REGULATIONS

&

SCHEME OF STUDIES
and
COURSE CONTENTS

for

BS Animal Science
(Four Years Degree Program)

Department of Livestock Production and Management

Faculty of Veterinary & Animal Sciences

Pir Mehr Ali Shah Arid Agriculture University, Rawalpindi

REGULATIONS RELATING TO THE

BS Animal Science

(Four Years Degree Program)

The Department BoS passed the following rules and regulations for BS Animals Science Degree Program in view of newly formulated HEC policy *(Reference DBoS meeting vide # 2023-5 dated September 06, 2023, and Academic Council Meeting # 75 dated September 14, 2023).*

THE REGULATIONS RELATING TO THE DEGREE OF BS Animal Science

In addition to the general regulations the following regulations are also applicable to the BS Animal Science (4 years) degree program.

1. Minimum Requirements for Award of bachelor's degree
2. The minimum duration for completing the course for the degree of BS Animal Science shall normally be eight semesters and maximum 12 semesters.
3. The minimum course requirement is as per credit hours in the approved Scheme of Studies.
4. Each student shall enroll himself/herself in each of the semesters for all the credit hours prescribed for these semesters.

Admission and Registration

1. *Minimum Academic Requirements:* - A candidate holding Intermediate Science Certificate (Pre-Medical/Pre-Engineering), A-level or an equivalent certificate from any recognized Institute/College with at least 50% marks excluding Hafiz-e- Quran, or any other marks specified shall be eligible for admission to BS Animal Science.
2. Admission will be on open merit basis (all Pakistan) and merit will be calculated on the basis of marks obtained in the last Highest Certificate (Intermediate or equivalent).
3. There will be Thirty seats in the morning session Exclusive of university employee children's (2 seats).
4. *Age*: A candidate must not be more than 23 years of age on 1st October of the admission year, provided that the Vice Chancellor may relax age limit in very exceptional cases.

Admission Authority

The Dean, Faculty of Veterinary and Animal Sciences (FV&AS) shall be responsible for admission to the program.

Minimum and Maximum Credit Hours

1. Each student shall enroll himself /herself in the first and second semester for all the credit hours prescribed for these semesters.
2. Subsequently (except for eighth semester) he/she shall have to enroll for courses carrying not less than 18 and not more than 21 credit hours.
3. In his/her sixth and seventh semesters, a student may enroll himself/herself for the courses carrying the remaining credit hours; provided that the maximum does not ordinarily exceed 24 credit hours; provided further that this limit may be extended by the Vice Chancellor upto 27 credit hours in 6th semester if no even semester course is left behind and similarly he/she may be allowed to enroll up to 27 credit hours in 7th semester if no odd semester course is left behind, in special circumstances to be determined carefully in each individual case. The same will be applicable to the 9th, 10th, 11th and 12th semester.
4. No course shall be offered during any semester, which does not fall within the "Scheme of Studies" in the respective semester.

Academic Standing

I. Grade Point Average

(a)	Maximum Grade Point Average (GPA/CGPA)	4.00
(b)	Minimum Grade Point Average for obtaining the degree (CGPA)	2.50

To remain on the roll of the University a student shall be required to maintain the following minimum CGPA in each semester.

Explanation:

Semester	CGPA
1st	0.75
2nd	1.00
3rd	1.25
4th	1.50
5th	1.75
6th	2.00
7th	2.25
8th	2.50

1. A student who maintains the minimum GPA/CGPA for promotion and meets the requirements will be promoted to the next semester.
2. A student who does not meet the above requirements may repeat the whole semester once only.
3. If a student fails to achieve CGPA 2.5 in the 8th semester, he shall have to repeat the course/courses of lowest grade(s) to make CGPA of 2.5 within the maximum time allowed for the degree otherwise he/she shall cease on the University rolls.

Agenda Item -2

SCHEME OF STUDIES & COURSE CONTENTS

for

BS Animal Science
(Four Years Degree Program)

The Department BoS passed the following scheme of studies and course contents for BS Animals Science Degree Program in view of newly formulated HEC policy *(Reference DBoS meeting vide # 2023-5 dated September 06, 2023).*

Approved in 75th Meeting of of Academic Council held on 14 September 2023

Scheme of Studies

BS Animal Science (Four Years Degree Program)

Semester Wise Courses

Semester-I

Course Code	Course Title	Credit Hours
PS-301	Introductory Poultry Science	2(1-2)
LM-301	Fundamentals of Livestock Management	2(1-2)
PHYS -301	Introductory Animal Physiology	3(2-2)
ENG-301	Functional English	3(3-0)
SSH-301	Civics and Community Engagement	2(2-0)
SOC-301	Introduction to Sociology	3(3-0)
SOS-301	Moral Foundation of Education	2(2-0)
TOQ-301	Translation of Holy-I (Audit Course)	1(1-0)
	Total	17+1

Semester-II

Course Code	Course Title	Credit Hours
AN-302	Fundamentals of Animal Nutrition	3(2-2)
ABG-302	Principles of Genetics	3(2-2)
ANAT -304	Introduction to Veterinary Anatomy	3(2-2)
SSH-302	Ideology and Constituition of Pakistan	2(2-0)
BCH-310	Introduction to Biochemistry	3(2-2)
ENG-302	Expository Writing	3(3-0)
CSC-100	Applications of Information & Communication Technologies	3(2-2)
	Total	20

Semester-III

Course Code	Course Title	Credit Hours
AN-401	Metabolism of Primary Nutrients	3(2-2)
ABG-401	Introductory Molecular Genetics and Genomics	3(2-2)
PS-403	Incubation Principles and Hatchery Management	3(2-2)
PS-407	Poultry Housing and Equipment	3(2-2)
BIOT-303	Introduction to Biotechnology	3(3-0)
QR-401	Quantitative Reasoning-I	3(3-0)
TOQ-401	Translation of Quran-II (Audit Course)	1(1-0)
	Total	18+1

Semester-IV

Course Code	Course Title	Credit Hours
LM-402	Milk Biosynthesis and Lactation	3(2-2)
AN-402	Minerals and Vitamins in Nutrition	3(2-2)
ABG-402	Population Genetics	3(2-2)
PS-408	Commercial Broiler Production	2(1-2)
STAT-408	Biostatistics and Computer Application	3(2-2)
QR-402	Quantitative Reasoning II	3(3-0)
IS-302/ET-302	Islamic Studies/Ethics (for Non-Muslims)	2(2-0)
SSH-304	Entrepreneurship	2(2-0)
	Total	21

Semester-V

Course Code	Course Title	Credit Hours
AN -501	Nutrition of Meat Animals	3(2-2)
AN-503	Dairy Nutrition	3(2-2)
LM-505	Dairy Farm Management	3(2-2)
LM-507	Equine and Camel Production	2(1-2)
ABG-501	Selection for Economic Traits in Farm Animals	2(1-2)
MICRO-501	Basic Microbiology	2(1-2)
PS-501	Layer Production and Management	3(2-2)
FT-503	Meat and Dairy Processing Technology	3(2-2)
TOQ-501	Translation of Quran (Audit Course)	1(1-0)
	Total	21+1

Semester-VI

Course Code	Course Title	Credit Hours
LM -502	Principles of Small Ruminant Production	3(2-2)
AN -502	Principles of Poultry Nutrition	3(2-2)
PS-502	Breeder Production and Management	3(2-2)
AGR-508	Forage and Fodder Production	3(2-2)
THER-502	Reproductive Management of Farm Animals	3(2-2)
MED-502	Introduction to Veterinary Preventive Medicine	3(2-2)
	Total	18

Semester-VII

Course Code	Course Title	Credit
LM -601	Principles of Meat Production	3(2-2)
LM-603	Livestock Farm Practices	1(0-2)
AN -603	Feed Milling Industry	3(2-2)
PS -603	Poultry Health Management	3(2-2)
ABG-601	Animal Breeding Plans and Policies	3(2-2)
PS-607	Poultry Breeding Practices	2(1-2)
FMPE-601	Precision Livestock Farm Machinery	3(2-2)
TOQ-301	Translation of Holy-IV (Audit Course)	1(1-0)
	Total	18+1

Semester-VIII

Course Code	Course Title	Credit Hours
AS-399	Capstone Project	3(0-6)
AS-299	Internship	3(0-6)
	Total	06

SUMMARY

a. Semester Wise

Semester	1	2	3	4	5	6	7	8	**Total**
Credit Hrs	17+1	20	18+1	21	21+4	18	18+1	6	**138**

b. All Degree Courses Details (Credit hours break-up)

Classes	**Credit Hrs**
General Courses	31
Major Courses	14+21+21+17=73
Veterinary Sciences (Minor)	14
Inter Disciplinary	15
Project	03
Internship	03
TOTAL	(132+6)139 + (4 Audit)

c. All Degree Courses Details (Subject wise details)

1. General Courses

Course Code	**Course Title**	**Credit Hours**	**Semester**
ENG-301	Functional English	3(3-0)	1
SSH-301	Civics and Community Engagement	2(2-0)	1
SOC-301	Introduction to Sociology	3(3-0)	1
SOS-301	Moral Foundation of Education	2(2-0)	1
SSH-302	Ideology and Constituition of Pakistan	2(2-0)	2
BCH-310	Introduction to Biochemistry	3(2-2)	2
ENG-302	Expository Writing	3(3-0)	2
CSC-100	Applications of Information & Communication Technologies	3(2-2)	2
QR-401	Quantitative Reasoning-I	3(3-0)	3
QR-402	Quantitative Reasoning II	3(3-0)	4
IS-302/ET-302	Islamic Studies/Ethics (for Non-Muslims)	2(2-0)	4
SSH-304	Entrepreneurship	2(2-0)	4
	TOTAL	30	

2. Teaching of Quran

Course Code	**Course Title**	**Credit Hours**	**Semester**
TOQ-301	Translation of Quran-I (Audit Course)	1(1-0)	1
TOQ-401	Translation of Quran-II (Audit Course)	1(1-0)	3
TOQ-501	Translation of Quran-III (Audit Course)	1(1-0)	5
TOQ-601	Translation of Quran-IV(Audit Course)	1(1-0)	7
	TOTAL	04	

3. Major Courses

i- Animal Breeding & Genetics

Course Code	Course Title	Credit Hours	Semester
ABG-302	Principles of Genetics	3(2-2)	2
ABG-401	Introductory Molecular Genetics and Genomics	3(2-2)	3
ABG-402	Population Genetics	3(2-2)	4
ABG-501	Selection for Economic Traits in Farm Animals	2(1-2)	5
ABG-601	Animal Breeding Plans and Policies	3(2-2)	7
	TOTAL	14	

ii- Animal Nutrition

Course Code	Course Title	Credit Hours	Semester
AN-302	Fundamentals of Animal Nutrition	3(2-2)	2
AN-401	Metabolism of Primary Nutrients	3(2-2)	3
AN-402	Minerals and Vitamins in Nutrition	3(2-2)	4
AN -501	Nutrition of Meat Animals	3(2-2)	5
AN-503	Dairy Nutrition	3(2-2)	5
AN -502	Principles of Poultry Nutrition	3(2-2)	6
AN -603	Feed Milling Industry	3(2-2)	7
	TOTAL	21	

iii- Poultry Sciences

Course Codes	Course Title	Credit Hours	Semester
PS-301	Introductory Poultry Science	2(1-2)	1
PS-403	Incubation Principles and Hatchery Management	3(2-2)	3
PS-407	Poultry Housing and Equipment	3(2-2)	3
PS-408	Commercial Broiler Production	2(1-2)	4
PS-501	Layer Production and Management	3(2-2)	5
PS-502	Breeder Production and Management	3(2-2)	6
PS-603	Poultry Health Management	3(2-2)	7
PS-607	Poultry Breeding Practices	2(1-2)	7
	TOTAL	21	

iv- Livestock Management

Course Code	Course Title	Credit Hours	Semester
LM-301	Fundamentals of Livestock Management	2(1-2)	1
LM-402	Milk Biosynthesis and Lactation	3(2-2)	4
LM-505	Dairy Farm Management	3(2-2)	5
LM-507	Equine and Camel Production	2(1-2)	5
LM -502	Principles of Small Ruminant Production	3(2-2)	6
LM -601	Principles of Meat Production	3(2-2)	7
LM-603	Livestock Farm Practices	1(0-2)	7
	TOTAL	17	

3. Veterinary Sciences (Minor)

Course Code	Course Title	Credit Hours	Semester
PHYS -301	Introductory Animal Physiology	3(2-2)	1
ANAT -304	Introduction to Veterinary Anatomy	3(2-2)	2
MICRO-501	Basic Microbiology	2(1-2)	5
MED-502	Introduction to Veterinary Preventive Medicine	3(2-2)	6
THER-502	Reproductive Management of Farm Animals	3(2-2)	6
	TOTAL	14	

4. Inter Disciplinary

Course Code	Course Title	Credit Hours	Semester
BIOT-303	Introduction to Biotechnology	3(3-0)	3
STAT-408	Biostatistics and Computer Application	3(2-2)	4
FT-503	Meat and Dairy Processing Technology	3(2-2)	5
AGR-508	Forage and Fodder Production	3(2-2)	6
FMPE-601	Precision Livestock Farm Machinery	3(2-2)	7
	TOTAL	15	

COURSES DETAILS (Course Contents)

Course Code	Course Title	Credit Hours	Semester
ABG-302	Principles of Genetics	3(2-2)	2
ABG-401	Introductory Molecular Genetics and Genomics	3(2-2)	3
ABG-402	Population Genetics	3(2-2)	4
ABG-501	Selection for Economic Traits in Farm Animals	2(1-2)	5
ABG-601	Animal Breeding Plans and Policies	3(2-2)	7
	TOTAL	14	

ABG-302 Principles of Genetics 3(2-2)

Learning outcomes
After the completion of this course, students will be able to:
- Understand basic concepts of genetics
- Understand concepts of inheritance

Theory
Genetics: historical development. Genetic basis of inheritance: Heredity and variations. The cell cycle. Gametogenesis: spermatogenesis, oogenesis. Mendelism: basic terminology, Mendel's laws, Monohybrid, dihybrid and polyhybrid crosses. Applications of Mendel's principle. Concept and laws of probability. Chi-square test and its applications. Modified segregation ratios, Epistasis and its different types. Multiple allelomorphism, Genetics of sex: sex determining mechanisms, sex linkage and its variation, Polygenic inheritance, Pleiotropy. Linkage, crossing over and chromosomal mapping. Extra nuclear inheritance.

Practical
Microscopic studies on the animal and plant cells undergoing mitosis and meiosis. Numerical problems on topics discussed in theory.

Books Recommended

1. Klug, W.S., M.R. Cummings, C. Spencer and A.M. Palladino. 2019. Concepts of Genetics. The Benjamin Publishing Co., Inc., Menlo Park, CA, USA.
2. Bonduriansky, R., and T. Day. 2018. Extended Heredity A New Understanding of Inheritance and Evolution. Princeton University Press.
3. Passarge, E., 2017. Color Atlas of Genetics. Thieme Pierce, B.A. 2012. Genetics–a conceptual approach. 4th Ed. http://bcs.whfreeman.com/pierce3e/default.asp
4. Elord, S. and W.E. Stansfield. 2009. Schaum's Outline of theory and Problems of Genetics. Tata McGraw-Hill Book Co., New Delhi, India.

ABG-401 Introductory Molecular Genetics and Genomics 3(2-2)

Learning outcomes
After the completion of this course, students will be able to:
- Information about description of DNA/RNA
- Know the genetic engineering and its applications
- Know the various cytogenetic techniques

Theory
Biochemical basis of heredity: the nature of genetic material, nucleic acids, structure of DNA and RNA, DNA replication, transcription, and translation. Developmental aspects of genetic control: Eukaryotic Gene Regulation gene expression and cell differentiation control of gene expression in eukaryotes, Genetic basis of immune response:

components of immune system. Mutations: gene mutations and their types. Genetic engineering: basic concepts of recombinant DNA technology, gene cloning and manipulation, application and future; Introduction to Genomics, Genetic and Physical Maps, Genome Sequencing and Annotation, Comparative Genomics, Genome Synteny and Evolution, Eukaryote Genome architecture, Transcriptomics and Epigenomics, Metagenomics, Proteomics, Variation in Genomes, Functional Genomics

Practical
DNA Extraction protocol, Polymerase Chain Reaction, Gel Electrophoresis, DNA extraction and sequencing; online genomics related exercises

Books Recommended:

1. Klug, W.S., M.R. Cummings, C. Spencer and A.M. Palladino. 2019. Concepts of Genetics. The Benjamin Publishing Co., Inc., Menlo Park, CA, USA.
2. Crew, F. 2014. Animal Genetics-The Science of Animal Breeding. Read Books Ltd.
3. Liu, X. 2018. Application of Genetics and Genomics in Poultry Science. BoD–Books on Demand.
4. Hartl, L. 2009. Genetics: Analysis of Genes and Genomes. 7th Ed. Jones and Bartlett Publishers, Inc. Sudbury, MA, USA.

ABG-402 Population Genetic 3(2-2)

Learning outcomes
After studying this course, the students would be able to:
- Explain about the basic population concepts of genetics.
- Solve problems related to central tendencies and dispersion.
- Different statistical analysis in animal production

Theory
Population Genetics: Gene and genotypic frequency. Hardy-Weinberg Law, forces affecting gene frequency and composition of population, effective population size. Quantitative Genetics: Quantitative characters and their inheritance. Biometry, biological population and its parameters; Statistical methods in animal production: measures of central tendency and dispersion for quantitative traits. Genetic parameters; Concepts of heritability, repeatability, correlations and regression. Experimental designs. Nature and causes of variation in quantitative traits. Concepts of breeding value. Lethal and semi-lethal genes, deletion and elimination of lethal genes from animal populations.

Practical
Exercises on gene and genotypic frequencies. Problems related to central tendencies and dispersion. Exercises on the estimation of variance, co-variance, standard deviation, genetic regression and correlation, heritability, repeatability, and breeding values from given data.

Books Recommended

1. Simm, G., G. Pollott, R. Mrode, R. Houston, and K. Marshall. 2020. Genetic Improvement of Farmed Animals. CABI.
2. Crew, F. 2014. Animal Genetics-The Science of Animal Breeding. Read Books Ltd.
3. Hamilton, M. 2009. Population Genetics. John Wiley and Sons, CA, USA.
4. Gillespie, J.L. 2004. Population Genetics: A Concise Guide. 2nd Ed. The Johns Hopkins University Press, USA.
5. Hartl, D.L. and A.G. Clark. 2007. Principles of Population Genetics, 4th Ed. Sinauer Associates.

ABG-501 Selection for Economic Traits in Farm Animals 2(1-2)
Learning outcomes
After the completion of this course, students will be able to:
- Describe about the traits of economic importance in farm animals
- Understand the implementations of economic values for livestock farming
- Understand the implementations of economic values with the farming.

Theory

Traits of economic importance in farm animals; Selection of dairy heifers and bulls, Use of standardized records, relative economic values; Breeding values and selection indices; Crossbreeding for milk and meat production, Traits of economic importance in poultry and their improvement, National breeding policy for improvement and conservation of livestock, Review of the animal breeding practices used by the developed countries, Future breeding plans for genetic improvement of farm animals in different agro-ecological zones of Pakistan, Emerging biotechnologies for increasing animal productivity,

Practical

Exercises on the maintenance and standardization of productive and reproductive records; Estimation breeding value using standardized records, Exercises on the estimation of relative economic values; Construction of selection indices for large and small animals, Orientation of computer packages for animal conservation and evaluation,

Recommended Books:

1. Kintore, C. (2013). Recent Advances in Animal Breeding. Delhi, India: DK publishers and distributors.
2. McDowell, R. E. (1994). Dairying with Improved Breeds in Warm Climates. Raleigh,NC.USA: Kinnic Publishers, Inc.
3. Lasley, J. F. (1987). Genetics of Livestock Improvement. Engle wood Cliffs, New Jersey: Prentice-Hall international Inc.

ABG-601 Animal Breeding Plans and Policies 3(2-2)

Learning outcomes

This course focuses on learning practical animal breeding knowledge and skills for application in the industry. At the end of this course students would be able to:

- Design a preliminary breeding program
- Estimate breeding values and determine response to selection
- Proposing various breeding systems and avoiding inbreeding

Theory

Defining Animal Breeding, Traits of economic importance in livestock, Selection: natural and artificial selection Methods of selection; tandem method, independent culling level and selection index, Selection for single and multiple traits, Various systems of breeding: Purebreeding, crossbreeding, inbreeding, line-breeding, out-breeding, out-crossing, grading up, Breeding goal, Breeding value and its importance; Genetic gain, Emerging breeding technologies, Overview of a typical breeding program, Animal genetic resources of Pakistan, Breeding policy and act, Role of breed registry societies/associations

Practical

Measurement of coefficient of relationship and inbreeding coefficient, Exercises on biometrical concepts related to measures of central tendency and measures of dispersions, Calculation of breeding values from single and repeated records, Estimation of genetic gain, Measurement of heterosis, Introduction to genetic prediction software

Recommended Books:

1. Bourdon, R. M. 2000. Understanding Animal Breeding. Upper Saddle River, NJ, USA: Prentice- Hall.
2. Willis, M. B. (1998). Dalton's Introduction to Practical Animal Breeding. UK: Blackwell Science.
3. Legates, J. E., & Warwick, E. J. (1990). Breeding and Improvement of Farm Animals. New York, USA: McGraw-Hill.
4. Lasley, J. F. (1987). Genetics of Livestock Improvement. New Jersey, Prentice-Hall; Englewood Cliffs, USA

Course Code	Course Title	Credit Hours	Semester
AN-302	Fundamentals of Animal Nutrition	3(2-2)	2
AN-303	Metabolism of Primary Nutrients	3(2-2)	3
AN-402	Minerals and Vitamins in Nutrition	3(2-2)	4
AN -501	Nutrition of Meat Animals	3(2-2)	5
AN-503	Dairy Nutrition	3(2-2)	5
AN -502	Principles of Poultry Nutrition	3(2-2)	6
AN -603	Feed Milling Industry	3(2-2)	7

AN-302 Fundamentals of Animal Nutrition 3(2-2)

Learning outcomes: At the end of the course, students will be able to

- Define and explain terminology used in the animal nutrition
- Describe major nutrient classes, feed classification, processing, and preservation procedures
- Elaborate relationship between dietary classification of animals and digestive processes in GIT

Theory

History, scope and development of science of nutrition; basic terms used in animal nutrition' digestive physiology of animals; classification of nutrients, water, its importance, functions, metabolism and turnover rates in the body, sources of water, water requirements, factors affecting water requirements, water quality; Classification, structure, functions and digestion of carbohydrates; Classification, structure, functions and digestion of protein; classification, structure, functions and digestion of lipids; classification of minerals and their general functions; classification of vitamins and their general functions; interrelationship of vitamins, minerals and their toxicity, absorption and transport of nutrients; anti-nutritional factors in feedstuffs, feed additives in animal feeding and usage.

Practical

Classification and identification of feed ingredients / feed raw materials, physical and nutritional characteristics of energy concentrates, physical and nutritional characteristics of protein concentrates, types of samples; feedstuff and feed samples collection techniques; sample preservation techniques; feed sample preparation for analysis, sample weighing techniques; introduction to feed analysis equipments, cleaning and washing of glassware for analysis; distilled water quality, preparation and standardization of different types of solutions.

Books Recommended

1. McDonald, P., R.A. Edwards, J.F.D. Greenhalf, C.A. Morgan, L.A. Sinclair and R. G. Wilkinson. 2022. Animal Nutrition. 8th Ed. Longman Scientific and Technical Publisher, UK.www.pearsoned.co.uk.
2. Wu, G. 2018. Principles of Animal Nutrition. CRC Press Taylor & Francis Group, Boca Raton, London New York.
3. G. Dryden. Animal Nutrition Science. CABI Publishers; 1st edition (October 5, 2008). ISBN-10: 1845934121.
4. Banerjee, G. C. Feeds and Principles of Animal Nutrition Revised, Subsequent Edition. Oxford & IBH; (December 20, 2018). ISBN-10 : 9788120401914.
5. Prafulla V. Patil. Handbook of Animal Nutrition. Write and Print Publications (January 1, 2018). ISBN-10 : 9387214028.

AN-303 Metabolism of Primary Nutrients 3(2-2)

Learning outcomes: At the end of the course, students will be able to:

- Describe primary nutrient classes, their utilization in the body.

- Elaborate relationship between primary nutrient metabolism and body nourishment.
- Perform feed analysis and describe its applications in animal Nutrition

Theory

Metabolic functions of water; Classification, structure, digestion and absorption of carbohydrates; metabolism of carbohydrates: glycolysis;, citric acid cycle, pentose phosphate pathway, gluconeogenesis; glycogenesis and glycogenolysis; Classification, structure, digestion and absorption of lipids; metabolism of lipids: 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; Classification, structure, digestion and absorption of proteins; metabolism of proteins: fate of absorbed amino acids; transamination; deamination; deamination; trans- methylation; decarboxylation, inter-conversion of amino acids; hormonal regulation of different biochemical processes, Interconversion of dietary metabolites

Practical

Lab safety measures, proximate analysis of feed; determination of moisture, dry matter, crude protein, ether extract, ash, crude fiber and nitrogen free extracts, determination of neutral detergent fiber, acid detergent fiber, cellulose, and lignin contents of feed samples, determination of acid insoluble ash

Books Recommended

1. Wu, G. 2018. Principles of Animal Nutrition. Taylor & Francis, UK
2. Murray. R., V. Rodwell, D. Bender, K. M. Botham, P. A. Weil and P. J. Kennelly. 2018. Harper's Illustrated Biochemistry. 31st Edition. McGraw-Hill Medical, USA.
3. Nelson, D. L., A. L. Lehninger, and M. M. Cox. 2017. Lehninger Principles of Biochemistry. Macmillan.
4. Ahmad, T. 2017. Basic Analytical Techniques in Animal Nutrition. 2nd Ed. Ramim Printer, Rawalpindi
5. Oltjen, J. W., E. Kebreab, and H. Lapierre. 2013. Energy and protein metabolism and nutrition in sustainable animal production. Springer.
6. Pond, W.G, D.C. Church, K.R. Pond and P.A. Schoknecht. 2005. Basic Animal Nutrition and Feeding. (5th Ed.), John Wiley and Sons, New York, USA.
7. AOAC. (2019). *Official Methods of Analysis of the Association of Official Analytical Chemists* (21st ed.) Arlington Virginia.

AN-402 Minerals and Vitamins in Nutrition 3(2-2)

Learning outcomes: At the end of the course, students will be able to:

- Describe the role of minerals and vitamins in the body
- Identify micro nutrient deficiencies in animals.
- Prepare mineral and vitamin premixes for commercial use.
- Perform mineral and selected vitamin analysis

Theory

Historical perspective of minerals and vitamins, minerals: classification of minerals, distribution of minerals in living body, functions of minerals, metabolism of macro-minerals, role of trace minerals in metabolism, interaction of minerals, deficiency and toxicity of minerals, relationship of minerals with other dietary ingredients, vitamins: nomenclature, nature and classification, stability, interdependence, deficiencies and toxicity, metabolic functions of vitamins. interrelationship among vitamins and with other nutrients, nutritional disorders related with minerals and vitamins, different available sources of minerals and vitamins.

Practical

Sample preparation for mineral analysis, estimation of important inorganic elements and vitamins in common feed ingredients, formulation of vitamin and mineral premixes, preparation of mineral blocks.

Books Recommended

1. Patel, V. 2019. Molecular Nutrition: vitamins. 1st Edition ed. Academic Press.
2. Surai, P. F. 2018. Selenium in poultry nutrition and health. Wageningen Academic Publishers, Netherlands.

3. Hendriks, W. H., M. W. A. Verstegen, and L. Babinszky. 2019. Poultry and Pig Nutrition: Challenges of the 21st Century. Wageningen Academic Publishers.
4. Suttle, N. F. 2010. Mineral nutrition of livestock. Cabi.
5. Eitenmiller, R. R., W. Landen Jr, and L. Ye. 2016. Vitamin analysis for the health and food sciences. CRC press.
6. AOAC. (2019). Official Methods of Analysis of the Association of OfficialAnalytical Chemists (21st ed.) Arlington Virginia.

AN-501 Nutrition of Meat Animals 3(2-2)

Learning outcomes: At the end of the course, students will be able to:

- Calculate nutrient requirements of meat animals
- Determine the growth rate and economic efficiency of weight gain
- Formulate rations for meat animals

Theory

Feeding standards for meat animals, their usefulness and limitations, Factors affecting digestibility, energy, protein, minerals and vitamins needs of farm animals, Nutrient requirements of sheep for maintenance, growth, production and reproduction, Nutrient requirements of goat for maintenance, growth, production and reproduction, Nutrient requirements of beef animals for maintenance, fattening and reproduction. Rumen by-pass nutrients and techniques used for enhancing by-pass proteins and lipids, feeding management of beef animals at different physiological stages, Feeding practices of small ruminants, Nutritional management of grazing livestock,

Practical

Calculation of nutrient balance, Formulation of least cost balanced rations for sheep, Formulation of least cost balanced rations for goat, Formulation of least cost balanced rations for beef animals, Formulation of least cost balanced rations for young calves

Books Recommended

1. NRC. 2016. Nutritional Requirements of Beef Cattle. 8th Edition. National Academy Press. Washington, USA.
2. McDonald, P., R.A. Edwards, J.F.D. Greenhalgh, C.A. Morgan, L, Sinclair and R. Wilkinson. 2011. Animal Nutrition. 7th ed. Benjamin Cummings, USA.
3. Jan Dijkstra, J., and J.M. Forbes. 2005. Quantitative Aspects of Ruminant Digestion and Metabolism. 2nd Ed. CAB International, NY, USA.
4. Garnsworthy and J. Wiseman. 2002. Recent Advances in Ruminant Nutrition. Empress Publishing. The Netherlands.
5. Pathak, N.N. 2000. Nutrient Requirement of Buffalo. Deradoon International Books, India.
6. Chamberain, A.T. and J.M. Wilkinson. 2002. Feeding the Dairy Cow. Empress Publishing. The Netherlands.

AN-502 Principles of Poultry Nutrition 3(2-2)

Learning outcomes: At the end of the course, students will be able to:

- Describe nutrient utilization in poultry birds
- Calculate nutrient requirements of poultry birds
- Formulate least cost rations for poultry birds

Theory

Avian digestive anatomy and physiology, classification of poultry feed ingredients and their chemical composition, anti-nutritional factors in feed stuffs for poultry, feed additives in poultry nutrition. measures of feed quality for poultry; protein efficiency ratio, biological value, the essential amino acid index, nutrition of broiler, layer and breeder birds, nutrition of pet birds, new concepts in poultry feeding, nutritional deficiency diseases in poultry.

Practical
Identification of poultry feed ingredients. composition of feedstuffs used in poultry rations, formulation of least cost rations for broilers, layers, breeders, feeding practices at poultry farm, demonstration of avian digestive system, visit to commercial poultry enterprise.

Books Recommended

1. Wu, G. 2017. Principles of Animal Nutrition. CRC Press, Taylor & Francis Group, New York.
2. Michael R. Bedford, M. C., Helen V. Masey O'Neill. 2016. Nutrition Experiments in Pigs and Poultry A Practical Guide. CAB International UK.
3. Blair, R. 2018. Nutrition and feeding of organic poultry. CABI.
4. Wu, G. 2013. Amino acids: biochemistry and nutrition. CRC Press.
5. Leeson, S. and J.D. Summers. 2008. Commercial Poultry Nutrition. 3rd Ed., Nottingham University Press, UK.
6. NRC. 1994. Nutrient Requirements of Poultry. National Academy of Science, USA

AN-503 Dairy Nutrition 3(2-2)

Learning outcomes: At the end of the course, students will be able to
- Enlist feed resources and describe their classification.
- Explain nutrient profile of feed resources and their role in ruminant ration.
- Elaborate ruminant digestive physiology and metabolism
- Calculate nutrient balance and formulate rations for dairy animals

Theory
Feed resources in feeding of ruminants, feeding standards, history, usefulness and limitations; rumen fermentation, fate of volatile fatty acids, utilization of nitrogen in ruminants, techniques for estimating body nutrient needs, calf nutrition, nutrient requirements of heifers for maintenance, growth and reproduction, nutrient requirements of dairy cattle for maintenance, growth, production and reproduction, nutrient requirements of buffaloes for maintenance, growth, production and reproduction;, nutrient requirements of dairy goat and sheep, digestibility and balance trials; factors affecting digestibility and balance of nutrients; partitioning of nutrients in body; factors governing energy; protein; minerals and vitamins needs of farm animals; concept of rumen bypass nutrients, feeding animals for maximum productivity

Practical
Determination of energy value of feedstuffs, demonstration of different nutrient digestibility techniques, calculation of nutrient balance, feed formulation: pearson square method, trial and error method, MS excel based feed formulation, formulation of least cost balanced rations for dairy animals using computer software.

Suggested Readings

1. NRC. 2021. Nutrient Requirements of Dairy Cattle. 8th revised edition. National Academy Press, Washington DC., USA.
2. Dryden, G.Mcl. 2008. Animal Feed Science. CABI Head Office Nosworthy Way Wallingford, Oxfordshire OX10 8DE, UK. www.cabi.org.
3. S. S. Paul and D. Lal. Nutrient Requirements of Buffaloes. 2010. Satish Serial Publishing House.
4. Peter R. Cheeke. Applied Animal Nutrition: Feeds and Feeding. 2004. 3rd E: Prentice Hall Publisher.

AN-603 Feed Milling Industry 3(2-2)

Learning outcomes: At the end of the course, students will be able to:

- Procure quality feedstuff for feed manufacturing.
- Design a feed mill plant.
- Run a feed processing unit
- Process feedstuffs for manufacturing compound feed

Theory

Present status of feed industry in Pakistan, Problems of feed industry in Pakistan, Conventional and non-conventional feed stuffs used in feed manufacturing, Techniques for estimating nutritive value of feed stuffs and their validity, factors affecting the nutritive value of feeds, Procurement of raw materials for fed mill. Preliminary inspection of feed ingredients, tests for quality evaluation, Introduction to different forms of feed mills. Preparation of feasibility report to establish a feed mill for poultry and ruminants, Construction and designing of feed mill for poultry and ruminants. Operational mechanism of feed mill, Sampling techniques at feed mill. Feed raw material handling, storage, conveyers, grinding, mixing, processing (pelleting, extrusion) and storage of finished feed; Storage Problems of Feedstuffs, Forms of feeds, quality control in feed processing; feedstuff laws and regulations.

Practical

Demonstration of modern techniques and equipment's for ingredient and feed quality testing i.e., NIR, HPLC, atomic absorption and amino acid analysis, availability pattern of feed stuffs in local market and their price structures, feed mill design/layout, Demonstration of different types of grinders. Demonstration of different types of mixers. Types of conveyers and elevators. Type of Silo for feed ingredient storages. Pellet machine use in feed mills. Different types of extruders for different animal feed manufacturing. Manufacturing of wholesome feed. Packing process of feed. Feed marketing techniques. Visit of feed mills (Poultry), Visit of feed mills (ruminants).

Books Recommended

1. Blair, R. 2018. Nutrition and feeding of organic poultry. CABI.
2. Wu, G. 2020. Amino Acids in Nutrition and Health: Amino Acids in Systems Function and Health. Springer Nature.
3. Hendriks, W. H., M. W. A. Verstegen, and L. Babinszky. 2019. Poultry and Pig Nutrition: Challenges of the 21st Century. Wageningen Academic Publishers.
4. Applegate, T. 2017. Achieving Sustainable Production of Poultry Meat: Breeding and Nutrition. Volume 2. Burleigh Dodds Science Publishing.
5. Wu, G. 2017. Principles of Animal Nutrition. CRC Press, Taylor & Francis Group, New York.
6. McEllihiney, R.R. 2005. Feed Manufacturing Technology V. American Feed Industry Association, Inc. Arlington, USA.

POULTRY SCIENCE COURSES FOR BS ANIMAL SCIENCE

Course #	Course Title	Credit Hours	Semester
PS-301	Introductory Poultry Science	2(1-2)	1
PS-403	Incubation Principles and Hatchery Management	3(2-2)	2
PS-407	Poultry Housing and Equipment	3(2-2)	3
PS-408	Commercial Broiler Production	2(1-2)	4
PS-501	Layer Production and Management	3(2-2)	5
PS-502	Breeder Production and Management	3(2-2)	6
PS-603	Poultry Health Management	3(2-2)	7
PS-607	Poultry Breeding Practices	2(1-2)	7
	Total	21	

PS-301 Introductory Poultry Science 2(1-2)

Learning outcomes

After the completion of the course, students will be able to:

- Understand importance of poultry industry in Pakistan
- Learn different purpose of poultry production
- Understand the prospects of poultry production

Theory

Importance of poultry farming; basic needs of poultry farming, development of world poultry industry; history of Pakistan Poultry industry; growth of poultry industry in Pakistan; present status and future potentials; problems of poultry industry in Pakistan, poultry industry vs livestock/agricultural enterprises; glossary in poultry science; taxonomic classification of poultry; prospects of poultry production other than chicken and their significance; introduction and planning of various poultry enterprises; poultry farm organization; significance of poultry meat and eggs. Institutes and associations of Poultry Sciences in Pakistan and world.

Practical

Demonstration of routine activities of various components at poultry farm; practices related to brooding, rearing of layer, broiler, and breeder production, hatchery practices; identification of different species of poultry; illustration of body parts of fowl. Five years' overview of economic survey of Pakistan; Visit to commercial poultry farm.

Books Recommended

1. Scanes, C. G., and K. D. Christensen. 2019. Poultry Science: Fifth Edition. Waveland Press.
2. Bell, D.D. and W.D. Weaver. 2007. Commercial Chicken Meat and Egg Production. 5th Ed. Springer Private, Limited, India.
3. Lawton, J. A. 2020. Encyclopedia of Avian Science: (4 Volume Set). Nova Science Publishers.
4. Brown, T. 2010. Poultry Farming. Apple Academic Press Mistwell Crescent Oakville, ON 6L6 0A2.
5. Sreenivasaih, P.V. 2006. Scientific Poultry Production. 3rd Ed. International Book Distributing Co., Lucknow, India.

PS-403 Incubation Principles and Hatchery Management 3(2-2)

Learning outcomes

After studying this course the students would be able to understand the

- Basic terminology and knowledge of poultry hatcheries design
- Various approaches of modern incubation concepts
- Manage the hatchery

Theory

History, development and scope of hatchery industry in Pakistan; collection, handling and transport of hatching eggs; maintenance of quality in hatching eggs; selection, care and storage of hatching eggs; seasonal hatching; natural incubation; incubation requirements for small incubators; characteristics of broody hen; selection of hatching eggs; nest preparation; management during incubation; types of incubator; role of computer in modern hatchery operations; incubation requirements; setting and candling of eggs; daily changes in embryonic development during incubation: extra embryonic membranes and their functions; classification of embryo positions; physical act of hatching; critical periods of embryo development; embryonic metabolism; factors influencing fertility, hatchability and quality of chicks; taking off the hatch; sexing, vaccination; grading, packing and transportation of baby chicks; hatchery sanitation and waste disposal; trouble shooting during incubation; incubation records.

Practical

Planning and designing of hatchery, Selection, candling and setting of hatching eggs; cleaning of hatching eggs; Preparation of eggs for incubation; dead embryo and dead in shell; estimation of fertility and hatchability. Trouble tracing chart of the chick embryo; demonstration of parts of incubators; handling of incubators; Practical demonstration of sexing, grading, detoeing, and dubbing of baby chicks; disinfection and fumigation of incubators; visits to commercial hatcheries.

Books Recommended

1. Scanes, C. G., and K. D. Christensen. 2019. Poultry Science: Fifth Edition. Waveland Press.
2. Sharma, S. 2019. Poultry Diseases, Production & Its Management. DAYA Publishing House.
3. D, S., D. Narahari, and J. D. Mahanta. 2017. Avian (Poultry) Production: 2nd Revised and Enlarged Edition. New India Publishing Agency.
4. Bell, D.D. and W.D. Weaver. 2007. Commercial Chicken Meat and Egg Production. 5th Ed. Springer Pvt, Limited, India.
5. Prasad, R. 2010. Poultry Management. Alpha Publications, New Delhi, India.
6. Taylor, L.W. 2003. Fertility and Hatchability of Chicken and Turkey Egg. International Book Distributing Co., Lucknow, India.

PS-407 Poultry Housing and Equipment 3(2-2)

Learning outcomes

After the completion of the course, students will be able to:

- Importance of housing in management of poultry
- Basic tools while construction of poultry shed
- Well enough to establish the poultry farm

Theory

Importance of poultry housing: selection of site and location of poultry house; modern trends in poultry housing system; types and styles of poultry houses; construction of poultry farm buildings. Precast poultry house material availability and price structure; heating and cooling systems; the role of insulation in environment control housing; types and principle of ventilation, procedure, and equipment, orientation and design of buildings in relation to the environment; open-sided and environmentally controlled housing; housing conditions and poultry welfare; brooding, rearing and laying house equipment; alternative power supply; farm water supply; sewage disposal. Cage management. Fogging system in the poultry house. Planning and implementation of biosecurity in poultry housing; Types of the feeders and drinkers; cages types and systems for the broiler, layer, and breeders; Calculations of the cost of housing and equipment for different housing systems for broilers, layers, and breeders.

Practical

Basic principles for poultry house construction. Demonstration of poultry farm buildings;

designing of farm buildings for specific purposes; demonstration and operation of poultry farm equipment; use of AutoCAD, automatic feeding and watering system, specifications, cost estimation and trouble-shooting; poultry housing practices. Demonstration on controller, fans, cooling pads, feeding and drinking line and sensors. Demonstration on air velocity meter, oxygen meter, Nitrogen meter, lux meter and infrared thermometer and other modern equipments. Application of IoT in controlled house. Insulation and calculation of R value; Visit to commercial poultry farms.

Books Recommended

1. Scanes, C. G., and K. D. Christensen. 2019. Poultry Science: Fifth Edition. Waveland Press.
2. Flanders, F., and J. R. Gillespie. 2015. Modern Livestock & Poultry Production. Cengage Learning.
3. Bell, D.D. and W.D. Weaver. 2007. Commercial Chicken Meat and Egg Production. 5th Ed. Springer Pvt, Limited, India.
4. Brown, T. 2010. Poultry Farming. Apple Academic Press 3333 Mistwell Crescent Oakville, ON 6L6 0A2.
5. Daghir, N.J. 2008. Poultry Production in Hot Climates. 2nd Ed. CABI Publications.Wallingford Oxon OX 10 8DE, UK.
6. Prasad, R. 2010. Poultry Management. Alpha Publications, New Delhi, India.

PS-408 Commercial Broiler Production 2(1-2)

Learning outcomes

After the completion of the course, students will be able to:

- Understand the basic concept about broiler and its origin
- Monitoring of growth performance of broilers
- Management of broiler throughout the life span

Theory

Introduction, origin of broiler, different breeds/strains used in broiler development; commercial broiler breeding plans, different commercial strains/genetic lines of broilers, breeding and production of slow growing broilers, housing, equipment and floor space requirements; open sided and environment control housing; water, feed and litter management; preparation for chicks arrival, procurement of quality chicks; chick placement; brooding requirements, managing broilers on litter; lighting regime for broilers; feed specifications; growth and feed consumption, measuring feed conversion ratio, sex separate raising; bio-security, health management; control measures for specific broiler diseases; food safety issues, Factors affecting the meat quality of broilers, broiler rearing problems; marketing broilers; trouble shootings in broilers; economical broiler production.

Practical

Pre-brooding and brooding management. Vaccination schedule for broilers, feeding strategies for broiler, monitoring of growth performance and uniformity of broilers viz. weekly feed consumption, weekly weight gain, mortality, feed to gain ratio, European efficiency factor; preparation feasibility reports; risk management, forecasting and casting of broiler business; visit of controlled broiler farm.

Books Recommended

1. Scanes, C. G., and K. D. Christensen. 2019. Poultry Science: Fifth Edition. Waveland Press.
2. https://ap.aviagen.com/
3. Ricke, S. C., and T. Applegate. 2017. Achieving Sustainable Production of Poultry Meat: Safety, quality and sustainability. Burleigh Dodds Science Publishing.
4. Applegate, T. 2017. Achieving sustainable production of poultry meat Volume 3: Health and welfare. Burleigh Dodds Science Publishing.
5. Applegate, T. 2017. Achieving Sustainable Production of Poultry Meat: Breeding and Nutrition. Volume 2. Burleigh Dodds Science Publishing.

PS-501 Layer Production and Management 3(2-2)

Learning outcomes

After studying this course, the students would be able to understand the

- Basic concepts layer production
- Management of layer throughout the life span
- Successful management of layer farm

Theory
Present status and future scope of layer farming; Breeds/strains used in the development of commercial layers, development of commercial laying hybrids/lines, traits of economic importance in layers; housing systems; pre-brooding requirements; procurement of quality chicks; management during brooding period; controlling early chick mortality; management during rearing; shifting and housing of pullets; feed and light management to control sexual maturity; management practices during laying for efficient egg production; nest management and egg collection; causes of poor performance in layers: prevention and control of common layer diseases; parasitic control; vices and their remedies in layer production; management in hot and cold environment; induced molting; trouble shootings; litter management and waste disposal; record keeping; factors affecting the egg quality and production; variation in the egg shell color and its genetics; egg enrichments; comparison of different egg laying lines/breeds; marketing of eggs and spent hens. Different types of cages for commercial layers; Care and management of layers in cage; Management of layer in free range system.
Practical
Demonstration of various types of brooders; vaccination and medication practices; beak trimming; identification of laying and non-laying; cost benefit ratio of layer enterprises; induced molting techniques; managing flock during stress; computerized record keeping softwares/apps; egg packaging and branding; demonstration of commercial egg grading machines; market feasibility report of layer flocks; Different type of cage systems for layers. Flock health monitoring; Visit of a commercial layer farm.

Books Recommended

1. Roberts, J. R. 2017. Achieving Sustainable Production of Eggs Volume 1: Safety and Quality. Burleigh Dodds Science Publishing Limited.
2. Roberts, J. 2017. Achieving Sustainable Production of Eggs Volume 2: Animal Welfare and Sustainability. Burleigh Dodds Science Publishing Limited.
3. Lambio, A. L. 2012. Poultry production in the tropics. UP Press.
4. Bell, D.D. and W.D. Weaver. 2007. Commercial Chicken Meat and Egg Production. 5th Edition. Springer Private, Limited, India.
5. Sreenivasaih, P.V. 2006. Scientific Poultry Production. 3rd Revised Edition, International Book Distributing Company, Lucknow, India

PS-502 Breeder Production and Management 3(2-2)

Learning outcomes
After studying this course, the students would be able to:
- Maintain and standardize the breeder poultry farm
- Handle different managemental practices involved at breeder farm
- Manage the breeder farm

Theory
Introduction, historical perspective of breeder production; lines/breeds used in the development of the broiler and layer breeders; breeder house layout and equipment requirements; environment control vs open sided housing; care and management during brooding period; rearing management; light and feed management during growing; monitoring body weights, uniformity, grading and selection during growing period; skip a day feeding; vaccination programs during growing; sexing errors; pre-breeder nutrition; feeding programs for adults; production standards; male to female ratio; sex separate feeding system; Breeding chicken cages; nest management; egg collection, handling and cleaning; fumigation of hatching eggs; spiking. Causes of poor fertility and hatchability; male management; offspring sex manipulation; major management health concerns with breeders; labour management; summer and winter strategies to enhance production; induced molting in breeder flocks; trouble shooting in breeder flocks; record keeping.

Practical
Environment control housing; ventilation and heating systems; reproductive system of male and female; vaccination programs; blood and tissue sampling; feeding management; monitoring body weights and uniformity calculations during growing; sex separate feeding system; hatching egg fumigation, storage and transportation; toe clipping, dubbing and beak trimming; calculating cost of producing hatching eggs and chicks; Sexing of embryos and day old chicks; feasibility report of broiler and layer breeder flocks; record keeping softwares/apps; Care and management of breeder in cage. Flock health monitoring, Visit of poultry breeder farm.

Books Recommended

1. Narahari, D, S., D. and J. D. Mahanta. 2017. Avian (Poultry) Production: 2nd Revised and Enlarged Edition. New India Publishing Agency.
2. Applegate, T. 2017. Achieving Sustainable Production of Poultry Meat: Breeding and Nutrition. Volume 2. Burleigh Dodds Science Publishing.
3. Managemental of Guide Parent Flock. 2019. Hubbard-Grandparent Poultry (PVT) LTD. Paksiatn.www.hubbardbreed.com
4. Lambio, A. L. 2012. Poultry production in the tropics. UP Press.
5. Bell, D.D. and W.D. Weaver. 2007. Commercial Chicken Meat and Egg Production. 5th Ed. Springer Pvt. Limited. India.
6. Jadhav, N.V. and M.F. Siddiqui. 2007. Handbook of Poultry Production and Management. Jaypee Brothers Medical Publishers (Pvt) Ltd. New Delhi, India.
7. Leeson, S. and J.D. Summers. 2001. Broiler Breeder Production. University Book Foundation, University of Guleph, Canada.

PS-603 Poultry Health Management 3(2-2)

Learning outcomes

After studying this course, the students would be able to:

- Implement the biosecurity and disinfection plans at poultry farms
- Understand the basic principles of the poultry diseases prevention
- Understand the vertically and horizontally transmitted diseases

Theory

Importance of poultry hygiene; bio-security measures; terms related to poultry diseases; cleaning and disinfection of poultry houses and equipment, disinfectants and their application; fumigation and its importance; principal aspects of management and disease prevention; prophylactic measures against bacterial viral, parasitic and mycotic diseases; nutritional disorders and their prevention; significance of drinking water in relation to diseases; practices involved in controlling vertically and horizontally transmitted diseases; Planning and implementation of the biosecurity; vaccination program design; Vaccination program for broiler, layer and breeder; Handling of field outbreaks of the infectious diseases of poultry; Flock management during epidemics; Role of water quality on the flock health and performance; role of human, birds, vehicles, and feed in the transmission of diseases; Protection of the poultry workers from exposure to zoonotic diseases.

Practical

Poultry carcass inspection; blood and carcass specimen collection, handling, and for dispatch to the diagnostic laboratory for flock health monitoring and surveillance; serodiagnostic tests for the interpretation and designing of the health management strategies; Molecular techniques for the flock health monitoring and tracing of outbreaks; Practical demonstration of the vaccination program designing; Selection of disinfectants, medicines and vaccines for flock health management; Common practices for bio-security measures; dead bird disposal. Farm record Analysis for prevention of diseases; Drinking water analysis.

Books Recommended

1. Swayne, D. E., J. R. Glisson, L. R. McDougald, L. K. Nolan, D. L. Suarez, and V. Nair. 2020. Diseases of Poultry. A John Wiley & Sons.
2. Giambrone, J. J. 2018. Poultry Health and Management. Poultry Science Department; Auburn University.
3. Ricke, S. C., D. Dittoe, A. Kiess, X. Wang, J. Zhao, J. Seifert, B. Tilocca, R. Moore, E. D. Peebles, and R. J. Arsenault. 2019. Improving Gut Health in Poultry. Burleigh Dodds Science Publishing Limited.
4. Charlton, B.R., A.J. Bermodaz, M. Boulianne, D.A. Halvorson, J.S. Schrader, L.J. Newman, J.E. Sander and P.S. Wakenell. 2006. Avian Disease Manual. American Association of Avian Pathologists, USA.
5. Wlliams, S. M. 2016. A laboratory manual for the isolation, identification and characterization of avian pathogens. S. M. Wlliams ed. American Association of Avian Pathologists, Jacksonville, Fl.

PS-607 Poultry Breeding Practices 2(1-2)

Learning outcomes

After studying this course, the students would be able to:

- Maintain and standardize the poultry farm record
- Select and develop the poultry breeding stock for layers & broilers
- Produce layers for different egg shell colours

Theory

Origin, domestication and historical development of fowl; poultry breeds and their characteristics; maintenance of pure lines; Traits of economic importance in poultry, commercial strains of broiler and layer; opportunities for breeding and improvement of poultry breeds in Pakistan, selection of poultry birds for genetic improvement, mating systems and their significance; pigmentation; body conformation and other qualities; culling procedure and its significance in maintaining growth and production performance; use of standardized records, relative economic values, breeding values and selection indices, crossbreeding for egg and meat production. Selection and development of breeding stock for layers, broilers, dual purpose chicken and rural poultry, breeding for the egg and plumage color, Review of the poultry breeding practices used by the developed countries.

Practical

Description and demonstration of different poultry breeds; judging; selection and culling techniques; preparation of birds for exhibition Exercises on the maintenance and standardization of productive and reproductive records; Calculation of relative economic values, Construction of selection indices for breeding value estimation; visits to commercial flocks and poultry shows.

Books Recommended

1. Liu, X. 2018. Application of Genetics and Genomics in Poultry Science. BoD–Books.
2. Simm, G., G. Pollott, R. Mrode, R. Houston, and K. Marshall. 2020. Genetic Improvement of Farmed Animals. CABI.
3. F. W. Bazer, G. C. Lamb, and G. Wu 2020. Animal Agriculture. F. W. Bazer, G. C. Lamb, and G. Wu eds. Academic Press.
4. Aggrey, S. E., H. Zhou, M. Tixier-Boichard, and D. D. Rhoads. 2020. Advances in poultry genetics and genomics. Burleigh Dodds Science Publishing Limited.
5. Weller, J. I. 2016. Genomic selection in animals. Wiley Online Library.
6. Pal, A., and A. K. Chakravarty. 2019. Genetics and Breeding for Disease Resistance of Livestock. Elsevier Science.

LIVESTOCK MANAGEMENT COURSES

Course Code	Course Title	Credit Hours	Semester
LM-301	Fundamentals of Livestock Management	2(1-2)	1
LM-402	Milk Biosynthesis and Lactation	3(2-2)	4
LM-505	Dairy Farm Management	3(2-2)	5
LM-507	Equine and Camel Production	2(1-2)	5
LM -502	Principles of Small Ruminant Production	3(2-2)	6
LM -601	Principles of Meat Production	3(2-2)	7
LM-603	Livestock Farm Practices	1(0-2)	7
		17	

LM-301 Fundamentals of Livestock Management 2(1-2)

Learning outcomes

At the end of the course, students will be able to

- Define livestock species and livestock management
- Identify types and breeds of farm animals.
- Learn management of housing, feeding, health and miscellaneous livestock operations

Theory

Role of livestock, its importance and production trends; livestock species and breeds (cattle, sheep, goats and camel); zoological classification of domestic animals; livestock production systems; general management practices; management of dairy animals; management of small ruminants; livestock housing systems; housing of dairy animals; housing of small ruminants; management of milking herd, dry stock, and replacement calves; milking parlors designs, types and equipment; sanitation of animal sheds, shelter and houses; plans for economical housing under different climatic conditions; transportation and welfare of animals.

Practical

Demonstration of animals body points; handling and restraining of farm animals; animal body grooming; animals weight estimation; animals age estimation; animals identification methods; Hoof trimming, Dehorning/Debudding; Docking, Castration, preparation of animals for shows, animal Milking practices; animal drying, housing and sheds measurements and facilities; Visit to livestock farms and shows.

Books Recommended

1. Vincent Martin. Animal Husbandry and Livestock Management. 2019. Callisto Reference. ISBN-13 : 978-1641162289.
2. Ahmad, T. 2020. Practical manual of animal husbandry. Remim Printer, Rawalpindi
3. Banerjee, G.C. (2010). A Textbook of Animal Husbandry. New Delhi, India: Oxford and IBH Publications.
4. Khan, B.B., Yaqoob, M., Riaz, M., Younas, M., & Iqbal, A. (2004). Livestock Management Manual for Introductory Courses. University of Agriculture, Department of Livestock Management. Faisalabad.
5. John Webster. 2013. Animal Husbandry Regained. The Place of Farm Animals in Sustainable Agriculture. 2013. 1st Edition. ISBN 9781849714211. Routledge publisher.

LM-402 Milk Biosynthesis and Lactation 3(2-2) Learning outcome:

At the end of the course, students will be able to;

1. Understand bovine mammary systems
2. Practice techniques for better mammary development
3. Improve milk yield and milk composition

Theory

Milk as diary product and its composition; Comparative milk composition; milk adulteration and its impacts External features of mammary glands; Mammary supportive structures; Mammary Lobule Alveolar system; Mammary Arterial; Mammary venous system; Mammary nervous system; Mammary lymphatic system; Mammogenesis during fetal stage; Mammogenesis from birth to puberty; Mammogenesis from puberty to 1st lactation; Milk initiation and Mammogenesis after parturition; Hormonal control of mammary development and lactation; Artificial induction of lactation; Hormonal stimulation of lactation; Synchronized role of hormones in mammary cell proliferation; Biology of milk secretary cell, Biosynthesis of milk proteins; Biosynthesis of lactose; Biosynthesis of milk fat; Biosynthesis of minerals and other constituents; Lactation curve and its philosophy; Milk drying and its benefits; Milk let down and inhibition; Milk ejection reflex; Factors affecting milk production and composition; Hand and machine milking; components of milk machine; Management aspects of Mastitis, milk production and processing, milk value added products.

Practical

Hygiene milk practices, types of milking; Hand milking, machine milking; milk quality tests for organoleptic properties, total fats, specific gravity, pH,. Milk Adulteration tests (urea, detergent, starch, Cob test). California Mastitis test, extra Teat removal. Yogurt and cheese making, visit to dairy farm and milk processing plant or unit.

Books Recommended

1. M'Hamdi, N. 2020. Lactation in Farm Animals: Biology, Physiological Basis, Nutritional Requirements and Modelization. IntechOpen, United Kingdom.
2. Patil, P. V. and M. K. Patil. 2020. Milk Production Management. Taylor & Francis Group.
3. Walstra, P., 2005. Dairy Technology; Principles of Milk Properties and Processes. Marcel Dekker Inc, New York, USA.
4. Bath, D.L., F.N. Dickenson and H.A. Tucker. 1985. Dairy Cattle, Principal, practices, problems, profits. Lea & Febiger, Philadelphia.

LM-505 Dairy Farm Management 3(2-2)

Learning outcomes:

At the end of the course, students will be able to;

- apply innovative dairy production practices
- manage the dairy animals for optimum production
- manage modern trends i.e. corporate dairy sector in Pakistan

Theory

Current status of Dairy Production in Pakistan; Characteristics of local dairy animals; Characteristics of crossbred animals; Characteristics of exotic animals; Housing of dairy animals as per animal welfare; Calf Management; Management of Replacement heifers; Management of pregnant animals; Reproductive management of dairy animals; Management of lactating animals at different physiological stages; Management of breeding bulls; Production Systems; Selection of dairy animals (Judging / Scoring); culling of dairy animals; Factors affecting milk quality and yield; Growth and fattening potential of cow and buffalo; Feeding for optimum milk production; Grazing management of cattle and buffalo; Human Resource (Labor) Management; Transportation of dairy

animals; Marketing of livestock and livestock products; Dairy herd health management; Grazing management of cattle and buffalo, electric fencing; RFID as innovative tool for identification; Bio-security measures; Principles and establishment of profitable dairy enterprise; Manure management; Importance of record keeping, Methods of record keeping, Dairy herd improvement associations (DHIA); Traceable dairy production; Global GAP; HACCP certification.

Practical

Demonstration of character of ideal dairy animals; Preparation of housing plans for small and medium dairy farms; Preparation of housing plans for corporate dairy (large); demonstration & planning of fodders production in different seasons; Silage making; Hay making; Stover making; Feed preparation practices; Record keeping using manual and dairy herd software; Determine animal behavior, dry stock management; Routine test for milk quality; Judging &selection, Dairy score card, Dehorning, castration & teat dip; Cleaning, sanitation and biosecurity measures in farm premises; Preparing feasibility reports; Visit to livestock farms and shows

Books Recommended

1. Patil, P. V. and M. K. Patil. 2020. Milk Production Management. Taylor & Francis Group.
2. Moran, J. and P. Chamberlain. 2016. Blueprints for Tropical Dairy Farming; Increasing Domestic Milk production in Developing Countries. CSIRO Publishing, Australia.
3. Khan, B.B. (Editor). 2008. Health and Husbandry of Dairy Animals. Pak Printers Publishers, Faisalabad.
4. Howard D. Tyler & M.E. Ensminger. 2006. Dairy Cattle Science. Pearson Education Inc., Upper Saddle River, New Jersey
5. Bath, D.L., F.N. Dickenson and H.A. Tucker. 1985. Dairy Cattle, Principal, practices, problems, profits. Lea & Febiger, Philadelphia.

LM-507 Equine and Camel Production 2(1-2) Leaning

Outcomes:

- The students will be able to manage the Equine & Camel Farm cost effectively.
- They could apply advanced concept of feeding for getting better growth and good quality product from camel
- They would be able to manage horses and equines farms for various draught purposes.

Theory:

Importance of camel and equine; Camel as a milk, meat, and draught animal; Equine (Horses, donkeys, mules) as draught animal; Breeds of Camel, donkey and equines; Special confirmation of camel and horse; Selection for various types; Management during different phases of life; Feeding and Breeding Management of Camels & Equines; Principles of equitation; Vices and their control; Peculiarities of camel feet; Common ailments and Prophylactics; Welfare of camels and equines; Transportation and marketing

Practical:

Identification of various breeds of Camel, horses and equines; Equine and Camel Housing; Grooming and cleaning; Gaits of horses and camels; Demonstration of body conformation and defects; determining age; marking camel and horses; use of various management tools and equipment; care of foot; use and care of harness and saddles; Vices and its control; equitation practices; Stable management; visit to farms

Books Recommended

1. Khan, B.B. 2005. Husbandry and Health of Horses. Department of Livestock Management, University of Agriculture, Faisalabad, Pakistan.
2. Khan, B.B. 2003. Production and Management of Camels. Department of Livestock Management, University of Agriculture, Faisalabad, Pakistan.
3. Omar, A.A., Bernard, F., Rajendra, P.A. 2020. Handbook of Research on Health and Environmental Benefits of Camel Products. IGI Global.
4. Brown, J.H., S. Pilliner, Z. Davies. 2003. Horse and Stable Management. 4th Ed. Wiley- Blackwell Publishers.
5. Wilson, R.T. 1998. Camels. MacMillan Education London
6. Kackar and Panwar. 1996. A Text Book of Equine Husbandry. Vikas Pub. Pvt. Ltd. New Delhi, India.

LM -502 Principles of Small Ruminant Production 3(2-2)

Learning outcomes
At the end of the course, students will be able to;

- To know about small ruminant's status and production trends.
- To identify species and breeds of small ruminants in different provinces of Pakistan
- To learn about housing and feeding requirements; conduct reproductive management
- To prepare feasibility report of small ruminant business

Theory
Scope of small ruminant industry in Pakistan; share in national economy; world distribution; domestication of small ruminants; Production System of production; different management practices; Sheep and goat as meat and dairy animals; Housing Requirements of small ruminants; Housing for sustainable small ruminant production; Feeding management of small ruminants; Reproduction and Breeding in small ruminants; Selection for genetic improvement; Kidding/lambing management; Rearing nursing orphan kids/lambs; measures for increased production; Characteristics and utility of wool, hair/mohair; Shearing and handling of wool/hair; Transportation and marketing; slaughter and flaying; Keeping flock healthy; Common ailments; Showing of sheep/goats; preparing feasibility reports;.

Practical
Identification of different sheep and goat breeds; judging for milk, meat and wool/hair production; farm practices as castration, hoof trimming, condition scoring feeding lambs/kids, animal's identification, docking, drenching, dipping and spraying; dentition; use of marking harness, housing plans, shearing and handling; grading and sorting wool; studying wool and mohair characteristics in the lab; flaying and skin preservation; various farm records; practical prophylactic measures; shepherd calendar; visit to sheep and goat farms.

Books Recommended

1. Khan, B.B., A. Iqbal and M.I. Mustafa. 2003. Sheep and Goat Production. Department of Livestock Management, University of Agriculture, Faisalabad, Pakistan.
2. Cody W. Faerber, Lyle G. McNeal, Robert L. Harding, Kevin L. Hill, J. D. Bobb, Scott Horner, Jonathan Merriam, S. Mario Durrant. 2004. Small Ruminant: Production Medicine and Management (Sheep and Goats). Animal Health Publications.
3. Pulina, G. 2004. Dairy Sheep Nutrition. Cabi Publisher, USA.
4. Sinn, Rosalee and P. Rudenberg. 2008. Raising Goats for Milk and Meat. Heifer International, I World Avenue, Little Rock, AR, USA.
5. Linda Coffey and Margo Hale. Small Ruminant Resource Manual. A project of the National Center for Appropriate Technology. 2010. United States Department of Agriculture's Rural Business Cooperative Service.

LM-601 Principles of Meat Production 3(2-2)

Leaning Outcomes:
At the end of the course, students will be able to;

- Manage the Beef Farm cost effectively.
- Apply advanced concept of feeding for getting better growth and good quality meat.
- Diagnose the issues regarding the meat production and safety and to make improvement plan

Theory:
Status of meat production in Pakistan; issues and potential of meat industry in Pakistan, Meat type breeds of farm animals; buffalo and camel as beef animals, Meat production systems; Growth rate and fattening potential of male calves, Management during inclement weather; flock healthy, Breeding and reproduction of meat animals; Feeding management for optimum growth; Grazing systems, Feed additives, hormones, probiotics, vitamins and antibiotics as growth promoters , Factors affecting carcass and meat quality, Slaughtering methods; Post slaughter changes in the carcass, Carcass grades of beef and mutton, Spoilage of meat, meat hygiene, storage and preservation, Establishing commercial beef/mutton farms, marketing of meat animals and meat economics of meat production, record keeping, Modern abattoirs, Data handling and feasibility reports

Practical:
Body conformation of beef/meat animals; judging meat animals; condition scoring of meat

animals; Farm practices (castration, trimming, milk suckling, docking, drenching, dipping and spraying), practical tips for housing and feeding of meat animals; Practical demonstrations on early feeding and weaning, Creep feeding, Vaccination schedule for meat animals; Maintenance of farm records; humane handling and animal welfare, Preparing animals for shows, design of modern slaughter, slaughter house management; Ante-mortem inspection, Carcass evaluation, Carcass grades and cuts, Feasibility reports for beef/mutton production, Visit to abattoir

Books Recommended

1. Ensminger, M.E. 1990. Beef Cattle Science. The Interstate Printers, Daville, Illinois, USA.
2. Holloway, J. W., J. Wu. 2019. Red Meat Science and Production: Volume 1. The Consumer and Extrinsic Meat character. Springer Nature Pte Ltd and Science Press, China
3. Fairlie, S. 2011. A Benign Extravagance. Chelsa Green Publishers, USA.
4. Scollan, N., D. Moran and E.J.Kim.2010. The Environmental Impact of Meat Production Systems. Report to the International Meat Secretariat.
5. Warris, P.D.2010. Meat Science - An Introductory Text .CAB International, UK.
6. Gregory, N.G. and T. Grandin. 2007. Animal Welfare and Meat Production. CAB International, UK.
7. Lawrie, R.A.and D.A. Ledward. 2006. Lawrie's meat science 7th Ed. Woodhead Publishing Limited and CRC Press LLC, USA.

LM-603 Livestock Farm Practices 1(0-2)

Students will be assigned different routine livestock farm activities and they will work on Livestock Farm. The farm practices as castration, hoof trimming, condition scoring feeding lambs/kids, animal milking, dentition, animal's identification, docking, drenching, dipping and spraying; dentition; use of marking harness, housing plans, shearing and handling; grading and sorting wool etc. will be performed.

Minor Courses

Course Code	Course Title	Credit Hours	Semester
PHYS -301	Introductory Animal Physiology	3(2-2)	1
ANAT -304	Introduction to Veterinary Anatomy	3(2-2)	2
MICRO-303	Basic Microbiology	2(1-2)	5
MED-502	Introduction to Veterinary Preventive Medicine	3(2-2)	6
THER-503	Reproductive Management of Farm Animals	3(2-2)	6

PHYS-301 Introductory Animal Physiology 3(2-2)

Leaning Outcomes:

At the end of the course, students will be able to;

- Differentiate between the normal and abnormal physiology of all vital systems,
- Identify the problem with the animals.

Theory

Introduction to Animal physiology: The Mammalian Cell and animal homeostasis. Cardiovascular system: Physiological properties, cellular and chemical constituents of blood, blood coagulation, blood groups and their importance in livestock, The conduction system of the heart; regulation of cardiac output, regulation of the heart and blood vessels. Digestive system: Saliva, simple stomach, cranial fermenters (Rumen biochemistry) / caudal fermenters, and avian. Respiratory system: Mechanism of respiration, types of breathing, air volumes and capacities exchange of gases, control of respiration. Endocrinology of farm animals: Hypothalamic-pituitary-thyroid axis, hypothalamic-pituitary-adrenal axis and hypothalamic-pituitary-gonadal axis. Introduction to renal physiology of farm animals: Anatomy and physiology of nephron, urine formation, glomerular filtration, physiological control and auto-regulation of glomerular filtration rate, tubular reabsorption and processing of glomerular filtrate, mechanism of tubular re-absorption and regulation, regulation of extra-cellular fluid osmolarity, balance of Sodium and Potassium by Kidney. Lactational physiology of farm animals: Functional anatomy of mammary glands, physiology of mammogenesis, lactogenesis and galactopoiesis, milk synthesis and secretion, biological functions of milk, its nutritive value, lactation performance and physiological factors affecting lactation.

Practical

Collection of blood in different species of animals and use of anticoagulants with their mechanism of action. measurement of normal pulse rate, respiration rate, rectal temperature, and blood pressure in animals. Hematological experiments (determination of total white blood cell and red blood cell count (animal source), determination of packed cell volume, hemoglobin concentration, coagulation and bleeding time, erythrocyte sedimentation rate, differential leukocyte count, packed cell volume and determination of blood groups). Saliva analysis, bile analysis, urine analysis and milk analysis. Demonstration of endocrine glands, their location and interaction of anatomical physiology among different endocrine glands.

Books Recommended

1. Cunningham, J.G., & Bradley, G.K. (2019). Textbook of Veterinary Physiology, 6th Edition. Philadelphia: Saunders.
2. William O. Reece, Eric W. Rowe. (2017). Functional Anatomy and Physiology of Domestic Animals, 5th Edition. Wiley Blackwell.
3. Ankers, R.M., & Denbow, D.M. (2013). Anatomy and Physiology of Domestic Animals. UK: Blackwell Publishing.

4. Basudeb Bhattacharyya, (2015). Textbook of Veterinary Physiology, (3rd Edition). Kalyani Publishers.
5. Rahman, Z. U., Aslam B., & Khaliq, T. (2010). Physiology-I. Faisalabad: University of Agriculture, Department of Physiology and Pharmacology.

ANAT-304 Introduction to Veterinary Anatomy 3(2-2)

The course aims to introduce students with basic anatomy of farm animals. Veterinary anatomy is the study of the internal biological structures and systems of animals, including the respiratory, cardiovascular, reproductive and neurological systems. Undergraduate programs in veterinary technology and animal science often include animal anatomy classes. The anatomy of animals has long fascinated people; with mural paintings depicting the superficial anatomy of animals, dating back to the Paleolithic era. Anatomy and physiology are unarguably fundamental aspects of medical education and can be taught in many ways including dissection, 'self-directed learning' and 'problem- based learning. Recent developments in technology have allowed digital anatomical models to be implemented into university curricula, allowing wider access to the study of anatomy for the contemporary student. This course will help the students to identify different anatomical structures of livestock. They will be able to differentiate animal species based on internal structures. Approach of students towards therapeutic treatments for different anomalies will become easy due to proper understanding of anatomical positions of different organs.

Theory

Anatomical terminology, classification and functions of skeleton, Muscular and nervous system; skeletal muscles and their functions; muscle contraction; levers Neurons: receptors; the reflex arc, Digestive system: the mouth, teeth, tongue, salivary glands, pharynx, esophagus, ruminant and non-ruminant, stomach, intestines, pancreas, liver and spleen; the peritoneum, Respiratory system: the nostrils, nasal cavity, pharynx, larynx and trachea; pleura and lungs, Urinary system: the kidneys, ureters, urinary bladder and urethra, Genital system: male genital organs including scrotum, testes, spermatic cord, vesiculae seminalis, prostate, uterus masculinus, bulbourethra glands and the penis, Female genital organs including ovaries, fallopian tubes, uterus, vagina, vulva and mammary glands, Endocrine glands: hypophysis cerebri, epiphysis cerebri, thyroid, parathyroid, adrenal, pancreas, ovaries and testes, Angiology study of heart pericardium and major arteries and veins; superficial lymph glands, Anesthesiology: study of sense organs and the common integuments,

Practical

Identification of various bones, ligaments, tendons and their attachment to the bones, Form, structure and topographical study of various organs located in the thoracic, abdominal and pelvic cavities of different domestic animals,

Book Recommended

1. Ankers R.M., & Denbow, D.M. (2008). Anatomy and Physiology of Domestic Animals. UK: Blackwell Publishing.
2. Frandson, R. D. (1975). Anatomy and Physiology of Farm Animals. Philadelphia, USA: Lea and Febiger.
3. Sisson, A., & Grossman, J. D. (1972). Anatomy of Domestic Animals. Philadelphia, USA: W.B.
4. Molgaard. (1999). Veterinarian Anatomy and Physiology. USA: Delmar Publishers.

MICRO-501 Basic Microbiology 2(1-2)

Leaning Outcomes:
At the end of the course, students will be able to;

- Isolate, cultivate and identify the important pathogenic microbes
- Isolate, cultivate and identify the important beneficial microbes
- Application of microbiology in everyday life and the environment.

Theory

Introduction to Microbiology, Scope, history, terminology, branches and applied areas of Microbiology. Diversity of microbes, Differentiation between Prokaryotes and Eukaryotes. Taxonomy of bacteria: basis of taxonomy, origin and evolution of bacteria, species concept in bacteria. Morphology and detailed anatomy of bacterial cell, Microbial growth and requirements: Physicochemical requirements; pH, temperature, oxidation reduction potential, gaseous and nutritional requirements. Microbial multiplication and growth curves. Immunity, Types of immunity, Principles of immunity. How microorganisms cause disease in humans and animals. Introduction to fungi: Molds and yeasts, Growth requirements and mode of replication of molds and yeasts, Isolation and identification of molds and yeasts, Classification of molds and yeasts, Clinical diagnosis of different fungal diseases, antifungal drugs, Fundamental characteristics of Viruses: Definition and history of virology; general properties of viruses, bacteriophages, Replication of viruses, methods for studying viruses: cell culture, embryonated chicken's egg and animal innoculation A brief introduction to structure and propagation of protozoa and algae. Introduction to Food Microbiology, industrial microbiology and role of beneficial microorganism in everyday life, research and environment.

Practical

Safety in the microbiological laboratory: contamination and decontamination, Principles of Sterilization, Disinfection, Filteration Demonstration of laboratory equipment, their basic functions and handling. Microscopy: An outline of principles and applications of Light, dark field, fluorescent, polarizing, phase contrast and electron microscopy, Preparation of various media to grow microorganisms. Isolation and Identification of microorganisms; Colony morphology, Smear preparation, obtaining pure culture, Simple staining, Gram Staining, Acid Fast Staining, Capsule staining and Negative Staining techniques to identify microorganisms. Biochemical tests and sugar fermentation tests to identify microorganisms. Bacterial cell count. Isolation and Identification of fungi. Methods to Cultivate of Viruses. Cytopathic effects produced by viruses. Virus titration.

Books Recommended

1. Tortora, G.J.,B.R. Funke and C.L. Case, 2018. Microbiology: An Introduction, 11th Edition. Benjamin Cummings Publisher.
2. Quinn, P.J., M.E. Carter, B.K. Markie and G.R. Carter, 2013. Clinical Veterinary, Microbiology. St. Louis, USA. (As practical manual)
3. Collins, C.H., Lyne, B.M., & Grange, J.M. (2000). Microbiological Methods (8th ed.). Oxford
4. .UK.: Butter Worth Heinemann.
5. Jawetz, E., & Levinson, W. (2000). Medical Microbiology and Immunology (5th ed.). London, UK: Prentice Hall.
6. Parker. M.T., & Collin, L.H. (1998). Topley and Wilson's Principles of Bacteriology. Virology & Immunity (9th ed). London, UK: Edward Arnold.
7. Schaeehter, M., Medoff, G., & Schlessinger, D. (1997). Mechanism of Microbial Diseases. Williams and Wilkins, Baltimore.

MED-502 Introduction to Veterinary Preventive Medicine 3(2-2)

Learning Outcomes

After the completion of course students would be able to

- Identify different livestock diseases
- Prevent, control, and eradicate diseases

Theory

Concept of disease and health in animal and human medicine, Importance of animal diseases in national economy, signs of health and disease, Types of animal diseases on the basis of etiology, Stress and immune system, body defense against diseases, Principles of treatment of diseases, prevention, control and eradication of diseases, Etiology, epidemiology, pathogenesis, diagnosis, treatment, prevention, control and eradication (where relevant) of important diseases/disorders of livestock, Macro and micro element deficiencies and imbalances relevant in Pakistan, Disinfection, biosecurity and metaphalyxis, vaccination protocol, Zoonosis, WTO Accord in relation to the animal diseases prevalent in Pakistan, Drug residues, veterinary medicine in relation to human health,

Practical

Behavior of different animal species as it relates to the practice of veterinary medicine, Demonstration of methods of restraining of different animal species, Recording the cardinal parameters of health (Body temperature, pulse and respiration), Demonstration of disease diagnostic methods, Methods of drug administration in animals (oral and parenteral), Demonstration of veterinary first aid procedures,

Books Recommended

1. Ettinger, Stephen J., Edward C. Feldman, and Etienne Cote. 2017. Textbook of Veterinary Internal Medicine-eBook. Elsevier health sciences.
2. Robert F. K. (2001). Viral Diseases of Cattle (2nd ed.). USA: Wiley Publishers, Iowa State University Press.
3. Chakrabarti, A. (2000). A Textbook of Preventive Veterinary Medicine. New Delhi, India: CBS & IBH Publications.
4. Hungerford, T.G. (1991). Hungerford's Diseases of Livestock (9th Ed.). Sydney, Australia: McGraw-Hill Book.

THER-603 Reproductive Management of Farm Animals 3(2-2)

Leaning Outcomes:

At the end of the course, students will be able to;:

- Improve the knowledge about anatomy and physiology of reproductive system of farm animals.
- Explain puberty estrous cycle and related process in animals
- Identify the common reproductive issues in animals at herd level

Theory

Commons terms used in reproduction, Anatomy of male and female reproductive systems of farm animals, Endocrinology of male and female animals, Breeding seasons in farm animals, Puberty, Estrous cycle and related events (oogenesis, folliclogenesis, estrus, ovulation, fertilization, gestation, parturition and puerperium), Estrus detection and breeding management, Clinical and laboratory methods for pregnancy diagnosis, Pre-partum, partum and post-partum reproductive management of farm animals, Dam and neonate care, Spermatogenesis, Semen characteristics and storage techniques in farm animals, Common reproductive disorders in male and female animals and prevention, Computer applications for fertility data recording, Use of advanced reproductive technologies (AI, Synchronization, Embryo transfer, *In vitro* embryo production etc.) in farm animals

Practical

Identification of male and female reproductive system in table and live animals, Breeding soundness examination of male and female animals, Estrus detection methods and breeding techniques in farm animals, Pregnancy diagnosis techniques, Semen collection, evaluation, processing and storage, Bull inventory, Screening of herd for different reproductive diseases of farm animals

Books Recommended

1. Richard, M. H., (2021). Bovine Reproduction. 2nd Edition. Wiley-Blackwell.
2. Senger, P.L., (2013). Pathways to Pregnancy & Parturition. 3rd Edition © Current Conceptions, Inc.
3. Noakes, D.E., T.J. Parkinson and G.C.W. England (2019). Veterinary Reproduction and Obstetrics. 10th Edition. Elsevier Ltd.
4. Hafez .E.S.E., and Hafez, B. (2000). Reproduction in Farm Animals. 7thEdition: Lea and Febiger, Philadelphia, USA.
5. Ball, P.J.H., and Peters, A.R. (2004). Reproduction in Cattle.3rd Edition: Blackwell Publishing, Oxford, UK.

Interdisciplinary Courses

Course Code	Course Title	Credit Hours	Semester
BIOT-303	Introduction to Biotechnology	3(3-0)	3
STAT-408	Biostatistics and Computer Application	3(2-2)	4
FT-503	Meat and Dairy Processing Technology	3(2-2)	5
AGR-508	Forage and Fodder Production	3(2-2)	6
FMPE-402	Precision Livestock Farm Machinery	3(2-2)	7

BIOT-303 Introduction to Biotechnology 3(3-0)

Theory

Biotechnology- definition and history; foundations of biotechnology and interdisciplinary pursuit; branches and/or applications of biotechnology in medicine, agriculture (food, livestock, fisheries, algae, fungi, etc.); protection of biotechnological products; safety in biotechnology; public perception of biotechnology; biotechnology and ethics; biotechnology and the developing world

Recommended Books

Latest editions of the following:

1. Daugherty E. Biotechnology: Science for the New Millennium. Paradigm Publication.
2. Smith JE. Biotechnology. Cambridge University Press.
3. Nicholl TSD. An Introduction to Genetic Engineering. Cambridge University Press, UK.
4. Purohit SS. Biotechnology Fundamentals & Application. Agro Bios, India.
5. Ratlegde C and Kristiansen B. Basic Biotechnology. Cambridge University Press, UK.
6. Thomas JA and Fuchs RL. Biotechnology and Safety Assessment. Academic Press, UK.

STAT-408 Biostatistics and Computer Application 3(2-2)

Learning outcomes

After studying this course the students would be able to

- Identify completely randomized designs, factorial designs, and complete block designs
- Perform correct analysis of experimental data using SAS.
- Data analysis and interpretation.

Theory

Introduction and scope of biostatistics. Types of data, Scales of measurements, Frequency distribution for discrete and continuous data. Visual representation of data, stem and leaf display, box-whisker plots, Measures of location and dispersion. kurtosis and skewness. Rates and ratios. Sampling distribution of mean and difference between means and its properties. Testing of hypothesis for mean, proportion, difference between means and difference between proportions.one way and two way ANOVA. Test of independence. Regression and correlation.

Practical

Introduction to computers and operating systems, laboratory and field experiments, statistical concepts and methods widely used in biomedical research. Installation+ use of MINITAB. Data Entry and import data from Excel, Manipulation of data and transformation. Data analysis and interpretation of computer output regarding the methods learned in Theory.

Books Recommended

1. Daniel, W. W., and C. L. Cross. 2018. Biostatistics: a foundation for analysis in the health sciences. Wiley.
2. Kaps, M., and W. R. Lamberson. 2017. Biostatistics for animal science. Cabi.
3. Motulsky, H. 2016. Essential biostatistics: a nonmathematical approach. Oxford

University Press.
4. Zar, J. 2005. Biostatistical Analysis. 8th Ed. Johsn Wiley and Sons, New York, USA.
5. Zhou, X.H., N.A. Obuchowski, and D.K. McClish. 2002 Statistical Methods in Diagnostic Medicine. John Wiley and Sons, New York, USA.

FT-403 Meat and Dairy Processing Technology 3(2-2)

Course learning outcome:

At the end of course the students should be able to;

- Determine the chemical and physical composition of meat
- Know about the meat value addition
- Know the effect of structure variability of milk and milk product on steps process and final dairy product
- Understanding and resolve manufacture problems of dairy & meat product
- Acquaint with techniques and technologies of testing and processing of milk into various product

Theory

Introduction of meat science, muscle structure and composition, conversion of muscle to meat rigor mortis, carcass classification boning and cutting, meat preservation, meat product and their processing, cooking methods, meat deterioration, General aspects of milk processing; Milk for liquid consumption, Factors affecting milk production and composition, biotechnology and enhanced milk production, Milk proteins and Enzymes, Milk chemistry, Milk microbiology, Milk deterioration, hygienic milk production, collection and transportation, processing and marketing of milk, cooling, homogenization and standardization, manufacturing of dairy products (yoghurt, butter, ghee, whey, cheese, etc.), Condensed and dried milks; Principles of cheese making; Fermented milk, Economics of milk and meat processing and value addition; planning, layout and management of dairy and meat plant products

Practical

Meat sampling; meat chemical analysis; moisture determination of meat, fat and ash determination, protein determination, meat test palatability; Meat preservation; meat preservation by salt, meat preservation by smoking, various meat products processing, Milk collection, cooling, standardization, homogenization, pasteurization and UHT practices, Sampling of milk, various physical and chemical milk test and tests for milk adulteration standardization of milk fat and problems ,Neutralization of cream, Microbiological examination of milk (raw and pasteurized milk),Cheese making, Yoghurt making, Making flavored milk, Cream making, economics of milk and meat production and processing, visit to dairy and meat processing plants.

Recommended Books:

1. Walstra, P., 2015. Dairy Technology; Principles of Milk Properties and Processes. Marcel Dekker Inc, New York, USA.
2. Alaa El-Din A. Bekhit. 2017. Advances in Meat Processing Technology. CRC Press.
3. Bath, D.L, F.N. Dickenson and H.A. Tucker, 2021. Dairy Cattle; Principles, Practices, Problems, Profits. Lea & fabiger, Philadelphia, U.S.A.
4. Davis, J.G., 1994. Milk testing. Agro-Botanical. Publications, India.
5. Larson, B.L., 1985. Lactation. The lowa State University Press. Lowa.
6. Schmidt, G.H., L.D. Van Vlk and M.F. Hutjens, 1988. Principles of Dairy Science. 2nd Ed. Prentice Hall Inc. Englewood cliffs, New Jersey, U.S.A.

AGR-508 Forage and Fodder Production 3(2-2)

Outcomes

After studying this course, it is expected that students will be able to

- Guide the farming / livestock rearing community to produce and preserve sufficient fodder for their livestock.

- Use different cereals/legumes mixtures for balanced nutrition.
- Make fodder calendar round the year for given animal heads.
- Introduce the fodder crops in different cropping systems to overcome the weeds and improve the economic return of the farming community.

Theory:
Importance of forages and fodders, Terminology and taxonomy of forage and fodder crops,Forage production in Pakistan-current status and future scenario, Critical period of fodder scarcity, Factors influencing productivity and quality, Factors affecting chemical composition and nutritive value of forages, Toxicity due to chemicals and poisonous plants, Establishment of grasses and legumes in range lands, Agro-techniques for production of legume/nonlegumes forages and fodders for sustainable forage production, Rangeland status, increasing productivity of pastures and range lands, Seed production of forages, nutrient management in fodders/forages, Forage quality-its status and improvement, Fodder/forage production constraints and remedies, Fodder preservation (hay and silage), Fodder research studies in Pakistan. Forage based cropping systems, Forage entrepreneurship.

Practical:
Identification of forage/fodder crops and poisonous plants, Estimation of sprout density and carrying capacity, Preparation of fodder calendar, Determination of forage quality parameters, Measurement of cover frequency, Preparation of silage and hay.`

Books recommended:

1. Hedayetullah, M., & Zaman, P. (2019). Fodder crops of the world, Vol-1, Major fodder crops. Florida, USA: Apple Academic Press.
2. Advan, R.L. (2018). New perspective in forage crops. Brazil: Intech open.
3. Ashraf, M. 2012. Crop Production for Agricultural Improvement.Springer, Cop Dordrecht.
4. Khalil, I.A. and A. Jan. 2006. Cropping Technology. National Book Foundation, Islamabad.
5. Reddy, D.V. 2006. Fodder Production and Grassland Management for Veterinarians. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
6. Singh, S.S. 2004. Crop Management. Kalyani Publishers, New Delhi.
7. Balasubramaniyan, P.O., &Polanippan, S. P. (2001). Principles and practices of Agronomy. India: Agrobios.

FMPE-601 Precision Livestock Farm Machinery 3(2-2)

Theory
Introduction to precision livestock farming, aspects of mechanization for livestock husbandry including systems at automation level; Operating principles of machines and plants; with reference to sowing, harvesting, storages for forage, livestock feed, performances evaluation and limitations of use; safety point of machinery use. Technological tools and sensors in precision agriculture and their application in livestock farming including soil, seed, water and grass yield management, automatic monitoring of individual animals, animal growth, milk production, and the detection of diseases as well as to monitor animal behavior and their physical environment.

Practical:
Practical shall be conducted related to the contents of course. Visit to local smart farms, automated sheds and related technologies setups

Recommended Books:

1. Adams, B.T. Farm Machinery Automation for Tillage, Planting Cultivation, and Harvesting. In Handbook of Farm, Dairy and Food Machinery Engineering, 3rd ed.; Kutz, M., Ed.; Academic Press: Cambridge, MA, USA, 2019; Volume 5, pp. 115–131. ISBN 9780128148037.
2. Chen G, editor. Advances in agricultural machinery and technologies. CRC Press; 2018.Berckmans D. Advances in precision livestock farming. Burleigh Dodds Science Publishing Limited, 24-May-2022
3. Halachmi I, editor. Precision livestock farming applications: making sense of sensors to support farm management. Wageningen Academic Publishers; 2015 Jun 5.

GENERAL COURSES

The courses content of all general courses given below except BCH-310, would be taught as per the course offering department approved courses in the University as recommended by HEC in undergraduate degree program policy, 2023.

ENG-301	Functional English	3(3-0)
SSH-301	Civics and Community Engagement	2(2-0)
ECON-301	Introduction to Economics	2(2-0)
SOC-301	Introduction to Sociology	2(2-0)
SOS-301	Moral Foundation of Education	2(2-0)
ANTH-301	Introduction to Anthropology	2(2-0)
SSH-302	Ideology and Constituition of Pakistan	2(2-0)
SOS-302	Seerat Studies	2(2-0)
ENG-302	Expository Writing	3(3-0)
CSC-100	Applications of Information & Communication Technologies	3(2-2)
ENG-401	Cross Cultural Communications and Translation of Skills	3(3-0)
QR-401	Quantitative Reasoning-I	3(3-0)
QR-402	Quantitative Reasoning-II	3(3-0)
IS-302/ET-302	Islamic Studies/Ethics (for Non-Muslims)	2(2-0)
SSH-304	Entrepreneurship	2(2-0)

BCH-310 Introduction to Biochemistry 3(2-2)

Theory

Introduction: Scope of Biochemistry, cell, biomolecules and water. Carbohydrates: sources, importance, classification, chemical reactions: monosaccharides, disaccharides, trisaccharides and polysaccharides. Metabolism and intermediary metabolism of carbohydrates. Glycolysis, pentose- phosphate pathway and citric acid cycle. Proteins: sources, amino acids, and classification. Peptide and proteins: classification, structure, and function. Enzymes and coenzymes. Metabolism of proteins and amino acids. Lipids: sources, classification, and energy values. Complex and derived lipids. Fatty acid classification, sources and chemical reaction related to fat/lipid metabolism. Nucleic acids: definition, nitrogeneous bases, purine and pyrimidine, nucleoside and nucleotides DNA and RNAs. Replication, transcription and translation. Vitamins and hormones: Classification and importance.

Practical

Preparation of laboratory solutions and pH determination. Estimation of sugars from different biological samples, differentiation of sugars like, monosaccharide and disaccharides, reducing and nonreducing sugars. Extraction and detection of proteins. Fat extraction from plant material by using soxhlet methods. Determination of moisture in plant samples Determination of vitamin C or ascorbic acid from citrus fruit. Determination of nucleic acids.

Books Recommended

1. David L. Nelson & Michael M. Cox. 2017. Lehninger Principles of Biochemistry. Publisher: W. H. Freeman; 7th edition
2. Zubay, G. L. Parson, W. W. and Vance, D. E. 2016. Principles of Biochemistry. 6th Ed. Wm.C. Brown Publ. England.
3. Voet, D. and Voet, J. 2016. Biochemistry. 5th Ed. John Wiley and Sons, Inc., N.Y.
4. Stryer, L. 2015. Biochemistry, 8th Ed. W.H. Freeman and Co., N.Y.
5. Lodish, Harvey; Berk, Arnold; Zipursky, S. Lawrence; Matsudaira, Paul; Baltimore, David; Darnell, James E 2012. Molecular Cell Biology. 7th ed. New York: W. H. Freeman & Co.
6. Boyer, R. 2011. Biochemistry Laboratory: Modern Theory and Techniques 2nd Edition. Pearson.

AS-399 Capstone Project 3(0-6)

Learning outcomes:
After studying this course, the students would be able to:

- Design a project in different areas of livestock production
- Execute project activities independently
- Write a report on project findings

Practical

A capstone project allows students to bring together the concepts, principles and methods that they have learned in their course of study and to apply their knowledge and acquired competencies to address the real-world problems. The capstone project (preferably undertaken after the fourth semester) shall be allotted to a student by a supervisor. The supervisor shall be allotted as per policy devised by the respective faculty/ institute. The students will be assigned a topic/problem for conducting a project. The evaluation will be done on the basis of project report, open house presentation and viva voce, conducted by the committee constituted by the the respective faculty/institute offering the degree program/or as per policy devised by the University for this purpose.

AS-299 Internship 3(0-6)

The internship/externship of six to eight weeks (preferably undertaken during the 8th semeste) shall be mandatory for the award of degree. The Evaluation of the internship shall be carried out as per the policy laid down by the university or by the faculty/institute offering the degree program. The internship marks will be counted towards final grading.