

Regularly-offered Water Courses

Please check the MSU website for current course offerings, prerequisites, and restrictions.

Department	Course Number	Course Title	Offered	Course Description
AEC	829	The Economics of Environmental Resources	Spring	Economic principles, theoretical models, and empirical methods related to environmental problems and policy interventions. Applications to air, land, water, forests, energy, fish and wildlife, and climate change, including in developing countries.
BE	230	Engineering Analysis of Biological Systems	Spring	Biosystems modeling of growth and dynamic interactions. Conservation of mass, and sustainability. Steady-state and stability analysis. Ecological concepts. Life-cycle analysis. Design for environment.
BE	351	Thermodynamics for Biological Engineering	Fall	Thermodynamics of biological systems. First and second laws of thermodynamics. Power and refrigeration cycles. Water relations and psychrometry. Chemical and phase equilibria.
BE	481	Water Resources Systems Analysis and Modeling	Fall	Hydrology of natural systems. Quantifying runoff, infiltration, and evapotranspiration. Geospatial data collection at watershed scale. Geographical information system application in hydrology and ecosystems engineering. Watershed modeling and applications in engineering design and decision-making.
BE	482	Diffuse-Source Pollution Engineering	Spring	Identification, estimation, and control of diffuse source pollution from agricultural and urban sources. Analysis of diffuse source pollutants in biological systems. Engineering design of practices and structures to prevent, mitigate, and treat diffuse source pollution, including low impact development (LID) strategies.
BE	845	Biosensor Principles and Applications	Spring	Nanotechnology-based biosensors, their components, desirable properties, and associated electronics. Applications related to healthcare, biodefense, food and water safety, agriculture, bio-production, and environment. Multidisciplinary interactions necessary for biosensor development.
BE	881	Ecohydrology	Fall, odd years	Identify and quantify the critical linkages between ecological processes and the hydrological cycle.

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Department	Course Number	Course Title	Offered	Course Description
BE	882	Advanced Topics in Ecological Engineering	Fall	Rural and suburban water quality challenges. Science and design of rural and suburban water treatment and resource recovery systems.
CE	492	Selected Topics in Civil Engineering	Fall, Spring	Selected topics related to construction engineering, fluid mechanics, geotechnical engineering, hydrology, pavements, structural engineering, or transportation engineering.
CMP	230	Utility Systems	Spring	Heating, cooling, ventilating, electrical, gas, lighting, water, waste water, telecommunications, fire protection, safety, security, and sound control systems in residential and commercial construction. Applicable codes.
CMP	305	Site Construction and Measurement	Fall	Site construction methods, materials and equipment for buildings, soil, foundation, erosion, and storm water. Layout, leveling, surveying, and underground utilities.
CSS	101	Introduction to Crop Science	Fall	Principles of crop production including crop and soil management and improvement. International and sustainable agriculture. Water quality issues.
CSS	178	Turfgrass Irrigation	Spring	Turfgrass irrigation systems. Installation and maintenance including water management. Offered first ten weeks of semester.
CSS	210	Fundamentals of Soil Science	Fall, Spring	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.
CSS	282	Turfgrass Physiology	Spring	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.
CSS	340	Applied Soil Physics	Spring	Soil physical properties including solids, water, air, and heat. Transport processes in soil.

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CSS	382	Turfgrass Physiology	Spring	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.
CSS	442	Agricultural Ecology		Ecological principles in the design and management of agricultural ecosystems. Integration of ecological factors regulating crop and rangeland productivity.
CSS	455	Environmental Pollutants in Soil and Water	Spring	Environmental sources, physiochemical and biological processes, management of plant nutrients, heavy metals, organic contaminants, pesticides and pharmaceuticals in soil and water.
CSS	850	Soil Chemistry	Spring	Ion activities, ionic exchange and equilibrium reactions. Soil pH, macro- and micronutrients, saline soils and availability of nutrients to plants.
CSUS	354	Water Resource Management	Spring	Biophysical, community, and institutional components of comprehensive water resources management. Biophysical and social processes that control the quality and quantity of aquatic resources at the watershed level.
CSUS	452	Watershed Concepts	Fall, Spring, Summer	Watershed hydrology and management. The hydrologic cycle, water quality, aquatic ecosystems, and social systems. Laws and institutions for managing water resources.
CSUS	476	Natural Resource Recreation Management	Fall	Natural resource recreation management principles, tools and models. Applications to trail, camping, watercraft and dispersed recreation settings. Security of visitors, resources and facilities. Case studies and integrated problem solving. Offered first half of semester.
CSUS	841	Building and Implementing Watershed Management Plans	Fall, Spring, Summer	Developing and implementing watershed management plans. Problem definition, data collection, public consultation, and program evaluation.
CSUS	842	Watershed Assessments and Tools	Fall, Spring, Summer	Assessing and predicting physical, chemical, biological and socioeconomic conditions within watersheds. Tools and techniques for identifying, evaluating, and prioritizing problems.

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Department	Course Number	Course Title	Offered	Course Description
CSUS	843	Legal, Financial and Institutional Frameworks in Watershed Management	Fall, Spring, Summer	Watershed management laws and regulations. Resolving financial and human conflicts arising from regulation.
ENE	280	Principles of Environmental Engineering and Science	Fall, Spring	Physical, chemical and biological processes related to environmental science and engineering. Environmental systems analysis with application to air, water and soil. Analysis of environmental problems and development of engineering solutions.
ENE	421	Engineering Hydrology	Fall	Hydrologic design of storm water systems. Equilibrium hydrograph analysis, unit hydrographs, infiltration, hydrograph synthesis, and reservoir routing. Groundwater: Darcy's law, flow nets, well hydraulics, design of capture wells.
ENE	483	Water and Wastewater Engineering	Fall	Engineering and scientific basis and design of physical, chemical and biological methods for the treatment of drinking water and wastewater. Operation process selection and design.
ENE	487	Microbiology for Environmental Science and Engineering	Spring	Fundamentals of microbiology. Application of these concepts to environmental processes such as wastewater treatment, human health and bioremediation.
ENE	492	Selected Topics in Environmental Engineering	Fall, Spring	Selected topics related to environmental engineering, fluid mechanics and hydrology.
ENE	802	Physicochemical Processes in Environmental Engineering	Fall	Physical and chemical principles of air and water pollution control and environmental contaminants in water, air and soils.
ENE	803	Water Quality and Public Health	Spring, odd years	Principles, applications, and latest research in the area of water quality and public health. Various chemical and microbiological water contaminants and their health effects. Concepts of public health and epidemiology, principles of toxicology, exposure characterization and risk assessment approaches, water management alternatives, and global issues of concern.
ENE	804	Biological Processes in Environmental Engineering	Fall	Engineering of microbial processes used in wastewater treatment, in-situ bioreclamation, and solid waste stabilization.

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Department	Course Number	Course Title	Offered	Course Description
ENE	805	Contaminated Site Remediation	Spring, odd years	Key topics within contaminated site remediation. Regulations relevant to remediation. Site characterization and assessment. Removal technologies, mechanisms involved, variations in approaches, advantages and limitations. Case studies for each method. Overview of air treatment technologies. Remediation approaches for problematic groundwater contaminants.
ENE	821	Groundwater Hydraulics	Fall	Physical properties of porous media. Equations of flow in saturated media. Flow nets, well flow and parameter measurement. Transport processes and the advective-dispersion equation for conservative contaminants.
ENE	822	Groundwater Modeling	Spring, even years	Analysis and modeling of groundwater flow, surface water and groundwater interaction, and reactive contaminant transport. Applied numerical methods for solving groundwater flow and contaminant transport equations. Case studies.
ENE	823	Stochastic Groundwater Modeling	Spring, odd years	Analysis and modeling of flow and solute transport in heterogeneous aquifers. Geostatistics and variogram modeling. Upscaling and effective models. Uncertainty modeling. Perturbation methods and Monte Carlo simulation.
ENE	829	Mixing and Transport in Surface Waters	Fall, odd years	Waves, tides and shallow-water processes. Numerical solutions and applications of shallow-water equations to lakes, rivers and estuaries. Principles and processes of sediment transport, and dispersion of materials in surface waters. Wind-driven circulation in Lake Michigan.
ENT	422	Aquatic Entomology	Fall, odd years	Biology, ecology and systematics of aquatic insects in streams, rivers and lakes. Field trips and aquatic insect collection required.
ENT	469	Biomonitoring of Streams and Rivers	Summer, odd years	Practical field and lab rapid bioassessment methodologies used to sample and assess the biota of streams and rivers. Sampling and identification of fish, macroinvertebrates and other biota.

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Department	Course Number	Course Title	Offered	Course Description
FOR	466	Natural Resource Policy	Spring	Natural resources policy-making in the context of scientific, environmental, social, and legal-institutional factors. Historical evolution of policies and case studies of contemporary policy issues.
FOR	465	Environmental Law and Policy	Fall	Legal principles and process related to the environment and natural resources. Common law, constitutional law, statutory and administrative law.
FW	101	Fundamentals of Fisheries and Wildlife Ecology and Management	Fall	Ecological and sociological concepts of fisheries and wildlife ecology and management. Career opportunities.
FW	110	Conservation and Management of Marine Resources	Spring	Marine environment, resource distribution, and human impacts on selected marine commercial fisheries. Conflicts in management goals between government and industry. Management goals and techniques in preserving and conserving marine resource biodiversity.
FW	181	Introduction to Science, Technology, the Environment and Public Policy	Fall	Relation of science and technology to ethics and public policy. Environmental law and public policy. Managing fish, water and wildlife resources at state, national, and international levels. Science and technology in developing countries. Impacts of military technology on environmental policy.
FW	207	Great Lakes: Biology and Management	Fall	Living aquatic resources of the Great Lakes, environmental history, and biological resources and their management. Policy issues.
FW	211	Introduction to Gender and Environment Issues	Spring	The concept of gender. Overview of environment and habitat. Historical gender roles in environmental management. Gender-based theoretical perspectives. Case studies on developing and developed countries. Environmental management with emphasis on fisheries, wildlife and wetlands. Women environmental professionals.
FW	238	Introductory Fisheries and Wildlife Field Experience	Summer	Terrestrial and aquatic field research techniques and their application to current issues. Interaction with professionals. Field trips required.
FW	293	Undergraduate seminar in Fisheries and Wildlife	Fall, Spring	Professional development and discussion of current case studies to prepare students for a career in Fisheries and Wildlife.

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Department	Course Number	Course Title	Offered	Course Description
FW	414	Aquatic Ecosystem Management	Fall	Management of aquatic habitats and populations for ecological and socioeconomic objectives; human impacts on aquatic ecosystems. Field trips required.
FW	416	Marine Ecosystem Management	Fall	Management of marine ecosystems and populations for ecological and socio-economic objectives. Anthropogenic impacts, mitigation, and marine resource conservation strategies. Field trips required.
FW	417	Wetland Ecology and Management	Fall	Biological, physical, and chemical processes controlling wetland structure and function. Utilization, mitigation, and conservation of wetlands on a sustainable basis.
FW	420	Stream Ecology	Fall	Biological and environmental factors determining structure and function of stream ecosystems.
FW	423	Principles of Fish and Wildlife Disease	Fall, odd years	Diseases of fish and wildlife species. Disease detection and diagnosis. Ecological and epidemiological analysis and management of major classes of wildlife diseases. Threatened and endangered species, game species, and fish and wildlife species that serve as vectors or reservoirs of human and domestic animal diseases.
FW	423L	Principles of Fish and Wildlife Disease Lab	Fall, odd years	Tools for diagnosis and assessment of disease in fish and wildlife populations.
FW	431	Ecophysiology and toxicology of fishes	Spring, odd years	Physiological processes and the effect of anthropogenic stresses on fishes. Fate of contaminants in the environment and biota. Individual, population and community effects. Temporal, spatial and scaling issues. Modeling tools and environmental risk assessment.
FW	454	Environmental Hydrology for Watershed Management	Spring, odd years	Effect of climate, topography, geology, soil, vegetation, and anthropogenic land uses on the amount, timing, and quality of water yield. Implications for fish and wildlife resource management. Field trips required.
FW	471	Ichthyology	Spring	Fish morphology and physiology. Development, behavior, evolution, and ecology. World fishes with emphasis on freshwater fishes. Field trips required.
FW	472	Limnology	Spring	Ecology of lakes with emphasis on interacting physical, chemical, and biological factors affecting their structure and function.

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Department	Course Number	Course Title	Offered	Course Description
FW	474	Field and Laboratory Techniques for Aquatic Studies	Fall	Field and laboratory techniques for the investigation and analysis of lake and stream ecosystems and their biota. Field trips required.
FW	479	Fisheries Management	Spring	Quantitative analysis of fish populations. Case study of ecological interactions linking fish to aquatic ecosystems and the challenge of balancing multiple human values in managing fisheries resources. Field trips required.
FW	868	Water Policy and Management	Fall, odd years	Environmental policy issues associated with the use, management, and protection of water resources and aquatic ecosystems. Case studies in water science and management.
FW	877	Fish Population Dynamics	Fall, even years	Quantitative analysis of fish populations. Evaluation, causes, and impacts of the rates of change in survival, growth, reproduction, and recruitment for fish populations and their yield.
FW	879	Advanced Limnology	Spring, even years	Theory and management of streams, rivers, lakes, reservoirs, and other deepwater habitats from ecosystem and landscape perspectives.
FW	101L	Fundamentals of Fisheries and Wildlife Ecology and Management Lab	Fall	Natural history and ecology of primary terrestrial, wetland, and aquatic ecosystems. Species and communities in Michigan and the United States. Species identification in various ecosystem types. Impacts of disturbances on ecosystems. Field trips required.
GEO	208	Physical Geography of the National Parks	Fall, odd years	Physical features such as geology, landforms, biota, and waters of United States and Canadian national parks, forests, seashores and lakeshores. Emphasis on formation and distribution.
GEO	211	Environmental Policy & Practice	Fall	Systematic study of environmental policy and resource management practices in the United States and the broader global context, emphasizing geographical and other social sciences perspectives.
GEO	306	Environmental Geomorphology	Spring, odd years	Relationships of running water, weathering, gravity, ice, waves, wind, and biota (including humans) to terrain and soils. Evolution of landscapes. Classical and modern interpretations.

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Department	Course Number	Course Title	Offered	Course Description
GEO	324	Remote Sensing of the Environment	Fall	Features and interpretation methods of remotely-sensed imagery, especially black-and-white and color infrared airphotos. Basic features of radar, thermal, and multispectral imagery. Interpretation for agriculture, archaeology, fisheries, forestry, geography, landscape architecture, planning, and wildlife management.
GEO	333	Geography of Michigan and the Great Lakes Region	Spring	Michigan's physical, historical, and economic geography. Interrelationships between the physical environment (rocks, landforms, soils, climate, vegetation, hydrology) and historical and contemporary land uses. Demographic and agricultural patterns. Human history and settlement patterns. Contemporary recreational opportunities.
GEO	402	Agricultural Climatology	Fall, even years	Relationships between climate and agriculture in resource assessment, water budget analysis, meteorological hazards, pests, crop-yield modeling, and impacts of global climate change.
GEO	409	Global Climate Change and Variability	Fall, odd years	Analysis of climate change and variability at various time and space scales. Climate systems, paleoclimatology, global warming, climate models, and climate impact assessment.
GEO	411	Stream Systems and Landforms	Spring, even years	Themes associated with stream systems. Evolution of drainage basins and channel hydrology. The nature of flowing water, stream discharge, and flooding. Controls of stream behavior. Channel patterns and landform development. Character of Michigan stream systems. Field project.
GEO	492	Geographic Research Problems	Fall, odd years	Supervised original research on selected aspects of geography.
GEO	892	Advanced Research in Geography (Section 001 Climate Change seminar)	Fall, even years	Advanced independent research
GLG	301	Geology of Continents and Oceans	Spring	Geological, physical and chemical processes related to the origin and evolution of the Earth, North American continent, and the Great Lakes environment. Soils, hydrology, Earth materials, geologic risks.

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Department	Course Number	Course Title	Offered	Course Description
GLG	411	Hydrogeology	Fall	Source, occurrence, and movement of groundwater emphasizing geologic factors and controls.
GLG	421	Environmental Geochemistry	Spring	Natural and anthropogenic processes affecting the chemistry of the environment with an emphasis on the water cycle. Equilibria and kinetic balances, biogeochemical cycling, contaminant chemicals, chemical origins, environmental health.
GLG	471	Applied Geophysics	Spring	Application of seismic, gravity, magnetic, resistivity, and electromagnetic methods to problems related to engineering studies, mineral and oil exploration, groundwater, subsurface mapping, pollution, and hazardous waste.
GLG	481	Reservoirs and Aquifers	Spring, odd years	Principles of the origin and evolution of porous media. Porosity and permeability of sediments and sedimentary rocks. Computing techniques for evaluating reservoirs and aquifers. Field trip required.
GLG	803	Seminar in Hydrogeology	Fall, Spring	Occurrence, movement and composition of groundwater in geologic settings.
GLG	821	Aqueous Geochemistry	Fall, odd years	Controls on the chemical and isotopic nature of water (fresh, marine, brine) and its solutes. Data acquisition and synthesis. Chemical modeling and evolution of water masses.
GLG	893	Special Problems in Hydrogeology	Fall, Spring, Summer	Individual study on the movement, occurrence and composition of groundwater in geologic environments.
HM	811	Public Health in the Middle East and North Africa	Summer	Introduction to public health in Middle East and North Africa; demography, disease patterns, food security, water, climate change. Effects of social justice and governance issues on public health such as health disparities, women/maternal and child health, aging, natural disasters and geopolitical conflicts.
HM	839	Water and Public Health: A Global Perspective	Spring, odd years	Role of water in public health, focusing on the global crisis of water quantity and quality. Specific water "hot spots" primarily the Middle East, Africa, Asia, the Western and Southern U.S., and Mexico.

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HM	870	Zoonotic Diseases of Public Health Importance	Fall, odd years	Zoonotic diseases by agent (bacterial, viral, parasitic, prion, rickettsial, fungal), modes of transmission (direct, indirect-food, water, vectorborne), and human, animal, environmental interactions leading to disease intervention/control methods. Impacts of climate change and changing dynamics of the human population (migration, global travel, shifts in housing preferences and urbanization) and the animal population.
HRT	218	Irrigation Systems for Horticulture	Spring	Design, installation and maintenance of irrigation systems for turfgrass and landscape plants. Design hydraulics, equipment selection, pump stations, water features, water quality and conservation.
HRT	220	Annual and Aquatic Landscape Plants	Fall	Identification and evaluation of annuals, biennials and aquatic plants used in landscapes and for other horticultural purposes.
ISE	832	Earth Science I	Summer	The solar system, including the sun, planets, earth, and its moon. Weather and the water cycle.
ISP	203A	Global Change	Fall, Spring, Summer	Science as a way of knowing about natural and anthropogenic global change. Implications for societies.
ISP	207	World of Chemistry	Fall, Spring, Summer	The language, concepts, models and techniques of chemical science, including atomic theory; nuclear energy; acids; chemicals in air, water, food and biological systems.
ISP	217	Water and the Environment	Fall, Spring	Application of the scientific method to identification and solution of environmental problems related to water.
ISP	207L	World of Chemistry Lab	Fall, Spring, Summer	Chemical combinations and reactivity with respect to such materials as acids, bases, dyes, foods, and detergents.
ISP	217L	Water and the Environment Lab	Fall, Spring	Application of the scientific method to identification and solution of environmental problems related to water.
JRN	472	Lab Environmental Journalism	Fall, Spring	Topics may include investigative environmental reporting, environmental video storytelling, wilderness experience and environmental writing.
LAW	523	Regulated Industries	Fall, Spring, Summer	Government regulation of electricity, gas, water, communications, and other highly-regulated industries.

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LAW	566D	Water Law	Spring	This course examines water rights under the riparian doctrine and the prior appropriation system.
PDI	636	Aquatic Animal Medicine Clerkship	Spring	Clinical, laboratory, and ecological principles of disease of aquatic organisms with special emphasis on impacts and management. Critical analysis and review of selected case studies and disease control regimen.
PKG	370	Packaging and the Environment	Spring	Effects of packaging on environmental quality. Solid waste. Air and water quality. Laws, economics and energy. Resource use and conservation.
PLB	218	Plants of Michigan	Fall	Plant taxa of Michigan and the Great Lakes region and the major habitats in which they occur. Principles and rationale of classification. Relationships between life histories, morphology and environment.
PLB	301	Introductory Plant Physiology	Fall	General principles of plant physiology relating plant structure to function. Cell physiology, water relations, effects of light and temperature, respiration, photosynthesis, mineral nutrition, and hormone action.
PLB	415	Plant Physiology	Spring	Principles of plant metabolism, growth, and development. Photosynthesis, water relations, nitrogen metabolism, and cell wall biosynthesis. Environmental and hormonal factors that control plant growth and development. Gene regulation and genetic engineering of plants.
PLB	424	Algal Biology	Fall even years, Summer odd years	Algal taxonomy, systematics, physiology, ecology, and environmental assessment. Lab focus on identification of freshwater algal genera collected from regional habitats.
PLB	863	Environmental Plant Physiology	Spring, odd years	Interaction of plant and environment. Photobiology, thermophysiology, and plant-water relations.
PLB	416L	Plant Physiology Laboratory	Spring	Experimental methods and experiment design in plant physiology and molecular biology, with emphasis in photosynthesis, water relations, plant growth, plant development, genetics and gene regulation. Communication of scientific information in written and graphical format.

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Department	Course Number	Course Title	Offered	Course Description
TSM	331	Water Management in Agriculture and Food Systems (Interim)	Spring	Principles of water management, use efficiency and conservation in agricultural production, natural resources 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.
TSM	431	Irrigation, Drainage and Erosion Control	Fall	Soil and water conservation engineering, including land and soil surveying, basic hydraulics, hydrology, soil moisture, and soil and water conservation practices. Applications to irrigation, drainage, and erosion control systems.
ZOL	303	Oceanography	Fall	Physical, chemical, biological, and geological aspects of oceanography: ocean circulation, waves, tides, air-sea interactions, chemical properties of ocean water, ocean productivity, shoreline processes, and sediments.
ENT	319	Introduction to Earth System Science	Fall	Systems approach to Earth as an integration of geochemical, geophysical, biological and social components. Global dynamics at a variety of spatio-temporal scales. Sustainability of the Earth system.
ZOL	384	Biology of Amphibians and Reptiles (W)	Fall	The evolution, systematics, ecology, and behavior of amphibians and reptiles. Laboratory emphasizes diversity and identification of families and Great Lakes species. Field trips may be required.
ZOL	824	Stable Isotope Biogeochemistry	Spring, even years	Principles of stable isotope chemistry applied to biogeochemical problems: climate change, ecology, contaminants, oceanography, limnology, and paleobiology.