885 Vertebrate Neural Systems
Spring of odd years. 3(2-2) Interdepartmental with Physiology.
Comparative analysis of major component systems of vertebrate brains. Evolution, ontogeny, structure, and function in fish, amphibians, reptiles, birds and mammals.

899 Master's Thesis Research
Fall, Spring, Summer. 1 to 8 credits. A student may earn a maximum of 12 credits in all enrollments for this course. R: Open only to graduate students in Anatomy.
Master's thesis research.

999 Doctoral Dissertation Research
Fall, Spring, Summer. 1 to 24 credits. A student may earn a maximum of 36 credits in all enrollments for this course. R: Open only to graduate students in Anatomy.
Doctoral dissertation research.

HUMAN ANATOMY ANTR

College of Human Medicine

350 Human Gross Anatomy and Structural Biology
Fall, Spring. 3(4-0) P:M: (BS 111 or LBS 149H or LBS 145) R: Not open to freshmen or approval of department. SA: ANT 316, ANTR 316
Survey of human systemic gross anatomy with clinical illustrations. Introduction to the language of medicine. Structural basis of physiological principles. Designed for pre-professional students entering health-care disciplines.

381 Human Gross Anatomy Laboratory
Spring, Summer. 2(0-6) P:M: (ANTR 350) R: Approval of department. Not open to students with credit in KIN 217 or ZOL 328.
Structured survey of human regional gross anatomy using prosections, cross-sections, medical imaging, multimedia, and hypermedia.

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 the 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. RB: (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.

140 Fundamentals of Horsemanship
Spring. 2(0-4) A student may earn a maximum of 4 credits in all enrollments for this course.
Safe horse handling skills. Riding skills. Riding aids and working with the horse at the beginner, intermediate or advanced level.

141 Draft Horse Basics
Fall, Spring. 2(0-4)
Safe handling, hitching and driving of draft horses. Care and maintenance of harness and horse drawn equipment.

142 Horse Training for Competition
Summer. 2(0-4) RB: (ANS 140) R: Approval of department.
Training techniques to prepare horses for competition. Exhibiting horses. Field trips required.

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. RB: (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.

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(3-0) 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. RB: (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) RB: (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. RB: (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. RB: (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) RB: (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) RB: (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. RB: (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) RB: (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) RB: (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) RB: (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. RB: (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: (CSS 210)
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) RB: (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. RB: (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) RB: (ANS 313) R: Not open to freshmen or sophomores. SA: ANS 498
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) RB: (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) RB: (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. RB: (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. RB: (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. RB: (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 socio-economic factors.

483 Ruminant Nutrition
Spring. 3(3-0) RB: (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. RB: (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, EEP 493, FIM 493, FW 493, HRT 493, PKG 493, PLP 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. 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. 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.

811 Integrated Nutrient Metabolism
Fall of odd years. 3(3-0) Interdepartmental with Human Nutrition and Foods. RB: (BMB 200 or BMB 401) or approval of department.
Comparative physiology of the absorption and metabolism of carbohydrates, lipids, protein, minerals, and vitamins and their regulation and integration. Basis for applied nutrition of humans, livestock and companion animals.

818 Comprehensive Nutrient Management Planning
Fall. 3(2-2) Interdepartmental with Biosystems Engineering.
Development of 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.

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.

826 Livestock Immunogenetics
Fall of odd years. 4(3-2) RB: (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. RB: (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. 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.

883 Applied Ruminant Nutrition
Summer. 3(2-2) RB: (ANS 313 or ANS 483 or ANS 513 or PSL 511)
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) RB: (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 signaling. 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 and Vitamin Nutrition and Metabolism
Spring of even years. 3(3-0) Interdepartmental with Human Nutrition and Foods. P:M: (BMB 461 and BMB 462)
Forms and locations of mineral elements in the body, metabolic functions, deficiencies, and toxicities, interrelationships and quantitative requirements. Significant vitamins and mineral interrelationships relative to bone metabolism, antioxidant health and erythropoiesis.

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) RB: (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. RB: (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 T-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

100 Public Speaking in Agriculture and Natural Resources
Fall, Spring. 2(2-0) R: Open only to students in the Institute of Agricultural Technology.
Public speaking skills for agriculture and natural resource professionals. Organizing and delivering effective speeches for diverse audiences.

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) RB: (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.

210 Approaches to ANR Technology and Information Systems
Fall. 2(1-2) RB: (AEE 110 or concurrently or AEE 101) R: Open only to students in Agriculture and Natural Resources Communications or Agriscience major. SA: AEE 201
Development of technology and learning resources in agriculture and natural resources. Graphic design, electronic publishing, database management, evaluation techniques, and educational technology.

211 Applications of ANR Technology and Information Systems
Spring. 2(1-2) RB: (AEE 111 or concurrently or AEE 101) R: Open only to students in the Agriculture and Natural Resources Communications or Agriscience major. SA: AEE 201
Application of technology and learning resources and systems in agriculture and natural resources for external audiences. Production of graphic designs, publishing and production of other informational materials.

212 American Agrarian Movements
Spring. 3(3-0) SA: AEE 203
Historical perspectives of America by pioneers, farmers, ranchers and others who cultivated the land from 1700s to 1930. Agricultural movements, trends and development.

300 Approaches to Information Management and Evaluation in ANR
Fall. 2(1-2) P:M: Completion of Tier I writing requirement. RB: (AEE 211 or AEE 201) R: Open only to students in the Agriculture and Natural Resources Communications or Agriscience major. SA: AEE 301
Advanced information and evaluation techniques to plan, implement and assess domestic and international communication, marketing, and educational projects in agriculture and natural resources. Qualitative and quantitative methods of inquiry.

311 Applications of Information Management and Evaluation in ANR
Spring. 2(1-2) P:M: Completion of Tier I writing requirement. RB: (AEE 300) R: Open only to students in the Agriculture and Natural Resources Communications or Agriscience major. SA: AEE 301
Marketing, educational, and public relations campaigns to solve and address problems in agriculture and natural resources. Application of distance education technology and field work to domestic and international projects.

314 Issues in Agricultural and Environmental Education Programs
Fall. 3(2-2) RB: (AEE 110 or TE 150) and (FW 203) R: Not open to freshmen or sophomores. SA: AEE 303
Assessment and analysis of current issues and their impact on agricultural and environmental education programs.

401 Agricultural and Natural Resources Communications Campaigns
Fall, Spring, Summer. 3(3-0) P:M: Completion of Tier I writing requirement. R: Open only to juniors or seniors in the College of Agriculture and Natural Resources or the College of Communication Arts and Sciences. Not open to students with credit in AEE 300 or AEE 410.
Planning and execution of agricultural and natural resource communication campaigns. Emphasis on theories, strategies and techniques using mass and controlled media channels.

410 Approaches to Problems in ANR Communications and Education
Fall. 2(1-2) P:M: Completion of Tier I writing requirement. RB: (AEE 311 or AEE 301) R: Open only to students in the Agriculture and Natural Resources Communications or Agriscience major. Not open to students with credit in AEE 401.
Team approach to current issues in agriculture and natural resources communications and education. Solving advanced problems with peers and professionals. Professional standards and ethical practice.

411 Applications of Problems in ANR Communications and Education
Spring. 2(1-2) P:M: Completion of Tier I writing requirement. RB: (AEE 410) R: Open only to students in the Agriculture and Natural Resources Communications or Agriscience major. Not open to students with credit in AEE 401.
Developing solutions for client problems through field work in agriculture and natural resources communications and education. Transition into the world of work.

412 Agricultural and Natural Resources Leadership and Education
Fall, Spring, Summer. 3(3-0) R: Open only to juniors or seniors. SA: AEE 403
Characteristics of leadership and group dynamics. Development of personal leadership skills. Educational methods and learning styles.