

- 480 Special Problems in Anatomy**
Fall, Spring, Summer. 1 to 5 credits. A student may earn a maximum of 15 credits in all enrollments for this course. R: Approval of department. SA: ANT 480

Topics from an anatomical field such as gross anatomy, histology, tissue culture, cytology, neurology, or embryology.

- 485 Directed Study in Human Prosection**
Fall, Spring, Summer. 2 to 4 credits. A student may earn a maximum of 15 credits in all enrollments for this course. P:M: (ANTR 350 or ZOL 328 or KIN 217) R: Open only to juniors or seniors.

Prosection of selected regions and isolated structures of preserved human cadavers.

- 534 Cell Biology and Physiology I**
Fall. 3 credits. Interdepartmental with Physiology; Biochemistry and Molecular Biology. Administered by Department of Physiology. R: Open only to graduate-professional students in the College of Human Medicine or College of Osteopathic Medicine.

Modern concepts of cell biology as a basis for understanding the physiology of human tissues and organ systems in health and disease.

- 535 Cell Biology and Physiology II**
Spring. 4 credits. Interdepartmental with Physiology; Biochemistry and Molecular Biology. Administered by Department of Physiology. R: Open only to graduate-professional students in the College of Human Medicine or the College of Osteopathic Medicine.

Modern concepts of cell biology as a basis for understanding the physiology of human tissues and organ systems in health and disease. Continuation of PSL 534.

- 551 Medical Gross Anatomy**
Fall. 6(4-6) R: Open only to graduate-professional students in the College of Human Medicine or College of Osteopathic Medicine or approval of department. SA: ANT 551

Human regional gross anatomy with clinical correlations using prosections, cross-sections, medical imaging, multimedia and hypermedia.

- 552 Medical Neuroscience**
Spring. 4(3-2) Interdepartmental with Neurology and Ophthalmology; Physiology; Radiology. Administered by Department of Neurology and Ophthalmology. R: Graduate-professional students in colleges of Human Medicine and Osteopathic Medicine. SA: ANT 552

Correlation of normal structure and function of the human nervous system with clinical testing, classical lesions, and common diseases.

- 562 Medical Histology**
Spring. 3(2-2) R: Graduate-professional students in colleges of Human Medicine and Osteopathic Medicine. SA: ANT 562

Histology of the human body.

- 585 Directed Study in Human Prosection**
Fall, Spring, Summer. 1 to 5 credits. A student may earn a maximum of 15 credits in all enrollments for this course. P:M: (ANTR 551) R: Open only to graduate-professional students in the College of Human Medicine or College of Osteopathic Medicine and approval of department.

Prosection of selected regions and isolated structures of preserved human cadavers. Oral presentation.

VETERINARY ANATOMY ANTV

College of Veterinary Medicine

- 515 Comparative Veterinary Gross Anatomy**
Fall. 6(2-10) R: Open only to graduate-professional students in the College of Veterinary Medicine. SA: ANT 515

Canine anatomy. Comparisons with ruminant, porcine, and equine anatomy.

- 516 Veterinary Histology and Cell Biology**
Fall. 4(3-2) R: Open only to graduate-professional students in the College of Veterinary Medicine. SA: ANT 516

Principles of developmental, cellular, and molecular biology as related to veterinary medicine.

- 517 Veterinary Neuroanatomy**
Spring. 1(1-0) R: Completion of Semester 1 of the graduate-professional program in the College of Veterinary Medicine. SA: ANT 517

Introduction to the anatomy of the nervous system using the canine species as a model.

- 610 Veterinary Gross Anatomy Dissection**
Spring. 1 to 3 credits. A student may earn a maximum of 6 credits in all enrollments for this course. P:NM: (ANTV 515) R: Open only to graduate-professional students in College of Veterinary Medicine. SA: ANT 610

Dissection and prosection of selected regions of domestic animals.

- 611 Research Problems in Veterinary Anatomy**
Fall, Spring, Summer. 1 to 3 credits. A student may earn a maximum of 6 credits in all enrollments for this course. R: Open only to graduate-professional students in the College of Veterinary Medicine. Approval of department. SA: ANT 611

Veterinary gross anatomy, cell biology, histology, or neurobiology.

ANIMAL SCIENCE ANS

Department of Animal Science College of Agriculture and Natural Resources

- 110 Introductory Animal Agriculture**
Fall, Spring. 4(3-2) SA: ANS 112

History of animal agriculture and its relationship to human needs, production systems, marketing, and environmental considerations. Current goals of and limitations affecting U.S. farm animal production.

- 200A Introductory Judging of Livestock or Carcasses**
Spring. 1 to 2 credits. A student may earn a maximum of 3 credits in all enrollments for this course. P:NM: (ANS 211) R: 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.

Evaluation of functional conformation of beef cattle, sheep and swine and their carcasses. Preparation for intercollegiate competition. Field trips required.

- 200C Introductory Judging of Dairy Cattle**
Spring. 1 to 2 credits. A student may earn a maximum of 3 credits in all enrollments for this course. R: A student may earn a maximum of 8 credits from the following courses: ANS 200A, ANS 200B, ANS 200C, ANS 200D, ANS 300A, ANS 300B, ANS 300C and ANS 300D. SA: ANS 200B

Evaluation of functional conformation of dairy cattle. Preparation for intercollegiate competition. Field trips required.

- 200D Introductory Judging of Horses**
Spring. 1 to 2 credits. A student may earn a maximum of 3 credits in all enrollments for this course. R: 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. SA: ANS 200B

Evaluation of functional conformation and performance of horses. Preparation for intercollegiate competition. Field trips required.

- 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 auction sales. Advertising, animal selection and budgeting of purebred livestock sales. Field trips required.

- 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, performance testing, housing, and diseases. Costs and returns. Field trips required.

- 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.

- 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.

Animal Science—ANS

- 252 Introduction to Management of Avian Species**
Fall of odd years. 3(2-2)
Management of commercial poultry flocks and aviaries. Feed requirements, reproduction, breeding, housing and disease.
- 261 Principles of Animal Environments**
Spring. 2(1-2) Interdepartmental with Agricultural Technology and Systems Management. Administered by Department of Agricultural Engineering. SA: AE 061, ATM 326
Animal environment requirements. Heat and moisture production rates. Psychrometrics of air and building materials. Heat loss and ventilation systems. Offered first ten weeks of semester.
- 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.
- 275 Seafood Systems Management**
Spring. 3 credits. Interdepartmental with Fisheries and Wildlife; Food Science. Administered by Department of Fisheries and Wildlife.
Domestic and international perspectives on major aquatic foods. Cultural and nutritional value; wild harvest; aquaculture; processing technology; food handling and food safety.
- 300A Advanced Livestock Judging**
Fall of even years. 2 credits. P:NM: (ANS 200A) R: Not open to freshmen. 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.
Evaluation of conformation and performance records of beef cattle, swine and sheep. Represent MSU in intercollegiate competition. Field trips required.
- 300B Advanced Meat Evaluation and Grading**
Fall. 2(0-4) P:NM: (ANS 200A) R: Not open to freshmen. 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.
Evaluation of beef, pork, and lamb carcasses and wholesale cuts according to industry standards. Federal grading standards. Field trips to meat packing operations required. Represent MSU in intercollegiate competition.
- 300C Advanced Dairy Cattle Judging**
Fall. 2 credits. P:NM: (ANS 200C) R: Not open to freshmen. 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.
Evaluation of conformation of various breeds of dairy cattle. Represent MSU in intercollegiate competition. Field trips required.
- 300D Advanced Horse Judging**
Fall. 2 credits. P:NM: (ANS 200D) R: Not open to freshmen. 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.
Evaluation of functional characteristics of horses. Represent MSU in intercollegiate competition. Field trips required.
- 305 Applied Animal Behavior**
Spring. 3(2-2) P:M: (BS 111)
Techniques for assessing health and welfare of domestic animals based on their behavior.
- 313 Principles of Animal Feeding and Nutrition**
Fall. 4(3-2) P:M: (BS 111) and (CEM 143 or concurrently or CEM 251 or concurrently) and completion of Tier I writing requirement.
Principles and practices of nutrition for cattle, horses, poultry, sheep and swine. Metabolism of protein, minerals, and vitamins. Diet formulation. Performance prediction. Nutritional maladies. Field trip required.
- 314 Genetic Improvement of Domestic Animals**
Fall. 4(3-2) P:M: (BS 111) and (MTH 110 or concurrently or MTH 116 or concurrently) and completion of Tier I writing requirement.
Molecular, Mendelian, population, and quantitative genetics of domestic animals.
- 315 Anatomy and Physiology of Farm Animals**
Spring. 4(3-2) P:M: (BS 111) and completion of Tier I writing requirement.
Gross and microanatomy of farm animals. Structure directed function of tissues. Endocrine integration for homeostasis. Regulation of growth, lactation, and reproduction. Homeorhesis.
- 320 Muscle Foods**
Spring. 3(2-3) Interdepartmental with Food Science. P:M: (ANS 210 or FSC 211 or HNF 150)
Structure of muscle. Meat technology and merchandising concepts.
- 401 Issues in Animal Agriculture**
Spring. 1(2-0) P:NM: (ANS 313 or ANS 314 or ANS 315) R: Open only to juniors or seniors.
Societal issues related to local, national and international animal agriculture.
- 404 Advanced Genetics of Farm Animals**
Spring. 2(1-2) P:M: (ANS 314)
Application of molecular genetics techniques to animal breeding. Genome maps for domestic species. Incorporation of genotype data into selection programs.
- 405 Endocrinology of Reproduction**
Fall. 4(3-2) P:NM: (ANS 315) R: Not open to freshmen or sophomores.
Endocrine regulation of reproduction. Cellular and molecular aspects of gametogenesis, folliculogenesis, sexual cycles, fertilization, sex differentiation, gestation, and parturition. Technology to regulate reproduction.
- 407 Food and Animal Toxicology**
Fall. 3(3-0) Interdepartmental with Food Science. P:M: (BMB 200 or BMB 401) and (PSL 250) R: Not open to freshmen or sophomores.
Fate and effects of chemicals in the food chain. Impact on animal production. Residues in food products. Food safety assessment. Control methods.
- 407L Toxicology Methods Laboratory**
Fall. 2(0-4) Interdepartmental with Food Science. P:NM: (ANS 407 or concurrently) R: Not open to freshmen or sophomores.
Laboratory techniques for evaluating potential toxicity of chemicals to living systems. Field trip to industrial toxicology laboratory required.
- 413 Non-Ruminant Nutrition**
Spring. 4(3-2) P:NM: (ANS 313) R: Not open to freshmen or sophomores.
Nutrition of horses, swine and poultry. Digestive and metabolic development and nutrient requirements. Relationships of genetics, endocrinology, immunology, and environment to nutrition.
- 414 Advanced Animal Breeding**
Spring. 2(2-0) P:M: (ANS 314) R: Not open to freshmen or sophomores.
Application of selection principles and mating systems within and among breeds of livestock. Selection index, expected progeny differences, animal models, crossbreeding systems, multiple ovulation and embryo transfer schemes, multiple trait selection, simulated populations.
- 415 Growth and Musculoskeletal Biology**
Spring. 3(3-0) P:NM: (ANS 315) R: Not open to freshmen or sophomores.
Principles of growth in mammalian and avian species. Regulation of bone, cartilage, connective tissue, fat, and muscle metabolism. Extracellular matrix proteins and their function. Introduction to musculoskeletal diseases.
- 416 Meat Science and Muscle Biology**
Fall. 2(2-0) P:NM: (ANS 315) R: Not open to freshmen or sophomores.
Structure, composition, development and function of muscle and its conversion to meat. Properties of fresh and processed meat. Microbiology, preservation, palatability, inspection and sanitation, nutritive value, and by-products.
- 417 Topics in Toxicology**
Spring. 1(1-0) Interdepartmental with Food Science. P:NM: (ANS 407) R: Not open to freshmen or sophomores.
Selected topics including regulatory toxicology, risk assessment, environmental toxicology, food safety, and safe handling of toxic substances.
- 418 Comprehensive Nutrient Management Planning**
Fall. 3(2-2) Interdepartmental with Biosystems Engineering. P:M: (ANS 110 or BE 230)
Comprehensive nutrient management plans (CNMP) for animal feeding operations. Trends in animal production, environmental issues, and diet formulation and their impact on manure production. Development of CNMP for a specific animal feeding operation.

- 422 Advanced Beef Cattle Feedlot Management**
Fall. 3(2-2) P:M: (ANS 222)
Feedlot management systems and issues. Feed systems, manure management, health maintenance, and cattle marketing. Field trips required.
- 425 Principles of Animal Biotechnology**
Fall of odd years. 3(3-0) P:NM: (BS 111) and (CEM 143 or concurrently and CEM 251 or concurrently)
Application of molecular biology concepts to the improvement of domestic animals. Transgenic animal production, molecular genetics and marker assisted selection.
- 427 Environmental Toxicology and Society**
Spring of odd years. 3(3-0) Interdepartmental with Environmental Engineering; Sociology. P:NM: (ISB 200 or ISB 202 or ISB 204 or ISB 206H or BMB 200 or BS 111 or BS 110)
Impact of environmental chemicals on health and modern society. Cellular and organ functions and their interface with the environment. Limitations of scientific investigation and environmental regulations.
- 432 Advanced Dairy Cattle Management**
Fall. 3(2-2) P:M: (ANS 232) R: Not open to freshmen or sophomores. SA: ANS 498
Management techniques for operating a dairy herd. Mastitis control, reproductive and nutrition management, records, and general herd health. Field trips required.
- 442 Advanced Horse Management**
Spring. 3(2-2) P:M: (ANS 242) P:NM: (ANS 313) R: Not open to freshmen or sophomores.
Management of stables and breeding farms. Pedigree and conformational selection, reproduction. Promotion, marketing, economics. Nutrition and feeding, facilities, and herd health. Field trips required.
- 445 Equine Exercise Physiology**
Fall. 4(3-2) P:NM: (ANS 313 and ANS 315)
Research in equine exercise science. Physical, physiologic, metabolic and mental adaptation to athletic training. Nutrition and bioenergetics of muscle metabolism. Field trip required.
- 455 Avian Physiology**
Spring. 4(3-3) P:NM: (ANS 315) R: Open only to juniors or seniors or graduate students.
Systemic and comparative physiology of birds: respiration, reproduction, endocrinology, digestion, urination, and the senses.
- 464 Statistical Methods for Biologists I**
Fall. 3(3-0) Interdepartmental with Statistics and Probability; Crop and Soil Sciences. Administered by Department of Statistics and Probability. P:NM: (STT 421)
Biological random variables. Estimation of population parameters. Testing hypotheses. Linear correlation and regression (prediction). Analyses of counted and measured data to compare several biological groups (contingency tables and analysis of variance).
- 465 Statistical Methods for Biologists II**
Spring. 3(3-0) Interdepartmental with Statistics and Probability; Crop and Soil Sciences. Administered by Department of Statistics and Probability. P:NM: (STT 464)
Concepts of reducing experimental error: covariance, complete and incomplete block designs, latin squares, split plots, repeated-measures designs, regression applications, and response surface designs.
- 472 Advanced Swine Management**
Fall of even years. 3(2-2) P:M: (ANS 272) R: Not open to freshmen or sophomores. SA: ANS 498
Management techniques for operating a swine herd. Management of reproduction and nutrition, records, and general herd health. Integration of husbandry and business principles for decision making. Field trips required.
- 475 Aquaculture**
Spring. 3(3-0) Interdepartmental with Fisheries and Wildlife. Administered by Department of Fisheries and Wildlife. P:NM: (ANS 313 or ZOL 355)
Propagation and rearing of aquatic organisms used for food, bait and recreational fisheries management. Culture principles and techniques for important aquatic species. Commercial potential.
- 480 Animal Systems in International Development**
Fall, Spring, Summer. 3(3-0) A student may earn a maximum of 6 credits in all enrollments for this course. R: Not open to freshmen. Approval of department; application required.
Animal systems in various global regions. Output, land and resource conservation, and socioeconomic factors.
- 483 Ruminant Nutrition**
Spring. 3(3-0) P:NM: (ANS 313 and ANS 315) R: Not open to freshmen or sophomores.
Physiology and metabolism in ruminants. Prehension, digestion, metabolism, absorption, and distribution of nutrients for productive functions. Feeding management strategies and diet formulation. Field trip may be required.
- 490 Independent Study**
Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 8 credits in all enrollments for this course. P:NM: (ANS 210) and (ANS 313 and ANS 314 and ANS 315) R: Open only to juniors or seniors. Approval of department; application required.
Independent study in genetics, nutrition, physiology, toxicology, meat science, or management of poultry, livestock, or horses.
- 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. R: Open only to juniors or seniors in the Animal Science major. Approval of department; application required. 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, CSS 493, FIM 493, FW 493, HRT 493, PKG 493, PRM 493, PRR 493, and RD 493.
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. P:NM: (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. Managerial 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.
- 807 Advanced Food Toxicology**
Fall of even years. 3(3-0) Interdepartmental with Food Science; Human Nutrition and Foods. Administered by Department of Food Science and Human Nutrition. R: Approval of department.
Toxicology related to food safety. Metabolism of toxicants as influenced by food constituents, mutagenesis, and chemical carcinogenesis. Risk assessment.
- 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.
- 813 Techniques in Animal Biotechnology**
Summer of odd years. 3(2-2) P:NM: (BMB 462 or BMB 472) R: Approval of Department; Application Required.
Basic molecular biology procedures with emphasis on mammalian systems.
- 824 Methods of Quantitative and Molecular Genetics for Livestock**
Spring of odd years. 3(2-2) P:NM: (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.

Animal Science—ANS

- 826 Livestock Immunogenetics**
Fall of odd years. 4(3-2) P:NM: (ANS 404 or ANS 425)

Evaluation and exploration of indicator traits and candidate genes of immunocompetence that contribute to resistance or susceptibility to infectious diseases of livestock.

- 827 Integrated Risk Assessment of Environmental Hazards**
Spring of odd years. 3(3-0) 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.

- 841 Advanced Endocrine Physiology and Pharmacology**
Fall. 4(4-0) Interdepartmental with Physiology; Pharmacology and Toxicology; Psychology. Administered by Department of Physiology. P:NM: (BMB 461 and PSL 432) R: Open only to graduate students in the Colleges of Human Medicine, Osteopathic Medicine, Veterinary Medicine, Natural Science, and Agriculture and Natural Resources.

Basic and advanced concepts of endocrine and reproductive physiology and pharmacology.

- 842 Population Genetics, Genealogy and Genomics**
Fall. 3(3-0) Interdepartmental with Forestry; Crop and Soil Sciences; Genetics; Fisheries and Wildlife; Horticulture. Administered by Department of Forestry. RB: 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; Forestry; Fisheries and Wildlife; Horticulture. P:NM: (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.

- 883 Applied Ruminant Nutrition**
Summer. 3(2-2) P:NM: (ANS 313 or ANS 513 or PSL 511) RB: (ANS 483)

Nutritional and metabolic principles for dairy and beef cattle and sheep. Diet formulation. Nutritional assessment and feeding management. Field trips required.

- 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.

- 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 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 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.

- 905 Biology of the Extracellular Matrix**
Spring of odd years. 2(2-0) P:NM: (BMB 461 and BMB 462) and (PSL 431 and PSL 432)
Extracellular matrix (ECM) composition and structure. Role of ECM in regulation of cell phenotype. Regulation of ECM remodeling. Biochemical and physiological properties of ECM degrading proteinases and their inhibitors. Integrins and cell signalling. ECM pathologies.

- 935 Nutrition: Lipid and Carbohydrate Metabolism**
Fall of even years. 3(3-0) Interdepartmental with Human Nutrition and Foods. Administered by Department of Food Science and Human Nutrition.

Regulatory aspects of lipid and carbohydrate metabolism as influenced by nutritional status.

- 936 Protein Nutrition and Metabolism**
Spring of even years. 3(3-0) Interdepartmental with Human Nutrition and Foods.
Nutritional and endocrine regulation of protein synthesis and degradation, protein quality assessment, protein status, protein-energy malnutrition. Protein metabolism during exercise. Metabolism, digestion, and absorption of amino acids and proteins.

- 937 Mineral Nutrition and Metabolism**
Fall of even years. 3(3-0) Interdepartmental with Human Nutrition and Foods.
Forms and locations of mineral elements in the body, metabolic functions, deficiencies, and toxicities, interrelationships and quantitative requirements.

- 938 Nutrition: Metabolism and Function of Vitamins**
Spring of odd years. 3(3-0) Interdepartmental with Human Nutrition and Foods. Administered by Department of Food Science and Human Nutrition.

Regulatory roles of vitamins at cellular and molecular levels.

- 970 Advanced Biometrical Methods for Quantitative Genetics**
Fall of even years. 3(3-0) P:NM: (ANS 870 and STT 441)

Advanced biometrical methods applied to inferential problems in animal breeding and genetics. Likelihood and Bayesian methods for estimation of genetic parameters and prediction of genetic merits. Quantitative genetic analysis of discrete, censored, survival, and growth/lactation curve data.

- 976 Multivariate Methods in Agriculture and Natural Resources**
Spring. 4(4-0) Interdepartmental with Forestry; Fisheries and Wildlife. Administered by Department of Forestry. P:NM: (STT 422 and MTH 314) R: Open only to graduate students in the College of Agriculture and Natural Resources and in the Interdepartmental Graduate Specializations in Ecology and Evolutionary Biology.

Application of multivariate methods to research problems. Hotelling's Test, profile analysis, discriminant analysis, canonical correlation, principal components, principal coordinates, correspondence analysis, and cluster analysis.

- 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 Animal Science. Approval of department.

Doctoral dissertation research.

ANR EDUCATION AND COMMUNICATION SYSTEMS

AEE

Department of ANR Education and Communication Systems College of Agriculture and Natural Resources

- 110 Foundations of ANR Communications: Learning and Leadership**
Fall. 2(1-2) R: Open only to students in Agriculture and Natural Resources Communications major or Agriscience major or the Agriculture and Natural Resources - No Preference undergraduate program. SA: AEE 101

Basic information systems applied to ANR communications, learning, and leadership. Communications skills, research techniques, learning theory, technology, and personal and professional development.

- 111 Applications of ANR Communications: Learning and Leadership**
Spring. 2(1-2) P:NM: (AEE 110) R: Open only to students in the Agriculture and Natural Resources Communications major or Agriscience major or Agriculture and Natural Resources - No Preference undergraduate program. SA: AEE 101

Application of information systems theory, communications skills, research techniques, learning theory, and technology to agriculture and natural resource problems. Issue identification, critical thinking, problem solving, team building, and working with diversity.

- 202 Michigan's Agricultural and Natural Resources Heritage**
Fall. 2(2-0) Interdepartmental with Agriculture and Natural Resources. Administered by Agriculture and Natural Resources. P:M: Completion of Tier I writing requirement.

Michigan's historical agricultural and natural resources. Orientation to sources for research and learning. Self-directed study integrating agricultural and natural resources heritage to family, community and careers.