Academic:

1. Degree Offered –PG, PhD
   Title of degree: MVSc and PhD in Animal Nutrition
   Duration: 02 Years MVSc and 03 years PhD
   Eligibility Criteria: BVSc& AH for MVSc and MVSc (Animal Nutrition) for PhD
   Intake Capacity: 04
   Opportunities: Job in Govt and private sector (Feed Industry and Entrepreneurship Development)

List of Admitted Students – First Year to Final Year (Veterinary Year wise / Fishery and Dairy Semester wise) :

Sr. No.	Name of Student	Enrl. No.	Email Address	Name of Advisor
1	WankhadeMeghaNandkumar	V/22/429	mwankhade1997@gmail.com	Dr. S.A. Amrutkar
2	DahekarSourabh Vijay	V/17/054	sourabhdahekar121@gmail.com	Dr. K.Y. Deshpande
3	TathodShubhamRaju	V/17/335	shubhamtathod45730@gmail.com	Dr. K.Y. Deshpande
4	TangadeMayuriAnnasaheb	V/17/334	tangademayuri@gmail.com	Dr. S.A. Amrutkar
5	Vaishnavi Vijay Kharche	V/18/186	vaishnavikharche57@gmail.com	Dr. K.Y. Deshpande
6	AvadappaDagaduGadade	V/18/097	amolgadade56@gmail.com	Dr. S.A. Amrutkar
7	SujitDattatrayaDighe	V/18/089	sujitdighe108@gmail.com	Dr. S.A. Amrutkar
8	SurnarTukaramUttamrao	V/18/356	surnartukaram01@gmail.com	Dr. K.Y. Deshpande

2. Course offered :: UG, PG , PhD - Semester / Year wise

   - List of UG Courses (B.V.Sc& AH) As per latest MSVE Guidelines) , B.Tech. (D.T.) and B.F.Sc as per ICAR – V Deans Committee – 2016.: **Yet to start**

Sr No	Course No.	Title	Credit	Course offered in the Year

   - List of PG Courses (MVSc) andM.Tech. (Dairy Technology)

Sr No	Course No.	Title	Credit	Semester
1.	ANN 601	Nutritional Biochemistry	1+0	I
2.	ANN 602	Energy and Protein Nutrition	2+0	I

3.	ANN 603	Minerals and Vitamin Nutrition and Feed Additives	2+1	I
4.	ANN 604	Feed and Fodder Technology	1+1	I
5.	ANN 605	Ruminant Nutrition	2+1	I
6.	ANN 606	Non-Ruminant Nutrition	2+1	II
7.	ANN 607	Research Methodology in Animal Nutrition	0+2	II
8.	ANN 608	Companion Animal Nutrition	1+0	II
9.	ANN 609	Nutrition of Laboratory, Wild and Zoo Animals	2+1	II
10.	ANN 610	Non-Conventional Feed Resources	1+1	II
11.	ANN 611	Introductory Clinical Nutrition	1+0	II
12.	ANN 612	Rumen Biotechnology	1+0	II

3. Lecture Schedule – UG, PG , PhD - Theory / Practical Schedule – Approved by BoS – Subject wise

Lecture and Practical Schedule – Animal Nutrition

I. Course Title : Nutritional Biochemistry
II. Course Code : ANN 601
III. Credit Hours : 1+0

Unit I (6 Lectures)	
1	Classification of carbohydrates and functions of carbohydrates
2	Monosaccharides, Disaccharides, Polysaccharides examples and significance
3	Glycolysis, Kreb's cycle
4	HMP shunt, Gluconeogenesis
5	Digestion, absorption and metabolism of carbohydrates in ruminants
6	Digestion, absorption and metabolism of carbohydrates in non-ruminants

Unit I (5 Lectures)	
7	Classification of lipids, Properties and biological significance of fats
8	Digestion, absorption and metabolism of fats in ruminants
9	Digestion, absorption and metabolism of fats in non-ruminants
10	Biosynthesis of Fatty acids
11	Cholesterol synthesis
Unit III (7 Lectures)	
12	Classification of amino acids, Properties and function of amino acids
13	Digestion, absorption and metabolism of proteins and other nitrogenous compounds in ruminants
14	Digestion, absorption and metabolism of proteins and other nitrogenous compounds non-ruminants
15	Ammonia transport, urea cycle
16	Biosynthesis of protein
17	Significance of purines and pyrimidines
18	Biological significance of nucleotides and nucleotides

Suggested Reading (ANN-601)

• Cheeke PR and Dierenfeld E. 2010. *Comparative Animal Nutrition and Metabolism*. CAB International.
• D'Mello JPF. 2003. *Amino Acids in Animal Nutrition*, 2nd ed. CAB International.
• Leeson S and Summers JD. 2001. *Scott's Nutrition of The Chicken*, 4th ed. University Books.
• Maynard LA, Loosli JK, Hintz HF and Warner RG. 1987. *Animal Nutrition*. Tata McGraw-Hill.
• McDonald P, Edwards RA, Greenhalgh JFD, Morgan CA, Sinclair LA and Wilkinson RG. 2011. *Animal Nutrition*, 7th ed. Benjamin Cummings.
• Nelson DL and Cox MM. 2017. *Lehninger Principles of Biochemistry*, 7th ed. Macmillan Learning.

Course Title: Energy and Protein Nutrition

I. **Course Code : ANN 602**

II. **Credit Hours : 2+0**

	Unit I (10 Lectures)
1	Measures of feed energy
2	Total digestible nutrients, its calculations, advantages and limitations
3	Partitioning of feed energy, Gross & Digestible energy
4	Metabolizable energy & Net Energy
5	Energy balance,
6	Fasting catabolism.
7	Direct calorimetry
8	Indirect calorimetry
9	Efficiency of energy utilization.
10	Efficiency of protein utilization.
Unit II (14 Lectures)	
11	Rumen degradable protein (RDP)
12	Rumen undegradable protein (UDP)
13	Protein fermentation kinetics.
14	Energetics of protein synthesis and Protein turnover.
15	Microbial protein synthesis and its significance
16	Microbial protein quantification
17	Protein quality determination in ruminants.
18	Protein quality determination in monogastrics
19	Utility of Biological value, its calculation, advantages and limitations.
20	Utility of Nutritive ratio, its calculation, advantages and limitations.
21	Supplementary value of amino acids.
22	NPN metabolism, urea fermentation potential (UFP)
23	Metabolizable protein
24	Amino acids imbalance, antagonism and toxicity.
Unit III (12 Lectures)	
25	Feeding standards: comparative appraisal and limitations.
26	Determination of energy requirements.
27	Determination of protein requirements.
28	Nutrients metabolism with special reference to milk production.
29	Nutrients metabolism with special reference to meat production.
30	Nutrients metabolism with special reference to wool production.
31	Energy requirement for maintenance and growth in farm animals.
32	Energy requirement for pregnancy in farm animals.
33	Energy requirement for lactation in farm animals.

24	Protein requirement for maintenance and growth in farm animals.
35	Protein requirement for pregnancy in farm animals.
36	Protein requirement for lactation in farm animals.

Suggested Reading(ANN-602)

• Blaxter K. 1989. *Energy Metabolism in Animal and Man*. Cambridge University Press.
• Bondi A. 1987. *Animal Nutrition*. Wiley InterScience.
• Cheeke PR and Dierenfeld E. 2010. *Comparative Animal Nutrition and Metabolism*. CAB International.
• Crampton EW and Harris LE. 1969. *Applied Animal Nutrition*. WH Freeman.
• Dryden GM. 2008. *Animal Nutrition Science*, 1st ed. CAB International.
• Maynard LA, Loosli JK, Hintz HF and Warner RG. 1987. *Animal Nutrition*. Tata McGraw-Hill.
• McDonald P, Edwards RA, Greenhalgh JFD, Morgan CA, Sinclair LA and Wilkinson RG. 2011. *Animal Nutrition*, 7th ed. Benjamin Cummings.
• Pond WG, Church DB, Pond KR and Schoknecht PA. 2004. *Basic Animal Nutrition and Feeding*, 5th ed. Wiley.
• Singh UB. 1987. *Advanced Animal Nutrition for Developing Countries*. Indo-Vision.

I. Course Title : Minerals and Vitamin Nutrition and Feed Additives

II. Course Code : ANN 603

III. Credit Hours : 2+1

Unit I (14 Lectures)	
1	General role of minerals
2	Factors affecting mineral requirements.
3	Macro-minerals their, distribution, metabolism, physiological functions of calcium
4	Macro-minerals their, distribution, metabolism, physiological functions of phosphorus
5	Macro-minerals their, distribution, metabolism, physiological functions of magnesium
6	Macro-minerals their, distribution, metabolism, physiological functions (Na, Cl, K, S)
7	Micro-minerals, their, distribution, metabolism, physiological functions
8	Micro-minerals, their, distribution, metabolism, physiological functions
9	Micro-minerals, their, distribution, metabolism, physiological functions
10	Deficiencies and excesses, sources and requirements of Macro minerals.
11	Deficiencies and excesses, sources and requirements of Micro minerals.
12	Critical minerals for non-ruminants
13	Critical minerals for ruminants.
14	Probable essential minerals.
Unit II (7 Lectures)	
15	Mineral interactions. Chelated minerals and concept of nano-minerals.
16	Bioavailability studies in minerals.
17	Impact of minerals on reproduction, fertility and immunity.
18	Soil-plant-animal-human relationship
19	Development of area-specific mineral mixture.
20	Toxic minerals; their role in health and production of farm animals.
21	Newly recognized trace minerals.
Unit III (11 Lectures)	
22	Definition, history, classification, chemistry and functions of water soluble vitamins
23	Requirements, Deficiencies and excesses of water soluble vitamins
24	Definition, history, classification, chemistry and functions of fat soluble vitamins
25	Requirements, Deficiencies and excesses of fat soluble vitamins
26	Role of vitamins in energy metabolism
27	Relationship of vitamins with carbohydrates and protein.
28	Vitamin-mineral interrelationship.
29	Vitamin toxicosis.
30	Critical vitamins for ruminants
31	Critical vitamins for non-ruminants.
32	Role of vitamins in reproduction, fertility and immunity.
Unit IV (4 Lectures)	
33	Feed additives and nutraceuticals.

34	Probiotics, prebiotics, synbiotics; eubiotics
35	Feed enzymes. Phytochemical feed additives; polyphenols and essential oils.
36	Organic acids and acidifiers.
Practical (16 Classes)	
1	General principles of mineral estimation. Sampling and processing techniques.
2	Estimation of Ca
3	Estimation of P and salt.
4	Estimation of Mg and sulphur.
5	Estimation of Cu, Co and I.
6	Estimation of Zn, Mn, Mo, etc.
7	Determination of bioavailability of minerals.
8	Formulation of mineral mixtures for ruminants.
9	Formulation of mineral mixtures for non-ruminants and poultry.
10	Identification of adulterants and quality control.
11	Atomic absorption spectrometry in mineral estimation of major elements.
12	Atomic absorption spectrometry in mineral estimation of trace elements.
13	Preparation of diets for mineral studies.
14	Principles of vitamin estimation and formulation of vitamin mixtures.
15	Estimation of vitamins-A, E and C.
16	Purified diets for mineral studies.
17	Purified diets for vitamin studies.
18	Calculation of mineral and vitamin requirements.

Suggested Reading(ANN-603)

• McDonald P, Edwards RA, Greenhalgh JFD, Morgan CA, Sinclair LA and Wilkinson RG. 2011. *Animal Nutrition*, 7th ed. Benjamin Cummings.
• McDowell RL. 1989. *Vitamins in Animal Nutrition*. Academic Press.
• McDowell RL. 2003. *Minerals in Animal and Human Nutrition*, 2nd ed. Elsevier Science.
• Suttle NF. 2010. *Mineral Nutrition of Livestock*, 4th ed. CAB International.

Course Title: Feed and Fodder Technology

I. **Course Code : ANN 604**
II. **Credit Hours : 1+1**

Unit I (5 Lectures)	
1	Various feed mill equipment and their handling; layout and operations in feed mill, (small, medium and large feed plants)
2	Automated feed mill: merits and demerits.
3	Procurement of feed ingredients: specification and guidelines.
4	Quality control of feed ingredients BIS standard.
5	Quality control of finished feeds BIS standard.
Unit II (4 Lectures)	
6	Principles and process of material handling, weighing, grinding, mixing, pelleting, packaging and other major processing operations.
7	Crumbling, flaking, popping and extrusion.
8	Preparation of Premixes.
9	Codex Alimentarius, HACCP.
Unit III (5 Lectures)	
10	Feed and fodder processing and preservation techniques.
11	Densification, chemical and biological treatment of feeds/ fodders.
12	Fodder conservation through silages
13	Microbiological evaluation of processed and preserved feeds
14	Effect of preservation on the nutritional value of feed.
Unit IV (4 Lectures)	
15	Feed storage and godown management; goods sanitation and hygiene of go-down.
16	Traditional and modern farm-level storage structures.
17	Factors affecting feedstuffs during storage. Liquid feed ingredients. Storage losses, insect pests and rodents control measures.
18	Mycotoxins in feedstuffs and its control measures.
Practical (18 Classes)	
1	Identification of feed ingredients and their specifications for different categories of livestock and poultry.
2	Quality control and inspection of feed materials.
3	Qualitative tests for adulterants urea, urease, thiram.
4	Identification of insect pests and fungi in stored products.
5	Feed microscopy.
6	Formulation and preparation of premixes.
7	Quality evaluation of silage and hay, Laboratory preparation of silage.
8	Visit to feed plant
9	Hands-on training on preparation of feed
10	Hands-on training on preparation of mineral mixture
11	Introduction to pelletisers.

12	Introduction to complete feed block equipments
13	Plant layout and design of different capacity of feed mills
14	Problems related to feasibility of feed mills.
15	Experiential learning at the feed plant for preparing urea molasses mineral blocks.
16	Experiential learning at the feed plant for preparing mineral mixture.
1	Preparation of project report on plant layout, problems related to feasibility.
18	Record-keeping in different sections of a feed mill.

Suggested Reading (ANN-604)

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

I. Course Title : Ruminant Nutrition
II. Course Code : ANN 605
III. Credit Hours : 2+1

Theory	
Unit I (5 Lectures)	
1	Functional anatomy of the digestive system of ruminants.
2	Introduction to rumen microflora and fauna.
3	Development of rumen and classification of rumen bacteria, protozoa and fungi
4	Degradation of various nutrients in rumen
5	Feeds and fodders for ruminant
Unit II (10 Lectures)	
6	Role and requirement of Water in ruminants.
7	Nutrient requirements and feeding of calves
8	Role of milk replacer, calf starter and preparation of milk replacers.
9	Nutrient requirements and feeding of heifer, dryand pregnant cows
10	Nutrient requirements and feeding oflactating cows
11	Nutrient requirements and feeding of heifer, dry and pregnant buffaloes
12	Nutrient requirements and feeding of lactating buffaloes
13	Nutrient requirements for lambs, dry, pregnant and lactating sheep
14	Nutrient requirements for kids, dry, pregnant and lactating goat.
15	Nutrition and feeding management of camels.
Unit III (4 Lectures)	
16	Voluntary feed intake.
17	Determination of digestibility,
18	Factors affecting digestibility.
19	Manipulation of rumen fermentation.
Unit IV (8 Lectures)	
20	Concept of complete feed, TMR and its advantages and disadvantages.
21	Precision feeding.
22	Phase feeding.
23	Limiting nutrients for high yielding ruminants.
24	Strategic feeding of high yielding ruminants
25	Feeding during transition phase
26	Concept of by-pass nutrients and their impact on production, reproduction and immune status - 1
27	Concept of by-pass nutrients and their impact on production, reproduction and immune status - 2
Unit V (9 Lectures)	
28	Nutritional approaches for increasing the functional properties of milk
29	Role of CLA

30	Role of omega fatty acids
31	Different system of feeding buffalo for beef production - 1
32	Different system of feeding buffalo for beef production - 1
33	Feeding of animals during stress
34	Feeding of animals during natural calamities.
35	Feeding of animals during scarcity
36	Feeding management of migratory/nomadic small ruminants
Practical (18 Classes)	
1	Feeding management of migratory/nomadic small ruminants
2	Design and planning of feeding experiments- RBD.
3	Design and planning of feeding experiments- LSD.
4	Design and planning of feeding experiments- Factorial methods.
5	Identification of feed and fodder based on its composition.
6	Ration formulation for cattle for different physiological stages.
7	Ration formulation for buffalo for different physiological stages
8	Ration formulation for sheep for different physiological stages
9	Ration formulation for goats for different physiological stages
10	Estimation of digestibility and nutritive value of feeds and fodders by metabolism trial in dairy cattle.
11	Determination of nutritive value of pastures by the use of range techniques.
12	Collection and processing of rumen liquor.
13	Estimation of rumen metabolic profile (pH, etc.)
14	Estimation of rumen metabolic profile (ammonia etc.)
15	Estimation of rumen metabolic profile (lactate)
16	Estimation of rumen metabolic profile (TVFA)
17	Artificial rumen technique
18	Estimation of purine derivatives.

Suggested Reading (ANN-605)

• Church DC. 1988. *The Ruminant Animal: Digestive Physiology and Nutrition*, 2nd ed.Prentice-Hall.
• Dehority BA. 2003. *Rumen Microbiology*. Nottingham University Press.
• D'Mello JPF. 2003. *Amino Acids in Animal Nutrition*, 2nd ed. CAB International.
• Givens D, Axford R and Owen E. (Ed.). 2000. *Forage Evaluation in Ruminant Nutrition*.CAB International.
• Hynd PI. 2019. *Animal Nutrition: From Theory to Practice*. CAB International.
• McDowell RL. 2012. *Nutrition of Grazing Ruminants in Warm Climates*. Academic Press.
• Moran J. 2005. *Tropical Dairy Farming: Feeding Management for Small Holder DairyFarmers in the Humid Tropics*. Landlinks Press
• NRC. 2001. *Nutrient Requirements of Dairy Cattle*, 7th rev. ed. National Research Council.National Academies Press.

• NRC. 2016. *Nutrient Requirements of Beef Cattle*, 8th rev. ed. National Academies of Sciences,Engineering, and Medicine. National Academies Press.
• NRC. 2007. *Nutrient Requirements of Small Ruminants: Sheep, Goats, Cervids, and New World Camelids*. National Research Council. National Academy Press.
• Pond WG, Church DB, Pond KR and Schoknecht PA. 2004. *Basic Animal Nutrition and Feeding*, 5th ed. Wiley.
• Shirley RL. 2012. *Nitrogen and Energy Nutrition of Ruminants*. Academic Press.10. Van Soest PJ. 1994. *Nutritional Ecology of the Ruminant*. Cornell University Press.

Course Title: Non-Ruminant Nutrition

I. **Course Code : ANN 606**

II. **Credit Hours : 2+1**

	Theory
Unit I (19 Lectures)	
1	Feeding of poultry for meat production 1
2	Feeding of poultry for meat production 2
3	Feeding of poultry for egg production 1
4	Feeding of poultry for egg production 2
5	Ideal protein concept
6	Standard ileal digestible amino acids.
7	Nutrient requirements for broilers.
8	Nutrient requirements for layers.
9	Feeding of breeder hens.
10	Nutritional factors affecting hatchability
11	Feeding systems for poultry.
12	Feeding of backyard poultry
13	Feed additives for poultry.
14	Nutritional approaches for designer egg
15	Nutritional approaches for designer meat production.
16	Nutritional disorders in poultry 1
17	Nutritional disorders in poultry 2
18	The role of nutrition in diseases prevention
19	Water intake and quality in poultry production.
Unit II 6 Lectures)	
20	Nutrition and feeding of swine in different stages of growth.
21	Nutrition and feeding of swine for production.
22	Feeding of piglets
23	Nutritional factors affecting the quality of the products,
24	Lean meat production.
25	Water intake and quality in pig production.
Unit III (11 Lectures)	
26	Feeding of equines 1
27	Feeding of equines 2
28	Feeding of rabbits.
29	Hindgut fermentation and its importance.
30	Nutrient requirements of equines.
31	Special features of equine feeding management.
32	Nutritional management of colic.
33	Nutritional management of other health disorders in horses

34	Nutrient requirements of rabbits for wool production.
35	Nutrient requirements of rabbits for meat production.
36	Nutrition-related disorders in rabbits.
Practical (18 Classes)	
1	Design and planning for feeding experiments in swine.
2	Design and planning for feeding experiments in layers
3	Design and planning for feeding experiments in broilers
4	Calculation of nutrient requirements for broilers.
5	Calculation of nutrient requirements for layers.
6	Formulation and compounding of general and least cost ration for broilers
7	Formulation and compounding of general and least cost ration for layers
8	Formulation and compounding of general and least-cost rations for swine
9	Calculation of different measures of protein quality 1
10	Calculation of different measures of protein quality 2
11	Determination of the nutritive value of poultry feeds by balance experiments.
12	Determination of the nutritive value of swine feeds by balance experiments.
13	Formulation of rations for horses.
14	Formulation of rations for rabbits.
15	Visit to layer farm.
16	Visit to broiler farm.
17	Visit piggery unit
18	Visit to feed and fodder stores.

Suggested Reading (ANN-606)

• Adamo G and Costanza A (Eds.). *Rabbits Biology, Diet and Eating Habits and Disorders*. Nova Biomedical.
• Cheeke PR. 1987. *Rabbit Feeding and Nutrition*. Academic Press, Inc.
• Chiba LI (Ed.). 2012. *Sustainable Swine Nutrition*. Wiley-Blackwell.
• de Blas C and Wiseman J. (Eds.). 2010. *Nutrition of the Rabbit*, 2nd ed. CAB International.
• D'Mello JPF. 2003. *Amino Acids in Animal Nutrition*, 2nd ed. CAB International.
• Frape D. 2010. *Equine Nutrition and Feeding*, 4th ed. Wiley-Blackwell.
• Hynd PI. 2019. *Animal Nutrition: From Theory to Practice*. CAB International.
• Leeson S and Summers JD. 2009. *Commercial Poultry Nutrition*, 3rd ed. Nottingham University Press.
• Leeson S and Summers JD. 2019. *Scott's Nutrition of The Chicken*, 4th ed. CBS Publishers and Distributors.
• NRC. 2007. *Nutrient Requirements of Horses*, 6th Rev. ed. National Research Council. National Academy Press.
• NRC. 1994. *Nutrient Requirements of Poultry*, 9th Rev. ed. National Research Council. National Academy Press.
• NRC. 2012. *Nutrient Requirements of Swine*, 11th Rev. ed. National Research Council. National Academy Press.
• Varga M. 2013. *Textbook of Rabbit Medicine*, 2nd ed. Butterworth-Heinemann.

Course Title: Research Methodology in Animal Nutrition

I. **Course Code : ANN 607**

II. **Credit Hours : 0+2**

Practical Unit I (7Practical)	
1	Principles of animal experimentation
2	Feeding experiments in Animal Nutrition, advantages and disadvantages (Comparative feeding trials)
3	Feeding trials with laboratory animals, Purified diet method
4	Feeding experiments in Animal Nutrition, advantages and disadvantages (Germ free technique, Group Vs Individual feeding, Controlled Vs Ad lib Feeding)
5	Feeding experiments in Animal Nutrition, advantages and disadvantages (Equalized paired or paired feeding, slaughter experiments)
6	Designs of experiments applied in Animal Nutrition Research
7	Common statistical tools for nutritional research.
Unit II (20Practical)	
8	Preparation of standard solutions. Preparation of percent solutions
9	Preparation of Normal Solutions acids and alkalis
10	Preparation of Molar Solutions acids and alkalis
11	Proximate analysis of feeds and fodders - Moisture Estimation
12	Proximate analysis of feeds and fodders - Ash and Acid Insoluble Ash Estimation
13	Proximate analysis of feeds and fodders - Crude Protein Estimation
14	Proximate analysis of feeds and fodders - Crude Fibre Estimation
15	Proximate analysis of feeds and fodders - Ether extract estimation, NFE Calculations
16	Cellwall partitioning using Van Soest methods - NDF Estimation
17	Cellwall partitioning using Van Soest methods - ADF Estimation
18	Cell wall partitioning using Van Soest methods - Cellulose Estimation, Hemicellulose calculation
19	Cellwall partitioning using Van Soest methods - Lignin Estimation
20	Markers in digestibility determination
21	*In-vitro* determination of digestibility and digestion kinetics
22	In *sacco* determination of digestibility and digestion kinetics
23	Determination of energy content of feed using bomb calorimeter
24	Determination of energy content of faeces using bomb calorimeter
25	Determination of energy content of urine using bomb calorimeter
26	Determination of blood metabolic profile
27	Determination of blood metabolic profile
Unit III (9Practical)	
28	Introduction and principles of GC
29	Introduction and principles of HPLC
30	Introduction and principles of AAS
31	Introduction and principles of ICP
32	Introduction and principles of Tracer Technique and Flame photometer
33	Introduction and principles of NIRS
34	Introduction and principles SF6 tracer technique

35	rumen-simulation technique
36	Amino acid analyzer

Suggested Reading(ANN-607)

• Bate ST and Clark RA. 2014. *The Design and Statistical Analysis of Animal Experiments*.Cambridge University Press.
• Hofmann A and Clokie S (Eds.). *Wilson and Walker's Principles and Techniques ofBiochemistry and Molecular Biology*, 8th ed. Cambridge University Press.
• Maynard LA, Loosli JK, Hintz HF and Warner RG. 1987. *Animal Nutrition*. Tata McGraw-Hill.
• McDonald P, Edwards RA, Greenhalgh JFD, Morgan CA, Sinclair LA and Wilkinson RG. 2011. *Animal Nutrition*, 7th ed. Benjamin Cummings.•Pounis G. 2018. *Analysis in Nutrition Research*. Academic Press.

I. **Course Title : Companion Animal Nutrition**

II. **Course Code : ANN 608**

III. **Credit Hours : 1+0**

Theory	
Unit I (6 Lectures)	
1	Philosophy of companion animal nutrition (dogs & cat)
2	Feeding habits and food pattern of companion animals (dogs & cat)
3	Digestion and absorption of nutrients in dogs and cats.
4	Nutrient requirements for dogs during different life stages: energy, protein, fat, minerals and vitamins.
5	Nutrient requirements for cats during different life stages: energy, protein, fat, minerals and vitamins.
6	Critical nutrients for cats.
Unit II (4 Lectures)	
7	Common feed ingredients and supplements for pets.
8	Homemade diets. Commercial pet foods: types and nutritional profile.
9	Processing techniques in pet food manufacturing. Nutraceuticals in pet foods
10	Pet food evaluation and quality control.
Unit III (4 Lectures)	
11	Feeding standards for companion animals (AAFCO)
12	Feeding management for dogs and cats of different age groups, viz., pregnancy, lactation, neonatal puppies and kitten, growth, adult maintenance
13	Feeding management for dogs and cats during stress and geriatrics including feeding behaviour.
14	Water requirements of dogs and cats
Unit IV (4 Lectures)	
15	Deficiencies and excesses of nutrients.
16	Nutritionally responsive disorders: inherited disorders of nutrient metabolism, diabetes mellitus, obesity, urinary tract health and kidney diseases.
17	Importance of colostrum and feeding of neonates and growing animals. Raising orphans
18	Parenteral nutrition for hospitalized pets. (Artificial feeding and feeding during emergency, Feeding and care of nursing mothers, Feeding of sick animals, Post - surgical nutrition Geriatric animal nutrition.

Suggested Reading (ANN-608)

• Buffington C, Holloway C, Abood S. 2004. *Manual of Veterinary Dietetics*. Elsevier.

• Case LP, Daristotle L, Hayek MG, Raasch MF. 2010. *Canine and Feline Nutrition: A Resource for Companion Animal Professionals*, 3rd ed. Elsevier.

• Case LP. 2005. *The Dog: Its Behavior, Nutrition, and Health*, 2nd ed. Blackwell Publishing.

• McNamara JP. 2013. *Principles of Companion Animal Nutrition*, 2nd ed. Pearson.

• NRC. 2006. *Nutrient Requirements of Dogs and Cats*. National Research Council. National Academy Press.

I. Course Title : Nutrition of Laboratory, Wild and Zoo Animals

II. **Course Code : ANN 609**

III. **Credit Hours : 2+1**

Theory	
Unit I (13 Lectures)	
1.	Digestive structure and functions of laboratory animals rats
2.	Digestive structure and functions of laboratory animals mice
3.	Digestive structure and functions of laboratory animals Guinea pigs
4.	Nutrient requirement of rats.
5.	Nutrient requirement of mice.
6.	Nutrient requirement of Guinea pigs.
7.	Feeding of rats.
8.	Feeding of mice.
9.	Feeding of Guinea pigs.
10.	Concept of purified diets for rats
11	Concept of purified diets for mice.
12	Concept of purified diets for Guinea pigs.
13	Nutrition of non - human primates.
Unit II (10 Lectures)	
14	Natural dietary habits of zoo carnivores 1
15	Natural dietary habits of zoo carnivores 2
16	Natural dietary habits of zoo herbivores 1
17	Natural dietary habits of zoo herbivores 2
18	Feeding schedule of various classes of captiveand zoo carnivores.
19	Feeding schedule of various classes of captiveand zoo herbivores.
20	Feeding schedule of various classes of captiveand zoo birds.
21	Feeding orphan and neonates.
22	Role of nutrition in themanagement of health disorders in zoo carnivores.
23	Role of nutrition in the management of health disorders in zoo herbivores.
24	Feeding of sick animals.
25	Feeding of old animals.
26	Parenteral nutrition.
Unit III (10 Lectures)	
27.	Feeding habits, and behaviour of wild carnivores.
28.	Feeding habits, and behaviour of wild herbivores.
29.	General aspects of digestive physiology of ruminant herbivores.
30.	General aspects of digestive physiology of non- ruminant herbivores.
31	General aspects of digestive physiology of carnivores.

32	Nutrition of mithun.
33	Nutrition of yak.
34	Nutritive characteristics of forages for wild animals.
35	Adequacy of forage plants for wild animals.
36	Adequacy of forage plants for zoo animals.
Practical	
1.	Formulation of balanced diets for rats.
2.	Formulation of balanced diets for mice.
3.	Formulation of balanced diets for Guinea pigs.
4.	Preparation of hygienic, balanced diets and feeding of rats.
5.	Preparation of hygienic, balanced diets and feeding of mice.
6.	Preparation of hygienic, balanced diets and feeding of Guinea pigs.
7.	Characteristics of ration formulation for wild and zoo carnivores.
8.	Characteristics of ration formulation for wild and zoo ruminant herbivores.
9.	Characteristics of ration formulation for wild and zoo non ruminant herbivores.
10.	Feeding schedules of wild and zoo carnivores.
11.	Feeding schedules of wild and zoo ruminant herbivores.
12.	Feeding schedules of wild and zoo non ruminant herbivores.
13.	Visit to zoological parks and wild life sanctuary.
14.	Visit to zoological wild life sanctuary.
15.	Collection of information on the feeding schedule of different categories of captive herbivores 1
16	Collection of information on the feeding schedule of different categories of captive herbivores 2
17	Collection of information on the feeding schedule of different categories of captive carnivores 1
18	Collection of information on the feeding schedule of different categories of captive carnivores 2

Suggested Reading (ANN 609)

• Barboza PS, Parker KL and Hume ID. 2008. *Integrative Wildlife Nutrition*. Springer.

• Clemons DJ and Seeman JL. 2011. *The Laboratory Guinea Pig*, 2nd ed. CRC Press/ Taylor and Francis.

• Gordon IJ and Prins HHT. 2008. *The Ecology of Browsing and Grazing*. Springer.

• Lane-Patter W and Pearson AEG. 1971. *The Laboratory Animal: Principles and Practice*, 2nd ed. Academic Press.

• NRC. 1995. *Nutrient Requirements of Laboratory Animals,* 4th rev. ed. National Research Council. National Academy Press.

• NRC. 2003. *Nutrient Requirements of Nonhuman Primates*. National Research Council. National Academy Press.

• NRC. 2011. *Guide for the Care and Use of Laboratory Animals,* 8th ed. National Research Council. National Academy Press.
• Pond WG, Church DB, Pond KR and Schoknecht PA. 2004. *Basic Animal Nutrition and Feeding*, 5th ed. Wiley.
• Robbins C. 1993. *Wildlife Feeding and Nutrition*, 2nd ed. Elsevier.
• Weichbrod RH, Thompson GAH and Norton JN (Eds.). 2018. *Management of Animal Care and Use Programs in Research, Education, and Testing*, 2nd ed. CRC Press/ Taylor and Francis.

Course Title: Non-Conventional Feed Resources

I. **Course Code : ANN 610**
II. **Credit Hours : 1+1**

Theory	
Unit I (8 Lectures)	
1.	Present and future feed requirements and current availability for livestock and poultry.
2.	Use of non-conventional feeds- byproducts of agriculture.
3.	Use of non-conventional feeds- byproducts of agro-industries.
4.	Use of non-conventional feeds- byproducts of food processing units.
5.	Use of non-conventional feeds- byproducts from forest.
6.	Use of non-conventional feeds- byproducts of slaughter house and aquatic weeds.
7.	Permissible levels of inclusion of various non-conventional feeds in the ration of different kinds of livestock.
8.	Formulation of economical rations using the non-conventional feed.
Unit II (6 Lectures)	
9.	Classification of toxic principles in animal feed-stuffs.
10.	Chemico-physical properties of various anti-nutritional factors (ANFs) 1
11.	Chemico-physical properties of various anti-nutritional factors (ANFs) 2
12.	Rumen microbial adaptation to various ANFs.
13.	Effect of anti-nutritional factors on health and production in livestock.
14	Effect of anti-nutritional factors on health and production in poultry.
Unit III (4 Lectures)	
15	Detoxification of toxic principles by various physical, chemical and biological techniques 1
16	Detoxification of toxic principles by various physical, chemical and biological techniques 2
17	Insecticide and pesticide residues in feeds andfodders.
18	Heavy metal residues in feeds and fodders.
Practical	
1	Qualitative methods for the presence/ detection of ANFs in feed-stuffs 1
2	Qualitative methods for the presence/ detection of ANFs in feed-stuffs 2
3	Estimation of mycotoxin (aflatoxin) in various feeds and fodders
4	Estimation of mycotoxin (ochratoxin) in various feeds and fodders
5	Estimation of nitrates in feed.
6	Estimation of HCN in feed.
7	Estimation of oxalates in feed 1
8	Estimation of oxalates in feed 2
9	Estimation of protease inhibitors in feed.
10	Estimation of tannins (spectrophotometer method) in feed.
11	Estimation of tanins (volumetric method) in feed

12	Estimation of saponins in feed.
13	Estimation of gossypol in feed.
14	Estimation of mimosine in feed.
15	Estimation of lead in feed.
16	Estimation of mercury in feed.
17	Estimation cadmium in feed.
18	Estimation of arsenic in feed.

Suggested Reading (ANN-610)

• Devendra C. 1985. *Non-conventional Feed Resources in Asia and the Pacific*, 2nd ed. APHCA, FAO.
• FAO. 1995. *Tropical Feeds and Feeding Systems*. Proceedings of the First FAO Electronic Conference. Food and Agriculture Organization of the United Nations, Rome.
• FAO. 2004. *Assessing Quality and Safety of Animal Feeds*. Food and Agriculture Organization of the United Nations, Rome.
• Liner IE. 1980. *Toxic Constituents of Animal Food Stuffs*, 2nd ed. Academic Press.
• Singh UB. 1987. *Advanced Animal Nutrition for Developing Countries*. Indo-Vision.
• Speedy A and Sansoucy R. 1991. *Feeding Dairy Cows in the Tropics*. Food and Agriculture Organization of the United Nations, Rome.
• *Select articles from journals*

I. Course Title : Introductory Clinical Nutrition
II. Course Code : ANN 611
III. Credit Hours : 1+0

Theory	
Unit I (9 Lectures)	
1	Metabolic disorders and peri-parturient diseases
2	Milk Fever
3	Ketosis,
4	downer cow syndrome,
5	Retained placenta, sub-acute ruminal acidosis,
6	Laminitis, Abomasal displacement,
7	Mastitis.
8	Nutrient parasite interaction.
9	Enterotoxaemia
Unit II (9 Lectures)	
10	Nutritional amelioration of biotic and abiotic stress
11	Nutritional amelioration of heat stress
12	Nutritional amelioration of cold stress
13	Nutritional amelioration of transportation stress
14	Potential plant toxicity to grazing animals.
15	Toxicity of grazing animals
16	Signs of poisoning, Nitrite poisoning
17	Toxic effects of goitrogens, glucosinolates.
18	Nutritional management of reproductive disorders.

Suggested Reading(ANN-611)

• Constable P, Hinchcliff KW, Done S and Gruenberg W. 2016. *Veterinary Medicine*, 11th ed.Saunders Ltd.
• Knight AP and Walter R. 2001. *A Guide to Plant Poisoning of Animals in North America*. Teton NewMedia.
• McDowell RL. 2012. *Nutrition of Grazing Ruminants in Warm Climates*. Academic Press.
• Select articles from Journals

Course Title: Rumen Biotechnology

I. **Course Code : ANN 612**
II. **Credit Hours : 1+0**

Theory	
Unit I (9 Lectures)	
1	Rumen ecology.
2	Manipulation of rumen fermentation for better utilization of fibrous feeds and reduction in methane production 1
3	Manipulation of rumen fermentation for better utilization of fibrous feeds and reduction in methane production 2
4	Biotechnological applications for lignin degradation.
5	Defaunation
6	Types of feed additives, advantages of use of feed additives in ruminants
7	Role of feed additives, chemicals, antibiotics and probiotics and their effect on rumen metabolism.
8	Role of feed additives, chemicals, antibiotics and probiotics and their effect on rumen metabolism.
9	Degradation of anti-nutritional factors in the rumen.
Unit II (9 Lectures)	
10	Genetic manipulation for improvement in rumen fermentation.
11	DNA extraction and quantification
12	DNA recombinant technology for improvement in rumen fermentation.
13	Factors influencing the fate of introduced microbes.
14	Nutrigenomics
15	Metagenomics for microbial diversity: concept
16	Metagenomics for microbial diversity: application.
17	Culturing rumen microbes 1
18	Culturing rumen microbes 2

Suggested Reading

• Dehority BA. 2003. *Rumen Microbiology*. Nottingham University Press.
• Dijkstra J, Forbes J and France J. 2005. *Quantitative Aspects of Ruminant Digestion and Metabolism*. CAB International.
• Kebreab E, Dijkstra J, Bannink A, Gerrits W and France J. 2006. *Nutrient Digestion and Utilization in Farm Animals*. CAB International.
• Millen DD, Arrigoni MDB and Pacheco RDL. (Eds.). 2016. *Rumenology*. Springer Nature.
• Van Soest PJ. 1994. *Nutritional Ecology of the Ruminant*. Cornell University Press.

Course Code: ANN 701

Course Title: Modern Concepts in Feeding of Ruminants
Credit Hours: 2+0

Sr. No.	Topics
Unit-1	**20 Lectures**
1	Developments in ruminant digestive physiology.
2	Advanced concepts in the determination of energy requirements.
3	Advanced concepts in the determination of protein requirements.
4	Importance of energy for milk production
5	Importance of energy for meat production
6	Importance of protein quality for milk production
7	Importance of protein quality for meat production
8	Recent concepts in protein and energy systems- CNCPS
9	Recent concepts in net energy
10	Recent concepts in metabolizable and available protein.
11	Methods of estimation of energy values of feeds for maintenance and growth in livestock.
12	Methods of estimation of energy values of feeds for reproduction in livestock.
13	Methods of estimation of energy values of feeds for lactation in livestock.
14	Methods of estimation of protein values of feeds for maintenance and growth in livestock.
15	Methods of estimation of protein values of feeds for reproduction in livestock.
16	Methods of estimation of protein values of feeds for lactation in livestock.
17	Kinetics of nutrient metabolism.
18	Hindgut fermentation.
19	Efficiency of nutrient utilization for different production purposes.
20	Hormonal regulation of nutrient partitioning.
Unit-2	**16 Lectures**
21	Concept of limiting amino acids for high yielders.
22	Concept of limiting amino acids for high yielders.
23	Strategic feeding of high yielding dairy cows
24	Strategic feeding of high yielding dairy cows
25	Strategic feeding of meat-producing ruminants.
26	Concept of phase feeding
27	Concept of phase feeding
28	Concept of precision feeding
29	Feeding during the transition period.

30	Feeding during the transition period.
31	Bypass nutrient technology.
32	Bypass nutrient technology.
33	Rumen manipulation to optimize productivity
34	Rumen manipulation to optimize productivity
35	Rumen manipulation to reduce methanogenesis.
36	Rumen manipulation to reduce methanogenesis.

Suggested Reading ANN 701

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

Course Code: ANN 702
Course Title: Forages in Animal Nutrition
Credit Hours: 1+0

Sr. No.	Topics
Unit I	**10 Lectures**
1	Forages in ruminant production.
2	Improvement in productivity of fodders and pasture feed-food crops,:
3	Improvement in productivity of silvi-pasture, horti-pasture, shrubs.
4	Use of conserved forages in ruminant feeding.
5	Factors affecting the nutritive value of cultivated and conserved forages
6	Hydroponics as an alternate to green fodder production.
7	Top feeds, fodder trees and their effective utilization.
8	Tree leaves as a source of condensed tannins:
9	Role of condensed tannins in tree leaves in protein protection
10	Role of condensed tannins in tree leaves in GI parasite control.
Unit II	**8 Lectures**
11	Methods in forage evaluation:
12	Methods in forage evaluation:
13	Method of calculation of in-vitro DOMD
14	Calculation of ME by using in-vitro gas production technique.
15	Calculation of ME by using in-vitro gas production technique.
16	Pasture consumption method
17	Pasture evaluation studies.
18	Pasture evaluation studies.

Suggested Reading ANN 702

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

Course Code: ANN 703
Course Title: Recent Concepts in Feeding of Non-Ruminants
Credit Hours: 1+0

Sr. No.	Topics
Unit I	**(10 Lectures)**
1	Latest concepts in nutrition and feeding in different phases of broilers
2	Latest concepts in nutrition and feeding in different phases of layers
3	Latest concepts in nutrition and feeding in different phases of breeder stock
4	Developments in-ovo nutrition and Recent developments in early chick nutrition
5	Nutritional disorders in modern poultry production and their amelioration.
6	Nutritional factors affecting egg quality and hatchability in poultry
7	Feeding strategies for the production of designer eggs and significance of omega fatty acids
8	Feeding strategies for the production of designer eggs and significance of omega fatty acids
9	Recent trends in amino acid nutrition in poultry
10	Advances in new generation feed additives.
Unit II	**(8 Lectures)**
11	Nutrition and feeding of piglets.
12	Nutrition and feeding of grower, finisher pigs and pigs for breeding
13	Nutrition and feeding of pregnant and lactating sows
14	Modern concepts in amino acids nutrition in swine production.
15	Emerging concepts in feed and feed additive for pigs.
16	Role of vitamins and minerals in health and disease.
17	Role of vitamins and minerals in health and disease.
18	Nutritional manipulation for lean meat and designer pork production, Carcass modifiers

Suggested Reading ANN 703

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

Course Code: ANN 704
Course Title: Advances in Rumen Metabolism
Credit Hours: 1+1

Sr. No.	Lectures
Unit-1	**9 Lectures**
1	Rumen development.
2	Rumen microflora: classification
3	Role of rumen microflora in fermentation and digestion, microbial interactions,
4	Rumen kinetics,(Contd...)
5	Rumen kinetics,
6	Nutrient requirement of rumen microbes.
7	Dynamics of nitrogen metabolism in the rumen(Contd...)
8	Dynamics of nitrogen metabolism in the rumen
9	Dynamics of nitrogen metabolism in the rumen
Unit-2	**9 Lectures**
10	Manipulation of rumen fermentation: physical approach
11	Manipulation of rumen fermentation:chemical approach
12	Manipulation of rumen fermentation: biological approach
13	Trans-faunation
14	Defaunation.
15	Concept of metagenomics in rumen manipulation.
16	Green-house gas production from rumen
17	Methane mitigation strategies
18	Methane mitigation strategies
Practical	**18 Classes**
1	Measurement of rumen microbial count.
2	Measurement of rumen protozoal count
3	Determination TVFA by chromatography.(Contd...)
4	Determination TVFA by chromatography
5	Estimation of ammonia in rumen liquor.
6	Estimation of rumen microbial protein
7	Study on protection of protein by physical means in relation to degradability. (Contd...)
8	Study on protection of protein by physical means in relation to degradability
9	Study on protection of protein by chemical means in relation to degradability. (Contd...)
10	Study on protection of protein by chemical means in relation to degradability
11	Estimation of rumen fermentation products-TVFA by artificial rumen techniques(Contd...)
12	Fractionation of rumen Volatile Fatty Acids
13	Estimation of rumen fermentation products- Ammonia by artificial rumen techniques. (Contd...)

14	Estimation of rumen fermentation products- Ammonia by artificial rumen techniques
15	Estimation of rumen fermentation products- Ammonia by artificial rumen techniques
16	Rumen enzyme assay.
17	Rumen enzyme assay.
18	Extraction of nucleic acids and quantification of rumen microbes by PCR technique

Suggested Reading ANN 704

• Dehority BA. 2003. *Rumen Microbiology*. Nottingham University Press.
• Dijkstra J, Forbes J and France J. 2005. *Quantitative Aspects of Ruminant Digestion and Metabolism*. CAB International.
• Kebreab E, Dijkstra J, Bannink A, Gerrits W and France J. 2006. *Nutrient Digestion and Utilization in Farm Animals*. CAB International.
• Millen DD, Arrigoni MDB and Pacheco RDL. (Eds.). 2016. *Rumenology*. Springer Nature.
• Van Soest PJ. 1994. *Nutritional Ecology of the Ruminant*. Cornell University Press.

Course Code: ANN 705
Course Title: Advances in Mineral and Vitamin Nutrition
Credit Hours: 2+0

Sr. No.	Topics
Unit I	**18 Lectures**
1	Role of minerals in nutrient metabolism.
2	Absorption, transport, metabolism and regulation of various macrominerals in animal body
3	Absorption, transport, metabolism and regulation of various macrominerals in animal body
4	Absorption, transport, metabolism and regulation of various microminerals in animal body
5	Absorption, transport, metabolism and regulation of various microminerals in animal body
6	Bio-availability of macro and micro minerals
7	factors affecting the bioavailability of minerals
8	Bio-markers for mineral status.
9	Mineral interactions.
10	Dietary cation-anion difference (DCAD).
11	Identification and correction of deficiencies and toxicities of minerals.
12	Mineral tolerance in animals.
13	Mineral requirements for growth
14	Mineral requirements for reproduction
15	Mineral requirements for lactation
16	Mineral toxicities concerning livestock feeding
17	Amelioration of mineral toxicities in livestock
18	Methods of mineral supplementation.
Unit II	**18 Lectures**
1	Chemical nature of fat-soluble vitamins
2	Chemical nature of water-soluble vitamins.
3	Role of vitamins in nutrient metabolism.
4	Advances in physiological functions and metabolism of vitamins
5	Fat soluble vitamin deficiencies, clinical signs and their management
6	Fat soluble vitamin deficiencies, clinical signs and their management
7	Water soluble vitamin deficiencies, clinical signs and their management
8	Water soluble vitamin deficiencies, clinical signs and their management
9	Water soluble vitamin deficiencies, clinical signs and their management
10	Antimetabolites to vitamins
11	Hypervitaminosis.
12	Vitamins as antioxidants.
13	Role of vitamins in immunity

14	Role of vitamins in stress
15	Dietary supplementation of water soluble vitamins: forms, storage and stability
16	Dietary supplementation of water soluble vitamins: forms, storage and stability
17	Dietary supplementation of fat soluble vitamins: forms, storage and stability
18	Dietary supplementation of fat soluble vitamins: forms, storage and stability

Suggested Reading ANN 705

• McDowell RL. 1989. *Vitamins in Animal Nutrition*. Academic Press.
• McDowell LR. 2003. *Minerals in Animal and Human Nutrition*, 2nd ed. Elsevier Science B.V.
• Suttle N. 2010. *The Mineral Nutrition of Livestock*, 4th ed. CAB International

Course Code: ANN 706
Course Title: Advanced Clinical Nutrition
Credit Hours: 1+1

Sr. No.	Topics
Unit-1	**7- Lectures**
1	Metabolic disorders in farm animals.
2	Metabolic disorders in farm animals.
3	Modern concepts in the metabolic alterations in milk fever
4	Modern concepts in the metabolic alterations in ketosis
5	Modern concepts in the metabolic alterations in downers cow syndrome, retained placenta, sub-acute ruminal acidosis and laminitis
6	Modern concepts in the metabolic alterations in abomasal displacement, mastitis
7	Optimum nutrition for peri-parturient dairy animals.
Unit-2	**6 Lectures**
8	Metabolic effects of infection: metabolism of carbohydrates, fats, proteins
9	Metabolic effects of infection: amino acids and minerals during various infection and inflammatory diseases.
10	Role of cytokines in nutrient homeorrhesis and Nutrition-immunity interaction
11	Role of nutrients fats and amino acids in the immune response.
12	Role of nutrients minerals and vitamins in the immune response.
13	Metabolic alterations during abiotic stress and Feeding management during stress situations
Unit-3	**5 Lectures**
14	Nutritional manipulation and feeding of sick and hospitalized animals.
15	Preventive and therapeutic nutrition.
16	Optimum nutrition for the management of diseases of the hepatic, renal and gastrointestinal system.
17	Convalescence diet and Feeding, management of pre- and post-operated animals.
18	Nutritional intervention in skin and cardiac disorders
Practical	**16 Classes**
1	Assessment of immunity by humoral immune response
2	Assessment of immunity by humoral immune response (continued...)
3	Assessment of immunity by cell mediated immune response
4	Assessment of immunity by cell mediated immune response (continued...)
5	Assessment of antioxidant status by estimation of Superoxide dismutase
6	Assessment of antioxidant status by estimation of Superoxide dismutase (continued)
7	Assessment of antioxidant status by estimation of Catalase
8	Assessment of antioxidant status by estimation of Catalase (continued...)
9	Assessment of antioxidant status by estimation of Glutathione peroxidase
10	Assessment of antioxidant status by estimation of Glutathione peroxidase (continued)
11	Assessment of antioxidant status by estimation of reduced glutathione (GSH)

12	Assessment of antioxidant status by estimation of reduced glutathione (GSH) cont..
13	Assessment of antioxidant status by estimation of lipid peroxides.
14	Assessment of antioxidant status by estimation of lipid peroxides. (continued...)
15	Assessment of antioxidant status by estimation of lipid peroxides. (continued...)
16	Formulation of diet for sick and diseased animals.
17	Formulation of diet for sick and diseased animals. (continued...)
18	Formulation of diet for sick and diseased animals. (continued...)

Suggested Reading ANN 706

Cheeke PR and Dierenfeld E. 2010. *Comparative Animal Nutrition and Metabolism*. CAB International.
• Constable P, Hinchcliff KW, Done S and Gruenberg W. 2016. *Veterinary Medicine*, 11th ed. Saunders Ltd.
• Naylor JM and Ralston SL. 1991. *Large Animal Clinical Nutrition*. Mosby Inc.
• Walker S, Beckett G, Rae P and Ashby P. 201. *Clinical Biochemistry: Lecture Notes*, 9th ed. Wiley-Blackwell

Course Code: ANN 707
Course Title: Advanced Techniques in Nutritional Research
Credit Hours: 1+1

Sr. No.	Lectures
Unit-1	**18- Lectures**
1	Good laboratory practices.
2	Analytical equipment in animal nutrition research.
3	Estimation of minerals using atomic absorption spectrophotometer
4	Estimation of minerals using atomic absorption spectrophotometer
5	Estimation of minerals using ICP.
6	Principles and applications and of GC
7	Principles and applications and of GC (continued...)
8	Principles and applications and of HPLC
9	Principles and applications and of HPLC (continued...)
10	Principles and applications and of amino acid analyser
11	Principles and applications and of SF-6
12	Principles and applications and of SF-6 (continued...)
13	Principles and applications and of SF-6 (continued...)
14	Principles and applications and of electron microscopy
15	Remote sensing and geographic information system (GIS) in animal nutrition research.
16	Analysis of feeds and fodders using NIR.
17	Analysis of feeds and fodders using NIR. (continued...)
18	Faecalinoculumas an alternative to rumen liquor for in-vitro studies.
Practical	**18 Classes**
1	Invitro digestibility determination using RUSITEC
2	Invitro digestibility determination using Tilley and Terry method
3	Sampling of feed and fodder sample for mineral estimation
4	Digestion and preparation of mineral aliquot for mineral estimation using AAS
5	Estimation of macro-minerals by atomic absorption spectrophotometer.
6	Estimation of micro-minerals by atomic absorption spectrophotometer.
7	Estimation of aflatoxins by HPLC
8	Estimation of aflatoxins by thin layer chromatography method
9	Estimation of ocharotoxins
10	Estimation of oxalate
11	Estimation of oxalate cont...
12	Estimation of nitrates
13	Estimation of tannin.
14	Estimation of volatile fatty acid
15	Estimation of volatile fatty acid cont...

16	Estimation of mimosine
17	Estimation of vitamins-A
18	Estimation of vitamin-C.

Suggested Reading

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

Course Code: ANN 708
Course Title: Advances in Feed Technology
Credit Hours: 1+0

Sr. No.	Topics
Unit-1	**10 Lectures**
1	Good manufacturer practices (GMP) in feed plants.
2	Planning and designing of feed plants of different capacities.
3	Recent developments in feed processing: particle size reduction, pelleting, extrusion, expanding, conditioning, micronizing
4	Post pelleting applications.Automation in feed processing.
5	Flow charts for preparation of feeds for various species
6	Mixer efficiency test, pellet durability test.
7	Densification of bulk feeds.
8	Densification of bulk feeds cont..
9	Silos of various capacity, silage preparation and silage additives.
10	Laws and regulations of the feed manufacturing industry, Introduction to labour laws and standards,
11	Planning and production programme, Record-keeping.
Unit-2	**07 Lectures**
12	Roughage processing, Whole plant processing.
13	Solid-state fermentation technology.
14	Preparation of complete feeds and its processing.
15	Formulation of premixes. Carriers and diluents. Liquid feed handling.
16	Formulation of premixes. Carriers and diluents. Liquid feed handling cont..
17	Latest concepts in feed microscopy.
18	Qualitative tests for rancidity.

Suggested Reading ANN 708

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

Course Code: ANN 709
Course Title: Toxicants and Anti-Metabolites in Animal Nutrition
Credit Hours: 1+0

Sr. No.	Topics
Unit-1	**14 Lectures**
1	Classification of toxicants in animal feeds.
2	Plant origin toxicants, and their effects on animal health and production. (Conti....)
3	Plant origin toxicants, and their effects on animal health and production.
4	Microbial origin toxicants and their effects on animal health and production.
5	Microbial origin toxicants and their effects on animal health and production.
6	Acquired toxicants (heavy metals) and their effects on animal health and production. (Conti....)
7	Acquired toxicants (heavy metals) and their effects on animal health and production.
8	Acquired toxicants (pesticide residues) and their effects on animal health and production. (Conti....)
9	Acquired toxicants (pesticide residues) and their effects on animal health and production.
10	Acquired toxicants (drug residues) and their effects on animal health and production.
11	Ameliorative measures.
12	Detoxification of plant origin toxicants
13	Residual effects on animal products and the environment.
14	Residual effects on animal products and the environment.
Unit-2	**4 Lectures**
15	Anti-metabolites in animal feedstuffs.
16	Effects of anti-metabolites on animal health
17	Effects of anti-metabolites on production and reproduction
18	Anti-vitamins and their occurrence in feedstuffs

Suggested Reading ANN-709

• Cheeke PR and Shull LR. 1985. *Natural Toxicants in Feeds And Poisonous Plants*. AVI Publishing Company Inc.
• FAO. 2004. *Assessing Quality and Safety of Animal Feeds*. Food and Agriculture Organization of the United Nations, Rome.
• Gremmels JF (Ed.). 2010. *Animal Feed Contamination Effects on Livestock and Food Safety*. Woodhead Publishing Ltd.
• Keeler RF, Van Kampen KR and James LF. 1978. *Effects of Poisonous Plants on Livestock.* Academic Press.
• Knight AP and Walter R. 2001. *A Guide to Plant Poisoning of Animals in North America*. Teton NewMedia.
• Liner IE. 1980. *Toxic Constituents of Animal Food Stuffs*, 2nd ed. Academic Press.
• Osweiler G. (Ed.) 2011. *Ruminant Toxicology*. *An issue of Veterinary Clinics: Food Animal Practice*. Elsevier.

Course Code: ANN 710
Course Title: Nutrigenomics in Animal Nutrition
Credit Hours: 1+0

	ANN 710 (1+0)
Sr No.	**Topics**
Unit 1	**4 Lectures**
1	Basic concepts of genetics
2	Basic concepts of molecular biology.
3	Nucleic acid structure and replication.
4	Transcription and translation.
Unit 2	**8 Lectures**
5	Introduction to nutrigenomics
6	Significance of nutrigenomics in animal nutrition
7	Introduction to nutrigenetics.
8	Nutritional regulation of gene expression.
9	Nutritional regulation of gene expression.
10	Introduction to epigenetics
11	Influence of epigenetics on early life nutrition
12	Influence of epigenetics on health
Unit 3	**4 Lectures**
13	Concepts of proteomics
14	Concepts of proteomics
15	Concepts of metabolomics.
16	Microbiome and diseases of nutritional importance.
17	Microbiome and diseases of nutritional importance.
18	Dietary influences on the microbiome.

Suggested Reading ANN-710

• Carlberg C, Ulven SM and Molnár F. 2016. *Nutrigenomics*. Springer
• Caterina RDE, Martinez, JA and Kohlmeier M.(Eds.) 2020. *Principles of Nutrigenetics and Nutrigenomics*. Elsevier Inc.
• Dodds JW and Laverdure DR. 2015. *Canine Nutrigenomics - The New Science of Feeding Your Dog for Optimum Health*. Dogwise Publishing.
• Select articles from Journals

Course Code : ANN 711
Course Title : Equine Nutrition
Credit Hours : 1+0

	ANN 711 (1+0)
Unit I	**8 Lectures**
1	Digestive function and metabolism of nutrients.
2	Nutrient requirements of foals
3	Nutrient requirements of yearlings
4	Nutrient requirements of mare and stallions
5	Nutrient requirements of pregnant mare
6	Nutrient requirements of lactating mare
7	Feed ingredient for horses.
8	Digestive disorders.
9	Digestive disorders.
Unit II	**8 Lectures**
10	Feeding of foal
11	Feeding of yearlings
12	Feeding of mares and stallions for production and reproduction
13	Feeding for performance and nutrient metabolism during exercise.
14	Nutritional management of race-horses
15	Diet formulation for foals & yearlings
16	Diet formulation for race horses
17	Nutritional disorders, prevention and remedial measures
18	Nutritional disorders, prevention and remedial measures

Suggested Reading ANN-711

• Frape D. 2010. *Equine Nutrition and Feeding*, 4th ed. Wiley-Blackwell.
• Geor R, Harris P and Coenen M (Eds). 2013. *Equine Applied and Clinical Nutrition*. Saunders, Elsevier.
• NRC. 2007. *Nutrient Requirements of Horses*, 6th Rev. ed. National Research Council. National Academy Press.
• Pagan JD. (Ed.). 2009. *Advances in Equine Nutrition IV*. Kentucky Nutrition Research.

4. College Classes Time Table :UG, PG , PhD - Year wise / Semester Wise

The timetable for M.V.Sc. Courses by Department of Animal Nutrition during the semester 2 (2023-24) is as under

Courses offered:

Sem no.	Course no.	Course title	Credits	Course teacher
2	ANN-606	Non-Ruminant Nutrition	2+1=3	Dr. K.Y.Deshpande
2	ANN-607	Research Methodology in Animal Nutrition	0+2=2	Dr. S.A.Amrutakar
2	ANN-608	Companion Animal Nutrition	1+0=1	Dr. S.A. Amrutkar
2	ANN-610	Non-Conventional Feed Resources	1+1=2	Dr. S.A. Amrutkar
2	ANN-611	Introductory Clinical Nutrition	1+0=1	Dr. K.Y.Deshpande

TIME TABLE

DAY	10 - 11	11 - 12	12 - 13	13 - 14	14 – 15	15 - 16	16 - 18
Mon	ANN-606(T)						ANN-606(P)
Tue					ANN-607(P)		
Wed		ANN-608(T)					
Thu	ANN- 606(T)						ANN-607(P)
Fri			ANN-611(T)			ANN-610(T)	ANN-610(P)

T-Theory

P-Practical

The timetable for M.V.Sc. Courses by Department of Animal Nutrition during the semester 3 (2024-25) is as under

Courses offered:

Sem no.	Course no.	Course title	Credits	Course teacher
3	ANN-691	Master's seminar	1+0=1	Dr.K.Y.Deshpande

TIME TABLE

DAY	10 - 11	11 - 12	12 - 13	13 - 14	14 – 15	15 - 16	16 - 18
Mon							
Tue							
Wed		ANN-691					
Thu							
Fri							