885 Security Management
Fall. 3(3-0) RB: (CJ 811 or concurrently) R: Open only to master's students in the School of Criminal Justice or to doctoral students in the Social Science-Criminal Justice major.
Organization and management of security operations in business, industry and government.

886 Security Administration
Spring. 3(3-0) R: Open only to master's students in the School of Criminal Justice or to doctoral students in the Social Science-Criminal Justice major.
Administrative and quantitative techniques for security operations. Statistical analyses. Analysis of financial statements. Operations research and computer techniques.

887 Quantitative Methods in Criminal Justice Research
Spring. 3(3-0) RB: (CJ 811) R: Open only to master's students in the School of Criminal Justice or to doctoral students in the Social Science-Criminal Justice major.
Descriptive and inferential statistics and computer use in criminal justice research.

890 Independent Study
Fall, Spring, Summer. 1 to 6 credits. A student may earn a maximum of 12 credits in all enrollments for this course. R: Open only to master's students in the School of Criminal Justice or to doctoral students in the Criminal Justice major. Approval of school.
Individual research and writing under faculty supervision.

894 Practicum
Fall, Spring, Summer. 1 to 6 credits. A student may earn a maximum of 6 credits in all enrollments for this course. R: Open only to master's students in the School of Criminal Justice or to doctoral students in the Social Science-Criminal Justice major. Approval of school.
Observation, study, and work in selected criminal justice agencies. Participation in domestic and foreign criminal justice systems.

896 Policy Analysis under Conditions of Change
Spring. 3(3-0) RB: (CJ 811) R: Open only to master's students in the School of Criminal Justice or to doctoral students in the Social Science-Criminal Justice major.
Methods of policy analysis in criminal justice settings. Policy analysis for the formulation, adoption and implementation of changes.

899 Master's Thesis Research
Fall, Spring, Summer. 1 to 6 credits. A student may earn a maximum of 12 credits in all enrollments for this course. R: Open only to master's students in the School of Criminal Justice or to doctoral students in the Social Science-Criminal Justice major.
Planned research and writing directed by student's thesis committee.

901 Seminar in Contemporary Criminal Justice Theory
Fall. 3(3-0) R: Open only to graduate students in Criminal Justice or in Social Science-Criminal Justice.
Theoretical perspectives and issues in criminal justice and criminology

902 Seminar in Criminal Justice Systems
Spring of even years. 3(3-0) R: Open only to graduate students in Criminal Justice or in Social Science-Criminal Justice.
Contemporary issues in the criminal justice system.

903 Research Utilization in Criminal Justice
Spring of odd years. 3(3-0) R: Open only to graduate students in Criminal Justice or in Social Science-Criminal Justice.
Research application in criminal justice theory and practice.

904 Criminal Justice Organizations and Processes
Spring. 3(3-0) R: Open only to graduate students in Criminal Justice.
Theoretical perspectives on organizations and processes in criminal justice. Evaluation of organizational performance in justice agencies.

905 Law and Society
Fall. 3(3-0) R: Open only to graduate students in Criminal Justice.
Theoretical perspectives on law. Impact of law on society and the criminal justice system.

906 Advanced Quantitative Methods in Criminal Justice Research
Fall. 3(3-0) RB: (CJ 887 and STT 421) or introductory statistics course. R: Open only to graduate students in Criminal Justice.
Applications of quantitative techniques to criminal justice data. Use of multiple regression and SPSS.

907 Advanced Topics in Criminal Justice Data Analysis
Spring. 3(3-0) A student may earn a maximum of 9 credits in all enrollments for this course. P:M: (CJ 906) R: Open only to graduate students in Criminal Justice.
Advanced quantitative analysis techniques for criminal justice data.

908 Advanced Topics in Criminal Justice
Spring. 3(3-0) A student may earn a maximum of 9 credits in all enrollments for this course. R: Open only to graduate students in Criminal Justice.
Intensive study of one subfield of criminal justice. Critical evaluation of the literature.

999 Doctoral Dissertation Research
Fall, Spring, Summer. 1 to 12 credits. A student may earn a maximum of 50 credits in all enrollments for this course. R: Open only to doctoral students in Criminal Justice.
Doctoral dissertation research.

CROP AND SOIL SCIENCES CSS

Department of Crop and Soil Sciences
College of Agriculture and Natural Resources

100 Crop Production
Fall. 3(2-2) R: Open only to students in the Institute of Agricultural Technology. SA: CSS 054 Not open to students with credit in CSS 101 or CSS 054.
Basic principles of crop production including soil fertility, weed control, tillage, cultivar selection, row spacing, crop rotation, and environmental concerns. Seed, crop, and weed identification.

101 Introduction to Crop Science
Fall. 3(2-2)
Principles of crop management, improvement, and fertilization. International and sustainable agriculture. Water quality issues.

110 Computer Applications in Agronomy
Fall. 2(1-2) R: Open only to students in the College of Agriculture and Natural Resources. Not open to students with credit in CSE 101.
Use of computers in agriculture. Basic computer operating systems. Management and use of storage media. Laboratory experience in word processing, spread sheets, data bases, programming languages, networking, and software related to agriculture.

164 Golf Course Design and Construction Techniques
Fall. 2(2-0) RB: (CSS 210 and CSS 232)
Concepts and theory of golf course design and construction including location, space, topography, clientele, and environmental concerns.

171 Operations Budgeting for Golf Course Managers
Spring. 2(3-0) RB: (CSS 232 and CSS 210) Not open to students with credit in CSS 071.
Budgeting. Financial analysis. Purchasing and materials management for golf course operations. Offered first ten weeks of semester.

178 Golf Turf Irrigation
Spring. 2(2-2) Not open to students with credit in CSS 078.
Golf course irrigation systems: installation and maintenance including water management. Offered first ten weeks of semester.

181 Pesticide and Fertilizer Application Technology
Spring. 3(3-3) SA: CSS 081
Effective and efficient application of pesticides and fertilizers to turf and ornamentals. Pesticide handling, legal, and environmental concerns. Calibration of equipment. Offered first ten weeks of semester.

192 Professional Development Seminar I
Spring. 1(0-2) R: Open only to students in the Department of Crop and Soil Sciences.
Career development, critical issues analysis, resume writing, scientific presentations and public speaking in crop and soil sciences.

201 Forage Crops
Fall. 3(2-2)
Forage crop production, management, and utilization. Crop identification. Soil fertilization. Planting and harvesting of grasses and legumes.

210 Fundamentals of Soil and Landscape Science
Fall, Spring. 3(2-3) Interdepartmental with Forestry. RB: (CEM 141)
Agricultural and natural resource ecosystems: soil, vegetation and ground water components. Energy, water and nutrient cycles. Soil classification and mapping. Land management and use issues.

211 Turfgrass and the Environment
Spring. 2(3-0) P: (CSS 232) RB: (CSS 210)
Pesticide and nutrient fate, site assessment, fuel use, equipment washing systems and criteria for recognizing sensitive sites. Conservation and best management practices to maximize protection of natural resources. Offered first ten weeks of semester.

212 Advanced Crop Production
Fall. 2(2-0) P: (CSS 100 or CSS 101) RB: (CSS 210 and CSS 110)
Systems approach to production of field crops including
corn, soybeans, small grains, sugar beets, and dry beans.

222 New Horizons in Biotechnology
Fall. 2(2-0) Interdepartmental with Entomology.
Perspectives on biotechnology for safer food production, environmental quality, and improved human health. Impacts of biotechnology on the national economy. Political and ethical ramifications of applied biotechnology.

232 Introduction to Turfgrass Management
Fall. 3(2-2) P: (CSS 210 or concurrently) RB: (CSS 110 or CSE 101)
Turfgrass utilization, identification, establishment and management principles. Responses to various cultural practices.

242 Athletic Field Maintenance and Construction
Fall. 2(2-0) P: (CSS 232 or concurrently and CSS 210 or concurrently)
Maintenance, renovation, and construction of athletic fields with emphasis on baseball and football. Soil testing, cultivar selection, and surveying. Safety and liability concerns. Field trips required.

262 Turfgrass Management Seminar
Fall. 1(2-0) A student may earn a maximum of 2 credits in all enrollments for this course. P: (CSS 232 or concurrently)
Presentations by individuals involved in turfgrass and golf course management. Topics include golf course construction and operations, preparation for tournaments, and public relations.

267 Turfgrass Practices
Spring. 2(2-2) P: (CSS 232) SA: CSS 067
Turfgrass establishment, renovation, and construction principles. Maintenance of golf course turf. Agronomic and management principles applied to golf course maintenance.

269 Turfgrass Strategies
Spring. 2(3-0) P: (CSS 232)
Issues in turfgrass management including employee relations, construction, and environmental problems. Offered first ten weeks of semester.

272 Turfgrass Soil Management
Fall. 3(2-2) RB: (CSS 043 or CSS 210) Not open to students with credit in CSS 044 or CSS 342.
Impact of fertilization programs on turfgrasses and the environment. Irrigation, drainage, cultivation, top dressing, amendments and pH control of turfgrass soils.

282 Turfgrass Physiology
Spring. 2(3-0) P: (CSS 232) RB: (PLB 105) Not open to students with credit in CSS 332.
Physiological principles of turfgrass growth and development. Water relations, light, temperature, respiration, photosynthesis, mineral nutrition, and hormone action. Impact of mowing, cultivation, and traffic on turfgrass growth. Offered first ten weeks of semester.

290 Independent Study in Crop and Soil Science
Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 6 credits in all enrollments for this course. R: Open only to students in the Institute of Agricultural Technology. SA: CSS 057 Not open to students with credit in CSS 057.
Field, laboratory, or library research problems.

292 Management of Turfgrass Weeds
Spring. 2(2-2) P: (CSS 232) RB: (BOT 105)
Chemical, biological, and cultural methods of managing turfgrass weeds. Environmental considerations in weed management.

310 Soil Management and Environmental Impact
Spring. 3(3-0) P: (CSS 210)
Management of soil physical and chemical properties for the production of food and fiber. Soil management systems that reduce the environmental impact on soil, water and air resources and maximize crop production potential.

332 Advanced Turf Management
Spring. 3(3-0) P: (CSS 232) and completion of Tier I writing requirement.
Effect of light, heat, cold, drought, and traffic on turfgrass growth and development. Impact of practices such as mowing, cultivation, and compaction on the growth of grasses.

350 Introduction to Plant Genetics
Spring. 3(4-0) P: (BOT 105 or BS 111) R: Not open to freshmen or sophomores.
Fundamentals of plant genetics with applications to agriculture and natural resources.

355 Environmental Soil Chemistry
Fall. 3(2-2) P: (CEM 143 and CSS 210)
Soil chemistry concepts as they apply to major chemical groups of environmental importance including metals, nitrogen, phosphorus, organic contaminants, and pesticides.

362 Management of Turfgrass Pests
Fall. 4(3-2) Interdepartmental with Plant Pathology; Entomology. P: (CSS 232)
Chemical, biological, and cultural methods of managing weeds, diseases, and insect pests of turfgrass. Environmental considerations in pest management.

380 Crop Physiology
Spring of even years. 3(2-3) P: (CSS 101) and (BOT 105 or BOT 301)
Physiological and metabolic function of plants from a whole plant viewpoint. Environmental effects on crop growth, development, and yield.

402 Principles of Weed Science
Fall. 3(2-2) RB: (BOT 105 and CEM 143) R: Not open to freshmen or sophomores.
Weed biology and ecology. Cultural, mechanical, biological, and chemical control practices. Herbicide action, selectivity in plants, and effects on environment.

404 Forest and Agricultural Ecology
Fall. 3(3-0) Interdepartmental with Forestry. Administered by Department of Forestry. P: (CSS 210) and (BOT 105 or BS 110) RB: (ZOL 355)
Ecological interactions crucial to the sustainable management of crop and forest ecosystems. Plant resources, competition, community development and dynamics, biodiversity, primary productivity, nutrient cycling, ecosystem structure and function, and impacts of global environmental change.

404L Forest and Agricultural Ecology Laboratory
Fall. 1(0-3) Interdepartmental with Forestry. Administered by Department of Forestry. P: (CSS 210) and (BOT 105 or BS 110) and (FOR 404 or concurrently) RB: (ZOL 355)
Field studies and data analysis of ecological processes central to the sustainable management of forest and agricultural resources. Field exercises cover primary production, community structure, soil resources, biodiversity, succession, nutrient cycling, critiques of primary literature. Two weekend field trips required.

406 Seed Production and Technology
Fall of even years. 3(2-2) P: (CSS 101 and CSS 350) R: Not open to freshmen or sophomores.
Principles and practices of field seed production. Crop improvement, variety release, seed production, seed technology and evaluation involved in producing high quality field crop seed.

425 Microbial Ecology
Spring. 3(3-0) Interdepartmental with Microbiology and Molecular Genetics. Administered by Department of Microbiology and Molecular Genetics. RB: (MMG 301) SA: MPH 425
Microbial population and community interactions. Microbial activities in natural systems, including associations with plants or animals.

426 Biogeochemistry
Summer. 3 credits. Given only at W.K. Kellogg Biological Station. Interdepartmental with Microbiology and Molecular Genetics; Geological Sciences; Zoology. Administered by Department of Microbiology and Molecular Genetics. RB: (BS 110 or LBS 144 or LBS 148H or BS 111 or LBS 145 or LBS 149H) and (CEM 143 or CEM 251) SA: MPH 426
Integration of the principles of ecology, microbiology, geochemistry, and environmental chemistry. Societal applications of research in aquatic and terrestrial habitats.

430 Soil Fertility and Chemistry
Spring. 3(2-2) P: (CSS 210) R: Not open to freshmen or sophomores.
Application of chemistry to diagnosing and improving soil fertility. Soil amendments including macro- and micro-nutrients. Reducing environmental degradation.

431 Soil and Plant Resources for Sustained World Food and Fiber Production
Spring of odd years. 3(3-0) P: (CSS 101 and CSS 210)
World food and fiber production capacities related to soil and climatic resources. Management and utilization of genetic resources for sustained production of human foods and animal feeds.

440 Soil Biophysics
Fall of even years. 3(2-2) P: (CSS 210) R: Not open to freshmen or sophomores.
Plant growth properties and soil physical conditions which influence productivity. Principles and applications of soil texture, structure, mechanical impedance, aeration and water. Root responses to the environment.

441 Plant Breeding and Biotechnology
Spring of even years. 4(3-2) Interdepartmental with Forestry; Horticulture. P: (CSS 350)
Plant improvement by genetic manipulation. Genetic variability in plants. Traditional and biotechnological means of creating and disseminating recombinant genotypes and cultivars.

451 Biotechnology Applications for Plant Breeding and Genetics
Spring. 3(2-2) Interdepartmental with Forestry; Horticulture. RB: (CSS 350 or ZOL 341) and (CSS 441)
Principles, concepts, and techniques of agricultural plant biotechnology. Recombinant DNA technology, plant molecular biology and transformation in relation to plant improvement.

452 Watershed Concepts
Fall, Spring, Summer. 3(3-0) Interdepartmental with Resource Development; Biosystems Engineering; Forestry; Fisheries and Wildlife. Administered by Department of Community, Agriculture, Recreation and Resource Studies. P: (RD 324 and ZOL 355) RB: organic chemistry
Watershed hydrology and management. The hydrologic cycle, water quality, aquatic ecosystems and social systems. Laws and institutions for managing water resources.

455 Pollutants in the Soil Environment
Fall. 3(3-0) P: (CEM 143) and completion of Tier I writing requirement. R: Open only to seniors or graduate students.
Chemical and biological reactions of organic and inorganic pollutants in soils.

464 Statistical Methods for Biologists I
Fall. 3(3-0) Interdepartmental with Statistics and Probability; Animal Science. 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; Animal Science. 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.

470 Soil Resources
Fall. 3(2-3) RB: (CSS 210) R: Not open to freshmen or sophomores.
Evaluation of the properties, genesis, and classification of soil resources to assist in making land-use decisions. Field trips required.

477 Pest Management I: Pesticides in Management Systems
Fall. 3(3-0) Interdepartmental with Entomology; Fisheries and Wildlife; Horticulture. Administered by Department of Entomology. RB: (CEM 143 or CEM 251) and (BOT 405 and CSS 402) and (ENT 404 or ENT 470 or FW 328)
Chemistry, efficient use, and environmental fate of pesticides. Legal and social aspects of pesticide use.

478 Pest Management II: Biological Components of Management Systems (W)
Spring of even years. 3(2-3) Interdepartmental with Entomology; Forestry; Fisheries and Wildlife; Horticulture. Administered by Department of Entomology. P: (ENT 404 or ENT 470 or PLP 405 or CSS 402 or FW 328) and completion of Tier I writing requirement.
Principles of host plant resistance and biological control and their relationship to the design of agroecosystems. Classification of insect biological control agents.

486 Biotechnology in Agriculture: Applications and Ethical Issues
Fall of even years. 3(3-0) Interdepartmental with Horticulture; Forestry; Philosophy. Administered by Department of Horticulture. P: (BOT 105 or BS 111) RB: (CSS 350 or ZOL 341) R: Not open to freshmen or sophomores.
Current and future roles of biotechnology in agriculture: scientific basis, applications. Environmental, social, and ethical concerns.

488 Agricultural Cropping Systems: Integration and Problem Solving
Spring. 3(2-2) P: (CSS 101 and CSS 210 and CSS 310) RB: (CSS 402 and CSS 430 and PLP 405 and ENT 404) Background/course work in crop production and management. R: Open only to seniors in the Crop and Soil Sciences major.
Integration and synthesis of agronomic and related concepts in agricultural cropping systems. Problem solving and application of information.

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: (CSS 101 or CSS 210) R: Approval of department; application required.
Individual work on field, laboratory, or library research problem of special interest to the student.

491 Special Topics
Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 8 credits in all enrollments for this course. P: (CSS 101 or CSS 210) RB:

Topics from crop production, crop physiology, turfgrass management, organic soils, turfgrass soils, soil fertility, plant and soil relationships, genetics, biotechnology, environmental science, or sustainable agriculture.

492 Professional Development Seminar II
Fall. 1(0-2) P: (CSS 210 and CSS 272) and completion of Tier I writing requirement. R: Open only to seniors in the Department of Crop and Soil Sciences.
Synthesis, integration and application of agronomic principles to current issues in agronomy via discussion and oral and written communication.

493 Professional Internship in Crop and Soil Sciences
Fall, Spring, Summer. 3 credits. A student may earn a maximum of 6 credits in all enrollments for this course. R: Approval of department; application required. A student may earn a maximum of 6 credits 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 experiences in agencies and businesses related to Crop & Soil Sciences and Environmental Soil Sciences

494 International Agriculture Seminar
Spring of odd years. 1(1-0) A student may earn a maximum of 3 credits in all enrollments for this course. P: Completion of Tier I writing requirement.
Global food, soil and water resources issues.

499 Undergraduate Research
Fall, Spring, Summer. 3(0-9) R: Approval of department; application required.
Faculty supervised research in a selected area of crop and soil sciences or environmental soil science.

805 Herbicide Action and Metabolism
Spring of odd years. 2(2-0)
Properties and characteristics of herbicides. Processes involved in herbicide action, transport, and fate in plants and soils.

819 Advanced Plant Breeding
Fall. 3(3-0) Interdepartmental with Horticulture; Forestry. Administered by Department of Horticulture. RB: (CSS 450 and STT 422)
Genetic expectations resulting from breeding strategies with cross- and self-pollinated crop plants. Germplasm collections, mapping populations, and modifications of reproductive biology useful for crop improvement.

820 Plant Reproductive Biology and Polyploidy
Spring. 1 credit. Interdepartmental with Horticulture; Forestry; Plant Pathology; Plant Biology. Administered by Department of Horticulture. RB: Introductory Genetics and Plant Biology
Genetic processes underlying variations in plant reproductive biology and polyploidy and the utilization of these characteristics in plant breeding.

821 Crop Evolution
Spring of odd years. 1 credit. Interdepartmental with Horticulture; Forestry; Plant Pathology; Plant Biology. Administered by Department of Horticulture. RB: Introductory Genetics and Plant Biology
Cultural and biological aspects of the evolution of domestic plants.

822 Historical Geography of Crop Plants
Spring of odd years. 1 credit. Interdepartmental with Horticulture; Forestry; Plant Pathology; Plant Biology. Administered by Department of Horticulture. RB: Introductory Genetics and Plant Biology
Development and spread of the major crop species.

825 Clay Mineralogy and Soils Genesis
Spring of even years. 4(3-2) Interdepartmental with Geological Sciences. R: Open only to graduate students in College of Agriculture and Natural Resources, College of Engineering, or College of Natural Science.
Mineral structures. X-ray diffraction, pedogenic processes, and mineral transformations and stability.

827 Techniques in Cytogenetics
Fall of odd years. 1(0-3) Interdepartmental with Forestry; Horticulture.
Preparation of chromosomes from commercially important plants for cytogenetic analysis.

829 Advanced Microbial Ecology
Spring of odd years. 3(3-0) Interdepartmental with Microbiology and Molecular Genetics. Administered by Department of Microbiology and Molecular Genetics.
Functional roles of microorganisms, their population dynamics and interactions, and their mechanisms of evolutionary change in natural communities, laboratory experiments, and mathematical models.

832 Environmental and Natural Resource Law
Fall. 3(3-0) Interdepartmental with Resource Development; Agricultural Economics; Forestry; Geography. Administered by Department of Community, Agriculture, Recreation and Resource Studies. RB: (RD 430)
Origin and development of environmental law. Theories of power, jurisdiction, sovereignty, property interests, pollution, and other bases for legal controls of natural resources. Common law and constitutional limitations on governmental power.

837 Confocal Microscopy
Fall, Spring. 2(2-2) Interdepartmental with Natural Science. Administered by College of Natural Science.
Confocal imaging, theory and practice. Basic optics. Lasers. Light paths for transmission, florescence and reflection. Image quality, analysis and processing.

840 Soil Physics
Fall of odd years. 3(2-3) R: Open only to graduate students in College of Agriculture and Natural Resources, College of Engineering, or College of Natural Science.
Physical properties of soil including texture, structure, consistency, aeration, moisture content, and temperature. Quantitative measurement of plant growth. Agronomic and engineering practices.

841 Soil Microbiology
Spring of even years. 3(3-0) Interdepartmental with Microbiology and Molecular Genetics. Administered by Department of Microbiology and Molecular Genetics. RB: (MMG 425) SA: MPH 841
Ecology, physiology, and biochemistry of microorganisms indigenous to soil.

842 Population Genetics, Genealogy and Genomics
Fall. 3(3-0) Interdepartmental with Forestry; Animal Science; 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.

850 Soil Chemistry
Spring. 3(3-3) R: Open only to graduate students in College of Agriculture and Natural Resources, College of Engineering, or College of Natural Science.
Ion activities, ionic exchange and equilibrium reactions. Soil pH, macro- and micronutrients, saline soils and availability of nutrients to plants.

853 Plant Mineral Nutrition
Fall of odd years. 3(3-0) Interdepartmental with Horticulture. RB: (BOT 301)
Inorganic ion transport in plant cells and tissues. Physiological responses and adaptation to problem soils. Genetic diversity in nutrient uptake and use by plants. Physiological roles of elemental nutrients in crop growth.

856 Plant Molecular Biology
Spring. 3(3-0) Interdepartmental with Plant Biology; Biochemistry and Molecular Biology. Administered by Department of Plant Biology. RB: (ZOL 341) SA: BOT 856
Recent advances in genetics and molecular biology of higher plants.

863 Mineral-Water Interactions
Fall of even years. 4(3-2) Interdepartmental with Geological Sciences. Administered by Department of Geological Sciences. R: Open only to graduate students in Crop and Soil Sciences or Geological Sciences or Geography.
Mineralogy, petrology and geochemistry of fluid-rock reactions in geologic, sedimentary and geochemical cycles. Rock and mineral weathering, soil formation, genesis and burial diagenesis of sediments and sedimentary rocks, and metamorphism.

865 Organic Chemistry of Soils
Spring of odd years. 2(2-0)
Chemistry of natural and anthropogenic organic substances in soils.

870 Techniques of Analyzing Unbalanced Research Data
Spring. 4(4-0) Interdepartmental with Animal Science; Forestry; Fisheries and Wildlife; Horticulture. Administered by Department of Animal Science. RB: (STT 464) R: Open only to graduate students in the College of Agriculture and Natural Resources. SA: ANS 943 Not open to students with credit in 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.

880 Scientific Communication and Professional Development
Spring. 1(0-2)
Interactive professional experiences including grant
preproposal preparation and presentation, scientific
presentations, mock position interviews, and resume preparation.

890 Independent Study
Fall, Spring, Summer. 1 to 6 credits. A student may earn a maximum of 8 credits in all enrollments for this course. R: Open only to graduate students in College of Agriculture and Natural Resources, College of Engineering, or College of Natural Science.
Individual study on field, laboratory, or library research.

891 Current Topics in Ecology and Evolution
Summer. 1 credit. Summer: Given only at W.K. Kellogg Biological Station. A student may earn a maximum of 8 credits in all enrollments for this course. Interdepartmental with Zoology; Plant Biology. Administered by Department of Zoology.
Presentation and critical evaluation of theoretical and empirical developments by visiting scientists.

891B Selected Topics in Plant 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. Interdepartmental with Horticulture; Forestry. Administered by Department of Horticulture. R: Open only to graduate students in Plant Breeding and Genetics or Genetics. Approval of department.
Selected topics in plant breeding.

892 Plant Breeding and Genetics Seminar
Fall, Spring, Summer. 1(1-0) A student may earn a maximum of 8 credits in all enrollments for this course. Interdepartmental with Horticulture; Forestry. Administered by Department of Horticulture.
Experience in review, organization, oral presentation, and analysis of research.

893 Selected Topics
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 students in College of Agriculture and Natural Resources, College of Engineering, or College of Natural Science.
Selected topics in crop and soil sciences of current interest and importance.

899 Master's Thesis Research
Fall, Spring, Summer. 1 to 12 credits. A student may earn a maximum of 99 credits in all enrollments for this course. R: Open only to master's students in Crop and Soil Sciences.
Master's thesis research.

921 Contemporary Statistical Models in Biology
Fall of odd years. 3(3-0) RB: (STT 465) or approval of department. Working knowledge of SAS software.
Estimating functions. Growth models, generalized linear models, linear and non-linear mixed models. Field experiments with spatial trends. Longitudinal data. Modeling in the presence of spatial and temporal correlations.

941 Quantitative Genetics in Plant Breeding
Spring of even years. 3(2-2) Interdepartmental with Forestry; Horticulture. RB: (CSS 819 and STT 464)
Theoretical and genetic basis of statistical analysis of
quantitative traits using genetic markers. Computational
tools for the study of quantitative traits.

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 Crop and Soil Sciences.
Doctoral dissertation research.

EARTH SCIENCE ES

Department of Geological Sciences
College of Natural Science

800 Special Problems in Earth Science
Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 12 credits in all enrollments for this course. R: Approval of department.
Individual faculty directed study on topics in earth science.

ECONOMICS EC

Department of Economics
College of Social Science

201 Introduction to Microeconomics
Fall, Spring, Summer. 3(3-0) Not open to students with credit in EC 251H.
Economic institutions, reasoning and analysis. Consumption, production, determination of price and quantity in different markets. Income distribution, market structure and normative analysis.

202 Introduction to Macroeconomics
Fall, Spring, Summer. 3(3-0) Not open to students with credit in EC 252H.
Determinants of Gross National Product, unemployment, inflation and economic growth. National income accounting and fiscal policy. Aggregate demand, supply management and monetary policy.

210 Economics Principles Using Calculus
Fall. 3(3-0) P: (MTH 133 or MTH 153H or MTH 126) Not open to students with credit in EC 201 or EC 202.
A combined microeconomics and macroeconomics course. Emphasis on topics of interest in engineering and management, such as discounting, cost-benefit analysis, innovation, externalities, and the role of government regulation.

251H Microeconomics and Public Policy
Fall, Spring. 4(4-0) Not open to students with credit in EC 301.
Theories of consumer behavior, production and cost. Output and price determination in competition and monopolies. Welfare economics, general equilibrium, externalities, and public goods.

252H Macroeconomics and Public Policy
Fall, Spring. 3(3-0) P: (EC 201 and EC 301) or (EC 251H) Not open to students with credit in EC 302.
Theory of national income, unemployment, inflation and economic growth and its application to economic analysis and policy.

293 Cooperative Education for Business Students
Fall, Spring. 1(1-0) A student may earn a maximum of 3 credits in all enrollments for this course. Interdepartmental with Marketing and Supply Chain Management; Accounting; Finance; Management; Hospitality Business. Administered by Department of Marketing and Supply Chain Management. R: By permission of the Department only.
Integration of pre-professional educational employment experiences in industry and government with knowledge and processes taught in the student's academic program. Educational employment assignment approved by the Department of Marketing and Supply Chain Management.

301 Intermediate Microeconomics
Fall, Spring, Summer. 3(3-0) P: (EC 201) RB: (EC 202) Not open to students with credit in EC 251H.
Theories of consumer choice, production, cost, perfect competition, and monopoly. Welfare economics, general equilibrium, externalities and public goods.

302 Intermediate Macroeconomics
Fall, Spring, Summer. 3(3-0) P: (EC 201 and EC 202) Not open to students with credit in EC 252H.
National income accounting. Determination of aggregate output, employment, price level, and inflation rate. Policy implications.

306 Comparative Economic Systems
Fall. 3(3-0) P: (EC 201 or EC 251H) and (EC 202 or EC 252H)
Characteristics and functions of economic systems. Alternative patterns of economic control, planning, and market structure. Theories, philosophies, and experiences associated with capitalism, socialism, and mixed economies.

310 Economics of Developing Countries
Spring. 3(3-0) P: (EC 201 or EC 251H)
Overview of economic patterns and policy issues of developing countries such as modern economic growth and structural transformation, state controls versus markets, poverty and human welfare, investments in human resources, and trade and industrialization.

320 Analysis of Economic Data
Fall, Spring. 3(3-0) P: (EC 201 or EC 251H) and (EC 202 or EC 252H) R: Not open to students in the Department of Accounting or Department of Finance or School of Hospitality Business or Department of Management or Department of Marketing and Supply Chain Management.
Sources of economic data. Techniques for presenting and summarizing economic data. Testing theories of economic behavior. Methods for forecasting in uncertain economic environments. Evaluation of current quantitative work in economics.

330 Money, Banking, and Financial Markets
Fall, Spring, Summer. 3(3-0) P: (EC 201 or EC 251H) and (EC 202 or EC 252H)
Money markets and financial intermediation. Money, the Federal Reserve System, and monetary policy. Regulation of money markets.

335 Taxes, Government Spending and Public Policy
Fall, Spring, Summer. 3(3-0) Interdepartmental with Environmental Economics and Policy. P: (EC 201 or EC 251H) SA: PRM 335 Not open to students with credit in EC 435 or EC 436.
Economics of the public sector. Public goods, externalities, design and incidence of the tax system. Equity and efficiency effects of government programs.

340 Survey of International Economics
Fall, Spring, Summer. 3(3-0) P: (EC 201 or EC 251H) and (EC 202 or EC 252H) Not open to students with credit in EC 440 or EC 441.
Comparative advantage. Costs and benefits of trade. International economic policies. Balance of payments. Foreign exchange markets. The international monetary system. Contemporary trade and international currency issues.

360 Private Enterprise and Public Policy
Fall, Spring, Summer. 3(3-0) P: (EC 201 or EC 251H)
Effects of antitrust, economic regulation, and other public policies on competition, monopoly, and other market problems in the United States economy.

380 Labor Relations and Labor Market Policy
Fall, Spring, Summer. 3(3-0) P: (EC 201 or EC 251H)
Development, functions, legal framework, and economic effects of unions and collective bargaining. Institutions and economic impacts of government programs. Minimum wages, workers' compensation, unemployment insurance, and antidiscrimination policies.

391 Special Topics in Economics
Fall, Spring. 3(3-0) A student may earn a maximum of 9 credits in all enrollments for this course. P: (EC 201 or EC 251H) and (EC 202 or EC 252H) R: Approval of department.
Special topics supplementing regular course offerings.

401 Advanced Microeconomics
Fall, Spring. 3(3-0) P: (EC 301 or EC 251H)
Economics of uncertainty and incomplete information. Game theory and theories of oligopoly. Transaction costs. Advanced topics in welfare economics, general equilibrium, externalities, and public goods.