Academic:

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

- **List of UG Courses (B.V.Sc & AH)**

Sr No	Course No.	Title	Credit	Course offered in the Year
1	ANN - I	**Animal Nutrition Paper - I** (New VCI-2016 syllabus for Unit-I & Unit- II) Unit -1 (Principles of Animal Nutrition & Feed Technology) and Unit-2 (Applied Ruminant Nutrition-I)	3+1= 04	II Year - B.V.Sc. & A.H. (Since 2016)
2	ANN - II	**Animal Nutrition Paper - II** (New VCI-2016 syllabus for Unit- III & Unit-IV) Unit -III (Applied Ruminant Nutrition- II) and Unit - IV (Applied Non-Ruminant Nutrition)	3+1= 04	II Year - B.V.Sc. & A.H. (Since 2016)

- **List of PG Courses (M. V. Sc)**

Sr No	Course No .	Title	Credit	Semester
1.	ANN-601	Nutritional Biochemistry	1+0=1	I
2.	ANN-602	Energy and Protein Nutrition	2+0=2	I
3.	ANN-603	Minerals and Vitamin Nutrition and Feed Additives	2+1=3	I
4.	ANN-604	Feed and Fodder Technology	1+1=2	I
5.	ANN-605	Ruminant Nutrition	2+1=3	I
6.	ANN -606	Non-Ruminant Nutrition	2+1=3	II
7.	ANN -607	Research Methodology in Animal Nutrition	0+2=2	II
8.	ANN- 608	Companion Animal Nutrition	1+0=1	II
9.	ANN -609	Nutrition of Laboratory, Wild and Zoo Animals	2+1=3	II
10.	ANN- 610	Non-Conventional Feed Resources	1+1=2	II
11.	ANN -611	Introductory Clinical Nutrition	1+0=1	II
12.	ANN -612	Rumen Biotechnology	1+0=1	II
13.	ANN -691	Master Seminar	1+0=1	III
14	ANN-699	Masster’s Research	0+10 = 10	III
15	ANN-699	Masster’s Research	0+20 = 20	IV

List of Ph. D. Courses (Ph. D.)

Sr No	Course No .	Title	Credit	Semester
1.	ANN 701	Modern Concepts in Feeding of Ruminants	2+0 = 02	I
2.	ANN 702	Forages in Animal Nutrition	1+0 = 01	I
3.	ANN 703	Recent Concepts in Feeding of Non-Ruminants	1+0 = 01	I
4.	ANN 704	Advances in Rumen Metabolism	1+1 = 02	I
5.	RPE 700	Research and Publication Ethics	1+1 = 02	II
6.	ANN 705	Advances in Mineral and Vitamin Nutrition	2+0 = 02	II
7.	ANN-706	Advanced Clinical Nutrition	1+1 = 02	II
8.	ANN-707	Advanced Techniques in Nutritional Research	1+1 = 02	II
9.	ANN -708	Advances in Feed Technology	1+0 = 01	II
10.	ANN- 709	Toxicants and Anti- Metabolites in Animal Nutrition	1+0 = 01	II
11.	ANN- 710	Nutrigenomics in Animal Nutrition	1+0 = 01	II
12.	ANN- 711	Equine Nutrition	1+0 = 01	II
13.	ANN -791	Doctoral Seminar-I	1+0 = 1	III
14.	ANN -792	Doctoral Seminar-II	1+0 = 1	III
15.	ANN- 799	Doctoral Research	0+15 = 15	III
16.	ANN- 799	Doctoral Research	0+20 = 20	IV
17.	ANN- 799	Doctoral Research	0+20 = 20	V
18.	ANN- 799	Doctoral Research	0+20 = 20	VI

2. **Lecture Schedule – Undergraduate (B.V.Sc. & A. H), P Theory / Practical Schedule**– Approved by BoS – Subject wise

Undergraduate (B.V.Sc. & A. H)

UNIT - 1

Title of Unit: Principles of Animal Nutrition and Feed Technology

Sr. No.	Topics
1	History of Animal Nutrition.
2	Importance of nutrients in animal production and health.
3	Composition of animal body and plants
4	Nutritional terms and their definitions
5	Nutritional aspects of carbohydrates, Protein, Fat
6	Role and requirements of water, metabolic water
7	General importance of minerals in animal health and production, Classification of minerals.
8	Major minerals, Importance of Calcium and Phosphorus in animal health and production, their requirement and supplementation in feed.
9	Importance of Sodium, Potassium, Chlorine, Sulfur and Magnesium in animal health and production, their requirement and supplementation in feed.
10	Trace minerals, Importance of Iron, Copper, Cobalt and Selenium in animal health and production, their requirement and supplementation in feed.
11	Importance of Iodine, Zinc, Manganese, Fluorine and Molybdenum in animal health and production, their requirement and supplementation in feed.
12	General importance of vitamins in animal health and production, Classification of vitamins.
13	Fat soluble vitamins, Importance of Vitamin A and D in animal health and production, their requirement and supplementation in feed.
14	Importance of Vitamin E and K in animal health and production, their requirement and supplementation in feed.
15	Importance of Thiamine, Riboflavin, Niacin and Pantothenic acid in animal health and production, their requirement and supplementation in feed.
16	Importance of Biotin, Pyridoxine, Folic acid, Cyanocobalamin and Choline and Vit. C in animal health and production, their requirement and supplementation in feed.
17	Common feeds and fodders and its classification,
18	Various types of concentrates and roughages, its importance for livestock health and production and availability.
19	Measures of food energy and their applications, gross energy, digestible energy , metabolizable energy and net energy.
20	Total digestible nutrients, Starch equivalent
21	Food units and physiological fuel value.

22	Direct calorimetry.
23	Indirect calorimetry, Carbon nitrogen balance studies.
24	Protein evaluation of feeds- Measures of protein quality in non-ruminants, Biological value of protein, protein efficiency ratio, protein equivalent.
25	Calorie protein ratio and nutritive ratio.
26	Measures of protein quality in ruminants- Digestible crude protein, RDP and UDP, metabolizable protein.
27	Introduction to feed technology- feed industry. Processing of concentrates and roughages.
28	Various physical methods of feed processing for improving the nutritive value of inferior quality roughages.
29	Various chemical and biological methods of feed processing for improving the nutritive value of inferior quality roughages
30	Preparation, storage and conservation of livestock feed through silage and its use in livestock feeding.
31	Preparation, Storage and conservation of livestock feed trough hay and its use in livestock feeding.
32	Harmful natural constituents and common adulterants in Roughages
33	Harmful natural constituents and common adulterants in Concentrates
34	Feed additives in the rations of livestock and their uses.
35	Feed additives in the rations of poultry and their uses.

UNIT - 2

Title of Unit: Applied Ruminant Nutrition- I

Sr. No.	Topics
36	Scientific feeding & its Importance.
37	Feeding experiments, different methods of feeding experiments.
38	Feeding experiments, different methods of feeding experiments.
39	Digestion & metabolism trials, norms adopted in digestion trial.
40	Norms adopted in digestion trial.
41	Measurement of digestibility by conventional methods.
42	Indicator method of determining digestibility.
43	Determining pasture consumption & its digestibility.
44	Factors affecting digestibility of feed.
45	Feeding standards and its classification.
46	Uses, significance, merits and demerits of various feeding standards with reference to ruminants.
47	Balanced ration & its characteristics.

UNIT -3

Title of Unit: Applied Ruminant Nutrition- II

Sr. No.	Topics
48	Energy and protein requirement of livestock for maintenance.
49	Energy and protein requirement of livestock for production.
50	Methods adopted for arriving energy requirement for maintenance.
51	Methods adopted for arriving protein requirement for maintenance.
52	Methods adopted for arriving energy requirements for production in terms of growth and reproduction.
53	Methods adopted for arriving protein requirements for production in terms of growth and reproduction.
54	Methods adopted for arriving energy requirements for production in terms of milk and meat.
55	Methods adopted for arriving protein requirements for production in terms of milk and meat.
56	Methods adopted for arriving energy & protein requirements for production in terms of wool and draft purpose.
57	Feeding of dairy cattle & buffalo- Calf stage (up to weaning)
58	Feeding of dairy cattle & buffalo- Growth stage and adult animal
59	Feeding of dairy cattle & buffalo- pregnant, dry and lactating animals
60	Feeding of dairy cattle & buffalo- breeding bulls & working animals.
61	General principles of computation of rations.
62	Formulation of ration for dairy cattle.
63	Formulation of ration for dairy cattle
64	Formulation of ration for lactating buffaloes.
65	Formulation of ration for cattle & buffalo- breeding bulls & working animals
66	Feeding of high yielding animals and role of bypass nutrients.
67	Feeding of goat- kid, grower, adult, pregnant, lactating goat, buck.
68	Formulation of ration for goat.
69	Feeding of sheep - pregnant, lactating ewes.
70	Formulation of ration for sheep and lambs.
71	Metabolic disorders and nutritional interventions in ruminants.
72	Importance and utilization of NPN compounds for ruminants.

UNIT -4

Title of Unit: Applied Non-ruminant Nutrition

Sr. No.	Topics
73	Methods adopted for arriving at energy requirement for maintenance.
74	Methods adopted for arriving at protein requirement for maintenance.
75	Methods adopted for arriving at energy requirement for growth, reproduction, egg, meat and work
76	Methods adopted for arriving at protein requirement for growth, reproduction, egg, meat and work
77	Feeding standards for poultry.
78	Energy requirement for maintenance and production for Poultry.
79	Protein requirement for maintenance and production for Poultry
80	Feeding of poultry- Broiler (with conventional and un-conventional feeds).
81	Feeding of poultry- Broiler (with conventional and un-conventional feeds).
82	Feeding of poultry- Layer (with conventional and un-conventional feeds).
83	Feeding of poultry- Layer (with conventional and un-conventional feeds).
84	Feeding of duck, quail and turkey.
85	Formulation of ration for poultry as per BIS and ICAR specifications.
86	Formulation of ration for poultry as per BIS and ICAR specifications
87	Feeding standards for non-ruminants
88	Energy requirement for maintenance and production for Swine.
89	Protein requirement for maintenance and production for Swine
90	Feeding of swine- piglets and growers, (with conventional and un-conventional feeds).
91	Feeding of swine- pregnant sows and lactating sow (with conventional and un-conventional feeds).
92	Feeding of swine- breeding boar and fattening animals (with conventional and un-conventional feeds).
93	Formulation of ration for swine as per BIS and ICAR specifications.
94	Formulation of ration for swine as per BIS and ICAR specifications
95	Energy and protein requirement for maintenance and production for Equine.
96	Feeding of equine- foal, yearling and brood mare (with conventional and un-conventional feeds).
97	Feeding of equine- stallion and race horses (with conventional and un-conventional feeds).
98	Formulation of ration for horse as per BIS and ICAR specifications
99	Nutrient requirement, feeding practices and diet formulation for mice and rat.

100	Nutrient requirement, feeding practices and diet formulation for rabbit.
101	Nutrient requirement, feeding practices and diet formulation for guinea pig.
102	Nutritional requirement and feeding of various breeds of dogs – pups and growing dogs.
103	Nutritional requirement and feeding of various breeds of dogs – adult dogs, pregnant and lactating bitches.
104	Nutritional requirement and peculiarities of feeding cats.
105	Feeding of wild animals in captivity – Carnivores.
106	Feeding of wild animals in captivity – Herbivores and Omnivores.
107	Feeding of wild birds in captivity
108	Metabolic disorders and nutritional interventions in non-ruminants.

Practical Schedule
Unit I
Title of Unit: Principles of Animal Nutrition and Feed Technology

Sr. No.	Topics
1	General precautions while working in nutrition laboratories.
2	Familiarization of various feed stuff and fodders, Preparation and processing of samples for chemical analysis-herbage, silages, faeces and urine.
3	Preparation of solutions.
4	Weende's system of analysis, Proximate principles in feed – general views and its main features.
5	Estimation of dry matter in feed samples.
6	Estimation of total ash in feed samples.
7	Estimation of acid insoluble ash in feed samples.
8	Estimation of crude protein in feed samples.
9	Estimation of ether extract in feed samples.
10	Estimation of crude fibre and calculation of nitrogen free extract in feed samples.
11	Estimation of calcium in feed samples.
12	Estimation of phosphorus in feed samples.
13	Demonstration of detergent method of forage analysis.
14	Qualitative detection of undesirable constituents and common adulterants of feed.

UNIT - 2
Title of Unit: Applied Ruminant Nutrition- I

Sr. No.	Topics
15	Determination of digestibility
16	Calculation of digestibility coefficient
17	Calculation of nutritive value in terms of DCP, TDN and NR (Nutritive ratio) and balance of nutrients.

UNIT -3

Title of Unit: Applied Ruminant Nutrition- II

Sr. No.	Topics
18	Calculation of requirements of nutrients in terms of DCP, TDN & ME for maintenance, growth, meat, milk, wool, reproduction and draft purpose.
19	Formulation of ration for growing, dry and pregnant cattle
20	Formulation of ration for growing, dry and pregnant buffalo.
21	Formulation of ration for milk production for cattle and buffalo
22	Formulation of ration for feeding livestock during scarcity period.
23	Visit to animal farm.
24	Visit to feed mill.

UNIT -4

Title of Unit: Applied Non-ruminant Nutrition

Sr. No.	Topics
25	Calculation of requirement of nutrient for growth, reproduction, egg and meat production.
26	Calculation of requirement of nutrient for growth, reproduction, egg and meat production.
27	Formulation of ration for Broilers (with conventional and unconventional feed ingredients).
28	Formulation of ration for Layers (with conventional and unconventional feed ingredients).
29	Formulation of ration for swine- Creep ration, grower and finisher ration (with conventional and unconventional feed ingredients).
30	Principles of compounding and mixing of feeds.
31	Formulation of balanced diets for horses.
32	Formulation of balanced diets for dogs.
33	Formulation of balanced diets for cats.
34	Feeds and feeding schedule of zoo animals, Birds diet charts.
35	Visit to farms.
36	Visit to farms.

Lecture Schedule – PG (M.V.Sc.) Theory / Practical Schedule – Approved by BoS – Subject wise

Lecture and Practical Schedule – Animal Nutrition

Course Title : Nutritional Biochemistry
Course Code : ANN 601
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

Course Title: Energy and Protein Nutrition

Course Code : ANN 602

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.

Course Title : Minerals and Vitamin Nutrition and Feed Additives
Course Code : ANN 603
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.

Course Title: Feed and Fodder Technology

Course Code : ANN 604
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.
17	Preparation of project report on plant layout, problems related to feasibility.
18	Record-keeping in different sections of a feed mill.

Course Title : Ruminant Nutrition
Course Code : ANN 605
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, dry and pregnant cows
10	Nutrient requirements and feeding of lactating 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.

Course Title: Non-Ruminant Nutrition

Course Code : ANN 606

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.

Course Title: Research Methodology in Animal Nutrition

Course Code : ANN 607

Credit Hours : 0+2

Practical Unit I (7 Practical)	
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 (20 Practical)	
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 (9 Practical)	
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

Course Title : Companion Animal Nutrition
Course Code : ANN 608
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.

Course Title : Nutrition of Laboratory, Wild and Zoo Animals
Course Code : ANN 609
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 captive and zoo carnivores.
19	Feeding schedule of various classes of captive and zoo herbivores.
20	Feeding schedule of various classes of captive and zoo birds.
21	Feeding orphan and neonates.
22	Role of nutrition in the management 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

Course Title: Non-Conventional Feed Resources

Course Code : ANN 610

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.

Course Title : Introductory Clinical Nutrition
Course Code : ANN 611
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.

Course Title: Rumen Biotechnology

Course Code : ANN 612
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

Lecture Schedule – PG (Ph.D.) Theory / Practical Schedule – Approved by BoS – Subject wise

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.

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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.

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

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

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

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...)

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	Faecal inoculumas 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.

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.

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

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.

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