Scheme of studies for M.Phil in Animal Nutrition, Department of Livestock and Poultry Production, Faculty of Veterinary Sciences, Bahauddin Zakariya University, Multan

Course Code.	Course Title	Credit hours
NUTR-701	Fundamentals of Animal Nutrition	3(3-0)
NUTR-702	Metabolism of Primary Nutrients	3(3-0)
NUTR-703	Feed Resources and Nutritive Value	3(2-1)
NUTR-704	Minerals and Vitamins in Animal Nutrition	3(2-1)
NUTR-705	Analytical Techniques in Animal Nutrition	3(0-3)
NUTR-706	Feed Formulation and Manufacturing Technology	3(2-1)
NUTR-707	Principles and Practices of Avian Nutrition	3(2-1)
NUTR-708	Ruminant Nutrition	3(2-1)
NUTR-709	Seminar	1(1-0)
NUTR-710	Special problem	1(1-0)
ARAB-711	Understanding of Holy Quran-I/Feham-e-Quran-I	1(0-1)
ARAB-712	Understanding of Holy Quran-I/Feham-e-Quran-II	1(0-1)
NUTR-713	Research Designing and Methodology in Animal Nutrition	3(2-1)
NUTR-714	Nutrition of Pet and Zoo Animals	3(3-0)
NUTR-720	Research and Thesis	3(0-3)
	Total Credit Hours	**34+6**

Note: For the course work of M.Phil program, 24 credit hours shall be selected out of given 34 credit hours. Six credit hours for research and thesis are compulsory.

Deficiency Courses Level-6

Course Code	Course Title	Credit Hours
NUTR-601	Principles of Animal Nutrition	3(2-1)
NUTR-602	Livestock Feed Resources and Forage Conservation	3(2-1)
NUTR-603	Poultry Nutrition and Feed Technology	2(1-1)

NUTR-701 Fundamentals of Animal Nutrition 3(3-0)

Learning objectives

- To understand composition and functions of major nutrients.
- To learn about digestive physiology and absorption of nutrients in ruminants and non-ruminants.
- Metabolic disorders related with improper utilization of nutrients.

THEORY

Basic chemistry, classification and biological functions of essential nutrients. Comparative digestive physiology of ruminants and non-ruminants. Importance of water in animal nutrition. Digestion and absorption of carbohydrate in ruminants and non-ruminants. Effect of structure of starch on digestion. Extracellular hydrolysis of complex carbohydrates. Digestion and absorption of lipids in ruminants and simple stomach animals. Fatty acid synthesis in tissues. Production and utilization of ketone bodies. Digestion and absorption of proteins in ruminants and non- ruminants. Nitrogen recycling in ruminants. Digestion and absorption of vitamins in different species. Minerals, their digestion and bioavailability. Energy metabolism. Hormonal control of metabolism. Major metabolic disorders in ruminants and simple stomach animals.

Textbook

Gita Cherian. 2020. A Guide to the Principles of Animal Nutrition. First edition. Oregon state University, USA.

Recommended books

1. Gordon McL Dryden. 2021. Fundamentals of Applied Animal Nutrition. CAB International, Oxfordshire UK.
2. McDonald P, Edwards R.A., Greenhalf J.F.D. and Morgan C.A. 2022. Animal Nutrition. 8th Ed. Longman Scientific and Technical Publisher, UK.
3. Wo G. 2017. Principles of Animal Nutrition. First Edition. CRC Press, Taylor and Francis Group.
4. Pond W.G, Church D.B., Pond K.R. & Schoknecht P.A. 2004. 5th edition. Basic animal nutrition and feeding. John Wiley & Sons, USA.

NUTR-702 Metabolism of Primary Nutrients 3(3-0) Learning objectives

- To learn metabolism of different nutrients and hormonal regulation of metabolic processes.
- To learn various metabolic pathways associated with energy metabolism and other body needs.
- To learn about measures of quality of protein and use of NPN in ruminants.

THEORY

Role of water in metabolism; Metabolism of carbohydrates; Classification, digestion, absorption and metabolism; Glycolysis; Citric acid cycle and electron transport chain; Lactic acid and volatile fatty acid fermentation; Pentose phosphate pathway; Gluconeogenesis; Glycogenesis and glycogenolysis; Metabolism of lipids; Classification, digestion, absorption and metabolism; Beta oxidation of fatty acids; Fate of glycerol with respect of fat synthesis, glucose/glycogen syntheses and its oxidation; Storage of fat; Catabolism of fat and ketosis; metabolism of proteins; Classification, digestion; Absorption and metabolism; Essential and non-essential amino acids; Protein quality; Fate of absorbed amino acids; Transamination; Deamination; Trans-methylation;

Decarboxylation and inter-conversion of amino acids; Utilization of non- protein nitrogenous compounds in ruminants

Textbook

1. Gita Cherian. 2020. A Guide to the Principles of Animal Nutrition. First edition. Oregon state University, USA.
2. Wu G. (Ed.). 2022. Recent Advances in Animal Nutrition and Metabolism. Springer.

Recommended books:

1. Nelson D.L and Cox M.M. 2021. Lehninger Principles of Biochemistry. 8th Edition, Wroth Publishers, USA.
2. McDonald P., Edwards R.A., Greenhalf J.F.D. and Morgan C.A. 2022. Animal Nutrition. 8th Ed. Longman Scientific and Technical Publisher, UK.
3. Chizzotti, M. L. 2019. Energy and Protein Metabolism and Nutrition. Wageningen Academic Publishers, Netherlands.
4. Rodwell V., Bender W, Botham D.A, Kennelly K.M. and Weil P.A. 2018. Harper's Illustrated Biochemistry 31st Ed. McGraw Hill Education, NY, USA.
5. Lanham-New S.A., Macdonald I.A., Roche H.M. 2011. Nutrition and Metabolism. The Nutrition Society Textbooks, Wiley-Blackwell. (ISBN: 978-1-4051-6808-3).
6. Cheeke P.R and Dierenfeld E.S. 2010. Comparative Animal Nutrition and Metabolism. Cabi publishing, Oxfordshire, UK.

NUTR-703 Feed Resources and Nutritive Value 3(2-1)

Learning objectives

- To learn about nutritive value of different feedstuffs.
- To study different methods for improvement of existing and low quality feed resources.
- To learn about concepts and methods of forage preservation.
- To understand feeding standards, by-pass nutrients, feed additives and toxic / anti nutritional factors in feed ingredients. of feed ingredients.

THEORY

Feed resources for livestock and poultry in Pakistan; Classification, characteristics, nutritive values and dynamics of feedstuffs. Role of fiber in ruminant nutrition. Utilization of NPN compounds in livestock feeds and its significance. Concept of fodder preservation. Making and feeding of hay, silage and haylage. Feed supplementation during different physiological phases of animal. Factors affecting nutritional quality of feeds. Feeding standards and their application. Methods of improving nutritive value of feedstuffs. Feeding rumen bypass proteins and lipids. 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. Visits to feed mills, livestock farms and research institutes.

Textbook

McDonald P., Edwards R.A., Greenhalf J.F.D. and Morgan C.A. 2022. Animal Nutrition. 8th Ed. Longman Scientific and Technical Publisher, UK.

R**ecommended books**

1. Gordon McL Dryden. 2021. Fundamentals of Applied Animal Nutrition. CAB International, Oxfordshire UK.
2. Wu A. 2019. Food Safety and Mycotoxins. Springer, NY, USA.
3. Yucel B and Taşkın T. 2018. Animal Husbandry and Nutrition. IntechOpen, UK.
4. Singh K. Chandrapal Prabhu T.M. 2013. Analytical Techniques in Animal Nutrition Research. Published by New India Publishing Agency (NIPA), New Delhi.
5. Jurgens M.H., Bregendahl K., Coverdale J. and Hansen H.L. 2012. Animal Feeding and Nutrition. 11th edition. Kendall Hunt Publishing, Iowa USA.

NUTR-704 Minerals and Vitamins in Animal Nutrition 3(2-1)

Learning objectives

- To study classification and functions of minerals and vitamins.
- To introduce impact of minerals and vitamin deficiency and toxicity on animal health.
- To study interaction of minerals and vitamins in animal body.

THEORY

Essential minerals, classification and functions. Distribution of mineral in animal body. Absorption, bioavailability and metabolism of mineral in animal body. Concept and importance of chelates in animal feeding. Role of minerals in acid-base homeostasis of animal body. Use of nanoparticles in animal feeding. Vitamins, classification and functions. Role of vitamins in metabolism. Interrelationship among minerals and vitamins. Impact of deficiency and toxicity of mineral and vitamins in livestock and poultry. Sources of mineral and vitamins. Concept of mineral mixture and pre-mix. Requirements of mineral and vitamins in livestock and poultry. Role of minerals and vitamins in animal growth, health, production and reproduction.

PRACTICAL

Sample preparation for the analysis of minerals. Estimation of minerals in feedstuffs by using flame photometer and spectrophotometer. Estimation of Ca by titration method. Calculation of mineral requirement of animal. Formulation and preparation of mineral mixtures and multi- nutrient block. Techniques for determination of vitamins in feedstuff. Formulation of vitamin- mineral pre-mix.

Textbook

McDonald P., Edwards R.A., Greenhalf J.F.D. and Morgan C.A. 2022. Animal Nutrition. 8th Ed. Longman Scientific and Technical Publisher, UK.

Recommended books

1. Suttle N.F. 2022. Mineral Nutrition of Livestock. 5th Edition. CAB International.
2. Wu G. (Ed.). 2022. Recent Advances in Animal Nutrition and Metabolism. Springer.
3. Gordon McL Dryden. 2021. Fundamentals of Applied Animal Nutrition. CAB International, Oxfordshire UK.
4. Vitti D.M., & Kebreab E. (Eds.). 2010. Phosphorus and calcium utilization and requirements in farm animals. CAB International. ISBN 978-1-84593-626-6
5. Lesson S. & Summers J.D. 2005. Commercial Poultry Nutrition. 3rd Edition. Published by Nottingham University Press, Manor Farm, Church Lane, Thrumpton, Nottingham, NG11 0AX, England.
6. Pond W.G, Church D.B., Pond K.R. & Schoknecht P.A. 2004. 5th edition. Basic animal nutrition and feeding. John Wiley & Sons, USA

NUTR-705 Analytical Techniques in Animal Nutrition 3(0-3)

Learning objectives

- To learn about proximate composition of feedstuff.
- To learn about chemical analysis of feedstuff, blood and urine.
- To study mineral estimation by atomic absorption spectrophotometry and aflatoxin / antinutritional factors infeedstuff.

PRACTICAL

Sampling of feeds for chemical analysis; preparation, grinding, labeling and preservation. Preparation of standard solutions for different chemical analysis. Preparation of buffers and determination of pH. Determination of dry matter by different methods. Proximate analysis of feed. Van Soest analysis of feed. Macro and micro mineral analyses. Determination of fatty acid profile of feeds. Determination of anti-nutritional components in feed stuffs. Determination of nitrites and nitrates in forages. Screening of feeds for aflatoxin. Analysis of blood, urine and milk with reference to nutrition. Demonstration of In vitro gas production technique.

Textbook

Prabhu T.M. 2020. Analytical Techniques in Animal Nutrition Research. New India Publishing Agency- Nipa.

Recommended books

1. Toldra F. 2019. Advances in Food and Nutrition Research. Elsevier Science & Technology, USA.
2. AOAC. 2019. Official Methods of Analysis of the Association of Official Analytical Chemists, 21st Edition. Arlington Virginia, USA.
3. Zaklouta M., Hilali M., Nefzaoui A. and Haylani M. 2011. Animal nutrition and product quality laboratory manual. ICARDA, Aleppo, Syria
4. FAO. 2004. Assessing Quality and Safety of Animal Feeds. http://www.fao.org/docrep/007/y5159e/y5159e00.htm#Contents. FAO. Rome.
5. Undersander D., Mertens D. R. & Thiex N. 2003. Forage Analysis Procedures, National Forage Testing Association. Omaha, NE, USA.

NUTR-706 Feed Formulation and Manufacturing Technology 3(2-1)

Learning objectives

- To understand prerequisites for feed formulation.
- To learn about methods of feed formulation and feed milling practices.
- To learn about use Excel program and different software to formulate feed for different classes of livestock and poultry.

THEORY

Pre-requisites for feed formulations. Using feeding standards for feed formulation. Different methods for formulation of feeds for different classes of livestock and poultry. 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 techniques and equipment, and analysis. Grains and raw material storage. Nutrient losses and other changes during storages. Manufacturing of various forms of compound feed. Effect of processing on feed quality. Animal feedstuffs and compound feed act. Quality control and biosecurity in feed milling industry. Feed marketing techniques.

PRACTICAL

Exercise of different methods of feed formulation. Use of excel and other software for feed formulation. Visit of local markets and feed mills. Feed raw material storage and handling. Feed processing; physical and chemical treatments. Preparation of micromixes.

Textbook

Gordon McL Dryden. 2021. Fundamentals of Applied Animal Nutrition. CAB International, Oxfordshire UK.

Recommended books

1. Pesti G.M. 2019. Animal Feed Formulation: Economics and Computer Applications. Chapman & Hall Publisher, UK.
2. National Research Council. (2021). Nutrient requirements of dairy cattle: 8th edition. National Academies Press. USA.
3. Schofield E.K. 2005. Feed Manufacturing Technology. American Feed Industry Association.
4. Turret R.A.I. 2003. Grain & Feed Milling Technology. Cornell University Press, USA.
5. Reddy V., Subba R. and Bhosal D.T. 2001. Handbook of Poultry Nutrition. American Soybean Association. New Dehli, India.
6. Moughan P.J., Vestegen M.W.A. and Visser-Reyneveid M.I. 2002. Feed Evaluation – Principles and Practice. Empress Publishing. The Netherlands.

NUTR-707 Principles and Practices of Avian Nutrition 3(2-1)

Learning Objectives

- To know about basic knowledge of poultry feeds and feeding.
- To understand different methods to evaluate the poultry feeds.
- To understand role of essential amino acids, supplementation, feed additives and antinutritional factors in poultry nutrition.
- To formulate and prepare feed mixtures.

THEORY

Importance of quality and quantity of various nutrients in poultry rations. Feed and host interaction; Abnormalities due to malnutrition. Nutrient allowances and feeding standards for broiler, layer and breeder. Effect of protein-energy and Ca-P ratios on growth and egg production. Feeding systems for broiler and layer. Role of added levels of vitamins, minerals and their effect on growth and egg production. Amino acid requirements and correcting the deficiencies on the basis of digestible amino acids in poultry rations. Formulation of suitable vitamin and mineral supplements. Effect of feed on the chemical composition of meat and egg. Use of feed additives for the improvement of growth and egg production. Anti-nutritional factors in feed ingredients. Feeding strategies during hot and cold climate.

PRACTICAL

Techniques for the evaluation of intestinal health. Formulation of balanced rations for all classes of birds. Computerized feed formulation. Metabolic trials on birds. Preparation of mineral and vitamin premixes. Evaluation of feed quality. Chemical analysis of egg and meat. Visits to poultry feed mills and allied industries.

Textbook

Leeson S. and Summers J.D. 2019. Scott's Nutrition of the Chicken. International Book Distributing Company, India.

Books Recommended

1. Paneri P.F., Christaki E. and Giannenas I. 2019. Feed additives: aromatic plants and herbs in animal nutrition and health. San Diego : Elsevier Science & Technology, USA.
2. Lee A.R. 2008. Poultry Feeds and Feeding. Kosta Press, UK.
3. Pesti G.M., Bakalli R.I., Driver J.P., Atencio A. and Foster E.H. 2005. Poultry Nutrition and Feeding. Trafford publishing, Trafford 1663 Liberty Drive, Bloomington, IN 47403. UK.
4. Lesson, S. and J.D. Summers. 2008. Commercial Poultry Nutrition. 3rd Edition. University Book, P.O. Box 1326, Guleph, Ontario, Canada.

NUTR-708 Ruminant Nutrition 3(2-1)

Learning objectives

- To study rumen ecosystem in relation to nutrition.
- To learn about recent trends in dairy cattle nutrition.
- To learn methods to improve nutritive value of poor quality feedstuffs.
- To study feeding systems and strategies to mitigate methane production in ruminants.

THEORY

Principles of feeding ruminant livestock at different physiological stages. Development of rumen and feeding of pre-ruminant calves. Rumen ecology and specialized features. Improvement in nutritive value of poor-quality feeds through physical, chemical and biological approaches. Fibre fraction, composition, fermentation and its utilization by ruminants. Metabolic problems and dysfunctions. Nutrient requirements of large and small ruminants for growth, production and reproduction. Microbial protein synthesis. Vitamins and minerals need of ruminants. Mitigation of rumen methanogenesis. Feeding systems for large and small ruminants. Special feeding regimes for fattening and sacrificial animals.

PRACTICAL

Digestion trials; total tract digestibility technique, digestibility using markers, in vitro and in- sacco digestibility techniques in dairy animals. Hay and silage preparation. Total mixed ration particle size evaluation. Rumen sampling techniques; rumen pH, rumen ammonia and VFA estimation. Urea-molasses block. Chemical treatment of poor-quality roughages.

Textbook

Amlan Patra A.K. (Ed). 2022. Animal Feed Science and Nutrition -Production, Health and Environment. BoD Publisher, Norderstedt, Germany.

Books Recommended

1. National Research Council. (2021). Nutrient requirements of dairy cattle: 8th edition. National Academies Press. USA.
2. Gordon McL Dryden. 2021. Fundamentals of Applied Animal Nutrition. CAB International, Oxfordshire UK.
3. Chizzotti M.L. 2019. Energy and Protein Metabolism and Nutrition. Wageningen Academic Publishers, Netherlands.
4. Yucel B and Taşkın T. 2018. Animal Husbandry and Nutrition. IntechOpen, UK.
5. Mario De Beni Arrigoni, Rodrigo Dias Lauritano Pacheco. 2016. Rumenology. Springer International Publishing.
6. McDonald P., Edwards R.A., Greenhalf J.F.D. and Morgan C.A. 2022. Animal Nutrition. 8th Ed. Longman Scientific and Technical Publisher, UK.
7. John Moron. 2005. Tropical Dairy Farming. CSIRO Publishing.
8. Robert Blair. 2011. Nutrition and Feeding of Organic Cattle. CAB International. ISBN 978-1-84593-758-4.

NUTR-709 Seminar 1(1-0)

- The graduate will be able to present the assigned topic publicly.

NUTR-710 Special Problem **1(1-0)**

The graduate will be able to fulfill the assignment and write a report about it

ARAB-711 Understanding of Holy Quran-I/ Feham-e-QuranI **1(0-1)**

ARAB-712 Understanding of Holy Quran-II/ Feham-e-QuranII **1(0-1)**

NUTR-713 Research Designing and Methodology in Animal Nutrition 3(2-1)

Learning objectives

- To study various skills about collection, tabulation and interpretation of scientific data.
- To learn research designing based on nature of research and type of experimental animals.
- To learn about use of citation software and different presentation skills.

THEORY

Concepts of review of scientific literature. Sources for data search and digital library access. Definition and finding of research problem. Development of synopsis. Selection of statistical design. Concepts of experimental controls and 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.

PRACTICAL

Various sources of data for scientific writing. Statistical designs used in biological research. Selecting animals/birds for research trial and collecting data during trial. Use of excel and statistical software for data analysis and graphical tools. Use of citation management software in scientific writing. Technical report writing and presentation skills.

Textbook

Lovegrove J.A., Hodson L., Sharma S., Lanham-New S.A. 2015. Nutrition Research Methodologies.

Recommended books/Readings

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

NUTR-714 Nutrition of Pet and Zoo Animals 3(3-0)

Learning objectives

- To learn about nutrient requirements and feed resources for pet and zoo animals
- To understand nutritional deficiency diseases of pet and zoo animals.
- To learn feed formulation for different pet an zoo animals.

THEORY

Major nutrients and their functions. Small and large pet animal's optimum requirements, natural foods for pets, feed supplements, their types, form and quality, and feeding practices. Canine nutrition; Amounts of feed, form and quality, and feeding practices. Canine nutrition: amounts of feed, feeding requirements of orphaned puppies, methods of feeding, forms and types of dog food, feed requirement during geriatric care and prescription diets. Feline Nutrition: Methods of feeding; forms and types of cat food. Important nutritional disorders in dog and cat. Use of roughages in wild animals and related toxic substances; Pet birds nutrition. Rabbit and Rodent nutrition. Feed formulation for different species of pet and zoo animals.

Textbook

1. Case L.P., Daristotle L., Hayek M.G. & Raasch M.F. 2011. Canine and Feline Nutrition: A Resource for Companion Animal Professionals. 3rd Edition. Mosby Elsevier.
2. Cheeke P.R. 2005. Applied Animal Nutrition. 3rd Edition. Pearson Education (USA).

Recommended books

2. NRC. 2006. Nutrient Requirements of Dogs and Cats. National Research Council, Division on Earth and Life Studies, Board on Agriculture and Natural Resources, Committee on Animal Nutrition, Subcommittee on Dog and Cat Nutrition.
3. Bastin D., Ashton J. & Nixon G. 2012. Better Food for Dogs: A Complete Cookbook & Nutrition Guide. Robert Rose Incorporated.
4. Charles T.R. 1983. Wildlife Feeding and Nutrition. Academic Press, New York, USA.
5. Hughes R.N. 1993. Diet Selection: An Interdisciplinary Approach to Foraging Oxford: Blackwell, UK.