates- Co-precipitates - Whey protein concentrates (WPC) - Lactose- Dairy whiteners.

Practical (17 Classes)

Platform tests - Determination of fat, SNF, TS, protein, lactose and ash contents of milk - Preparation of butter, ice cream, cheese – cheddar, mozzarella and cottage cheese, khoa, paneer, channa, ghee, dahi, yoghurt, casein, caseinate, co-precipitate, flavoured milk - Determination of degree of browning - Measurement of rheological properties of different milk products - Evaluation of sensory quality of milk and milk products - Visit dairy plants.

Suggested Reading

1. Aneja RP, Mathur BN, Banerjee AK and Chandan RC. 2002. Technology of Indian Milk Products. Dairy India.
2. Chandan RC, Kilara A and Shah NP. 2008. Dairy Processing and Quality Assurance, 1st ed. Willey–Blackwell.
3. Davis JG. 2010. Milk Testing: A Laboratory Control of Milk. Agribios.
4. MIF. 2005. Analysis of Milk and its Products: A lab Manual, 2nd ed. Milk Industries Foundation. Biotech Books, Delhi
5. Singh S. 2014. Dairy Technology, Vol. 1 and 2. New India Publishing Agency.
6. Spreer E. 1993. Milk and Dairy Products. Marcel Dekker.
7. Varnam AH and Sutherland JP. 1994. Milk and Milk Products Technology. Chapman and Hall, UK.
8. Walstra P, Wouters JTM and Geurts, TJ. 2006. Dairy Science and Technology, 2nd ed. Taylor and Francis Group.
9. Web BH, Johnson AH and Alford JA. 1987. Fundamental of Dairy Chemistry, 3rd ed. Westport AVI Publ.

11. BCT 604-Analytical Techniques and Instrumentation in Biochemistry 1+1 =2

Theory

Unit 01

Solutions and Buffers: Units of expression of concentration of solutions – Preparation of solutions - Preparation of Buffers - Henderson-Hasselbalch equation in the preparation of buffers. Spectroscopy: Theory and applications of Colorimetry and Spectrophotometry; Major components of the following instruments and their functions: UV-Visible Spectrophotometer, Spectrofluorometer, Flame photometer, atomic absorption spectrophotometer, Inductively Coupled Plasma Atomic Emission Spectroscopy (ICP-AES).

Unit 02

Chromatographic Techniques: Basic principle and applications of Paper, Column and Thin layer chromatography including HPTLC; Factors affecting chromatographic resolution; Methods of preparation of biological samples for chromatographic analysis and common methods for qualitative and quantitative chromatography of amino acids, lipids and sugars including elution and densitometry. Molecular Sieving and its application in Biochemistry – General properties of dextran, acrylamide, agar and other media used for gel filtration. Principles and applications of chromatographic techniques, viz., ion-exchange, gel-filtration, affinity, hydrophobic interaction chromatography, metal chelate chromatography, planar chromatography, lateral flow immunochromatographic assays, Introduction to GLC and HPLC (Normal and Reverse Phase).

Unit 03

Theory and applications of Electrophoresis: Factors affecting migration of charged particles – Moving boundary, paper and gel electrophoresis - Electrophoresis of amino acids, proteins and nucleic acids – Use of SDS PAGE in molecular weight determination. Isoelectric focusing and Isotachophoresis - Densitometry procedures and quantitative assays. Introduction to 2-D gel electrophoresis; Immuno electrophoresis and other techniques like ELISA, RIA and Immuno-blotting.

Unit 04

Theory and applications of Centrifugation: Basic principle of sedimentation – Types, care and safety aspects of Centrifuges – Preparative centrifugation and Analytical centrifugation - Introduction to Ultracentrifugation - Fractionation of sub-cellular components - Density Gradient centrifugation – Determination of relative molecular mass.

N.B.: GLC and HPLC at length are to be discussed under BCT 705 (Ph.D. course); here only introduction.

Practical

• Preparation of solutions and buffers; Solving problems using Henderson–Hasselbalch equation, pH, pKa and buffer concentration, normality; Verification of Beer's – Lambert's law;

Estimation of glucose and total cholesterol in serum; Determination of absorption maxima and molar extinction coefficient of p-Nitrophenol from its absorption spectrum; Estimation of proteins using biuret ,foiln-ciocalteau methods and UV spectrophotometry; Estimation of enzyme activity by spectrophotometry (Kinetic mode).

• Separation of Lipids/ amino acids using paper chromatography and TLC; Fractionation of proteins by ammonium sulphate precipitation and desalting by dialysis; Separation of proteins using Ion-exchange chromatography, affinity chromatography and gel-filtration chromatography; Demonstration of separation of fatty acid methyl esters using GLC

• Electrophoretic analysis of albumin using non-denaturing and denaturing conditions – Detection of molecular weight of protein by SDS-PAGE -Characterization of immunoglobulins by PAGE - Demonstration of sub-cellular fractionation by centrifugation.

Suggested Reading

1. David L Nelson and Cox Michael M. 2017. Lehninger's Principles of Biochemistry. 7th Ed. Freeman.
2. Wilson K and Walker J. (Eds.). 2010. Principles and Techniques of Biochemistry and Molecular Biology. 7th Ed. Cambridge Univ. Press.
3. Willard et al. 1988. Instrumental Methods of Analysis. 7th Ed. Wadsworth Pub Co.
4. Garrity S. 1999. Experimental Biochemistry. 3rd Ed. Academic Press.
5. Gowenlock AH. 2002. Varley's Practical Clinical Biochemistry. 6th Ed. CBS.
6. Holme DJ and Hazel P. 1998. Analytical Biochemistry. 3rd Ed. Longman.
7. George W. Latimer, Jr. 2016. Official Methods of Analysis of AOAC International, 20th Ed. AOAC International.
8. Carl A. Burtis, Edward R. Ashwood and David E. Burns, 2014. Tietz Textbook of clinical Biochemistry and Molecular Diagnostics. 5th Edition. Elsevier

12. VGO 506-Basics of Reproductive Biotechnology (2+1)

Theory

Unit 01

Embryo transfer technology: selection of donors and recipients.

Unit 02

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

Unit 03

Cryopreservation of embryos, transfer of embryos to donors. Sexed semen production, sexing of embryos. Guidelines for export and import of bovine germplasm. Guidelines and standards regarding embryo production.

Unit 04

In-vitro culture of granulosa cells, cumulus cells, luteal cells and oviductal cells. Recovery of bovine oocytes; from abattoir ovaries and live animals, *invitro* fertilization, *in-vitro* maturation, micromanipulation of embryos.

Unit 05

Immuno-neutralization of hormones. Immunomodulation of fertility.

Practical

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

Suggested Reading

1. Ian Gordon. 2017. Reproductive Technologies in Farm Animals. Wallingford, Oxfordshire CABI.
2. Hafez ESE and B Hafez. 2013. Reproduction in Farm Animals. Wiley-Blackwell.
3. B Singh, SK Gautam and MS Chauhan. 2012. Textbook of Animal Biotechnology, Pearson Education.
4. Heiner Niemann, Christine Wrenzycki. 2018. Animal Biotechnology 1: Reproductive Biotechnologies. Springer.
5. Heiner Niemann, Christine Wrenzycki. 2018. Animal Biotechnology 2. Springer International Publishing AG.
6. Troy L Ott, Zhihua Jiang. 2010. Reproductive Genomics in Domestic Animals. John Wiley.
7. Marcelo Marcondes Seneda, Katia Cristina Silva-Santos LS Rafagnin Marinho. 2016. Biotechnology of Animal Reproduction, Nova Science Pub. Inc; UK Ed.
8. Tacia Gomes Bergstein-Galan. 2018. Reproduction Biotechnology in farm animals. Avid Science

13. LPM 605-Behaviour and Welfare of Farm Animals (1+1)

Theory

Unit 01 (4 Lectures)

Introduction to Animal behaviour. Evolution of animal behaviour: Theories of animal behaviour. Importance of animal behaviour studies. Physiological basis of behaviour. Natural selection, proximate and ultimate causes, fitness, optimality theory, selfish genes, kin selection, and game theory. Influence of genetic, environmental and physiological influence. Daily and seasonal cycles of behaviour. Patterns of behaviour. Favourable and unfavourable behaviours of domestication.

Unit 02 (4 Lectures)

Ethogram construction for general behaviour management – interpretation -behaviour assisted animal management - flight zone, Animal learning and training conditioning-operant and classical, animal behaviour-based housing designs –Methods of studying animal behaviour-Vices – causes and prevention.

Unit 03 (2 Lectures)

Group formation. Social relationships like hierarchy and aggression, the process of socialization, locality and behaviour. Behavioural characters for management practices.

Unit 04 (6 Lectures)

Animal welfare – concepts – animal rights – animal freedoms – animal welfare organizations Measurement of animal welfare: - indicators of animal welfare improvement of animal welfare through selection- the welfare of livestock in commercial farms and captivity, environmental enrichment- Welfare of livestock during various management activities such as handling, transportation, etc., Legislation and regulations of animal welfare – welfare and economics.

Practical (14 Classes)

Behavioural characters for managemental practices. Behavioural adaptations under domestication. Analysis of behaviour in relation to climate. Analysis of social behaviour. Preparation of ethogram (time budgeting).

Suggested Reading

1. Agarwal VK. 2013. Animal Behaviour (Ethology) S. Chand and Company
2. Albright JL and Arave CW. 1997. The Behaviour of Cattle. CAB International.
3. Arora MP. 1995. Animal Behaviour. WB London.
4. Benson BJ and Rollin BE. 2004. The Well-being of Farm Animals: Challenges and Solutions. Blackwell Publishing, USA.
5. Bouenger EG. 1994. Animal Behaviour. WB London.

6. Broom DM and Fraser AF. 2007 Domestic Animal Behaviour and Welfare, 4th ed. CABI.
7. Fraser AF and Broom DM. 1990. Farm Animal Behaviuor and Welfare. CAB international
8. Hafez ESE. 1969. The Behaviour of Domestic Animals, 2nd ed. Balliere, Timdall and Cassell.
9. Houpt KA. 2018. Domestic Animal Behavior for Veterinarians and Animal Scientists. 6th ed. Wiley Blackwell.
10. Kumar V. 1996. Animal Behaviour. WB London.
11. *Selected articles from journals.*