101 Introduction to Crop Science
Fall, Spring. 3(3-0) R: Open to undergraduate students or agricultural technology students.

101L Introduction to Crop Science Laboratory
Fall. 10(0-2) P: CSS 101 or concurrently R: Open to undergraduate students or agricultural technology students.
Identification of crops, seeds, plant structures; plant nutrient deficiency symptoms; crop growth stages and environmental stresses including pests, nutrients, drought, and temperature. Field trips required.

105 Agricultural Industries Seminar
Fall. 1(2-0) R: Open to agricultural technology students in the Agricultural Industries Major. SA: AEE 105
Preparation for academic and professional success. Introduction to opportunities in the agriculture industry.

110 Computer Applications in Agronomy
Fall. 2(1-2) R: Open to undergraduate students or agricultural technology 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, spreadsheets, databases, programming languages, networking, and software related to agriculture.

120 Issues in Food and Agriculture
Fall, 3(3-0) R: Open to undergraduate students or agricultural technology students.
Current and historical issues impacting food and agriculture.

124 Introduction to Sustainable Agriculture and Food Systems
Fall, Spring. 2(2-0) Interdepartmental with Animal Science and Community Sustainability and Horticulture. Administered by Crop and Soil Sciences. R: Open to undergraduate students or agricultural technology students.
Contemporary research and movements involving agricultural and food system sustainability. Socio-cultural factors influencing food and agriculture.

135 Crop Scouting and Investigation
Spring. 3(4-0) Interdepartmental with Horticulture. Administered by Crop and Soil Sciences. P: CSS 101 or HRT 203 RB; CSS 101L R: Open to undergraduate students or agricultural technology students.
Crop scouting and agricultural clientele interactions for improved crop management. Offered first ten weeks of semester.

143 Introduction to Soil Science
Fall, Spring. 2(2-0) Fall: W. K. Kellogg Biological Station and Grand Rapids and Traverse City. R: Open to agricultural technology students in the Institute of Agricultural Technology. Not open to students with credit in CSS 210.
Soil and its impact on plant growth, plant and water relations, drainage, nutrients, soil as a resource, and erosion control techniques.

151 Seed and Grain Quality
Spring. 2(2-2) R: Open to undergraduate students or agricultural technology students. SA: CSS 051
Principles and practices of producing, conditioning, testing and marketing field crop seed. Grain grading and quality evaluation. Offered first ten weeks of semester.

171 Operations Budgeting for Golf Course Management
Spring. 3(3-0) RB: CSS 232 and CSS 210 SA: CSS 071

178 Turfgrass Irrigation
Spring. 3(3-2) P: CSS 232
Turfgrass 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
Fall. 1(0-4) R: Open to undergraduate students or agricultural technology students.
Career development, critical issues analysis, resume writing, scientific presentations and public speaking in crop and soil sciences.

201 Forage Crops
Fall. 3(2-2) R: Open to undergraduate students or agricultural technology students.
Forage crop production, management, and utilization; crop identification; soil fertilization; planting and harvesting of grasses and legumes.

202 World of Turf
Fall, Spring, Summer. 2(2-0) Not open to students or agricultural technology students.
Role of turf in society and the environment. Principles underlying establishment and maintenance of turf on athletic fields, parks, home lawns, and golf courses. Aesthetic, safety, and economic aspects of turfgrass management practices.

202L World of Turf Lab
Fall, Summer. 1(0-2) P: CSS 202 or concurrently Not open to students with credit in CSS 232.

210 Fundamentals of Soil Science
Fall, Spring. 3(2-3) RB: CEM 141 R: Open to undergraduate students or agricultural technology students.

212 Advanced Crop Production
Fall. 2(2-0) P: CSS 101 RB: CSS 210 and CSS 110 R: Open to undergraduate students or agricultural technology students.
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) R: Open to undergraduate students or agricultural technology students.
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.

224 Sustainable Farm and Food Systems Field Studies
Fall. 1(0-4) Interdepartmental with Animal Science and Community Sustainability and Horticulture. Administered by Crop and Soil Sciences. P: CSS 124 R: Not open to freshmen or agricultural technology students.
Field visits to farm and food system operations that utilize sustainable practices in Michigan. Offered first half of semester.

232 Turfgrass Management
Fall. 4(3-2) P: CSS 210 or concurrently RB: CSS 110 or CSE 101
Turfgrass utilization, identification, establishment and management principles. Responses to various cultural practices.

251 Organic Farming Principles and Practices
Spring. 3(3-0) Interdepartmental with Horticulture. Administered by Horticulture.
History and principles of organic farming. Farms as ecological systems. Certification process and agencies. Organic matter management, the soil food web, and nutrient availability. Biodiversity, crop rotations, plant competition, ground cover, and plant health. Integrating crops and animals. Organic animal husbandry. Field trip 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 turf students and industry professionals. Topics include internship experiences, technical expertise, and keys to successful career pathways.

264 Golf Course Design and Construction Techniques
Fall. 3(2-0) P: CSS 210 and CSS 232 and CSS 267 SA: CSS 164
Concepts and theory of golf course design and construction including location, space, topography, clientele, and environmental concerns.
Performance Turf Design and Construction
Spring, 2(2-2) P: CSS 232
Performance turfgrass design, construction, renovation and establishment principles.

Turfgrass Strategies: Integration and Synthesis
Spring, 2(3-0) P: CSS 232 and CSS 267
Issues in turfgrass management including employee relations, cultural, and environmental problems. Offered first ten weeks of semester.

Turfgrass Soil Fertility
Spring, 2(3-0) RB: CSS 210 SA: CSS 044, CSS 342
Soil-plant relationships, soil acidity and alkalinity, macro- and micro-nutrients, fertilizer materials, soil fertility, evaluations, and fertilizer programming. Offered first ten weeks of semester.

Turfgrass Physiology
Spring, 2(3-0) P: (CSS 232) Completion of Tier I writing requirement. RB: PLB 105 SA: CSS 392, CSS 688, 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.

Principles of Weed Management
Fall, 3(2-2) P: CSS 101 or PLB 105 or BS 161 or HRT 203 or CSS 232 or LB 145 R: Open to undergraduate students or agricultural technology students. SA: CSS 402, CSS 156, CSS 302
Cultural, mechanical, biological, and chemical weed management principles and practices. Environmental considerations. Field trips required.

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 to students in the Institute of Agricultural Technology. Approval of department; application required. SA: CSS 057
Field, laboratory, or library research problems.

Issues in International Agriculture
Spring, 1(1-0) P: Completion of Tier I Writing Requirement R: Open to undergraduate students or agricultural technology students. SA: CSS 494
Global issues related to food production, soil resources and sustainability of agriculture in developing and developed countries.

Soil Chemistry
Spring, 2(2-2) P: CSS 210 and CEM 141
Organic and inorganic soil processes including mineralogy, adsorption, desorption, and precipitation. Chemistry of soil organic matter and inorganic soil components.

Applied Soil Physics
Spring, 2(2-2) P: CSS 210
Soil physical properties including solids, water, air, and heat. Transport processes in soil.

Introduction to Plant Genetics
Spring, 3(4-0) P: PLB 105 or BS 161 R: Not open to freshmen. Fundamentals of plant genetics with applications to agriculture and natural resources.

Soil Biology
Fall, 3(2-2) P: CSS 210 RB: CSS 330
Overview of organismal diversity and biological soil processes. Role of macroorganisms and microorganisms in soil processing, including nutrient cycling.

Sustainable Agriculture and Food Systems: Integration and Synthesis
Fall, 3(3-0) Interdepartmental with Animal Science and Community Sustainability and Horticulture. Administered by Crop and Soil Sciences. P: CSS 124 and (CSS 224 or concurrently) R: Open to juniors or seniors or graduate students.


Microbial Ecology
Spring, 3(3-0) Interdepartmental with Microbiology and Molecular Genetics. Administered by 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.

International Agricultural Systems
Spring, 3(3-0) P: (ANR 250 or EEP 260 or ISS 310 or ISS 315 or ISS 318 or ISS 320 or ISS 330A or ISS 330B or ISS 330C) and writing requirement R: Not open to freshmen.

World production capacity for food, fiber and biofuel as related to soil, biology and climatic resources. Principles and case studies of sustainable systems presented from developing and developed countries. Emerging issues in agricultural globalization and biodiversity.

Plant Breeding and Biotechnology
Spring, 3(3-0) Interdepartmental with Forestry and Horticulture. Administered by Crop and Soils Sciences. P: CSS 101
Plant improvement by genetic manipulation. Genetic variability in plants. Traditional and biotechnological means of creating and disseminating recombinant genotypes and cultivars. Importance of plant breeding to our food system, economy, and environment.

Agricultural Ecology
Fall, 3(3-0) R: Open to juniors or seniors or graduate students.
Ecological principles in the design and management of agricultural ecosystems. Integration of ecological factors regulating crop and rangeland productivity.

Evolution (W)
Fall, Spring, Summer. 3(3-0) Interdepartmental with Integrative Biology and Plant Biology. Administered by Integrative Biology. P: (IBIO 341 or CSS 350) and completion of Tier I writing requirement R: Not open to freshmen. SA: ZOL 345, ZOL 445

Biotechnology Applications for Plant Breeding and Genetics
Spring, 3(2-2) Interdepartmental with Forestry and Horticulture. Administered by Crop and Soil Sciences. P: CSS 350 or IBIO 341 R: Open to juniors or seniors or graduate students.

Principles, concepts, and techniques of agricultural plant biotechnology. Recombinant DNA technology, plant molecular biology and transformation in relation to plant improvement.

Watershed Concepts
Fall, Spring, Summer. 3(3-0) Interdepartmental with Biosystems Engineering and Community Sustainability and Forestry and Fisheries and Wildlife. Administered by Community Sustainability. P: CSS 354 RB: Organic chemistry SA: RD 452, ESA 452
Watershed hydrology and management. The hydrologic cycle, water quality, aquatic ecosystems, and social systems. Laws and institutions for managing water resources.

Environmental Pollutants in Soil and Water
Spring, 3(3-0) P: CEM 143 or CEM 251 RB: CSS 210 R: Open to juniors or seniors or graduate students.
Environmental sources, physicochemical and biological processes, management of plant nutrients, heavy metals, organic contaminants, pesticides and pharmaceuticals in soil and water.

Seminar in Plant, Animal and Microbial Biotechnology
Spring, 1(1-0) Interdepartmental with Animal Science and Biosystems Engineering and Horticulture. Administered by Horticulture. P: (ANS 425 or concurrently) or (BE 360 or concurrently) or (CSS 451 or concurrently) or (MMG 445 or concurrently)
Current applications of plant, animal and microbial biotechnology in agriculture and related industries. Technologies under development and factors associated with moving from laboratory to product development. Field trips required.

Statistics for Biologists
Fall, 3(3-0) Interdepartmental with Animal Science and Statistics and Probability. Administered by Statistics and Probability. P: MTH 103 or MTH 110 or MTH 116 or MTH 132 RB: STT 421
Biological random variables. Estimation of population parameters. Testing hypotheses. Linear correlation and regression. Analyses of counted and measured data to compare several biological groups including contingency tables and analysis of variance.

BioEnergy Feedstock Production
Fall, 3(3-0) Interdepartmental with Biosystems Engineering and Forestry. Administered by Crop and Soil Sciences. P: MTH 103 or MTH 116 or MTH 124 or MTH 132 or LB 118 or MTH 152 or MTH 133 or MTH 153H or LB 119 RB: CSS 310 and CSS 210
Agronomic, economic, technological, and environmental principles involved in bioenergy feedstock production. Cultivation, harvest, transportation, and storage of agricultural and forest biomass.

Soil Resources
Fall, 3(2-3) P: 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.
477 Pesticides in Pest Management
Fall of even years. 3(3-0) Interdepartmental with Entomology and Horticulture. Administered by Entomology. RB: General chemistry, entomology, plant pathology, weed science. R: Open to juniors or seniors or graduate students. Chemistry, modes of action, product development and regulation of pesticides. Environmental and social aspects of pesticide use.

480 Soil Fertility and Management
Fall. 3(3-0) P: CSS 210 and (CSS 330 or CSS 340 or CSS 360 or (CSS 470 or concurrently)) R: Open to seniors in the Agronomy minor or in the Crop and Soil Sciences major. Comprehensive management of agricultural soils. Soil fertility, including liming and fertilizer materials and other nutrient sources. Site specific soil management. Environmental impacts including soil erosion, runoff, and organic matter mineralization.

486 Biotechnology in Agriculture: Applications and Ethical Issues
Fall of even years. 3(3-0) Interdepartmental with Forestry and Horticulture and Philosophy. Administered by Horticulture. P: BS 161 or PLB 105 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 completion of Tier I writing requirement. RB: (PLP 405 and ENT 404) and Course work in crop production and management. R: Open to seniors in the Agronomy minor or 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 6 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 6 credits in all enrollments for this course. P: CSS 101 or CSS 210 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 192 or CSS 262) and (CSS 210 and completion of Tier I Writing requirement) R: Open to seniors in the Department of Plant, Soil and Microbial 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
Summer. 3 credits. A student may earn a maximum of 6 credits in all enrollments for this course. A student may earn a maximum of 6 credits in all enrollments for any or all of these courses: ABM 493, ANR 493, ANS 493, CMP 493, CSS 493, CSUS 493, EEP 493, FIM 493, FSC 493, FW 493, HRT 493, PKG 493, and PLP 493. P: Completion of Tier I Writing Requirement R: Approval of department; application required. Supervised professional experiences in crop and soil sciences.

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.

802 Weed Biology
Spring of even years. 2(2-0) RB: A previous course in weed science or plant biology or ecology. Weed biology, including weed seed production and dispersal and seed fate. Weed life history traits and ecolophysiology, including invasive species. Data collection in weed ecology research.

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.

814 Advanced Statistics for Biologists

819 Advanced Plant Breeding
Fall of even years. 3(3-0) Interdepartmental with Forestry and Horticulture. Administered by Horticulture. RB: STT 422 and ZOL 341 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 of odd years. 1(3-0) Interdepartmental with Forestry and Horticulture and Plant Biology and Plant Pathology. Administered by Horticulture. RB: Introductory Genetics and Plant Biology Genetic processes underlying variations in plant reproductive biology and polyploidy. Utilization of these characteristics in plant breeding.

821 Crop Evolution
Spring of odd years. 1 credit. Interdepartmental with Forestry and Horticulture and Plant Biology and Plant Pathology. Administered by 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 Forestry and Horticulture and Plant Biology and Plant Pathology. Administered by Horticulture. RB: Introductory Genetics and Plant Biology Development and spread of the major crop species.

840 Soil Physics
Fall of odd years. 3(2-3) R: Open to graduate students in the College of Agriculture and Natural Resources or in the College of Engineering or in the 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.

842 Population Genetics, Genealogy and Genomics
Fall. 3(3-0) Interdepartmental with Animal Science and Forestry and Fisheries and Wildlife and Genetics and Agriculture. Administered by Forestry. RB: Pre-calculus, basic genetics Population genetic processes underlying patterns of molecular genetic variation. Genetic approaches to the study of genomic diversity, phylogenetic reconstruction, and molecular ecology.

850 Soil Chemistry
Spring. 3(3-3) R: Open to graduate students in the College of Agriculture and Natural Resources or in the College of Engineering or in the 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. Administered by Horticulture. RB: PLB 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 and Omic Biology
Spring. 3(3-0) Interdepartmental with Biochemistry and Molecular Biology and Plant Biology. Administered by Plant Biology. RB: ZOL 341 SA: BOT 856 Recent advances in genetics and molecular biology of higher plants.

865 Environmental Fate of Organic Contaminants in Soils
Spring of even years. 3(3-0) RB: Undergraduate level coursework in general and organic chemistry, and introductory microbiology Chemistry and biology of toxicants in soils as determinants of environmental fate.
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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 6 credits in all enrollments for this course. R: Open to graduate students in the College of Agriculture and Natural Resources or in the College of Engineering or in the College of Natural Science. Individual study on field, laboratory, or library research.

891 Current Topics in Ecology and Evolution
Summer. 1 to 2 credits. A student may earn a maximum of 6 credits in all enrollments for this course. Interdepartmental with Integrative Biology and Plant Biology. Administered by Integrative Biology. SA: ZOL 891 Presentation and critical evaluation of theoretical and empirical developments in ecology and evolutionary biology 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 Forestry and Horticulture. Administered by Horticulture. 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 Forestry and Horticulture. Administered by Horticulture. Experience in review, organization, oral presentation, and analysis of research.

892B Ecological Food and Farming Systems Seminar
Fall, Spring. 1 credit. Interdepartmental with Community, Agriculture, Recreation and Resource Studies. Administered by Crop and Soil Sciences. Experiential learning, and multidisciplinary and applied research, in ecological food and farming systems.

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 to graduate students in the College of Agriculture and Natural Resources or in the College of Engineering or in the 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 to master's students in the Department of Plant, Soil and Microbial Sciences. Master's thesis research.

921 Geostatistics
Fall of odd years. 3(3-0) RB: Statistical methods or approval of department. Working knowledge of SAS software. Spatial variability analysis. Variogram models. Kriging and cokriging. 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 and Horticulture. Administered by Crop and Soil Sciences. 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 36 credits in all enrollments for this course. R: Open to doctoral students in the Department of Plant, Soil and Microbial Sciences. Doctoral dissertation research.