

# ANIMAL NUTRITION

## Course Structure

<b>COURSE NO.</b>	<b>COURSE TITLE</b>	<b>CREDITS</b>	<b>SEM</b>
ANN 601*	ANIMAL NUTRITION – ENERGY AND PROTEIN	3+0	I
ANN 602*	ANIMAL NUTRITION – MINERALS, VITAMINS AND FEED ADDITIVES	3+1	II
ANN 603	FEED TECHNOLOGY	1+1	II
ANN 604*	FEED CONSERVATION STORAGE AND QUALITY CONTROL	2+2	I
ANN 605	RUMINANT NUTRITION	2+1	I
ANN 606	NON-RUMINANT NUTRITION	1+1	I
ANN 607	NUTRITION OF COMPANION / LABORATORY, WILD AND ZOO ANIMALS	2+1	II
ANN 608*	RESEARCH TECHNIQUES IN ANIMAL NUTRITION	1+3	II
ANN 609	NON CONVENTIONAL FEED STUFF AND TOXIC CONSTITUENTS / ANTIMETABOLITES IN ANIMAL FEEDSTUFF	2+1	II
ANN 691	MASTER’S SEMINAR	1	I, II
ANN 699	MASTER’S RESEARCH	20	I, II
ANN 701**	MODERN CONCEPTS OF FEEDING RUMINANTS AND FORAGE UTILIZATION	3+0	I
ANN 702	MODERN CONCEPTS OF FEEDING MONOGASTRIC ANIMALS	2+0	I
ANN 703	NUTRITION AND RUMEN FERMENTATION	1+1	II
ANN 704	ADVANCES IN MICRONUTRIENTS	1+0	II
ANN 705**	ADVANCED TECHNIQUES IN NUTRITION AND RESEARCH	1+2	I
ANN 706	ADVANCES IN FEED TECHNOLOGY	1+1	II
ANN 707	CLINICAL NUTRITION	1+1	I
ANN 708	NUTRIENT AND DRUG INTERACTION	2+0	II
ANN 709**	NEW FEED RESOURCES AND TOXICANTS IN ANIMAL FEEDING	2+0	II
ANN 791	DOCTORAL SEMINAR I	1	I, II
ANN 792	DOCTORAL SEMINAR II	1	I, II
ANN 799	DOCTORAL RESEARCH	45	I, II
<b>SERVICE COURSE</b>			
ABM 531	FEED BUSINESS MANAGEMENT	2+0	

\*Compulsory for Master’s programme; \*\*Compulsory for Doctoral programme



**Practical**

General principles of mineral estimation, Sampling and processing techniques, Estimation of macro- and micro-minerals. Determination of bioavailability of minerals. Formulation of mineral mixture for various species. Identification of adulterants and quality control. Atomic absorption spectrometry in mineral estimation. Preparation of diets for mineral studies. Principles of vitamin estimation. Estimation of some important vitamins (vitamin A, E, C). Formulation of vitamin mixture for various species.

**Suggested Readings**

Banerjee GC. 1988. *Feeds and Principles of Animal Nutrition*. Oxford & IBH.  
Krishna G & Ranjhan SK. 1991. *Special Analytical Techniques*. Kalyani.  
McDonald P, Edwards RA & Greenhalgh JFD. 1995. *Animal Nutrition*. Longman.  
McDowell LR. 2003. *Minerals in Animal and Human Nutrition*. Reed Elsevier India.  
Peter RC. 2005. *Applied Animal Nutrition Feeds and Feeding*. Pearson Prentice Hall.  
Ponds WG, Church DC, Pond KR & Schoknecht PA. 2005. *Basic Animal Nutrition and Feeding*. Wiley Dreamtech India.  
Reddy DV. 2003. *Principles of Animal Nutrition and Feed Technology*. Oxford & IBH.  
Underwood EJ & Shuttle 1999. *The Mineral Nutrition of Livestock*. 3<sup>rd</sup> Ed. CABI.

**ANN 603****FEED TECHNOLOGY****1+1****SEM - II****Objective**

Introduction to the subject, formula feed manufacturing and different operations involved. Layout, designing, operation and management of feed mill.

**Theory**

**UNIT-I:** Importance of feed technology in relation to animal productivity. The integrated biological, chemical and physical basis for evaluating the inherent nutritional quality of feed ingredients and feeds. Familiarization of various feed mill equipments, layout and operations. Problems of feed manufacturing units and control measures. Quarantine measures.

**UNIT-II:** Introduction to the formula feed manufacturing including principles of material handling, grinding, mixing, pelleting and other major processing operations. Crumbling, Flaking, Popping, Extrusion. Principles of instrumentation and analysis, with emphasis on application to quality control and research in the feed industry.

**UNIT-III:** The formulation of concentrate mixtures, premixes and rations using computer. Automated feed mill. Personal management in feed plants, laws and regulation of feed manufacturing industry. Codex alimentarius, HACCP. Organizational charts for small, medium and large feed plants, labour standard, planning and production programme, handling of plant equipment. Merits and demerits of automated feed plant

**Practical**

Identification of feed ingredients and their specifications, as well as compound feed for different categories of livestock and poultry. Feed microscopy. Formulating premixes. Introduction to Pulverisers, pelletisers, complete feed blocks equipments Plant layout and design of different capacity of feed mills, problems related to feasibility, records keeping in different sections of feed mill. Experiential learning at the feed plant for preparing feed, urea molasses mineral blocks, mineral mixture.

**Suggested Readings**

Banerjee GC. 1988. *Feeds and Principles of Animal Nutrition*. Oxford & IBH.  
Givens DI. 2000. *Forage Evaluation in Ruminant Nutrition*. Great Britain Publ.  
Gohl BO. 1985. *Tropical Feeds*. FAO.  
Lohan OP, Chahal SM & Kishore N. 1998. *Feed Quality Evaluation Techniques*. CCS Haryana Agricultural Univ. Press.  
McElliherny, Robert R. 1994. *Feed Manufacturing Technology*. The American Feed Industry Assoc.  
Perry TW. 2004. *Feeds and Feeding*. Prentice Hall.  
Ponds WG, Church DC & Pond KR. 1995. *Basic Animal Nutrition and Feeding*. John Wiley & Sons.  
Zaworski F. 1997. *Feed Industry Red Book*. ZMAG Publ.

**ANN 604**                      **FEED CONSERVATION, STORAGE AND**                      **2+2**                      **SEM - I**  
**QUALITY CONTROL**

**Objective**

To acquaint with inherent nutritional quality of feed ingredients and feeds. Evaluation of feeds and fodders and feed preservation techniques. Procurement and storage of feed ingredients. Losses during storage and its control.

**Theory**

UNIT-I: Principles of feed and fodder processing and preservation techniques, their merits and demerits. Procurement, planning and purchase procedures; traditional and modern farm level storage structures. Feed storage and godown management, estimation of storage capacity and stack plan.

UNIT-II: Evaluation of processed and preserved feeds and forages. Role of moisture, temperature and relative humidity during storage of feedstuffs and their effect on biotic factors. Handling and storage of liquid feed Ingredients. Physical and chemical changes in feeds during storage; storage losses; insect pests and rodents in feed stores and their control; Role of fungi, tolerance limits and measures to check them in stored products.

UNIT-III: Factors affecting the quality of feed and feedstuffs on preservation. Microbiological evaluation of processed and preserved feeds, Effect of preservation on nutritional value of feed. Properties and mode of action of pesticides and fumigants; principles of good sanitation and hygiene of godowns.

UNIT-IV: Proximate composition, Limitations of various systems of analysis, Partitioning of forage fibre by Van Soest method, Quality control of fed ingredients, Specifications of feed ingredients and finished feeds, BIS standard., Pesticide and insecticide residues in feeds

**Practical**

Laboratory evaluation of preserved and processed feed and forages. Physical properties of feeds and feedstuffs; identification of insect-pests and fungi in stored products; techniques for detection of hidden infestation in grains; quality control and inspection of stored feed materials; moisture equilibrium determination and estimation of chemical changes including alcoholic acidity, rancidity and uric acid in feeds during storage. Weende proximate analysis, Van Soest fibre fractionation, Enzymatic evaluation, Pro rata deduction (Feed laws), urea, FFA, peroxide value, adulterants, and heavy metal.

**Suggested Readings**

- Givens DI. 2000. *Forage Evaluation in Ruminant Nutrition*. Great Britain Publ.
- Khare BP. 1994. *Stored Grain Pests and their Management*. Kalyani.
- Krishna G & Ranjhan SK. 1991. *Special Analytical Techniques in Nutritional Biochemistry*. Kalyani.
- Lohan OP, Chahal SM & Kishore N. 1998. *Feed Quality Evaluation Techniques*. CCS Haryana Agricultural Univ. Press.
- McEllihner Robert R. 1994. *Feed Manufacturing Technology*. The American Feed Industry Assoc.
- Ponds WG, Church DC & Pond KR. 1995. *Basic Animal Nutrition and Feeding*. John Wiley & Sons.

**ANN 605**                      **RUMINANT NUTRITION**                      **2+1**                      **SEM - I**

**Objective**

Requirement of nutrients for different physiological functions in various ruminant species. Latest concepts of feeding the nutrients for maximising production.

**Theory**

UNIT-I: Nutrients and their metabolism with special reference to milk, meat and wool production.

UNIT-II: Feeding standards, their history, comparative appraisal and limitations. Classification of feedstuffs. Nutrient requirements for calves, heifers, dry, pregnant and lactating cows, buffaloes, sheep and goat.

UNIT-III: Introduction to rumen microflora and fauna. Development of rumen. Role of milk replacers and calf starters.

UNIT-IV: Feed formulation of large and small ruminants for different physiological stages. Concept of complete feed. Limiting nutrients and strategic feeding of high yielding

ruminants. Concept of by-pass nutrients and their impact on production, reproduction and immune status. Importance of CLA, omega fatty acids, Scope for value addition in milk, Different systems of feeding buffalo for beef production. Feeding during natural calamities, feeding in various agro-climatic zones of India.

**Practical**

Design and planning of feeding experiments. Identification of feed and fodder on the basis of its composition. Artificial rumen technique, Methods for evaluation of feedstuffs-in vitro gas, *in sacco* digestion kinetics. Determination of nutritive value of feeds and fodders by metabolism trial in dairy cattle, determination of nutritive value of pastures by the use of range techniques, study of rumen metabolic profile. Preparation of bypass Nutrients Identification of rumen microbes and rumen studies.

**Suggested Readings**

Dhority BA. 2003. *Rumen Microbiology*. Nottingham Univ. Press.  
 Kellems RO & Church DC. 2002. *Livestock Feeds and Feeding*. Prentice Hall.  
 Ranjhan SK. 2001. *Animal Nutrition in the Tropics*. Sangam Books.

**ANN 606                      NON-RUMINANT NUTRITION                      1+1                      SEM - I**

**Objective**

Requirement of nutrients and feeding of various non-ruminants species for efficient quality production.

**Theory**

UNIT-I: Nutrients, their metabolism and requirements for poultry and swine during different stages of growth and production. Limiting amino acids-lysine and methionine.

UNIT-II: Feeding systems and feed additives, feed formulations for different purposes including least cost rations.

UNIT-III: Quality control of poultry and swine rations for efficient egg and meat production. Nutrition in relation to disease and stress.

UNIT-IV: Nutritional factors affecting quality of the products. Hind gut fermentation and its importance, Nutrient requirements of rabbits and equines, Nutritional manipulation for producing value added egg, meat / pork.

**Practical**

Design and planning for poultry and swine feeding experiments, formulation and compounding of general and least cost rations, determination of nutritive value of poultry and swine feeds by balance experiments, evaluation of protein quality, Visit to poultry and piggery units, feed and fodder stores, Use of software in least cost feed formulations. Basic principles governing the least cost formulation software's.

**Suggested Readings**

Leeson S & Summers JD. 2005. *Commercial Poultry Nutrition*. International Publ. House.  
 Ponds WG, Church DC, Pond KR & Schoknecht PA. 2005. *Basic Animal Nutrition and Feeding*. Wiley Dreamtech India.

Rose SP. 1996. *Principles of Poultry Science*. CABI.

Stevan I, Scott ML & John DS. 2001. *Nutrition of the Chicken*. Univ. of Guelph.

**ANN 607                      NUTRITION OF COMPANION,                      2+1                      SEM - II**  
**LABORATORY, WILD AND ZOO ANIMALS**

**Objective**

Preparation, storage and evaluation of feeds and feeding standards of companion/ laboratory /wild and zoo animals.

**Theory**

UNIT-I: Feed Habbits, food Patterns, digestive structure and functions companion, laboratory , wild and zoo animals. Natural dietary habits. Nutritional requirements of various species of animals.

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

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



UNIT-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. Chemo-physical properties of various toxins. Effect of toxins on biological system and nutrients utilization in different species of livestock. Detoxification of toxin principles by various physical, chemical and biological techniques. Insecticide and pesticide residue detection.

**Practical**

Estimation of various protease inhibitors; tannins; and mycotoxins in various feeds and feedstuffs. Nitrates, HCN, oxalates, insecticide and pesticide residues, saponins, Gossypol, mimosine, heavy metals.

**Suggested Readings**

- Banerjee GC. 1988. *Feeds and Principles of Animal Nutrition*. Oxford & IBH.  
Liner IE. 1980. *Toxic Constituents of Animal Food Stuffs*. Academic Press.  
Lohan OP, Chahal SM & Kishore N. 1998. *Feed Quality Evaluation Techniques*. CCS Haryana Agricultural Univ. Press.  
McDonald P, Edwards RA & Greenhalgh JFD. 1995. *Animal Nutrition*. Longman.  
Ponds WG, Church DC & Pond KR. 1995. *Basic Animal Nutrition and Feeding*. 4<sup>th</sup> Ed. John Wiley & Sons.  
Ranjhan SK. 2001. *Animal Nutrition in the Tropics*. Sangam Books.  
Reddy DV. 2003. *Principles of Animal Nutrition and Feed Technology*. Oxford & IBH.

**ANN 701                      MODERN CONCEPTS OF FEEDING                      3+0                      SEM - I**  
**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: Concept of limiting amino acids for high yielders. Strategic feeding of high yielding dairy cows and meat producing ruminants. Concept of Phase feeding. Bypass Nutrient technology. Feeding during stress. Nutrition-immunity interaction. Designer milk and meat. Rumen manipulation to reduce methanogenesis. Nitrogen oxide emission and heavy metal residues. Metabolic profile tests.

UNIT-III: Use of conserved forages in ruminant feeding. Chemical composition of common and newer forage – Factors affecting nutritive value of commonly available grasses, pastures, silage, hay and crop residues, voluntary intake of fodder at different stages of growth. Newer methods of forage evaluation – calculated in vitro ME and DOMD by using prediction equations. Merits and demerits of using leaf protein. Top feeds and their effective utilization – pasture consumption and evaluation studies.

UNIT-IV: Seminars on current topics of special interest.

**Suggested Readings**

Selected articles from journals.

**ANN 702                      MODERN CONCEPTS OF FEEDING                      2+0                      SEM - I**  
**MONOGASTRIC ANIMALS**

**Objective**

To impart knowledge on modern concepts in nutrient requirement and feeding of monogastric livestock.

**Theory**

UNIT-I: Nutritional factors affecting egg quality and hatchability in poultry. Feeding for designer eggs. Role of essential fatty acids, amino acids imbalance, toxicity and interactions in monogastrics.

UNIT-II: Developments in digestive physiology of swine – equines – Measurement of protein and energy requirements – Influence of processing of feeds and fodders in monogastric animal nutrition.

UNIT-III: Modern concepts of amino acid nutrition at various physiological status – Role of vitamins and minerals in health and disease. Advances in new generation feeds and feed additives.

**Suggested Readings**

Leeson S & Summers JD. 2005. *Commercial Poultry Nutrition*. International Publ. House.  
Ponds WG, Church DC, Pond KR & Schoknecht PA. 2005. *Basic Animal Nutrition and Feeding*. Wiley Dreamtech India.  
Selected articles from journals.

**ANN 703                      NUTRITION AND RUMEN FERMENTATION    1+1                      SEM - II**

**Objective**

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

**Theory**

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

UNIT-II: Rumen microflora and microfauna –considerations and limitations in relation to ruminant feeding practices. Manipulation of rumen fermentation – physical, chemical and biological means – Role of sulphur and phosphorus in rumen fermentation –. Modeling ruminant digestion and metabolism – principles.

**Practical**

Microbial and protozoal count, Determination TVFA by chromatography. Estimation of ammonia in rumen liquor – study on protection of protein in relation to degradability, Rumen fermentation products – Artificial rumen techniques. Rumen enzyme assay

**Suggested Readings**

Selected articles from journals.

**ANN 704                      ADVANCES IN MICRONUTRIENTS                      1+0                      SEM - II**

**Objective**

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

**Theory**

UNIT-I: Developments in the study of major, minor and toxic minerals in animals – animal – soil - plant interrelationship – concepts in absorption and transport of micronutrients – Kinetics and metabolism physiological and biochemical interactions among nutrients – interrelationship of minerals and vitamins in relation to metabolism and requirements – mineral toxicities in relation to livestock feeding.

UNIT-II: Developments in vitamin and mineral requirements for growth, reproduction and lactation – Identification and correction of deficiencies and toxicities of minerals in farm animals.

UNIT-III: Bio-availability of macro and micro nutrients – factors affecting the bio-availability of minerals – bio-marker concept for mineral requirement for correction of deficiencies and toxicity of minerals.

**Suggested Readings**

Peter RC. 2005. *Applied Animal Nutrition Feeds and Feeding*. Pearson Prentice Hall.  
Ponds WG, Church DC, Pond KR & Schoknecht PA. 2005. *Basic Animal Nutrition and Feeding*. Wiley Dreamtech India.  
Selected articles from journals.

**ANN 705                      ADVANCED TECHNIQUES IN NUTRITION    1+2                      SEM - I  
AND RESEARCH**

**Objective**

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

**Theory**

UNIT-I: Developments in analysis of nutrients in feeds. Estimation of toxins and mycotoxins – Application of atomic absorption spectrophotometer, HPLC – Enzymatic methods of feed analysis – Isotopes in nutrition research – Feed microscopy – Analytical aspect of feeds and fodders using N.I.R.

UNIT-II: Faecal innoculum as alternative to rumen liquor in in vitro studies – Degradability of feeds by various techniques – rates of VFA and microbial production.

**Practical**

Estimation of major, minor and toxic minerals by atomic absorption spectrophotometer, Estimation of mycotoxin by HPLC, Estimation of oxalate, nitrates, tannin and mimosine, VFA fractionation by GC. SF6 Technique, amino acid analyzer, NIR, HPLC, Purine derivatives, milk fat and FA estimation.

**Suggested Readings**

Selected articles from journals.

**ANN 706                      ADVANCES IN FEED TECHNOLOGY                      1+1                      SEM - II****Objective**

To impart knowledge on modern feed processing methods and automated feed plant layout.

**Theory**

UNIT-I: Feed and fodder processing – Particle size reduction – bulk density – processing of grains and oil seeds – processing of roughages – feed plant layout and design – feed plant management – storage of feeds.

UNIT-II: Non conventional feed resources – Formulation of concentrates, premixes and rations – improvement of nutritive value of poor quality roughages – liquid feed supplements. Solid state fermentation (SSF) technology.

**Practical**

Feed microscopy tests for certain adulterants and anti nutritional factors, Feed plant design– processing of roughages – feed plant sanitation, Wild seed identification – qualitative tests for rancidity, minerals and adulterants, Visit to commercial feed plant.

**Suggested Readings**

Selected articles from journals.

**ANN 707                      CLINICAL NUTRITION                      1+1                      SEM - I****Objective**

Impact of nutrition on health, immunity, digestive/metabolic disorders, reproductive performance, bacterial and parasitic infestations, organic toxins and stress nutrition, feeding management of sick animals.

**Theory**

UNIT-I: Nutritional factors responsible for disorders. Metabolic disorders and production diseases in farm animals. Prevention of metabolic disorders – recommended dietary regimen.

UNIT-II: Effect of coccidiostats and dietary antigens in early weaned livestock. Nutrition in relation to emerging diseases. Effect of nutrition on fertility, reproduction and lactation. Toxic minerals and counter action (Selenium and fluorine).

UNIT-III: Stress nutrition and post surgical nutrition. Nutritional manipulation and feeding of sick animals. Pesticides residues in feeds and fodders and their impact on animal health, reproduction and production.

**Practical**

Determination of blood glucose, blood urea nitrogen, SGOT SGPT, total protein, cholesterol and ketone bodies, Metabolic profile tests.

**Suggested Readings**

Selected articles from journals.

**ANN 708                      NUTRIENT AND DRUG INTERACTION                      2+0                      SEM - II****Objective**

To impart knowledge on the effects of drugs on nutrient utilization.

**Theory**

UNIT-I: Effects of drugs on digestion and absorption of nutrients – Drugs and intestinal microbial interaction – Effect of drugs and antibiotics as feed additives. Physiological effects – Use and abuse.

UNIT-II: Nutrients in drug detoxification – Antagonists – Hormones and their effect on growth and carcass qualities. Drug residues in animal products - milk and meat – effect on food change. Legal aspects of drugs in animal products.

**Suggested Readings**

Selected articles from journals.

**ANN 709****NEW FEED RESOURCES AND TOXICANTS 2+0  
IN ANIMAL FEEDING****SEM - II****Objective**

To impart knowledge on newer feed resources and their value in animal feeding and various toxic substances prevalent in feeds and fodders.

**Theory**

UNIT-I: Demand and availability of feed – formulation of database in computer – strategy in food animal production – agricultural by-products – Agroindustrial by-products, Farm waste, crop residues, organic wastes of animal origin. Slaughter house waste, industrial waste and their feeding value in animals.

UNIT-II: Processing to enhance feed utilization and availability. Possible health hazards due to waste utilization-chemical and nutritional changes in waste product due to processing. Quality standard and their acceptance.

UNIT-III: Naturally occurring toxicants – Toxicants of plants and non-microbial origin. Naturally occurring alkaloids, mycotoxins and their toxicity – Acquired toxicants, pesticides, weedicides and heavy metals.

UNIT-IV: Effect of toxins on rumen fermentation and nutrient utilization. Methods of detoxification. Food and feed contaminants – their impact on animal performance.

**Suggested Readings**

Selected articles from journals.

# ANIMAL NUTRITION

## List of Journals

- Animal Feed Science and Technology
- Animal Nutrition and Feed Technology
- Animal Research
- Animal Science Journal
- Archives of Animal Nutrition
- Australian Journal of Animal Sciences
- British Journal of Nutrition
- British Poultry Science
- Canadian Journal of Animal Sciences
- Feed Industry Review
- Feed International
- Feed Management
- Feed Stuffs
- Feed Trends
- Grass and Forage Science
- Indian Journal of Animal Nutrition
- Indian Journal of Animal Science
- Indian Journal of Dairy Science
- Indian Journal of Poultry Sciences
- International Journal of Sheep and Wool Science
- Italian Journal of Animal Science
- Journal of Animal and Feed Sciences
- Journal of Animal Nutrition
- Journal of Animal Physiology and Animal Nutrition
- Journal of Food Science and Technology
- Livestock Research for Rural Development
- Malaysian Journal of Nutrition
- Nutrition Journal
- Pakistan Journal of Nutrition
- Small Ruminant Research

## e- Resources

- <http://www.vivo.colostate.edu/hbooks/pathphys/digestion/index.html>
- <http://www-biol.paisley.ac.uk/kinetics/contents.html>
- [http://en.wikipedia.org/wiki/Enzyme\\_kinetics#column-one](http://en.wikipedia.org/wiki/Enzyme_kinetics#column-one)
- <http://mark.asci.ncsu.edu/SwineReports/2004-2005/Contents.htm>
- <http://www.das.psu.edu/dairynutrition/>
- <http://www.vet.ed.ac.uk/clive/cal/RUMENCAL/Frames/frmMega.html>
- <http://www.uky.edu/~dhild/biochem/supp.html>
- <http://vanat.cvm.umn.edu/run/plate7.html>
- <http://www.ales2.ualberta.ca/afns/drtc/>
- <http://www.clfmaofindia.org/>
- <http://www.nianp.res.in/>
- <http://www.nutrisocietyindia.com/>
- <http://www.fao.org>
- [http://www.codexalimentarius.net/web/index\\_en.jsp](http://www.codexalimentarius.net/web/index_en.jsp)
- <http://www.ars.usda.gov>
- <http://www.fao.org/ag/AGA/AGAP/FRG/afris/default.htm>
- <http://www.aphca.org/>
- <http://www.fao.org/ag/AGA/AGAP/FRG/frg1.htm>

- <http://www.fao.org/prods/index.asp>
- <http://www.fao.org/ag/AGA/AGAP/FRG/Feedsafety/feedsafety.htm>

### **Suggested Broad Topics for Masters and Doctoral Research**

- Utilization of non conventional feed/ fodder resources
- Evolving / Assessing feed additives / supplements
- Manipulation of rumen fermentation to enhance productivity
- Feed processing for efficient utilization
- Improving palatability, digestibility of companion food
- Preservation and storage of feed / fodder
- Developing functional foods through 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

# ANIMAL PRODUCTION PHYSIOLOGY

## Course Structure

COURSE NO.	COURSE TITLE	CREDITS	SEM
APP 601*	PHYSIOLOGY OF LACTATION	2+1	II
APP 602	HORMONES IN ANIMAL PRODUCTION	3+0	II
APP 603*	PHYSIOLOGY OF BOVINE FEMALE REPRODUCTIVE FUNCTIONS	2+1	I
APP 604*	PHYSIOLOGY OF BOVINE MALE REPRODUCTIVE FUNCTIONS	2+1	II
APP 605	PHYSIOLOGY OF REPRODUCTION- OVINE, CAPRINE AND CAMEL	2+1	I
APP 606	PHYSIOLOGY OF REPRODUCTION- CANINE, SWINE AND EQUINE	2+0	I
APP 607	PHYSIOLOGY OF AVIAN REPRODUCTION	2+1	I
APP 608	EMBRYO BIOTECHNOLOGY	2+1	I
APP 609	PHYSIOLOGY OF GROWTH	2+1	I
APP 610	ADVANCED ENVIRONMENTAL PHYSIOLOGY	2+1	II
APP 611**	RESEARCH METHODOLOGY IN ANIMAL PRODUCTION PHYSIOLOGY	1+2	I
APP 612	PHYSIOLOGY OF WORK/EXERCISE	2+1	II
APP 691	MASTER'S SEMINAR	1	I, II
APP 699	MASTER'S RESEARCH	20	I, II
APP 701**	BIOENERGETICS	3+0	II
APP 702	ADVANCES IN ANIMAL PRODUCTION	3+1	I
APP 703	PHYSIOLOGY AND BIOCHEMISTRY OF SEMEN	2+1	II
APP 704**	ADVANCES IN PROTEIN AND STEROID HORMONES PHYSIOLOGY	2+1	I
APP 791	DOCTORAL SEMINAR I	1	I, II
APP 792	DOCTORAL SEMINAR II	1	I, II
APP 799	DOCTORAL RESEARCH	45	I, II

\*Compulsory for Master's programme; \*\*Compulsory for Doctoral programme