145  Horse Behavior and Welfare
   Spring. 1(0-2) R: Open to students in the
   Institute of Agricultural Technology. SA: ANS
   063a
   Principles of horse behavior. Training philosophy.
   Horse welfare issues.

146  Fundamentals of Horse Training
   Spring. 3(0-6) R: Open to students in the
   Institute of Agricultural Technology. SA: ANS
   063a
   Training and preparing an untrained horse for show-
   ing. Sale preparation.

147  Horse Management Placement Seminar
   Spring. 1(1-0) R: Open to students in the In-
   stitute of Agricultural Technology. SA: ANS
   064
   Securing a placement training experience. Writing a
   resume.

148  Methods of Instructing Safe
     Horsemanship
     Spring. 2(2-0) R: Open to students in the In-
     stitute of Agricultural Technology. SA: ANS
     041
     Lesson planning and communication skills for riding
     instructors. Safety and legal issues. Riding instructor
     certification. Organizations.

149  Horse Management Clerkship
     Spring. 2(0-4) R: Open to students in the In-
     stitute of Agricultural Technology. SA: ANS
     025
     Management of a working horse farm. Feeding, repro-
     duction, genetics, selection, facilities maintain-
     ance, and daily management skills.

150  Introductory Judging of Livestock or
     Carcasses
     Fall. 3(1-4) P: ANS 232 RB: ANS 132 and
     ANS 205 and ANS 232 R: Open to students in the In-
     stitute of Agricultural Technology. SA: ANS
     069
     Evaluation of functional conformation of beef cattle,
     sheep and swine and their carcasses. Production records
     and soundness of breeding animals. Quality grading, yield
     grading and pricing of market animals and carcasses.

151  Animal and Product Evaluation
     Fall. 3(1-4)
     Evaluation of breeding stock, market animals and
     carcasses. Production records and soundness of
     breeding animals. Quality grading, yield grading and
     pricing of market animals and carcasses.

151  Animal Products
     Fall. 4(3-3) R: Not open to freshmen.
     Edible animal products. Processing, preservation,
     storage and distribution of dairy, meat, and egg
     products.

200E  Introductory Animal Welfare Assessment
     Fall. 1(0-2) A student may earn a maximum
     of 8 credits in all or any enrollments in 200A,
     200C, 200D, 200E, 300A, 300B, 300C,
     300D, or 300E. RB: (ANS 305 or ZOL 313)
     and ANS 110 R: Not open to freshmen.
     Physiological and behavioral indicators of animal
     welfare. Quantitative measures and ethical issues.
     Written and oral assessments of animal welfare.

203  Principles of Livestock Feeding
     Spring. 2(2-0) RB: ANS 110 or ANS 222 or
     ANS 232 or ANS 242 or ANS 272 R: Open
     to students in the Institute of Agricultural
     Technology. SA: ANS 059
     Feed nutrients, digestion and metabolism. Classifi-
     cation of feeds. Nutrition requirements for dairy and
     beef cattle, sheep, swine and horses.

205  Reproduction in Livestock
     Spring. 2(2-0) RB: ANS 110 or ANS 222 or
     ANS 232 or ANS 242 or ANS 272 R: Open
     to students in the Institute of Agricultural
     Technology. SA: ANS 069
     Reproductive anatomy and physiology of livestock.
     Fertility and infertility. Reproductive health. Goals
     and management for reproduction.

210  Animal Products
     Fall. 4(3-3) R: Not open to freshmen.
     Edible animal products. Processing, preservation,
     storage and distribution of dairy, meat, and egg
     products.

211  Animal and Product Evaluation
     Fall. 3(1-4)
     Evaluation of breeding stock, market animals and
     carcasses. Production records and soundness of
     breeding animals. Quality grading, yield grading and
     pricing of market animals and carcasses.

212  Merchandising Purebred Livestock
     Spring of odd years. 2(1-2) RB: ANS 110
     Purebred livestock industry. Private treaty and auc-
     tion sales. Advertising, animal selection and budget-
     ing of purebred livestock sales.

215  Growth, Health and Lactation in Dairy
     Cattle
     Fall. 2(2-0) RB: ANS 205 and ANS 232 R: Open
     to students in the Institute of Agricultural
     Technology.
     Mammary anatomy and growth. Immunization and
     biosecury. Lactation and mastitis. Transition into
     lactation.

222  Introductory Beef Cattle Management
     Spring. 3(2-2) RB: ANS 110 Not open to
     students with credit in ANS 422.
     Management practices and systems for beef herds.
     Feed requirements, reproduction, breeding, perfor-
     mance testing, housing, and diseases. Costs and
     returns.

225  Horse Behavior and Welfare
     Summer. 2(2-0) RB: ANS 242
     Natural behavior, senses, training psychology, and
     common behavioral problems of horses. Equine
     welfare issues.

230  Dairy Herd Management
     Fall. 3(2-2) P: ANS 232 RB: ANS 132 and
     ANS 205 and ANS 215 R: Open to students
     in the Institute of Agricultural Technology.
     SA: ANS 032
     Analysis of dairy farm management. Investigation
     and problem solving. Collecting data and formulat-
     ing conclusions and recommendations. Oral pres-
     entation.
### Animal Science—ANS

#### 232 Introductory Dairy Cattle Management
Fall: 3(2-2) Not open to students with credit in ANS 432.
Principles and techniques of dairy herd management including calf and heifer care plus lactating and dry cow management.

#### 233 Dairy Feed Management
Fall: 3(2-2) RB: ANS 203 R: Open to students in the Institute of Agricultural Technology. SA: ANS 051

#### 235 Dairy Herd Reproduction
Fall: 2(2-0) P: ANS 205 RB: ANS 232 or concurrently R: Open to students in the Institute of Agricultural Technology.
Application of reproductive principles to dairy production.

#### 238 Dairy Health Management
Spring: 3(2-2) P: ANS 232 or concurrently R: Open to students in the Institute of Agricultural Technology.
Detection of dairy cattle disease. Infections and metabolic problems.

#### 240 Horse Farm Management
Fall: 3(2-2) RB: ANS 203 and ANS 205 and ANS 242 and ABM 130 R: Open to students in the Horse Management major. SA: ANS 066
Integration of principles and skills into a farm management system. Managerial qualities, goal setting, facilities management. Health programs.

#### 242 Introductory Horse Management
Fall: 3(2-2) Not open to students with credit in ANS 442.
Principles of horse management. Reproduction, nutrition, herd health, genetics, economics, marketing. Field Trips required.

#### 243 Horse Nutrition and Feeding
Fall: 2(2-0) P: ANS 203 R: Open to students in the Institute of Agricultural Technology. SA: ANS 078
Nutrient requirements of the horse, selection and evaluation of feedstuffs, balancing diets by hand and by computer, pasture management.

#### 245 Horse Exercise Physiology
Fall: 2(2-0) RB: ANS 242 R: Open to students in the Institute of Agricultural Technology. SA: ANS 068
Horse body systems, physiology of exercise and conditioning programs. Goals of various conditioning programs. Common ailments of sport horses.

#### 252 Introduction to Management of Avian Species
Fall of odd years. 3(2-2)
Management of commercial poultry flocks and avian species. Feed requirements, reproduction, breeding, housing and disease.

#### 261 Principles of Animal Environments
Spring: 2(1-2) Interdepartmental with Agricultural Engineering, Administered by Agricultural Engineering. SA: AE 061, ATM 261

#### 262 Introductory Sheep Management
Spring: 3(2-2) R: Open only to sophomores or juniors or seniors.
Principles of sheep management: genetics, reproduction, nutrition, marketing, and economics. Field Trips required.

#### 272 Introductory Swine Management
Fall: 3(2-2) Not open to students with credit in ANS 472.
Swine production principles, practices, technologies, and systems. Field Trips required.

#### 280 Introduction to International Animal Agriculture
Spring: 3(3-0) RB: ANS 110

#### 282 Companion Animal Biology and Management
Spring: 3(3-0)
Principles of companion animal management. Breeds, reproduction, feeding, housing, health, and diseases.

#### 290 Independent Study in Agricultural Technology
Fall, Spring, Summer. 1 to 3 credits. A student may earn a maximum of 8 credits in all enrollments of ANS 290.
Field Trips required.

#### 300A Advanced Livestock Judging
Fall of even years. 2 credits. A student may earn a maximum of 8 credits from ANS 200A, ANS 200B, ANS 200C, ANS 200D, ANS 300A, ANS 300B, ANS 300C and ANS 300D. RB: ANS 200A R: Not open to freshmen.
Evaluation of conformation and performance records of beef cattle, swine and sheep. Represent MSU in intercollegiate competition.

#### 300C Advanced Dairy Cattle Judging
Fall. 2 credits. A student may earn a maximum of 8 credits from ANS 200A, ANS 200B, ANS 200C, ANS 200D, ANS 300A, ANS 300B, ANS 300C and ANS 300D. RB: ANS 200C R: Not open to freshmen.
Evaluation of conformation and performance records of beef cattle. Represent MSU in intercollegiate competition.

#### 300D Advanced Horse Judging
Fall. 2 credits. A student may earn a maximum of 8 credits from ANS 200A, ANS 200B, ANS 200C, ANS 200D, ANS 300A, ANS 300B, ANS 300C and ANS 300D. RB: ANS 200D R: Not open to freshmen.
Evaluation of functional characteristics of horses. Represent MSU in intercollegiate competition.

#### 300E Animal Welfare Judging
Fall. 1(0-2) A student may earn a maximum of 8 credits in any or all enrollments of ANS 200A, 200C, 200D, 200E, 300A, 300B, 300C, 300D, or 300E. P: ANS 200E RB: ANS 110 and (ANS 305 or ZOL 313) R: Not open to freshmen.
Enhanced understanding of the physiological and behavioral indicators of animal welfare. Ethical values in the assessment of welfare status. Intercollegiate competition. Field trip required.

#### 301 Professional Development in Animal Science II
Fall. 2(1-2) P: (ANS 101 and ANS 110) and completion of Tier I writing requirement R: Open to juniors or seniors in the Department of Animal Science.

#### 305 Applied Animal Behavior
Spring. 3(2-2) P: BS 111
Techniques for assessing health and welfare of domestic animals based on their behavior.

#### 309 Health and Hygiene of Livestock
Fall: 3(3-0) P: ANS 110
Normal and abnormal physical parameters. Common diseases. Role of housing, husbandry, sanitation, and animal treatment in health.

#### 313 Principles of Animal Feeding and Nutrition
Fall: 4(3-2) P: (BS 111) and completion of Tier I writing requirement and ((CEM 143 or concurrently) or (CEM 251 or concurrently)) Principles and practices of nutrition for cattle, horses, poultry, sheep and swine. Metabolism of protein, minerals, and vitamins. Diet formulation. Performance prediction. Nutritional maladies.

#### 314 Genetic Improvement of Domestic Animals
Fall: 4(3-2) P: (BS 111) and completion of Tier I writing requirement) and (MTH 103 or concurrently) or (MTH 116 or concurrently) or (MTH 124 or concurrently) or (MTH 117 or concurrently)
Molecular, Mendelian, population, and quantitative genetics of domestic animals.

#### 315 Anatomy and Physiology of Farm Animals
Spring: 4(3-2) P: (BS 111) and completion of Tier I writing requirement.

#### 390 Animal Science Practicum
Fall, Spring, Summer. 20-6 A student may earn a maximum of 4 credits in all enrollments for this course. P: ANS 110 and (ANS 222 or ANS 232 or ANS 242 or ANS 252 or ANS 262 or ANS 272) RB: Institutional Animal Care and Use Training. Personal health insurance. R: Approval of department.
Farm animal production and management. Animal care. Farm management decisions.

#### 401 Ethical Issues in Animal Agriculture
Spring: 1(0-2) RB: ANS 313 or ANS 314 or ANS 315 R: Open to juniors or seniors.
Ethical issues related to local, national, and international animal agriculture.

#### 404 Advanced Animal Genetics
Spring of odd years. 2(1-2) P: (ANS 314 or concurrently) or ZOL 341
Application of molecular genetics and genome technologies to animal breeding. Genome maps for agricultural, aquacultural, and companion animal species. Incorporation of genotype data into selection programs.
493 Professional Internship in Animal Science
Fall, Spring, Summer. 3 credits. A student may earn a maximum of 6 credits in all enrollments for this course. A student may earn a maximum of 6 credits in all enrollments for any or all of these courses: ABM 493, AEE 493, ANR 493, ANS 493, CMP 493, CSS 493, CEP 493, FIM 493, FSC 493, FWR 493, HRT 493, PKG 493, PLP 493, PRR 493, and ESA 493. R: Open to juniors or seniors in the Animal Science major. Approval of department; application required. Supervised professional experience in the animal industry.

499 Senior Thesis in Animal Science
Fall, Spring, Summer. 3 to 9 credits. A student may earn a maximum of 9 credits in all enrollments for this course. RB: ANS 313 and ANS 314 and ANS 315 R: Open only to seniors. Approval of department; application required. Maximum of 10 credits may be earned in ANS 499 and ANS 490. Individual studies in an area of choice with both oral and written final communications. Topic to be determined by student and guidance committee.

511 Animal Science for Veterinarians
Fall. 2(2-0) R: Open only to graduate-professional students in the College of Veterinary Medicine. Husbandry of domestic, laboratory, and zoo animals. Management systems in animal agriculture. Production and management goals.

513 Animal Nutrition for Veterinarians
Spring. 2(2-0) R: Open only to graduate-professional students in the College of Veterinary Medicine. Nutrition for domestic animals and wildlife. Comparative nutrient digestion and metabolism. Nutritive requirements for maintenance, growth, reproduction, lactation, and work.

805 Animal Welfare Assessment
Fall, Spring. 3(3-0) Interdepartmental with Zoology. Administered by Animal Science. RB: (ANS 305 or ZOL 313) or background in animal science or zoology including exposure to topics such as animal behavior, physiology, management, and husbandry Multidisciplinary online computer-based instruction in animal welfare and related issues including physiology, behavior, human-animal interactions, suffering and pain, ethics, health, assessment and standards, and economics.

810 Gastrointestinal Microbiology of Domestic Animals
Fall. 3(3-0) Microbial ecology of gastrointestinal tract. Microbial role in nutrition, health, and productivity. Environmental applications. Livestock species emphasized.

814 Advanced Statistics for Biologists

816 Integrative Toxicology: Mechanisms, Pathology and Regulation
Fall of odd years. 3(3-0) Interdepartmental with Biochemistry and Molecular Biology and Pathobiology and Diagnostic Investigation and Pharmacology and Toxicology. Administered by Pharmacology and Toxicology. P: PHM 819 Biochemical, molecular, and physiological mechanisms of intoxication. Functional and pathological responses of major organ systems to chemical insult. Mechanisms of mutagenesis, carcinogenesis, and reproductive toxicity. Concepts in risk and safety assessment.

824 Methods of Quantitative and Molecular Genetics for Livestock
Spring of odd years. 3(2-2) RB: ANS 404 Quantitative and molecular methods for animal geneticists. Identification and evaluation of molecular markers, genome maps, linkage and segregation analyses, optimal mating designs, and marker-quantitative trait loci associations in livestock species.

825 Animal Biotechnology
Spring of even years. 3(3-0) R: Approval of department; application required. Basic concepts in animal biotechnology. Application of molecular biology to animal studies. Current topics in animal biotechnology and use of animals in pharmaceutical development.

827 Integrated Risk Assessment of Environmental Hazards
Spring of odd years. 3(3-0) Interdepartmental with Environmental Engineering. Administered by Animal Science. R: Open only to graduate students in the College of Agriculture and Natural Resources or College of Engineering or College of Human Medicine or College of Natural Science or College of Osteopathic Medicine or College of Veterinary Medicine. Alternative approaches to assessing environmental and health risk. Analyzing, interpreting, and using scientific data from ecology, agriculture, environmental chemodynamics, biology, geological sciences, and toxicology in the risk assessment process.

842 Population Genetics, Genealogy and Genomics
Fall. 3(3-0) Interdepartmental with Crop and Soil Sciences and Forestry and Fisheries and Wildlife and Genetics and Horticulture. Administered by Forestry. R: Pre-calculus, basic genetics. Population genetic processes underlying patterns of molecular genetic variation. Genealogical approaches to the study of genomic diversity, phylogenetic reconstruction, and molecular ecology.

870 Techniques of Analyzing Unbalanced Research Data
Spring. 4(4-0) Interdepartmental with Crop and Soil Sciences and Forestry and Fisheries and Wildlife and Horticulture. Administered by Animal Science. RB: STT 464 R: Open only to graduate students in the College of Agriculture and Natural Resources. SA: ANS 943 Linear model techniques to analyze biological research data characterized by missing and unequal number of observations in classes. Simultaneous consideration of multiple factors. Prediction of breeding values and estimation of population parameters from variance and covariance components.

890 Advanced Independent Study
Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 8 credits in all enrollments for this course. R: Approval of department; application required. Investigation of topics of special interest.

892 Food Science and Animal Science Seminar
Fall. Spring. 1(1-0) A student may earn a maximum of 4 credits in all enrollments for this course. Interdepartmental with Food Science. Administered by Food Science. R: Open to graduate students in the Department of Animal Science or in the Department of Food Science and Human Nutrition. Critical review of literature. Organization and communication of scientific data in food science and animal science.

898 Master's Research
Fall, Spring, Summer. 1 to 6 credits. A student may earn a maximum of 10 credits in all enrollments for this course. R: Open only to master's students in the Department of Animal Science. Approval of department; application required. Scholarly project for non-thesis (Plan B) master's degree.

899 Master's Thesis Research
Fall, Spring, Summer. 1 to 6 credits. A student may earn a maximum of 99 credits in all enrollments for this course. R: Open only to master's students in the Department of Animal Science. Approval of department. Master's thesis research.

901 Selected Topics in Animal Breeding and Genetics
Fall, Spring, Summer. 1 to 2 credits. A student may earn a maximum of 6 credits in all enrollments for this course. Selected topics of current interest and importance in animal breeding and genetics.

935 Nutrition: Lipid and Carbohydrate Metabolism
Fall of even years. 3(3-0) Interdepartmental with Human Nutrition and Foods. Administered by Human Nutrition and Foods. Regulatory aspects of lipid and carbohydrate metabolism as influenced by nutritional status.

936 Protein Nutrition and Metabolism

937 Mineral and Vitamin Nutrition and Metabolism
Spring of even years. 3(3-0) Interdepartmental with Human Nutrition and Foods. Administered by Animal Science. Forms and locations of mineral elements in the body, metabolic functions, deficiencies, and toxicities, interrelationships and quantitative requirements. Significant vitamins and mineral interrelations to bone metabolism, antioxidant health and erythropoiesis.
999 Doctoral Dissertation Research
Fall, Spring, Summer. 1 to 24 credits. A
student may earn a maximum of 99 credits
in all enrollments for this course. R: Open
only to doctoral students in the Department
of Animal Science. Approval of department.
Doctoral dissertation research.