

# **POST GRADUATE COURSES**

## **(M.Phil.)**

Designed by IQRA KHAN



UNIVERSITY OF VETERINARY AND  
ANIMAL SCIENCES LAHORE

## **Department of Animal Nutrition**

### **Courses for M.Phil.**

| Course No. | Course Title                                                 | Credit hours |
|------------|--------------------------------------------------------------|--------------|
| NUTR-1001  | Physiology and Biochemistry of Animal Nutrition              | 4(4-0)       |
| NUTR-1002  | Feed Resources and their Nutritive Value                     | 3(2-1)       |
| NUTR-1003  | Protein Metabolism                                           | 3(2-1)       |
| NUTR-1004  | Minerals in Animal Nutrition                                 | 3(2-1)       |
| NUTR-1005  | Analytical Techniques in Animal Nutrition                    | 4(0-4)       |
| NUTR-1006  | Research Designing and Methodology in Animal Nutrition       | 3(2-1)       |
| NUTR-1007  | Nutrition of Broilers                                        | 3(2-1)       |
| NUTR-1008  | Nutrition of Dairy Animals                                   | 3(2-1)       |
| NUTR-1009  | Nutrition of Small Ruminants                                 | 3(2-1)       |
| NUTR-1010  | Feed Manufacturing Technology                                | 3(2-1)       |
| NUTR-1011  | Recent Advances in Animal Nutrition                          | 2(2-0)       |
| NUTR-1012  | Toxins and Anti-Nutritional Factors in Indigenous Feedstuffs | 3(2-1)       |
| NUTR-1013  | Clinical Nutrition                                           | 2(2-0)       |

**Course Title: Physiology and Biochemistry of Animal Nutrition**

**Course No: NUTR-1001**

**Course Duration: 1 semester (16 weeks)**

**Credit hours: 4(4-0)**

### **Course Description**

This course has been designed for understanding of different functions, digestion mechanisms and utilization of different nutrients in different types of animals. Working of different biological cycles and end-products produced in result of catabolism. Understanding of different metabolic disorders related with different nutrients will also be part of this course.

### **Course Goals and performance Objectives**

#### **Objective 1**

To understand functions of major nutrients.

#### **Objective 2**

To learn about digestion and metabolism of nutrients.

#### **Objective 3**

Metabolic disorders related with improper utilization of nutrients.

### **Course Contents**

#### **Theory:**

Chemistry of essential nutrients and their functions. Comparative digestive physiology of ruminants and non-ruminants. Digestion and absorption of carbohydrate in ruminants and non-ruminants. Effect of structure of starch on digestion. Digestion of milk and plant sources. Extracellular hydrolysis of complex carbohydrates. Digestion and absorption of lipids in ruminants and simple stomach animals. Fatty acid (FA) synthesis in tissues. Production and utilization of ketone bodies. Digestion and absorption of proteins in ruminants and non-ruminants. Digestion and absorption of vitamins in different species. Quasi vitamins in animal nutrition. Minerals, their digestion and metabolism. Biological cycles involve in metabolism. Hormonal control of metabolism. Extremophile and eicosanoid metabolism. Major metabolic disorders in ruminants and simple stomach animals. Importance of water in animal nutrition.

### **Detail Course Outline**

| <b>Serial No</b> | <b>Theory</b>                                    | <b>Serial No</b> | <b>Theory</b>                          |
|------------------|--------------------------------------------------|------------------|----------------------------------------|
| 01               | Introduction to chemistry of essential nutrients | 33               | Digestion of proteins in non-ruminants |

|    |                                                                                   |    |                                                                            |
|----|-----------------------------------------------------------------------------------|----|----------------------------------------------------------------------------|
| 02 | Importance of functions of essential nutrients                                    | 34 | Absorption of proteins in ruminants                                        |
| 03 | Comparative digestive physiology of ruminants                                     | 35 | Absorption of proteins in mono gastric species                             |
| 04 | Comparative digestive physiology of non-ruminants                                 | 36 | Interconversion of nutrients in ruminants                                  |
| 05 | Chemistry of proteins                                                             | 37 | Interconversion of nutrients in poultry                                    |
| 06 | Chemistry of carbohydrates                                                        | 38 | Protein synthesis                                                          |
| 07 | Chemistry of fats                                                                 | 39 | Water and its importance for poultry birds                                 |
| 08 | Digestion of carbohydrates in simple stomach animals                              | 40 | Water and its importance for ruminants                                     |
| 09 | Absorption of carbohydrate in simple stomach animals                              | 41 | digestion of fat soluble vitamins in ruminants                             |
| 10 | Digestion of simple carbohydrates in ruminants                                    | 42 | digestion of water soluble vitamins for ruminants                          |
| 11 | Digestion of complex carbohydrates in ruminants                                   | 43 | digestion of water soluble vitamins for non-ruminants                      |
| 12 | Absorption of simple and complex carbohydrates in ruminants                       | 44 | digestion of fat soluble vitamins in non-ruminants                         |
| 13 | Effect of structure of starch on digestion                                        | 45 | Utilisation of macro minerals in ruminants                                 |
| 14 | Substrate specificity and developmental changes of carbohydrates in non-ruminants | 46 | Utilisation of micro minerals in ruminants                                 |
| 15 | Digestion of milk and plant sources                                               | 47 | Utilisation of macro minerals in non-ruminants                             |
| 16 | Trafficking of monosaccharides from small intestine to liver                      | 48 | Utilisation of micro minerals in non-ruminants                             |
| 17 | Extra cellular hydrolysis of complex carbohydrates                                | 49 | Quasi vitamins in animal nutrition                                         |
| 18 | Digestion of glycerol lipid substances in ruminants                               | 50 | Biological cycles involved in metabolism of fats in ruminants              |
| 19 | Digestion of non-glycerol lipid substances in ruminants                           | 51 | Biological cycles involved in metabolism of fats in non-ruminants          |
| 20 | Digestion of glycerol lipid substances in non-ruminants                           | 52 | Biological cycles involved in metabolism of fats in ruminants              |
| 21 | Digestion of glycerol lipid substances in non-ruminants                           | 53 | Biological cycles involved in metabolism of carbohydrates in non-ruminants |
| 22 | Absorption of lipids in ruminants                                                 | 54 | Biological cycles involved in carbohydrates metabolism in large animals    |
| 23 | Absorption of lipids in mono gastric species                                      | 55 | Biological cycles involved in protein metabolism in large animals          |
| 24 | Fatty acid synthesis and role of hormones                                         | 56 | Biological cycles involved in metabolism of proteins in non-ruminants      |

|    |                                                    |    |                                                     |
|----|----------------------------------------------------|----|-----------------------------------------------------|
| 25 | Fatty acid synthesis and role of hormones          | 57 | Extremophile metabolism of non-ruminants            |
| 26 | Importance of essential fatty acids in animal body | 58 | Extremophile metabolism of ruminants                |
| 27 | Production of ketone bodies                        | 59 | Eicosanoid metabolism in ruminants                  |
| 28 | Utilisation of ketone bodies                       | 60 | Eicosanoid metabolism in non-ruminants              |
| 29 | Digestion of proteins in ruminants                 | 61 | Hormonal control of metabolism                      |
| 30 | Digestion of proteins in ruminants                 | 62 | Hormonal control of metabolism                      |
| 31 | Utilization of NPN substances in ruminants         | 63 | Major metabolic disorders in ruminants              |
| 32 | Digestion of proteins in non-ruminants             | 64 | Major metabolic disorders in simple stomach animals |

### Teaching learning strategies

|                  |
|------------------|
| <b>Theory</b>    |
| Lectures         |
| Presentation     |
| Group discussion |
| Assignments      |
| Quiz             |

### Class work Policies

- Equal opportunity
- Intellectual honesty
- Regularity and Punctuality
- Adherence to deadlines
- Fairness
- Conformity to discipline

### Assessment Strategies

|                  |                   |                 |                   |              |
|------------------|-------------------|-----------------|-------------------|--------------|
| <b>Theory</b>    |                   |                 |                   |              |
| <b>Modality</b>  | <b>Assignment</b> | <b>Mid term</b> | <b>Final Term</b> | <b>Total</b> |
| <b>Max Marks</b> | <b>08</b>         | <b>24</b>       | <b>48</b>         | <b>80</b>    |

### Recommended Books/Readings

#### Text Book:

1. Guoyao Wo. 2017. Principles of Animal Nutrition. First Edition. CRC Press, Taylor and Francis Group.

**Reference Books:**

1. P. McDonalds, R. A. Edwards, J. F. D. Greenhalgh, C. A. Morghan, L. A. Sinclair, R. G. Wilkinson. 2010. Animal Nutrition. 7<sup>th</sup> Edition. Pearson Publications. United Kingdom.
2. Wilson G. Pond. 2005. Basic Animal Nutrition and Feeding. 5<sup>th</sup> Edition. Wiley Publishers, USA.
3. David L. Nelson & Michal M. Cox. 2000. Lehninger Principles of Biochemistry. 3<sup>rd</sup> Edition, Wroth Publishers, USA.
4. S.A. Lanham-New, I.A. Macdonald, H.M. Roche. 2011. Nutrition and Metabolism. The Nutrition Society Textbooks, Wiley-Blackwell. (ISBN: 978-1-4051-6808-3).

**Course Title: Feed Resources and their Nutritive Value**

**Course No: NUTR-1002**

**Course Duration: 1 semester (16 weeks)**

**Credit hours: 3(2-1)**

### **Course Description**

This course has been designed to introduce different types of feed resources for livestock and poultry. Feeding standards and their application will also be part of this source. Contents of said course will also impart knowledge about different conventional and non-conventional feedstuffs and students will be able to learn different toxin and anti-nutritional factors and their impact on nutritional profile of different feed resources.

### **Performance Objectives**

#### **Objective 1**

To learn about nutritive value of different feedstuffs.

#### **Objective 2**

To study different methods for improvement of existing feed resources.

#### **Objective 3**

To introduce presence of toxins, anti-nutritional factors and their effect on nutrient potential of feed ingredients.

### **Course Contents**

#### **Theory:**

Feed resources of Pakistan; Classification, availability and requirements. Dynamics and characteristics of feed resources. Grass and forage crops. Making and feeding of silage and hay. Roots, tubers and related by-products. Cereal grains and cereal by-products. Protein concentrates from different sources. Factors affecting nutritional quality of feeds in livestock and poultry. Feeding standards and their application. Methods of improving nutritive value of feedstuffs. Feeding rumen bypass proteins and lipoids. Utilization of NPN compounds in livestock feeds and its significance. Significance of feed additives for livestock and poultry. Toxins and anti-Nutritional factors in feedstuffs. Non-conventional feed resources.

#### **Practical:**

Chemical analysis, *in vivo*, *in vitro* and *in sacco* techniques for the feed evaluation. Techniques for estimation of toxins in feed. Chemical and biological treatments of roughages. Preparation of hay and silage. Use of computer software in feed formulation. Visits to feed mills, livestock farms and research institutes.

### **Detail Course Outline**

| Serial No | Theory                                                                        | Serial No | Practical                                                     |
|-----------|-------------------------------------------------------------------------------|-----------|---------------------------------------------------------------|
| 01        | Classification of feed resources                                              | 01        | Chemical analysis of feedstuff                                |
| 02        | Dynamics of available feed resources in Pakistan                              | 02        | Chemical analysis of feedstuff                                |
| 03        | Nutritional profile of different types of feedstuffs                          | 03        | Estimation of energy value of feedstuff                       |
| 04        | Nutritive value of grasses for livestock                                      | 04        | Determination of <i>in vivo</i> technique for feed evaluation |
| 05        | Forage crops and their nutritional profile                                    | 05        | Description of <i>in vitro</i> technique for feed evaluation  |
| 06        | Silage making                                                                 | 06        | Description of <i>in sacco</i> technique for feed evaluation  |
| 07        | Hay making                                                                    | 07        | Estimation of aflatoxin in feeds                              |
| 08        | Roots, timbers and related by-products with their feeding value for ruminants | 08        | Estimation of Glucosinolates in Canola Meal                   |
| 09        | Cereal grains and by-products as energy source for ruminants                  | 09        | Estimation of KOH solubility in SBM                           |
| 10        | Cereal grains and by-products in poultry feeding                              | 10        | Estimation of urease activity in SBM                          |
| 11        | Vegetable protein sources in animal ration                                    | 11        | Preparation of hay                                            |
| 12        | Animal protein sources in animal ration                                       | 12        | Preparation of silage                                         |
| 13        | Factors effecting nutritive value of feedstuffs                               | 13        | Preparation of silage                                         |
| 14        | Feeding standards for livestock                                               | 14        | Use of computer software for feed formulation                 |
| 15        | Feeding standards for poultry                                                 | 15        | Use of computer software for feed formulation                 |
| 16        | Different methods of improving nutritive value of feedstuffs                  | 16        | Visit to feed mills, Farms and Research Institutes            |
| 17        | Importance of rumen bypass proteins                                           |           |                                                               |
| 18        | Importance of rumen bypass lipids                                             |           |                                                               |
| 19        | Strategies to enhance bypass values of proteins and lipids                    |           |                                                               |
| 20        | Utilization of NPN substances in Livestock ration                             |           |                                                               |
| 21        | Significance of feed additives for livestock                                  |           |                                                               |
| 22        | Significance of feed additives for livestock                                  |           |                                                               |
| 23        | Significance of feed additives for poultry                                    |           |                                                               |
| 24        | Significance of feed additives for poultry                                    |           |                                                               |

|    |                                               |  |  |
|----|-----------------------------------------------|--|--|
| 25 | Anti-nutritional factors in livestock rations |  |  |
| 26 | Anti-nutritional factors in livestock rations |  |  |
| 27 | Anti-nutritional factors in poultry rations   |  |  |
| 28 | Anti-nutritional factors in poultry rations   |  |  |
| 29 | Mycotoxins and their impact on livestock      |  |  |
| 30 | Mycotoxins and their impact on poultry        |  |  |
| 31 | Non-conventional feed resources for livestock |  |  |
| 32 | Non-conventional feed resources for livestock |  |  |

### Teaching learning strategies

| Theory           | Practical        |
|------------------|------------------|
| Lectures         | Performance      |
| Presentation     | Presentations    |
| Group discussion | Group discussion |
| Assignments      | Assignments      |
| Quiz             |                  |

### Class work Policies

- Equal opportunity
- Intellectual honesty
- Regularity and Punctuality
- Adherence to deadlines
- Fairness
- Conformity to discipline

### Assessment Strategies

| Theory    |            |          |            |       | Practical         |       |       |
|-----------|------------|----------|------------|-------|-------------------|-------|-------|
| Modality  | Assignment | Mid term | Final Term | Total | Class performance | Final | Total |
| Max Marks | 04         | 12       | 24         | 40    | 12                | 08    | 20    |

### Recommended Books/Readings

#### Textbooks:

1. P. McDonalds, R. A. Edwards, J. F. D. Greenhalgh, C. A. Morghan, L. A. Sinclair, R. G. Wilkinson. 2010. Animal Nutrition. 7<sup>th</sup> Edition. Pearson Publications. United Kingdom.

**Reference Books:**

1. Weseley Ewing. 2002. The Feeds Directory Commodity Products. Empress Publishing, The Netherlands.

2. Gordon McL. Dryden. 2008. Animal Nutrition Science. CAB International. ISBN 978-1-84593-412-5.

3. J. M. McNab, K. N. Boorman. 2002. Poultry Feedstuffs: Supply, Composition, and Nutritive Value. CABI Publishing Series. Issue 26 of Poultry science symposium, Poultry Science Symposium. ISBNB 0851994644, 9780851994642

4. Singh K. Chandrapal Prabhu T.M. 2013. Analytical Techniques in Animal Nutrition Research. Published by New India Publishing Agency (NIPA), New Delhi. ISBN 13: 9789381450505.

**Course Title: Protein Metabolism**

**Course No: NUTR-1003**

**Course Duration: 1 semester (16 weeks)**

**Credit hours: 3(2-1)**

### **Course Description**

Contents of this course have been updated regarding different sources of protein for large animals and poultry. Moreover, digestion mechanism, end-product of digestion and metabolism of protein will also be studied. Concept of synthetic amino acids and NPN compounds will be part of contents. Protein quality estimation of different sources will also be taught in this course.

### **Performance Objectives**

#### **Objective 1**

To introduce protein sources and their classification.

#### **Objective 2**

To learn about digestion and absorption of protein in different species of animals.

#### **Objective 3**

To study utilization of rumen bypass protein in large animals.

#### **Objective 4**

To study supplementation of crystalline amino acids and their impact on animal performance.

### **Course Contents**

#### **Theory:**

Protein sources, classification, digestion and absorption in simple stomach (mono-gastric) and compound stomach (ruminants) animals. Rumen bypass protein and methods of production of feed protein from rumen degradation. Absorption and distribution of amino acids in the body. Biosynthesis and major pathways of metabolism of proteins. Protein energy relationships. Protein Quality. Concept of amino acids supplementation. NPN compounds in livestock feeds. Ammonia/urea toxicity in ruminants. Essential and non-essential amino acid ratios. Crystalline amino acids and nitrogen emission. Economic assessment of amino acid responses in poultry. Chemical reactions of free amino acids in the body.

#### **Practical:**

Analysis of NPN and true protein in feeds. In vitro pepsin solubility measurement. *In sacco* protein degradability technique. Techniques for estimation of protein requirements. Amino acid analysis of feed. Measuring ileal digestibility of protein.

## Detail Course Outline

| Serial No. | Theory                                                              | Serial No. | Practical                                                                                                             |
|------------|---------------------------------------------------------------------|------------|-----------------------------------------------------------------------------------------------------------------------|
| 01         | Classification of protein sources for different species             | 01         | Estimation of crude protein by kjeldhal method                                                                        |
| 02         | Importance of vegetable protein sources for monogastric animals     | 02         | Estimation of crude protein by Dumas method                                                                           |
| 03         | Importance of animal protein sources                                | 03         | Estimation of true protein in animal feed                                                                             |
| 04         | Importance of protein sources for ruminants                         | 04         | Analysis of NPN in feed                                                                                               |
| 05         | Significance of bypass proteins in livestock feeding                | 05         | <i>In-vitro</i> pepsin solubility measurements                                                                        |
| 06         | Digestion of protein in poultry                                     | 06         | <i>In-sacco</i> protein degradability techniques                                                                      |
| 07         | Digestion of protein in poultry                                     | 07         | <i>In-sacco</i> protein degradability techniques                                                                      |
| 08         | Digestion of protein in ruminants                                   | 08         | Techniques for estimation of protein requirements                                                                     |
| 09         | Digestion of protein in ruminants                                   | 09         | Techniques for estimation of protein requirements                                                                     |
| 10         | Methods to enhance bypass values of proteins in ruminants           | 10         | Sample preparation of amino acid analysis                                                                             |
| 11         | Absorption of amino acids in small intestine                        | 11         | Amino acid analysis of prepared samples                                                                               |
| 12         | Protein synthesis with in the body                                  | 12         | Description of measuring ileal digestibility of proteins                                                              |
| 13         | Synthesis of amino acids in liver                                   | 13         | Determination of ileal digestibility of proteins                                                                      |
| 14         | Majors pathways of protein metabolism                               | 14         | Ration formulation on the basis of digestible amino acids for livestock                                               |
| 15         | Majors pathways of protein metabolism                               | 15         | Ration formulation on the basis of digestible amino acids for poultry                                                 |
| 16         | Importance of energy protein relationship                           | 16         | Protein quality estimation of Soybean Meal (Urease activity Index, KOH solubility test, Protein dispersibility index) |
| 17         | Protein quality estimation in poultry                               |            |                                                                                                                       |
| 18         | Protein quality estimation in ruminants                             |            |                                                                                                                       |
| 19         | Utilization of NPN substances in livestock feed                     |            |                                                                                                                       |
| 20         | Nutritional strategies to reduce urea toxicity in ruminants         |            |                                                                                                                       |
| 21         | Concept of synthetic amino acid supplementation in livestock ration |            |                                                                                                                       |

|    |                                                                   |  |  |
|----|-------------------------------------------------------------------|--|--|
| 22 | Concept of synthetic amino acid supplementation in poultry ration |  |  |
| 23 | Essential and non-essential amino acid ratios in poultry          |  |  |
| 24 | Crystalline amino acids and nitrogen emissions                    |  |  |
| 25 | Ratios of synthetic amino acids and protein in animal ration      |  |  |
| 26 | Economic assessment of amino acid responses in poultry            |  |  |
| 27 | Economic assessment of amino acid responses in livestock          |  |  |
| 28 | Chemical reaction of free amino acids in poultry birds            |  |  |
| 29 | Chemical reaction of free amino acids in ruminants                |  |  |
| 30 | Metabolic disorders related with protein metabolism               |  |  |
| 31 | Introduction to protein deficiency diseases                       |  |  |
| 32 | Inter-relationship of protein and other nutrients                 |  |  |

### Teaching learning strategies

| Theory           | Practical        |
|------------------|------------------|
| Lectures         | Performance      |
| Presentation     | Presentations    |
| Group discussion | Group discussion |
| Assignments      | Assignments      |
| Quiz             |                  |

### Class work Policies

- Equal opportunity
- Intellectual honesty
- Regularity and Punctuality
- Adherence to deadlines
- Fairness
- Conformity to discipline

## Assessment Strategies

| Theory    |            |          |            |       | Practical         |       |       |
|-----------|------------|----------|------------|-------|-------------------|-------|-------|
| Modality  | Assignment | Mid term | Final Term | Total | Class performance | Final | Total |
| Max Marks | 04         | 12       | 24         | 40    | 12                | 08    | 20    |

## Recommended Books/Readings

### Textbooks:

1. J.P.F. D'Mello. 2003. Amino acids in Animal Nutrition. Second Edition. Formerly of the Scottish Agricultural College. Edinburgh, UK.

### Reference Books:

1. S.A. Lanham-New, I.A. Macdonald, H.M. Roche. 2011. Nutrition and Metabolism. The Nutrition Society Textbooks, Wiley-Blackwell. (ISBN: 978-1-4051-6808-3).

2. J. Dijkstra, J. M. Forbes, J. France. 2005. Quantitative Aspects of Ruminant Digestion and Metabolism. 2<sup>nd</sup> Edition. CAB International. ISBN 0-85199-8143.

3. AOAC. 2000. Official Methods of Analysis of the Association of Official Analytical Chemists, 17<sup>th</sup> Ed. Vol. 1,2 Supplement. Arlington V.A.USA.

4. Evrier, C., A. Aumaitre F. Habe, T. Vares and M. Zjilic, 2002. Protein Feed for Animal Production. Empress Publishing. The Netherlands.

**Course Title: Minerals in Animal Nutrition**

**Course No: NUTR-1004**

**Course Duration: 1 semester (16 weeks)**

**Credit hours: 3(2-1)**

### **Course Description**

Contents of this course will include utilization of essential minerals, their classification and requirements for livestock and poultry. Kinetic models for study of essential mineral metabolism will also be covered in this course. Deficiency, excessiveness and toxicity of minerals will be part of course contents. A new concept about hydroxyl minerals and their utilization will also be introduced in this course.

### **Performance Objectives**

#### **Objective 1**

To study classification and functions of minerals.

#### **Objective 2**

To learn kinetic models of essential mineral metabolism in animal body.

#### **Objective 3**

To introduce impact of minerals deficiency and toxicity on animal health.

#### **Objective 4**

To study utilization of hydroxyl minerals and other essential elements in different species of animals.

### **Course Contents**

#### **Theory:**

Essential minerals, their classification, function and interrelationships. Mineral requirements of livestock and poultry. Mineral absorption in different species of animals and role of chelating agents. Kinetic models for study of essential mineral metabolism in ruminants and non-ruminants. Essential toxic elements (aluminum, arsenic, cadmium and fluorine). Occasionally beneficial elements and their role in animal body. Mineral feeding of animal under industrial conditions. Regulation of essential element metabolism. Endogenous losses, apparent and actual assimilation of minerals. Kinetics of mineral metabolism in blood. Deficiency symptoms, excessiveness and toxicity of minerals. Hydroxy minerals and their utilization. Use of nanoparticles in animal feeding.

#### **Practical:**

Estimation of minerals in feedstuffs by using atomic absorption spectrophotometer. Estimation of Ca by titration method. Estimation of P by using spectrophotometer. Estimation of Na and K by using flame photometer. Calculation of mineral requirement of animal. Formulation and

preparation of mineral mixtures and licks. Factorial methods for determination of animal's mineral requirements.

### Detail Course Outline

| Serial No | Theory                                                            | Serial No | Practical                                                                 |
|-----------|-------------------------------------------------------------------|-----------|---------------------------------------------------------------------------|
| 01        | Functions and classification of minerals                          | 01        | Preparation of samples for mineral by wet digestion for mineral analysis  |
| 02        | Mineral requirements of large ruminants                           | 02        | Estimation of macro-minerals by using atomic absorption spectrophotometer |
| 03        | Mineral requirements of small ruminants                           | 03        | Estimation of micro-minerals by using atomic absorption spectrophotometer |
| 04        | Mineral requirements of poultry ruminants                         | 04        | Estimation of Ca by titration method                                      |
| 05        | Digestion and absorption of macro-mineral in large animals        | 05        | Estimation of P by using spectrophotometer                                |
| 06        | Digestion and absorption of micro-mineral in large animals        | 06        | Estimation of Na and K by using flame photometer                          |
| 07        | Digestion and absorption of macro-mineral in poultry              | 07        | Calculation of mineral requirements for large animals                     |
| 08        | Digestion and absorption of macro-mineral in poultry              | 08        | Calculation of mineral requirements for poultry birds                     |
| 09        | Role of chelating agents                                          | 09        | Formulation of mineral mixture for large ruminants                        |
| 10        | Kinetic models for essential minerals metabolism in ruminants     | 10        | Formulation of mineral mixture for small ruminants                        |
| 11        | Kinetic models for essential minerals metabolism in non-ruminants | 11        | Preparation of mineral premix for poultry birds                           |
| 12        | Essential toxic elements in large animal ration                   | 12        | Factorial method for determination of minerals requirements               |
| 13        | Essential toxic elements in poultry ration                        | 13        | Factorial method for determination of minerals requirements               |
| 14        | Beneficial elements and their role in animal body                 | 14        | Estimation of total ash contents of animal feeds                          |
| 15        | Mineral feeding of livestock under industrial conditions          | 15        | Estimation of Acid Insoluble Ash in animal feeds                          |
| 16        | Mineral feeding of poultry birds under commercial conditions      | 16        | Estimation of Ca contents in different sources of limestone               |
| 17        | Hormonal control of mineral metabolism in ruminants               |           |                                                                           |
| 18        | Hormonal control of mineral metabolism in poultry                 |           |                                                                           |
| 19        | Indigenous mineral losses                                         |           |                                                                           |
| 20        | Apparent and actual assimilation of minerals                      |           |                                                                           |
| 21        | Kinetics of mineral metabolism in ruminant bloods                 |           |                                                                           |

|    |                                                        |  |  |
|----|--------------------------------------------------------|--|--|
| 22 | Kinetics of mineral metabolism in non-ruminant bloods  |  |  |
| 23 | Deficiency symptoms of macro-minerals in ruminants     |  |  |
| 24 | Deficiency symptoms of micro-minerals in ruminants     |  |  |
| 25 | Toxicity of macro-minerals in ruminants                |  |  |
| 26 | Toxicity of micro-minerals in ruminants                |  |  |
| 27 | Deficiency symptoms of macro-minerals in non-ruminants |  |  |
| 28 | Deficiency symptoms of micro-minerals in non-ruminants |  |  |
| 29 | Toxicity of macro-minerals in non-ruminants            |  |  |
| 30 | Toxicity of micro-minerals in non-ruminants            |  |  |
| 31 | Utilization of hydroxyl minerals in animal body        |  |  |
| 32 | Use of nanoparticles in animal feeding                 |  |  |

### Teaching learning strategies

| Theory           | Practical        |
|------------------|------------------|
| Lectures         | Performance      |
| Presentation     | Presentations    |
| Group discussion | Group discussion |
| Assignments      | Assignments      |
| Quiz             |                  |

### Class work Policies

- Equal opportunity
- Intellectual honesty
- Regularity and Punctuality
- Adherence to deadlines
- Fairness
- Conformity to discipline

## Assessment Strategies

| Theory    |            |          |            |       | Practical         |       |       |
|-----------|------------|----------|------------|-------|-------------------|-------|-------|
| Modality  | Assignment | Mid term | Final Term | Total | Class performance | Final | Total |
| Max Marks | 04         | 12       | 24         | 40    | 12                | 08    | 20    |

## Recommended Books/Readings

### Text Book:

1. N. F. Suttle. 2010. Mineral Nutrition of Livestock. 4<sup>th</sup> Edition. CAB International. ISBN 978-1-84593-472-9.

### Recommended Books:

1. Dorinha M. S. S. Vitti, E. Kebreab. 2010. Phosphorus and Calcium Utilization and Requirements in Farm Animals. CAB International. ISBN 978-1-84593-626-6

2. Alexander N. Hristov, Ernst Pfeffer. 2006. Nitrogen and Phosphorus Nutrition of Cattle: Reducing the Environmental Impact of Cattle Operations. CAB International. ISBN 0-85199-013-4.

3. S. Lesson, J.D. Summers. 2005. Commercial Poultry Nutrition. 3<sup>rd</sup> Edition. Published by Nottingham University Press, Manor Farm, Church Lane, Thrumpton, Nottingham, NG11 0AX, England.

4. Wilson G. Pond. 2005. Basic Animal Nutrition and Feeding. 5<sup>th</sup> Edition. Wiley Publishers, USA.

**Course Title: Analytical techniques in Animal Nutrition**

**Course No: NUTR-1005**

**Course Duration: 1 semester (16 weeks)**

**Credit hours: 4(0-4)**

### **Course Description**

This course will cover different methods for proximate analysis and fibre fractions. Different chemical techniques for knowledge of postgraduate students will be studied in this course. These techniques will help them to learn analytical skills for working in livestock and poultry industry.

### **Performance Objectives**

#### **Objective 1**

To study proximate composition of feedstuff.

#### **Objective 2**

To learn about chemical analysis of feedstuff, blood and urine.

#### **Objective 3**

To study mineral estimation by atomic absorption spectrophotometry and aflatoxin in feedstuff.

### **Course Contents**

#### **Practical:**

Sampling and grinding of feedstuffs for analysis. Cleaning and washing of glassware. Preparation of buffers and determination of pH. Determination of dry matter by different methods (heat and toluene). Proximate analysis. Analysis of neutral detergent fibre (NDF), acid detergent fibre (ADF), lignin and acid insoluble ash/silica. Chemical analysis of blood, urine and milk. True protein and NPN substances in feed. Urease activity test. KOH solubility estimation. Protein dispersibility index in SBM. Mineral estimation by using atomic absorption. DCP solubility test. Rancidity test for oils. Estimation of aflatoxin in feed ingredients.

### **Detail Course Outline**

| <b>Serial No</b> | <b>Practical</b>                                          | <b>Serial No</b> | <b>Practical</b>           |
|------------------|-----------------------------------------------------------|------------------|----------------------------|
| 01               | Introduction to Animal Nutrition laboratory               | 33               | Chemical analysis of blood |
| 02               | Sampling of feedstuffs for analysis                       | 34               | Chemical analysis of urine |
| 03               | Grinding of feedstuffs for analysis (grains and meals)    | 35               | Chemical analysis of urine |
| 04               | Grinding of feedstuffs for analysis (Forages and Fodders) | 36               | Chemical analysis of milk  |

|    |                                                                             |    |                                                                   |
|----|-----------------------------------------------------------------------------|----|-------------------------------------------------------------------|
| 05 | Cleaning and washing of glassware                                           | 37 | Chemical analysis of milk                                         |
| 06 | Preparation of Distil water                                                 | 38 | True protein estimation (Sample preparation)                      |
| 07 | Preparation of buffers                                                      | 39 | True protein estimation                                           |
| 08 | Preparation of buffers                                                      | 40 | Digestion of samples for estimation of NPN substances             |
| 09 | Determination of pH                                                         | 41 | Titration and distillation for analysis of NPN substances         |
| 10 | Determination of Dry matter content by different methods                    | 42 | Urease activity test of SBM                                       |
| 11 | Estimation of crude protein by kjeldhal method (Introduction)               | 43 | Urease activity test of SBM                                       |
| 12 | Estimation of crude protein by kjeldhal method (Digestion)                  | 44 | KOH solubility estimation in SBM (sample preparation)             |
| 13 | Estimation of crude protein by kjeldhal method (Distillation and titration) | 45 | KOH solubility estimation in SBM (distillation and titration)     |
| 14 | Estimation of crude protein by Dumas method                                 | 46 | Protein dispersibility index estimation of SBM                    |
| 15 | Estimation of crude protein by Dumas method                                 | 47 | Protein dispersibility index estimation of SBM                    |
| 16 | Estimation of crude fat by Soxhelet apparatus                               | 48 | Sample preparation by wet digestion method for mineral estimation |
| 17 | Estimation of crude fat by Soxhelet apparatus                               | 49 | Sample preparation by wet digestion method for mineral estimation |
| 18 | Estimation of crude fat by Ankom apparatus                                  | 50 | Estimation of macro-minerals by using atomic absorption           |
| 19 | Estimation of crude fat by Ankom apparatus                                  | 51 | Estimation of macro-minerals by using atomic absorption           |
| 20 | Estimation of total ash content                                             | 52 | Estimation of micro-minerals by using atomic absorption           |
| 21 | Estimation of total ash content                                             | 53 | Estimation of micro-minerals by using atomic absorption           |
| 22 | Estimation of crude fibre                                                   | 54 | Estimation of Ca by titration method                              |
| 23 | Estimation of crude fibre                                                   | 55 | Estimation of Ca by titration method                              |
| 24 | Analysis of Neutral detergent fibre (Sample preparation)                    | 56 | Estimation of Na and K by flame photometer                        |
| 25 | Analysis of Neutral detergent fibre (NDF)                                   | 57 | Estimation of Na and K by flame photometer                        |
| 26 | Estimation of Acid detergent fibre (ADF) (Sample Preparation)               | 58 | DCP solubility test                                               |
| 27 | Estimation of Acid detergent fibre (ADF)                                    | 59 | Rancidity test for oils                                           |
| 28 | Estimation of lignin                                                        | 60 | Rancidity test for oils                                           |
| 29 | Estimation of lignin                                                        | 61 | Estimation of aflatoxin in feed samples (Qualitative)             |
| 30 | Estimation of Acid Insoluble Ash/Silica                                     | 62 | Estimation of aflatoxin in feed samples (Quantitative)            |

|    |                                         |    |                                                             |
|----|-----------------------------------------|----|-------------------------------------------------------------|
| 31 | Estimation of Acid Insoluble Ash/Silica | 63 | Introduction to Near Infrared spectroscopy (NIRS) technique |
| 32 | Chemical analysis of blood              | 64 | Proximate analysis by using NIRS                            |

### Teaching learning strategies

|                  |
|------------------|
| <b>Practical</b> |
| Performance      |
| Presentations    |
| Group discussion |
| Assignments      |
|                  |

### Class work Policies

- Equal opportunity
- Intellectual honesty
- Regularity and Punctuality
- Adherence to deadlines
- Fairness
- Conformity to discipline

### Assessment Strategies

| Theory    |            |          |            |       | Practical         |       |       |
|-----------|------------|----------|------------|-------|-------------------|-------|-------|
| Modality  | Assignment | Mid term | Final Term | Total | Class performance | Final | Total |
| Max Marks |            |          |            |       | 48                | 32    | 80    |

### Recommended Books/Readings

#### Text Book:

1. S.P. Tiwari, S. Rajagopal, Usha Rani Mehra. 2012. Analytical Techniques in Animal Nutrition. Satish Serial Publishers. ISBN 13: [9789381226018](#)

#### Recommended Books:

1. S. Suzanne Nielson. 2017. Food analysis laboratory manual. 3<sup>rd</sup> Edition. Springer International Publishing. ISBN- 9783319441252.

2. Shaline Sehgal. 2016. A laboratory manual of food analysis. Kindle Edition. K International Publishing House. ASIN: B01F58FM36.

3. AOAC, 2000. Official Methods of Analysis of the Association of Official Analytical Chemists, 17<sup>th</sup> Ed. Vol. 1,2 Supplement. Arlington V.A.USA.

4. Singh K. Chandrapal Prabhu T.M. 2013. Analytical Techniques in Animal Nutrition Research. Published by New India Publishing Agency (NIPA), New Delhi. ISBN 13: 9789381450505
5. J. M. McNab, K. N. Boorman. 2002. Poultry Feedstuffs: Supply, Composition, and Nutritive Value. CABI Publishing Series. Issue 26 of Poultry science symposium, Poultry Science Symposium. ISBNB 0851994644, 9780851994642
6. S. K. Ranjhan, G. Krishna. 1980. Laboratory Manual for Nutrition Research. Advent Books Division, Stosius, Incorporated, 01-Jan-1980.

**Course Title: Research Designing and Methodology in Animal Nutrition****Course No: NUTR-1006****Course Duration: 1 semester (16 weeks)****Credit hours: 3(2-1)****Course Description**

Concepts of scientific literature, sources for data search and types of research problems will be part of this course. Skills regarding citation of various software and interpretation of scientific data and their presentation will be introduced to students.

**Performance Objectives****Objective 1**

To study various skills about collection, tabulation and interpretation of scientific data.

**Objective 2**

To learn about different presentation skills.

**Course Contents**

Concepts of review of scientific literature. Sources for data search and digital library access. Definition of research problem. Types of research problem. Development of synopsis. Selection of statistical design. Concepts of experimental controls, treatment specifications. Types of research animals/ birds and their selection and housing management, Logistics and cost of research plan. Collection, tabulation and interpretation of research data/ results. Use of computer software for data handling and presentation. Scientific report writing and citation. Citation by using various software. Poster preparation and presentation. Writing of a Research/Review article. Oral presentation at a scientific conference.

**Detail Course Outline**

| <b>Serial No</b> | <b>Theory</b>                                       | <b>Serial No</b> | <b>Practical</b>                                        |
|------------------|-----------------------------------------------------|------------------|---------------------------------------------------------|
| 01               | Introduction to course contents                     | 1                | Introduction to course contents                         |
| 02               | Concepts of review of scientific literature         | 2                | Demonstration on sources of data for scientific writing |
| 03               | Sources of data for review of scientific literature | 3                | Research engines used in scientific writing             |
| 04               | Introduction to digital library and its usage       | 4                | Demonstration on digital library access and its usage   |
| 05               | Difference between research and review article      | 5                | Demonstration on statistical designs used in research   |
| 06               | Introduction to research article and its components | 6                | Selection of animals/birds for trial                    |
| 07               | Introduction to review article and its components   | 7                | Peer review of articles and its types                   |

|    |                                                                    |    |                                                                 |
|----|--------------------------------------------------------------------|----|-----------------------------------------------------------------|
| 08 | Difference between research questions and research problems        | 8  | Demonstration on data collection during research trial          |
| 09 | Introduction to research problem                                   | 9  | Practical demonstration on citation by using various software   |
| 10 | Types of research problem                                          | 10 | Insert citation in scientific writing using endnote             |
| 11 | Introduction to research question                                  | 11 | Demonstration on data analysis on excel                         |
| 12 | Development of synopsis                                            | 12 | Demonstration on poster preparation for scientific conference   |
| 13 | Guidelines for synopsis writing                                    | 13 | Demonstration on poster presentation at a scientific conference |
| 14 | Abstract writing                                                   | 14 | Demonstration on oral presentation at a scientific conference   |
| 15 | Introduction writing                                               | 15 | Synopsis presentation                                           |
| 16 | Review of literature writing                                       | 16 | Poster presentation                                             |
| 17 | Materials and methods writing                                      |    |                                                                 |
| 18 | Summary and references writing                                     |    |                                                                 |
| 19 | Common errors during scientific writing                            |    |                                                                 |
| 20 | Selection of statistical design                                    |    |                                                                 |
| 21 | Concepts of experimental controls and treatment specifications     |    |                                                                 |
| 22 | Types of research animals/birds                                    |    |                                                                 |
| 23 | Selection and housing management of animals/birds                  |    |                                                                 |
| 24 | Reduce cost of research                                            |    |                                                                 |
| 25 | Collection, tabulation and interpretation of research data/results |    |                                                                 |
| 26 | Use of computer for data handling and presentation                 |    |                                                                 |
| 27 | Scientific report writing and citation                             |    |                                                                 |
| 28 | Citation by using various software                                 |    |                                                                 |
| 29 | Difference between primary and secondary citation                  |    |                                                                 |
| 30 | Guidelines for poster presentation                                 |    |                                                                 |
| 31 | Guidelines for oral presentation                                   |    |                                                                 |
| 32 | Difference between poster and oral presentation                    |    |                                                                 |

### Teaching learning strategies

| Theory           | Practical        |
|------------------|------------------|
| Lectures         | Performance      |
| Presentation     | Presentations    |
| Group discussion | Group discussion |
| Assignments      | Assignments      |
| Quiz             |                  |

### **Class work Policies**

- Equal opportunity
- Intellectual honesty
- Regularity and Punctuality
- Adherence to deadlines
- Fairness
- Conformity to discipline

### **Assessment Strategies**

| <b>Theory</b>    |                   |                 |                   |              | <b>Practical</b>         |              |              |
|------------------|-------------------|-----------------|-------------------|--------------|--------------------------|--------------|--------------|
| <b>Modality</b>  | <b>Assignment</b> | <b>Mid term</b> | <b>Final Term</b> | <b>Total</b> | <b>Class performance</b> | <b>Final</b> | <b>Total</b> |
| <b>Max Marks</b> | <b>04</b>         | <b>12</b>       | <b>24</b>         | <b>40</b>    | <b>12</b>                | <b>08</b>    | <b>20</b>    |

### **Recommended Books/Readings**

1. Writing your thesis. 2<sup>nd</sup> edition. 2010. Paul Oliver. Sage. London DC.
2. Julie A. Lovegrove, Leanne Hodson, Sangita Sharma, Susan A. Lanham-New. 2015. Nutrition Research Methodologies.
3. Alley, M. 2003. The craft of scientific presentations: critical steps to succeed and critical errors to avoid. Springer, New York.
4. Gustavii, B. 2003. How to write and illustrate a scientific paper. Cambridge university press, Cambridge.
5. Robert K. Yin. 2009. Case Study Research: Design and Methods. 4<sup>th</sup> Edition. SAGE India Private Ltd.
6. Peat, J., Elliot, E., Baur, L. and Keena, V. 2002. Scientific writing: Easy When You Know How. BMJ books, London.
7. McMillon, V.E. 2001. Writing papers in the biological sciences. 3<sup>rd</sup> ed. Palgrave McMillan, Basingstoke.
8. Swales, J.M. and Feak, C.B. 2000. English in Today's Research World: A Writing Guide. University of Michigan Press, Ann Arbor.
9. Nilva K Sakmoura, Rob Gous, Llias Kyriazakis, L Hauschild. 2014. Nutritional Modelling for Pigs and Poultry. CABI Internationals.

**Course Title: Nutrition of Broilers**

**Course No: NUTR-1007**

**Course Duration: 1 semester (16 weeks)**

**Credit hours: 3(2-1)**

### **Course Description**

This course has been designed to learn about different feeding strategies of broiler birds to get economic benefits. Moreover, recent trends in broiler nutrition will be acquainted to students.

### **Performance Objectives**

#### **Objective 1**

To learn digestion and metabolism of nutrients in broilers.

#### **Objective 2**

To study recent trends in broiler nutrition.

### **Course Contents**

Digestion, absorption and metabolism of nutrients in broilers. Feed resources and their nutritional profile. Nutritional requirements of broilers. Effects of amino acid-energy ratio on growth of broilers. Essential amino acid and their role in broilers. Feed additives, micronutrients (Vit. & Min) and their role. Feeding program for broiler (starter, grower and finisher) and broiler breeders. Molting of broiler breeders. Feeding of broilers in hot weather and stress. Nutrient deficiencies/disease and their prevention. Anti-nutritional factors in broiler feedstuffs and their effect on broiler performance. Effect of feed on meat quality. Storage of broiler feeds. Measure to avoid feed wastage. Recent trends in broiler nutrition, feed restriction. Water requirement, its quality and significance. Effects of pre-biotic and pro-biotic on broiler performance. Effects of diet structure on broiler live performance and GIT. Feeding behavior of broiler chickens. Nutritional strategies to reduce heat stress in broilers and broiler breeders. Concepts of Ideal Proteins. Limiting Amino Acids and their importance. Heat requirements of broiler effected by diet density (pellet vs. mash). Concept of microbial protein. Cocktail of different enzymes and growth performance of broiler. Gut microbes and introducing new species to gut microbes. Social issues like in-feed antibiotics, environment, welfare, traceability, use of meat and bone meal. Use of growth models. Use of Oil and fats in broiler ration. Utilization of Nutricines to improve productivity. Use of phytogenic substances to improve gut health. Precision nutrition for broiler. Nutrition and epigenetics. Phase feeding.

### **Practical**

Least cost feed formulation for different age groups of broilers and breeder. Physical evaluation of feedstuffs. Laboratory analysis of feed and feedstuffs. Visits to commercial feed mills and commercial broiler/breeder farms. Antibiotic free diets. Hygiene practices during feed processing.

### **Detail Course Outline**

| <b>Serial No</b> | <b>Theory</b>                                            | <b>Serial No</b> | <b>Practical</b>                                                    |
|------------------|----------------------------------------------------------|------------------|---------------------------------------------------------------------|
| 01               | Feed resources and their nutritional profile             | 01               | Least cost ration formulation for broilers during pre-starter phase |
| 02               | Nutritional requirements of broilers                     | 02               | Least cost ration formulation during starter phase                  |
| 03               | Effect of amino acid energy ratio on broiler performance | 03               | Least cost ration formulation during grower and finisher phase      |
| 04               | Role of essential amino acids in broilers                | 04               | Least cost ration formulation for broiler breeders                  |
| 05               | Feeding programs for broilers                            | 05               | Physical evaluation of feed stuffs                                  |
| 06               | Feeding programs for broilers breeders                   | 06               | Laboratory analysis of feed ingredients                             |
| 07               | Digestion and absorption of proteins in broilers         | 07               | Estimation of gross energy                                          |
| 08               | Digestion and absorption of lipids in broilers           | 08               | Preparation of samples for mineral contents                         |
| 09               | Digestion and absorption of carbohydrates in broilers    | 09               | Estimation of mineral contents                                      |
| 10               | Metabolism of proteins in broilers                       | 10               | Estimation of mineral contents                                      |
| 11               | Metabolism of lipids in broilers                         | 11               | Formulation of antibiotic free diets                                |
| 12               | Metabolism of Carbohydrates in broilers                  | 12               | Hygienic practices during feed processing                           |
| 13               | Role of feed additives in broiler feeding                | 13               | Estimation of aflatoxin in broiler feed                             |
| 14               | Importance of macro-minerals in broilers                 | 14               | Estimation of amino acid contents in broiler feed                   |
| 15               | Importance of micro-minerals in broilers                 | 15               | Visit to commercial broiler farms                                   |
| 16               | Importance of fat soluble vitamins                       | 16               | Visit to commercial Feed Mills                                      |
| 17               | Importance of water soluble vitamins                     |                  |                                                                     |
| 18               | Use of Oil and fats in broiler ration                    |                  |                                                                     |
| 19               | Utilization of Nutricines to improve productivity        |                  |                                                                     |
| 20               | Use of phytogenic substances to improve gut health       |                  |                                                                     |
| 21               | Molting of broiler breeders                              |                  |                                                                     |
| 22               | Feeding of broilers in hot weather and stress            |                  |                                                                     |
| 23               | Nutritional deficiency diseases                          |                  |                                                                     |
| 24               | Impact of anti-nutritional factors on broilers           |                  |                                                                     |
| 25               | Effect of feed on meat quality                           |                  |                                                                     |
| 26               | Water quality and its importance                         |                  |                                                                     |
| 27               | Nutrition and epigenetics                                |                  |                                                                     |
| 28               | Antibiotics growth promoters in broilers                 |                  |                                                                     |

|    |                                                              |  |  |
|----|--------------------------------------------------------------|--|--|
| 29 | Feeding behaviour of broiler chicken, Phase feeding          |  |  |
| 30 | Concept of ideal proteins<br>Precision nutrition for broiler |  |  |
| 31 | Effect of diet structure in broiler on GIT                   |  |  |
| 32 | Introduction of new species of gut microbes                  |  |  |

### Teaching learning strategies

| Theory           | Practical        |
|------------------|------------------|
| Lectures         | Performance      |
| Presentation     | Presentations    |
| Group discussion | Group discussion |
| Assignments      | Assignments      |
| Quiz             |                  |

### Class work Policies

- Equal opportunity
- Intellectual honesty
- Regularity and Punctuality
- Adherence to deadlines
- Fairness
- Conformity to discipline

### Assessment Strategies

| Theory    |            |          |            |       | Practical         |       |       |
|-----------|------------|----------|------------|-------|-------------------|-------|-------|
| Modality  | Assignment | Mid term | Final Term | Total | Class performance | Final | Total |
| Max Marks | 04         | 12       | 24         | 40    | 12                | 08    | 20    |

### Recommended Books/Readings

#### Textbook:

1. Lesson, S and J.D Summers. 2002. Scott's Nutrition of the chicken. International Book Distributing Co. Guelph Ontario, Canada.

#### Reference Books:

1. Rick Kleyn 2013. Chicken Nutrition: A Guide for Nutritionists and Poultry Professionals.
2. Granswothy, P.C and J. Wiseman. 2012. Recent advances in animal nutrition.

3. Lesson, S and J.D Summers. 2009. Commercial poultry nutrition. International Book Distributing Co. Guelph Ontario, Canada
4. Reddy Y.R and T. Bhosale. 2004. Handbook of poultry nutrition.
5. D.J.A. Cole, W. Haresign. 2013. Recent Developments in Poultry Nutrition. Elsevier Science.

**Course Title: Nutrition of Dairy Animals**

**Course No: NUTR-1008**

**Course Duration: 1 semester (16 weeks)**

**Credit hours: 3(2-1)**

### **Course Description**

This course will incorporate knowledge about rumen ecology, microbial functions and fermentation processes. Different strategies related with feeding of dairy cattle will also be introduced. Different digestibility techniques and feed formulation for various classes of dairy animals will also be taught in this course.

### **Performance Objectives**

#### **Objective 1**

To study different pathways occurring in rumen ecosystem.

#### **Objective 2**

To learn about recent trends in dairy cattle nutrition.

### **Course Contents**

#### **Theory:**

Rumen Function (Motility, Rumen Cycle, Particle Size Reduction). Plant Nutrients Important in Ruminant Nutrition. Fermentation of Carbohydrates. Ruminal Microbial Ecology. Pathways of Carbohydrate Fermentation. VFA Production and Utilization. Digesta Flow and Microbial Protein Synthesis. Ketogenesis & Gluconeogenesis. Rumen Methanogenesis and Mitigation. Fermentation of Nitrogenous Compounds. Rumen Lipid Metabolism, Bio-hydrogenation, Absorption, and Partitioning. Energy Metabolism and Energy Feeding Systems. Feed additives for Enhanced Feed Efficiency. Nutrition and Reproduction. Protein Metabolism and Protein Feeding Systems. Endocrine and Metabolic Responses to Feeding. Environmental Aspects of Feeding for dairy Cattle. Research Techniques in Ruminant Nutrition.

#### **Practical:**

Digestion trials; total tract digestibility technique, *In-sacco* digestibility techniques in dairy animals, Digestibility using markers. Feed formulation for various classes of dairy animals: manual feed formulation, computerized feed formulation, Excel, CPM Dairy, NRC 2001. Hay and silage preparation. TMR particle size evaluation. Rumen sampling techniques; rumen pH, rumen ammonia estimation. Proximate analysis of feedstuffs for dairy animals.

### **Detail Course Outline**

| <b>Serial No</b> | <b>Theory</b>                                             | <b>Serial No</b> | <b>Practical</b>                        |
|------------------|-----------------------------------------------------------|------------------|-----------------------------------------|
| 01               | Understanding Rumen function                              | 01               | Total tract digestibility technique     |
| 02               | Importance of plant nutrients in small ruminant nutrients | 02               | <i>In-Sacco</i> digestibility technique |

|    |                                                                      |    |                                                                         |
|----|----------------------------------------------------------------------|----|-------------------------------------------------------------------------|
| 03 | Importance of plant nutrients in large ruminant nutrients            | 03 | Digestibility measurement by using makers technique                     |
| 04 | Rumen microbial ecology                                              | 04 | Introduction to feed formulation for dairy animals                      |
| 05 | Fermentation of carbohydrates                                        | 05 | NRC, 2001 recommendations for nutritional requirements of dairy animals |
| 06 | Utilization of VFAs                                                  | 06 | Manual feed formulation technique                                       |
| 07 | Factors controlling rate of digesta flow in ruminant digestive tract | 07 | Feed formulation by using Excel sheet                                   |
| 08 | Digestion mechanism for crude protein in ruminants                   | 08 | Use of CPM software for feed formulation                                |
| 09 | Microbial protein synthesis                                          | 09 | Hay Preparation                                                         |
| 10 | Nutritional value of microbial proteins                              | 10 | Silage Preparation                                                      |
| 11 | Ketogenesis in ruminants                                             | 11 | TMR particle size evaluation                                            |
| 12 | Gluconeogenesis                                                      | 12 | Rumen sampling techniques                                               |
| 13 | Methane synthesis in rumen and mitigation                            | 13 | Rumen pH Estimation                                                     |
| 14 | Fermentation of NPN substances                                       | 14 | Rumen ammonia estimation                                                |
| 15 | Lipid digestion in ruminants                                         | 15 | Proximate analysis of feedstuffs for dairy animals                      |
| 16 | Lipid metabolism in ruminants                                        | 16 | Proximate analysis of feedstuffs for dairy animals                      |
| 17 | Significance of bio-hydrogenation process                            |    |                                                                         |
| 18 | Absorption of nutrients in ruminants                                 |    |                                                                         |
| 19 | Energy metabolism in small ruminants                                 |    |                                                                         |
| 20 | Energy metabolism in large ruminants                                 |    |                                                                         |
| 21 | Kinetics of nutrient metabolism in complex stomach animals           |    |                                                                         |
| 22 | Energy feeding systems for small ruminants                           |    |                                                                         |
| 23 | Energy feeding systems for large ruminants                           |    |                                                                         |
| 24 | Protein feeding systems for small ruminants                          |    |                                                                         |
| 25 | Protein feeding systems for small ruminants                          |    |                                                                         |
| 26 | Endocrine responses to feeding                                       |    |                                                                         |
| 27 | Metabolic responses to feeding                                       |    |                                                                         |
| 28 | Research techniques in ruminant nutrition                            |    |                                                                         |
| 29 | Environmental aspect of feeding to dairy cattle                      |    |                                                                         |

|    |                                                |  |  |
|----|------------------------------------------------|--|--|
| 30 | Environmental aspect of feeding to dairy goats |  |  |
| 31 | Nutrition and reproduction                     |  |  |
| 32 | Importance of TMR in dairy ruminants           |  |  |

### Teaching learning strategies

| <b>Theory</b>    | <b>Practical</b> |
|------------------|------------------|
| Lectures         | Performance      |
| Presentation     | Presentations    |
| Group discussion | Group discussion |
| Assignments      | Assignments      |
| Quiz             |                  |

### Class work Policies

- Equal opportunity
- Intellectual honesty
- Regularity and Punctuality
- Adherence to deadlines
- Fairness
- Conformity to discipline

### Assessment Strategies

| <b>Theory</b>    |                   |                 |                   |              | <b>Practical</b>         |              |              |
|------------------|-------------------|-----------------|-------------------|--------------|--------------------------|--------------|--------------|
| <b>Modality</b>  | <b>Assignment</b> | <b>Mid term</b> | <b>Final Term</b> | <b>Total</b> | <b>Class performance</b> | <b>Final</b> | <b>Total</b> |
| <b>Max Marks</b> | <b>04</b>         | <b>12</b>       | <b>24</b>         | <b>40</b>    | <b>08</b>                | <b>12</b>    | <b>20</b>    |

### Recommended Books/Readings

#### Text Book:

1. Mario De Beni Arrigoni, Rodrigo Dias Lauritano Pacheco. 2016. Rumenology. Springer International Publishing.

#### Reference Books:

1. Church, D.C. 1988. Ruminant Animal Digestive Physiology and Nutrition. Prentice Hall, New Jersey, USA.
2. 3. Minson, D.J. 1990. Forage in Ruminant Nutrition. Harcourt Brae Jovanovich Publishers, New York, USA.

4. Wilson G. Pond. 2005. Basic Animal Nutrition and Feeding. 5<sup>th</sup> Edition. Wiley Publishers, USA.
5. P. McDonalds, R. A. Edwards, J. F. D. Greenhalgh, C. A. Morghan, L. A. Sinclair, R. G. Wilkinson. 2010. Animal Nutrition. 7<sup>th</sup> Edition. Pearson Publications. United Kingdom
6. Robert Blair. 2011. Nutrition and Feeding of Organic Cattle. CAB International. ISBN 978-1-84593-758-4.

**Course Title: Nutrition of Small Ruminants**

**Course No: NUTR-1009**

**Course Duration: 1 semester (16 weeks)**

**Credit hours: 3(2-1)**

### **Course Description**

This course will incorporate knowledge about rumen ecology, microbial functions and fermentation processes. Different strategies related with feeding of small ruminants will also be introduced. Different digestibility techniques and feed formulation for various classes of small ruminants will also be taught in this course.

### **Performance Objectives**

#### **Objective 1**

To study different pathways occurring in rumen ecosystem.

#### **Objective 2**

To learn about recent trends in small ruminants nutrition.

### **Course Contents**

#### **Theory:**

Digestive physiology and microbial ecology of rumen. Rumen fermentation, Digestion and metabolism of nutrients. Principles of supplementary feeding. Nutrient requirement of sheep and goat: Maintenance, Growth, lactation and wool production. Nutrition for conception (flushing ration) and pregnancy. Special feeding regimes for fattening and sacrificial animals. Nutritional management under range and pasture. Mineral and vitamins in small ruminants. Factors affecting digestion in sheep and goats. range land grasses, shrubs, fodders and concentrates etc. Feeding of breeding animals. Nutritional disorders and deficiency in sheep and goats.

#### **Practical:**

Introduction to small ruminant feeding systems and comparison of feeding behaviour of sheep and goats. Feed resources: conventional and non-conventional feed resources. Feed formulation: concentrate and TMR formulation. Digestibility techniques: total tract digestibility, in situ digestibility and in vitro digestibility techniques. Supplement preparations, preparation of mineral blocks/ mixtures, urea treatment of straw. Observations on a grazing habit of sheep/goat.

## Detail Course Outline

| Serial No | Theory                                                 | Serial No | Practical                                                            |
|-----------|--------------------------------------------------------|-----------|----------------------------------------------------------------------|
| 01        | Introduction to digestive physiology of rumen          | 01        | Introduction to small animals feeding systems                        |
| 02        | Introduction to microbial ecology of rumen             | 02        | Comparison of feeding behaviour of sheep and goats                   |
| 03        | Rumen fermentation                                     | 03        | Introduction to feed resources                                       |
| 04        | Digestion of nutrients in small ruminants              | 04        | Conventional feed resources for small ruminants                      |
| 05        | Metabolism of nutrients in small ruminants             | 05        | Non-conventional feed resources for small ruminants                  |
| 06        | Absorption of nutrients in small ruminants             | 06        | Concentrate formulation for small ruminants                          |
| 07        | Principles of supplementary feeding                    | 07        | TMR feeding to small ruminants                                       |
| 08        | Introduction of nutrient requirements in goats         | 08        | Introduction to digestibility techniques in small ruminants          |
| 09        | Introduction of nutrient requirements in sheep         | 09        | Total tract digestibility technique in small ruminants               |
| 10        | Nutrient requirements for maintenance in goats         | 10        | <i>In-situ</i> digestibility technique in small ruminants            |
| 11        | Nutrient requirements for growth in goats              | 11        | <i>In-vitro</i> digestibility technique in small ruminants           |
| 12        | Nutrient requirements for lactation in goats           | 12        | Supplements preparation for small ruminants                          |
| 13        | Nutrient requirements for maintenance in sheep         | 13        | Preparation of mineral blocks and mineral mixture in small ruminants |
| 14        | Nutrient requirements for growth in sheep              | 14        | Urea treatment of straw                                              |
| 15        | Nutrient requirements for lactation in sheep           | 15        | Observations on grazing habit of sheep                               |
| 16        | Nutrient requirements for wool production in sheep     | 16        | Observations on grazing habit of sheep                               |
| 17        | Nutrient requirement for conception in small ruminants |           |                                                                      |
| 18        | Nutrient requirement for pregnancy in small ruminants  |           |                                                                      |
| 19        | Special feeding regimes for fattening animals          |           |                                                                      |
| 20        | Special feeding regimes for fattening animals          |           |                                                                      |
| 21        | Special feeding regimes for sacrificial animals        |           |                                                                      |
| 22        | Nutritional management under range and pasture         |           |                                                                      |
| 23        | Micro-minerals in small animals nutrition              |           |                                                                      |

|    |                                                                                |  |  |
|----|--------------------------------------------------------------------------------|--|--|
| 24 | Macro-minerals in small animals nutrition                                      |  |  |
| 25 | Vitamins in small animals nutrition                                            |  |  |
| 26 | Factors affecting digestion in sheep and goats                                 |  |  |
| 27 | Range land grasses, shrubs, fodders and concentrate feeding in small ruminants |  |  |
| 28 | Feeding of breeding animals                                                    |  |  |
| 29 | Nutritional disorders and deficiency diseases in goats                         |  |  |
| 30 | Nutritional disorders and deficiency diseases in sheep                         |  |  |
| 31 | Recent trends in small animal nutrition                                        |  |  |
| 32 | Recent trends in small animal nutrition                                        |  |  |

### Teaching learning strategies

| <b>Theory</b>    | <b>Practical</b> |
|------------------|------------------|
| Lectures         | Performance      |
| Presentation     | Presentations    |
| Group discussion | Group discussion |
| Assignments      | Assignments      |
| Quiz             |                  |

### Class work Policies

- Equal opportunity
- Intellectual honesty
- Regularity and Punctuality
- Adherence to deadlines
- Fairness
- Conformity to discipline

### Assessment Strategies

| <b>Theory</b>    |                   |                 |                   |              | <b>Practical</b>         |              |              |
|------------------|-------------------|-----------------|-------------------|--------------|--------------------------|--------------|--------------|
| <b>Modality</b>  | <b>Assignment</b> | <b>Mid term</b> | <b>Final Term</b> | <b>Total</b> | <b>Class performance</b> | <b>Final</b> | <b>Total</b> |
| <b>Max Marks</b> | <b>04</b>         | <b>12</b>       | <b>24</b>         | <b>40</b>    | <b>12</b>                | <b>08</b>    | <b>20</b>    |

## **Recommended Books/Readings**

### **Text Book:**

1. Freer, M., & Dove, H. (Eds.). 2002. Sheep nutrition. CABI.

### **Recommended Books:**

1. Millen, Danilo Domingues, Mario De Beni Arrigoni, and Rodrigo Dias Lauritano Pacheco, 2016 eds. Rumenology. Springer.
2. Church, D.C. 1988. Ruminant Animal Digestive Physiology and Nutrition. Prentice Hall, New Jersey, USA.
3. Fehr, P.M. 1991. Goat Nutrition. Netherlands: Pudoc Wageningen.
4. NRC. 2000. Nutrient Requirements of Goat, Angora, Dairy & Meat Goat in Temperate and Tropical Countries. National Academy Press Washington USA.
5. NRC. 2000. Nutrient Requirements of Sheep. National Research Council National Academy Press Washington D.C.
6. Antonello Cannas, Giuseppe Pulina. 2007. Dairy Goats Feeding and Nutrition. CAB International. ISBN 978-1-84593-348-7 (alk. Paper). Original Edition published in Italian.

**Course Title: Feed Manufacturing Technology**

**Course No: NUTR-1010**

**Course Duration: 1 semester (16 weeks)**

**Credit hours: 3(2-1)**

### **Course Description**

Updated course contents will help students to get modern knowledge about feed manufacturing technology. After studying this course, students will be able to learn modern skills related with feed milling and they can implement these skills at working with feed mills.

### **Performance Objectives**

#### **Objective 1**

To learn about modern feed milling practices.

#### **Objective 2**

To learn about use of different software to formulate feed for different classes of livestock and poultry.

### **Course Contents**

#### **Theory:**

Present status and problems of feed industry in Pakistan. Preparation of feasibility report to establish a feed mill. Construction and designing of feed mill. Operational mechanism of feed mill. Procurement of raw materials. Sampling equipment and techniques. Grains and raw material storage. Nutrient losses and other changes during storages. Formulation of feeds for different classes of livestock and poultry. Importance and composition of micromixes and additives in animal feed. Manufacturing of compound feeds. Selecting, cleaning, grinding, mixing and storing of feed ingredients. Effect of processing on feed, significance and choice of processing methods. Feeding standards and feed laws. Quality control in feed milling industry. Feed marketing techniques.

#### **Practical:**

Visit of local markets and feed mills. Feed raw material storage and handling. Feed processing, physical and chemical treatments. Preparation of micromixes. Chemical analysis of raw material and finished feed.

### **Detail Course Outline**

| <b>Serial No</b> | <b>Theory</b>                                              | <b>Serial No</b> | <b>Practical</b>                                                                     |
|------------------|------------------------------------------------------------|------------------|--------------------------------------------------------------------------------------|
| 01               | Present status and problems of feed industry in Pakistan   | 01               | Visit to local markets for identification of feed ingredients                        |
| 02               | Preparation of feasibility report to establish a feed mill | 02               | Visit to commercial feed mills for identification of feed ingredients and processing |

|    |                                                             |    |                                                         |
|----|-------------------------------------------------------------|----|---------------------------------------------------------|
| 03 | Preparation of feasibility report to establish a feed mill  | 03 | Handling of feed raw materials                          |
| 04 | Construction and designing of feed mill                     | 04 | Storage of feed raw materials                           |
| 05 | Construction and designing of feed mill                     | 05 | Feed processing techniques                              |
| 06 | Operational mechanism of feed mill                          | 06 | Feed processing techniques                              |
| 07 | Operational mechanism of feed mill                          | 07 | Physical and Chemical treatments in feed processing     |
| 08 | Procurement of raw material                                 | 08 | Physical and Chemical treatments in feed processing     |
| 09 | Procurement of raw material                                 | 09 | Preparation of micro mixes                              |
| 10 | Sampling equipment and techniques                           | 10 | Preparation of micro mixes                              |
| 11 | Grains and raw material storage                             | 11 | Physical evaluation of raw materials                    |
| 12 | Nutrient losses and other changes during storage            | 12 | Chemical analysis of raw materials (Proximate analysis) |
| 13 | Formulation of feed for different classes of livestock      | 13 | Chemical analysis of raw materials (Proximate analysis) |
| 14 | Formulation of feed for different classes of poultry        | 14 | Chemical analysis of finished feed                      |
| 15 | Importance and composition of micro mixes in animal feed    | 15 | Toxins analysis of raw material and finished feeds      |
| 16 | Importance and composition of feed additives in animal feed | 16 | Quality control measures in feed manufacturing          |
| 17 | Manufacturing of compound feeds                             |    |                                                         |
| 18 | Selection of feed ingredients                               |    |                                                         |
| 19 | Cleaning of feed ingredients                                |    |                                                         |
| 20 | Grinding of feed ingredients                                |    |                                                         |
| 21 | Mixing of feed ingredients                                  |    |                                                         |
| 22 | Storage of feed ingredients                                 |    |                                                         |
| 23 | Effect of processing on feed                                |    |                                                         |
| 24 | Significance and choice of processing methods               |    |                                                         |
| 25 | Feeding standards and Feed laws                             |    |                                                         |
| 26 | Feeding standards and Feed laws                             |    |                                                         |
| 27 | Quality control in feed milling industry                    |    |                                                         |
| 28 | Quality control in feed milling industry                    |    |                                                         |
| 29 | Feed marketing techniques                                   |    |                                                         |
| 30 | Feed marketing techniques                                   |    |                                                         |
| 31 | Recent advances in feed manufacturing technology            |    |                                                         |
| 32 | Recent advances in feed manufacturing technology            |    |                                                         |

## Teaching learning strategies

| <b>Theory</b>    | <b>Practical</b> |
|------------------|------------------|
| Lectures         | Performance      |
| Presentation     | Presentations    |
| Group discussion | Group discussion |
| Assignments      | Assignments      |
| Quiz             |                  |

## Class work Policies

- Equal opportunity
- Intellectual honesty
- Regularity and Punctuality
- Adherence to deadlines
- Fairness
- Conformity to discipline

## Assessment Strategies

| <b>Theory</b>    |                   |                 |                   |              | <b>Practical</b>         |              |              |
|------------------|-------------------|-----------------|-------------------|--------------|--------------------------|--------------|--------------|
| <b>Modality</b>  | <b>Assignment</b> | <b>Mid term</b> | <b>Final Term</b> | <b>Total</b> | <b>Class performance</b> | <b>Final</b> | <b>Total</b> |
| <b>Max Marks</b> | <b>04</b>         | <b>12</b>       | <b>24</b>         | <b>40</b>    | <b>12</b>                | <b>08</b>    | <b>20</b>    |

## Recommended Books/Readings

### Textbooks:

1. Eileen K. Schofield. 2005. Feed Manufacturing Technology V. American Feed Industry Association.

### Reference Books:

1. McEllihiney, R.R. 1994. Feed Manufacturing Technology iv. American Feed Industry Association, Inc, Arlington, USA.

2. Add feed milling book latest

3. Reddy, V. Rama Subba and D.T. Bhosal. 2001. 4. Handbook of Poultry Nutrition. American Soybean Association. New Dehli, India.

4. Moughan, P.J., M.W.A. Vestegen and M.I. Visser-Reyneveid. 2002. Feed Evaluation – Principles and Practice. Empress Publishing. The Netherlands.

**Course Title: Recent Advances in Animal Nutrition**

**Course No: NUTR-1011**

**Course Duration: 1 semester (16 weeks)**

**Credit hours: 2(2-0)**

### **Course Description**

This course will help students to review scientific literature and utilization of different software for statistical analysis. Students will be able to use citation software and preparation of scientific literature.

### **Performance Objectives**

#### **Objective 1**

To study use of digital library for literature review.

#### **Objective 2**

To prepare students for scientific write up.

### **Course Contents**

#### **Theory:**

History, development and present scope of nutrition in improving the performance of livestock and poultry. Compilation of classic papers; Resources in UVAS for literature review: use of digital library. Introduction to Animal Nutrition Journals; Article reading; components of an article, construction of research hypothesis, Importance of literature review. Experimental designs in animal nutrition; introduction to software used for statistical analysis. Identification of areas for future research; class projects. Use of Endnote as citation software. Assignments of different topics and preparation of abstracts.

### **Detail Course Outline**

| <b>Serial No</b> | <b>Theory</b>                                                                                 |
|------------------|-----------------------------------------------------------------------------------------------|
| 01               | History, development and present scope of nutrition in improving the performance of livestock |
| 02               | History, development and present scope of nutrition in improving the performance of poultry   |
| 03               | Compilation of classic papers                                                                 |
| 04               | Resources in UVAS for literature review                                                       |
| 05               | Resources in UVAS for literature review                                                       |
| 06               | Use of digital library                                                                        |
| 07               | Use of digital library                                                                        |
| 08               | Introduction to journals related to Ruminant Nutrition                                        |
| 09               | Introduction to journals related to Poultry Nutrition                                         |
| 10               | Introduction to article reading                                                               |
| 11               | Components of a research article                                                              |
| 12               | Components of a research article                                                              |

|    |                                                      |
|----|------------------------------------------------------|
| 13 | Components of a research article                     |
| 14 | Construction of research hypothesis                  |
| 15 | Construction of research hypothesis                  |
| 16 | Importance of literature review                      |
| 17 | Techniques to improve literature review              |
| 18 | Experimental designs in Animal Nutrition             |
| 19 | Experimental designs in Animal Nutrition             |
| 20 | Introduction to software used for statistical design |
| 21 | Introduction to SPSS                                 |
| 22 | Introduction to SAS                                  |
| 23 | Identification for areas of future research          |
| 24 | Identification for areas of future research          |
| 25 | Class projects                                       |
| 26 | Class projects                                       |
| 27 | Introduction to Endnote                              |
| 28 | Use of Endnote as citation software                  |
| 29 | Use of Endnote as citation software                  |
| 30 | Assignments of different topics                      |
| 31 | Preparation of abstracts                             |
| 32 | Preparation of abstracts                             |

### Teaching learning strategies

|                  |
|------------------|
| <b>Theory</b>    |
| Lectures         |
| Presentation     |
| Group discussion |
| Assignments      |
| Quiz             |

### Class work Policies

- Equal opportunity
- Intellectual honesty
- Regularity and Punctuality
- Adherence to deadlines
- Fairness
- Conformity to discipline

### Assessment Strategies

|                  |                   |                 |                   |              |
|------------------|-------------------|-----------------|-------------------|--------------|
| <b>Theory</b>    |                   |                 |                   |              |
| <b>Modality</b>  | <b>Assignment</b> | <b>Mid term</b> | <b>Final Term</b> | <b>Total</b> |
| <b>Max Marks</b> | <b>04</b>         | <b>12</b>       | <b>24</b>         | <b>40</b>    |

## **Recommended Books/Readings**

### **Journals:**

Journals including J. Animal Sciences, British Journal of Nutrition, J. Poultry Science, J. Dairy Science, Dairy Research, J. of Animal Production, J. Nutrition, J. Animal Feed Science and Technology, Indian J. of Animal Nutrition, Small Ruminants Research and Buffalo Journal.

### **Text Books:**

1. Garnsworthy, P.C. and J. Wiseman. 2002. Recent Advances in Animal Nutrition – 2002. Empress Publishing, The Netherlands.

### **Recommended Books:**

2. Hall, M. B., W. H. Hoover, J. P. Jennings, and T. K. M. Webster. 1999. A method for partitioning neutral detergent-soluble carbohydrates. Journal of the Science of Food and Agriculture 79(15):2079-2086.

3. Modern analytical techniques used in animal nutrition research

**Course Title: Toxins and Anti-Nutritional Factors in Indigenous Feedstuffs****Course No: NUTR-1012****Course Duration: 1 semester (16 weeks)****Credit hours: 3(2-1)****Course Description**

This course has been prepared to familiarise students with different classes of toxins and anti-nutritional factors. Learning about these anti-nutritional factors as well as toxins will help them to study their impact on animal health. Different measures can be devised to detoxify the mycotoxins in livestock and poultry feed.

**Performance Objectives****Objective 1**

To study various classes of anti-nutritional factors in feed ingredients.

**Objective 2**

Impact of different mycotoxins on animal health and their interaction with each other.

Measures to detoxify mycotoxins

**Course Contents****Theory:**

Classification of anti-nutritional factors and antimetabolites. Toxic proteins (Trypsin inhibitors and lectins). Toxic dipeptides (gizzerosine and linatins). Anti-nutritional effects of toxic and lethargic amino acids. Toxic carbohydrates, fatty acids and phenolic compounds. Phytate and oxalates in Feedstuffs and their detoxification. Anti-vitamin compounds in feed ingredients. Anti-nutritional factors during frying conditions for growth of mycotoxins. Impact of different mycotoxins (aflatoxins, ochratoxins, DON, fumonisins, T2 toxins and others) on animal health and their interaction with each other. Measures to detoxify mycotoxins in livestock and poultry feed.

**Practical:**

Determination of glucosinolates. Estimation of trypsin inhibitors. Determination of mycotoxins in feedstuffs. Determination of protein solubility by KOH solubility test. Determination of trypsin inhibitors by urease activity index. Determination of per oxide value. Determination of free fatty acids. Determination of adulteration by Leather mixing test.

**Detail Course Outline**

| <b>Serial No</b> | <b>Theory</b>                                                  | <b>Serial No</b> | <b>Practical</b>                                                 |
|------------------|----------------------------------------------------------------|------------------|------------------------------------------------------------------|
| 01               | Classification of anti-nutritional factors and antimetabolites | 01               | Determination of glucosinolates in canola meal and rapeseed meal |

|    |                                                                                     |    |                                                                            |
|----|-------------------------------------------------------------------------------------|----|----------------------------------------------------------------------------|
| 02 | Introduction to toxic proteins                                                      | 02 | Determination of glucosinolates in canola meal and rapeseed meal           |
| 03 | Trypsin inhibitors and lectins                                                      | 03 | Estimation of trypsin inhibitors in Soybean meal                           |
| 04 | Introduction to toxic dipeptides                                                    | 04 | Estimation of trypsin inhibitors in Soybean meal                           |
| 05 | Gizzerosine and linatins                                                            | 05 | Determination of mycotoxins in raw material (Strip test)                   |
| 06 | Anti-nutritional effects of toxic and lethargic amino acids                         | 06 | Determination of mycotoxins (Aflatoxin) in raw material (ELISA technique)  |
| 07 | Anti-nutritional effects of toxic and lethargic amino acids                         | 07 | Determination of mycotoxins (Aflatoxin) in finished feed (Strip test)      |
| 08 | Toxic carbohydrates                                                                 | 08 | Determination of mycotoxins (Aflatoxin) in finished feed (ELISA technique) |
| 09 | Toxic fatty acids                                                                   | 09 | Determination of protein solubility by KOH solubility test                 |
| 10 | Toxic phenolic compounds                                                            | 10 | Determination of protein solubility by KOH solubility test                 |
| 11 | Phytate and oxalate in feedstuffs and their detoxification                          | 11 | Urease activity index for soybean meal                                     |
| 12 | Phytate and oxalate in feedstuffs and their detoxification                          | 12 | Determination of per oxide value                                           |
| 13 | Anti-vitamin compounds in feed ingredients                                          | 13 | Determination of per oxide value                                           |
| 14 | Anti-vitamin compounds in feed ingredients                                          | 14 | Determination of free fatty acids                                          |
| 15 | Anti-nutritional factors during frying conditions for growth of mycotoxins          | 15 | Determination of free fatty acids                                          |
| 16 | Anti-nutritional factors during frying conditions for growth of mycotoxins          | 16 | Determination of adulteration by leather mixing test                       |
| 17 | Impact of aflatoxins on animal health                                               |    |                                                                            |
| 18 | Impact of ochratoxins on animal health                                              |    |                                                                            |
| 19 | Impact of DON on animal health                                                      |    |                                                                            |
| 20 | Impact of fumonsins on animal health                                                |    |                                                                            |
| 21 | Impact of T2 toxins on animal health                                                |    |                                                                            |
| 22 | Impact of other toxins on animal health                                             |    |                                                                            |
| 23 | Interaction of different mycotoxins with each other and relation with animal health |    |                                                                            |

|    |                                                                                     |  |  |
|----|-------------------------------------------------------------------------------------|--|--|
| 24 | Interaction of different mycotoxins with each other and relation with animal health |  |  |
| 25 | Measures to detoxify mycotoxins in livestock feed                                   |  |  |
| 26 | Measures to detoxify mycotoxins in livestock feed                                   |  |  |
| 27 | Measures to detoxify mycotoxins in poultry feed                                     |  |  |
| 28 | Measures to detoxify mycotoxins in poultry feed                                     |  |  |
| 29 | Introduction to development of new varieties of ingredients with less ANFs          |  |  |
| 30 | Introduction to development of new varieties of ingredients with less ANFs          |  |  |
| 31 | Recent trends in feed industry to compensate ANFs                                   |  |  |
| 32 | Recent trends in feed industry to compensate ANFs                                   |  |  |

### Teaching learning strategies

| <b>Theory</b>    | <b>Practical</b> |
|------------------|------------------|
| Lectures         | Performance      |
| Presentation     | Presentations    |
| Group discussion | Group discussion |
| Assignments      | Assignments      |
| Quiz             |                  |

### Class work Policies

- Equal opportunity
- Intellectual honesty
- Regularity and Punctuality
- Adherence to deadlines
- Fairness
- Conformity to discipline

### Assessment Strategies

| <b>Theory</b>    |                   |                 |                   |              | <b>Practical</b>         |              |              |
|------------------|-------------------|-----------------|-------------------|--------------|--------------------------|--------------|--------------|
| <b>Modality</b>  | <b>Assignment</b> | <b>Mid term</b> | <b>Final Term</b> | <b>Total</b> | <b>Class performance</b> | <b>Final</b> | <b>Total</b> |
| <b>Max Marks</b> | <b>04</b>         | <b>12</b>       | <b>24</b>         | <b>40</b>    | <b>12</b>                | <b>08</b>    | <b>20</b>    |

## **Recommended Books/Readings**

### **Text Book:**

1. S. Leeson and J.D. Summers. 2004. Scott's Nutrition of the Chicken. Fourth Edition. University Books Publishers. ISBN 9780969560043

### **Recommended Books:**

1. M. MAzquiz, G.D. Hill, C. Cuadrado, M.M. Pedrosa, C. Burbano. 2004. Recent advances of research in anti-nutritional factors in legume seeds and oilseeds. EAAP Publication No.110 Toledo Spain.

2. P.R. Cheeke. 2005. Applied Animal Nutrition. 3<sup>rd</sup> Edition. Pearson Education (US).

3. C. Caygill. and I.M. HJarvey. 2002. Secondary Plant Products. Empress Publishing. The Netherlands.

4. J.P.F. D'Mello. 2000. Farm Animal Metabolism and Nutrition. Biotechnology Department, the Scottish Agricultural College, Edinburg, UK.

**Course Title: Clinical Nutrition**

**Course No: NUTR-1013**

**Course Duration: 1 semester (16 weeks)**

**Credit hours: 2(2-0)**

### **Course Description**

This course has been prepared to familiarise students with dealing for nutrition of sick or diseased animals. After studying this course, students will be able to deal with the nutritional therapy of diseased animals.

### **Performance Objectives**

#### **Objective 1**

Nutritional requirements of diseased animals

#### **Objective 2**

Selective feeding for different species of animals

### **Course Contents**

#### **Theory**

Overview of process of clinical nutrition. Nutritional assessment of diseased animals. Body condition score. Development of comprehensive feeding plans for injured/sick animals. Reassessment/monitoring of the patient. Nutrigenomics and nutrigenetics: Nutritional genomics in health and disease. Feed intolerance and sensitivity. Selective feeding for different type of animals/pets. Critical case nutrition. Pre and post operational feeding.

### **Detail Course Outline**

| <b>Serial No</b> | <b>Theory</b>                                                  |
|------------------|----------------------------------------------------------------|
| 01               | Introduction to clinical nutrition                             |
| 02               | Overview of process of clinical nutrition                      |
| 03               | Overview of process of clinical nutrition                      |
| 04               | Nutritional assessment of diseased animals                     |
| 05               | Nutritional assessment of diseased animals                     |
| 06               | Body condition score                                           |
| 07               | Development of comprehensive feeding plans for injured animals |
| 08               | Development of comprehensive feeding plans for injured animals |
| 09               | Development of comprehensive feeding plans for sick animals    |
| 10               | Development of comprehensive feeding plans for sick animals    |
| 11               | Reassessment/monitoring of the patient                         |
| 12               | Nutrigenomics and nutrigenetics                                |
| 13               | Nutrigenomics and nutrigenetics                                |
| 14               | Nutritional genomics in health and disease                     |
| 15               | Nutritional genomics in health and disease                     |
| 16               | Feed intolerance and sensitivity                               |

|    |                                                      |
|----|------------------------------------------------------|
| 17 | Feed intolerance and sensitivity                     |
| 18 | Selective feeding for different type of animals/pets |
| 19 | Selective feeding for different type of animals/pets |
| 20 | Critical case nutrition                              |
| 21 | Critical case nutrition                              |
| 22 | Pre operational feeding                              |
| 23 | Post operational feeding                             |
| 24 | Clinical nutrition for small ruminants               |
| 25 | Clinical nutrition for large ruminants               |
| 26 | Clinical nutrition for poultry birds                 |
| 27 | Clinical nutrition for pheasants                     |
| 28 | Clinical nutrition for canines                       |
| 29 | Clinical nutrition for felines                       |
| 30 | Clinical nutrition for zoo animals                   |
| 31 | Recent trends in clinical nutrition                  |
| 32 | Recent trends in clinical nutrition                  |

### Teaching learning strategies

|                  |
|------------------|
| <b>Theory</b>    |
| Lectures         |
| Presentation     |
| Group discussion |
| Assignments      |
| Quiz             |

### Class work Policies

- Equal opportunity
- Intellectual honesty
- Regularity and Punctuality
- Adherence to deadlines
- Fairness
- Conformity to discipline

### Assessment Strategies

|                  |                   |                 |                   |              |
|------------------|-------------------|-----------------|-------------------|--------------|
| <b>Theory</b>    |                   |                 |                   |              |
| <b>Modality</b>  | <b>Assignment</b> | <b>Mid term</b> | <b>Final Term</b> | <b>Total</b> |
| <b>Max Marks</b> | <b>04</b>         | <b>12</b>       | <b>24</b>         | <b>40</b>    |

### Recommended Books/Readings

#### Text Book:

1. Michael S. Hand, Craig D. Thatcher, Rebecca L. Remillard, Phillip Roudebush, Bruce J. Novotny. 2010. Small Animal Clinical Nutrition. 5th Edition.

**Reference Books:**

1. W Jean Dodds, Diana R Laverdure. 2015. Canine Nutrigenomics: The New Science of Feeding Your Dog for Optimum Health. Dog wise Publishing.
2. Andrea J. Fascetti, Sean J. Delaney. 2013. Applied Veterinary Clinical Nutrition. 1<sup>st</sup> Edition. John Wiley & Sons Ltd.
3. Don Hamilton, Richard Pitcairn. 2010. Homeopathic Care for Cats and Dogs, Revised Edition: Small Doses for Small Animals. Revised Edition.