<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>CSS 101</td>
<td>Introduction to Crop Science</td>
<td>Fall, Spring; 3(3-0); R: Open to undergraduate students or agricultural technology students. Principles of crop production including integrated crop management. Sustainable agriculture. International agriculture. Environmental challenges to crop production.</td>
</tr>
<tr>
<td>CSS 104L</td>
<td>Introduction to Crop Science Laboratory</td>
<td>Fall; 1(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.</td>
</tr>
<tr>
<td>CSS 105</td>
<td>Agricultural Industries Seminar</td>
<td>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.</td>
</tr>
<tr>
<td>CSS 106</td>
<td>Computer Applications in Agronomy</td>
<td>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.</td>
</tr>
<tr>
<td>CSS 120</td>
<td>Issues in Food and Agriculture</td>
<td>Fall; 3(3-0); R: Open to undergraduate students or agricultural technology students. Current and historical issues impacting food and agriculture.</td>
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<tr>
<td>CSS 124</td>
<td>Introduction to Sustainable Agriculture and Food Systems</td>
<td>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. Sociocultural factors influencing food and agriculture.</td>
</tr>
<tr>
<td>CSS 126</td>
<td>Introduction to Weed Management</td>
<td>Fall; 2(2-0); P: CSS 101 or CSS 232 or HRT 109; R: Open to students in the Institute of Agricultural Technology. SA: CSS 156 Biology, identification, and management of weeds.</td>
</tr>
<tr>
<td>CSS 135</td>
<td>Crop Scouting and Investigation</td>
<td>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.</td>
</tr>
<tr>
<td>CSS 201L</td>
<td>World of Turf Lab</td>
<td>Fall, Spring, Summer; 1(0-2); P: CSS 202 or concurrently; Not open to students with credit in CSS 232. Turfgrass identification. Site analysis and recommendations. On campus facility and venue visits. Mowing equipment and practices. Turf establishment. Soil cultivation and amendments. Fertilizer and pest management. Field trips required.</td>
</tr>
<tr>
<td>CSS 210</td>
<td>Fundamentals of Soil Science</td>
<td>Fall; Spring; 3(2-3); R: CEM 141 R: Open to undergraduate students or agricultural technology students. 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.</td>
</tr>
<tr>
<td>CSS 212</td>
<td>Advanced Crop Production</td>
<td>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.</td>
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<tr>
<td>CSS 222</td>
<td>New Horizons in Biotechnology</td>
<td>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.</td>
</tr>
<tr>
<td>CSS 224</td>
<td>Sustainable Farm and Food Systems Field Studies</td>
<td>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.</td>
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<tr>
<td>CSS 226L</td>
<td>Weed Science Laboratory</td>
<td>Fall; 1(0-2); P: (CSS 126 or concurrently) or (CSS 326 or concurrently)); and (CSS 101 or CSS 232 or HRT 203 or HRT 109) SA: CSS 156, CSS 302, CSS 402 Weed and weed seed collection and identification. Mechanical and chemical tools involved in managing weeds. Herbicide application and calibration. Weed and crop selectivity, crop injury symptoms.</td>
</tr>
<tr>
<td>CSS 232</td>
<td>Turfgrass Management</td>
<td>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.</td>
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Crop and Soil Sciences—CSS

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. 2(2-2) 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.

267 Performance Turf Design and Construction
Spring. 2(2-2) P: CSS 232
Performance turfgrass design, construction, renovation and establishment principles.

269 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.

272 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.

282 Turfgrass Physiology
Spring. 2(3-0) P: (CSS 232) Completion of Tier I writing requirement. RB: PLB 105 SA: CSS 382, CSS 068, 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 to students in the Institute of Agricultural Technology. Approval of department; application required. SA: CSS 057 Field, laboratory, or library research problems.

294 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.

313 Data Interpretation and Writing in the Agronomic Sciences
Spring. 2(2-0) P: (CSS 110 and CSS 210) and (CSS 101 or CSS 232) R: Not open to freshmen.
Data analysis, interpretation, integration, and technical writing in agronomic sciences.

326 Weed Science
Fall. 2(2-0) P: CSS 101 or CSS 232 or HRT 203 R: Not open to students in the Institute of Agricultural Technology. SA: CSS 302, CSS 402 Weed biology and ecology, integrated weed management including cultural, mechanical, biological, and chemical control practices. Herbicide mode of action, selectivity in plants, environmental considerations.

330 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.

331 Water Management in Agriculture and Food Systems
Spring. 3(3-0) Interdepartmental with Technology Systems Management. Administered by Technology Systems Management. P: MTH 103 or MTH 124 or MTH 132 or LB 118 SA: TSM 431 Principles of water management, use efficiency and conservation in agricultural production, natural resource and food processing facilities. Best agricultural water management practices, water rights, irrigation scheduling, irrigation systems selection, evaluation and management and drainage principles. Large scale water use, management and conservation in food processing.

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

343 Principles of Precision Agriculture

350 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.

360 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.

424 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 101 or (CSS 224 or concurrently) R: Open to juniors or seniors or graduate students. Biogeochemical and socio-economic aspects of food, fiber, and fuel production. Environmental impacts and social context. Experiential learning projects.

425 Microbial Ecology
Spring. 3(3-0) Interdepartmental with Microbiology and Molecular Genetics. Administered by Microbiology and Molecular Genetics. P: (CSS 350 or concurrently) R: Not open to freshmen. Microbial microbial and community interactions. Microbial activities in natural systems, including associations with plants or animals.

431 International Agricultural Systems
Spring. 3(3-0) P: (ANR 250 or ANR 315 or ANR 318 or ANR 320 or CSS 330A or CSS 330B or ISS 330C or ISS 336) and completion of Tier I 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.

441 Plant Breeding and Biotechnology
Spring of even years. 3(3-0) Interdepartmental with Forestry and Horticulture. Administered by Crop and Soil Sciences. P: (CSS 350 or concurrently) or (IBIO 341 or concurrently) R: Not open to freshmen. Plant improvement by genetic manipulation. History of plant breeding. Traditional and biotechnological means of improving plant cultivars by genetic manipulation. Importance of plant breeding to our food system, economy, and environment.

442 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.

445 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 Processes of evolutionary change in animals, plants. Microbes. Population genetics, microevolution, speciation, adaptive radiation, macroevolution. Origin of Homo sapiens.

451 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.

452 Watershed Concepts
Fall, Spring, Summer. 3(3-0) Interdepartmental with Agricultural Engineering and Forestry and Fisheries and Wildlife. Administered by Agricultural Engineering. RB: Organic chemistry SA: ESA 452, RD 452, CSSUS 452 Watershed hydrology and management. The hydrologic cycle, water quality, aquatic ecosystems, and social systems. Laws and institutions for managing water resources.
Environmental sources, physiochemical and biological processes, management of plant nutrients, heavy metals, organic contaminants, pesticides and pharmaceuticals in soil and water.

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.

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.

Agronomic, economic, technological, and environmental principles involved in bioenergy feedstock production. Cultivation, harvest, transportation, and storage of agricultural and forest biomass.

Evaluation of the properties, genetics, and classification of soil resources to assist in making land-use decisions.

Chemistry, modes of action, product development and regulation of pesticides. Environmental and social aspects of pesticide use.

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.

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.

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.

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 and approval of department; application required. 

Individual work on field, laboratory, or library research problem of special interest to the student.

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 and approval of department; application required. 

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.

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.

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.

Undergraduate Research
Fall, Spring. Summer. 3(0-9) A student may earn a maximum of 9 credits in all enrollments for this course. R: Approval of department; application required. 

Faculty supervised research in a selected area of crop and soil sciences or environmental and soil science.

Weed Biology
Spring of even years. 2(2-0) R: 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 ecophysiology, including invasive species. Data collection in weed ecology research.

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.

Advanced Statistics for Biologists


Advanced Plant Breeding
Fall of even years. 3(3-0) Interdepartmental with Forestry and Horticulture and Plant Pathology. 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.

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.

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.

Forum in Computational and Plant Sciences
Fall. Spring. 1(1-0) A student may earn a maximum of 4 credits in all enrollments for this course. Interdepartmental with Biochemistry and Molecular Biology and Computational Mathematics, Science, & Engineering and Horticulture and Plant Biology. Administered by Plant Biology.

Professional development focused on diverse modes of communication in support of interdisciplinary science with an emphasis on plant and computational sciences.
Crop and Soil Sciences—CSS

846 Integrated Climate and Cropping System Modeling
Spring of odd years. 3(3-0) Interdepartmental with Biosystems Engineering. Administered by Crop and Soil Sciences. RB: GEO 402
Crop simulation modeling for water and nutrient use under resource limitations and varying climatic conditions.

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 Geological Sciences. 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

863 Mineral-Water Interactions
Fall of even years. 4(3-2) Interdepartmental with Geological Sciences. Administered by Geological Sciences. R: Open only to graduate students in the Department of Crop and Soil Sciences or Department of Geological Sciences or Department of 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 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.

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

890 Independent Study
Fall, Spring. 1 to 6 credits. A student may earn a maximum of 8 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 10 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. R: Open only to graduate students in the Plant Breeding and Genetics major or Genetics major. 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 6 credits in all enrollments for this course. Interdepartmental with Forestry and Horticulture. RB: Open to graduate students in the College of Agriculture and Natural Resources or in the College of Engineering.
Experience in review, organization, oral presentation, and analysis of research.

892B Ecological Food and Farming Systems Seminar
Fall, Spring. 1 credit. Interdepartmental with Community, Ag, Recreation & Res 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.

941 Quantitative Genetics in Plant Breeding
Spring of even years. 3(2-0) 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.