

# Environmental Resources Engineering

## LOWER DIVISION

**ENGR 114. Whole Earth Engineering** (2). Apply engineering and science concepts and methods to self-sufficient habitat systems: housing, energy, water and food supply. [CR/NC. Not allowed for credit toward major in engineering.]

**ENGR 115. Introduction to Environmental Science & Engineering** (3). Case studies in water quality, water resources, energy resources, and geotechnical resources. [Prereq: MATH 115 (C) or Math Code 50. Weekly: 2 hrs lect, 3 hrs lab.]

**ENGR 210. Solid Mechanics: Statics** (3). Particle and rigid body equilibrium; vector concepts; equivalent systems of forces; centroids; moments of inertia; friction. Must be taken concurrently with ENGR 225. [Prereq: MATH 109 or Math Code 65. Weekly: 2 hrs lect, 3 hrs lab.]

**ENGR 211. Solid Mechanics: Dynamics** (3). Kinetics and kinematics of particles; work and energy; impulse and momentum; kinematics and plane motion of rigid bodies. Engineering design applications. Must be taken concurrently with ENGR 325. [Prereq: MATH 110, ENGR 210, ENGR 215. For engineering majors, this is prereq. to PHYX 110. Weekly: 2 hrs lect, 3 hrs lab.]

**ENGR 215. Introduction to Design** (3). Engineering design process, including critical analysis of problems, teamwork, Internet, word processing, spreadsheets, computer-aided drawing. Engineering design applications. [Prereq: ENGR 115 and MATH 109 (C) or Math Code 65. Weekly: 2 hrs lect, 3 hrs lab.]

**ENGR 225. Computational Methods for Environmental Engineering I** (3). Introduction to computer computational methods for environmental engineering analysis and design using MATLAB and the Fortran 95 programming language. Must be taken concurrently with ENGR 210. [Prereq: ENGR 115, MATH 109 or Math Code 65. Weekly: 2 hrs lect, 3 hrs lab.]

**ENGR 280. Selected Topics in Engineering** (1-3). Selected topics offered at the lower division level as demand warrants. Lect/lab as appropriate. [Prereq: vary with topics. Rep. with different topic.]

## UPPER DIVISION

**ENGR 305. Appropriate Technology** (3). Engineering technology principles. Energy, waste disposal, food production technologies. Lab exercises involve working systems at Campus Center for Appropriate Technology. [Prereq: lower division science GE; ENGR 114 or PHYX 106 or PHYX 109. Not allowed for credit toward engineering major. Weekly: 2 hrs lect, 3 hrs lab. GE.]

**ENGR 308. Technology & the Environment** (3).

Environmental and resource-related case studies applying technology to supply society's needs and demands. [Prereq: completed lower division science GE. Weekly: 2 hrs lect, 2 hrs activity. GE.]

**ENGR 313. Systems Analysis** (4). Microeconomics, systems analysis, and math modeling in environmental resources, allocation, linear and nonlinear optimization. Case studies in resource management. Engineering design applications. [Prereq: MATH 210, ENGR 115, ENGR 225.]

**ENGR 322. Environmental Data Modeling & Analysis** (4). Introduction to probability theory, probabilistic models, and stochastic processes. Parameter estimation and model evaluation for environmental systems models with applications in environmental engineering. [Prereq: MATH 210, ENGR 325 (C).] Weekly: 3 hrs lect, 3 hrs lab.]

**ENGR 325. Computational Methods for Environmental Engineering II** (3). Introduction to numerical methods for environmental engineering analysis, design and resource management using the Fortran 95 programming language. [Prereq: ENGR 225, MATH 110. Must be taken concurrently with ENGR 211. Weekly: 2 hrs lect, 3 hrs lab.]

**ENGR 326. Computational Methods for Environmental Engineering III** (3). Numerical methods for linear and differential equations used in environmental engineering analysis, design and resource management problems. [Prereq: MATH 210, ENGR 325 and either ENGR 331 (C) or ENGR 333 (C). Weekly: 2 hrs lect, 3 hrs lab.]

**ENGR 330. Mechanics & Science of Materials** (3). Physical properties of materials. Analyze stresses and deformations involving elastic behavior of materials. Tension, compression, torsion, and flexure. Combined stresses, static indeterminacy. Beams of two materials. Engineering design applications. [Prereq: MATH 210, CHEM 109, ENGR 210. Weekly: 2 hrs lect, 3 hrs lab.]

**ENGR 331. Thermodynamics & Energy Systems I** (3). Thermodynamics' 1st and 2nd laws; thermodynamic properties of materials; thermodynamic processes; system and control volume analysis; application to energy systems. Prereq: CHEM 109, MATH 210, ENGR 211 (C). Weekly: 2 hrs lect, 3 hrs lab.]

**ENGR 333. Fluid Mechanics** (4). Fluid properties; fluid statics; flow concepts; control volume analysis; continuity; energy and momentum concepts; boundary layer concepts; drag theory, flow measurements; flow in pipes/ducts; open channel flow; dimensional analysis and similitude. Engineering design applications. [Prereq: ENGR 325, ENGR 331 (C). Weekly: 3 hrs lect, 3 hrs lab.]

**ENGR 351. Water Quality & Environmental Health** (4). Water quality analysis. Physical, chemical, and biological factors of water quality. Introduction to drinking water and wastewater

treatment processes. Engineering aspects of communicable disease control and exposure to toxic materials. [Prereq: ENGR 115, CHEM 110, BIOL 105. Weekly: 3 hrs lect, 3 hrs lab.]

**ENGR 356. Water Quality Analysis** (3). Physical, chemical, and biological analysis of water and wastewater. Limitation of test methods, statistical analysis of data, and correlation of water quality parameters with environmental effects. [Prereq: ENGR 322 or ENGR 324, ENGR 351 or ENGR 350, ENGR 416 (C). Weekly: 1 hr lect, 6 hrs lab.]

**ENGR 370. Energy, Technology, & Society** (3). Interdisciplinary course introduces students to issues in energy, the environment, and society. Includes a focus on energy and climate change, emphasizing physical science, social science, and policy dimensions. [Prereq: CHEM 107 or CHEM 109, PHYX 107 (C) or PHYX 110 (C), ENVS 230; or instructor approval.]

**ENGR 380. Community Agriculture** (3). Small-scale sustainable agriculture practices: soil fertility, crop management, composting, farm planning, water use, integrated pest management, marketing. Ecological, economic, and social concerns in agriculture. [Prereq: BIOL 105 or BOT 105 or SOIL 260. Weekly: 2 hrs lect, 3 hrs lab.]

**ENGR 399. Supplemental Work in Engineering** (1-3). Directed study for transfer student whose prior course work isn't equivalent to corresponding courses at HSU. [Prereq: DA. Rep.]

**ENGR 410. Environmental Impact Assessment** (3). Enabling legislation that established environmental impact statements; EIS preparation; risk analysis; collecting data and evaluating its adequacy and accuracy; interpreting data; predicting impacts associated with proposed activities. Design applications. [Prereqs: ENGR 313, ENGR 351 or ENGR 350, ENGR 440 (C).]

**ENGR 416. Transport Phenomena** (3). Heat and mass transfer. Pollutant transport and assimilation in the environment. Engineering design applications. [Prereq: ENGR 322 or ENGR 324, ENGR 351 or ENGR 350, ENGR 326, ENGR 333. Weekly: 2 hrs lect, 3 hrs lab.]

**ENGR 418. Applied Hydraulics** (3). Pipe networks; transient pipe flow; open channel flow; irrigation, drainage, and flood control; numerical methods for hydraulic analysis. Engineering design applications. [Prereq: ENGR 326, ENGR 333. Weekly: 2 hrs lect, 3 hrs lab.]

**ENGR 421. Advanced Numerical Methods for Engineers I** (3). Finite difference and finite element methods for linear and nonlinear partial differential equations; simulation of flow, mass and energy transport in environmental systems; large scale parameter estimation methods. Engineering design applications. [Prereq: ENGR 313, ENGR 326. Weekly: 2 hrs lect, 3 hrs lab.]

**ENGR 431. Air Quality Management** (3). Nature, causes, and effects of air pollution; air quality standards, their measurement and control;

Gaussian Plume model; particulate and gaseous pollutant control devices. Engineering design applications. [Prereq: CHEM 110, ENGR 416. Weekly: 2 hrs lect, 3 hrs lab.]

**ENGR 435. Solid Waste Management** (3). Nature and scope of solid waste problem. Collection, disposal, and recycle technology. Management alternatives considering social, economic, and technical constraints, including resource recovery. Engineering design applications. [Prereq: CHEM 110, ENGR 313 (C), ENGR 330, ENGR 333. Weekly: 2 hrs lect, 3 hrs lab.]

**ENGR 440. Hydrology I** (3). Hydrologic cycle; math models of rainfall runoff; surface and ground water hydrology; probabilistic design concepts. [Prereqs: ENGR 313, ENGR 322 or ENGR 324, ENGR 326, ENGR 333. Weekly: 2 hrs lect, 3 hrs lab.]

**ENGR 441. Hydrology II** (3). Rainfall runoff processes; infiltration and groundwater vadose zone; water quality models and operational (stochastic) hydrology; groundwater quality. Engineering design applications. [Prereq: ENGR 440. Weekly: 2 hrs lect, 3 hrs lab.]

**ENGR 443. Groundwater Hydrology** (3). Groundwater and vadose zone hydrology; well hydraulics; introduction to groundwater planning, management, and remediation; large-scale flow and mass transport simulation models. [Prereq: ENGR 313 and ENGR 325. Weekly: 2 hrs lect, 3 hrs lab.]

**ENGR 445. Water Resources Planning & Management** (3). Engineering applications of economics, risk analysis, and mathematical simulation and optimization models to water resource planning; multiobjective and sequential decision problems in reservoir operation and water quality management. Engineering design applications. [Prereq: ENGR 440. Weekly: 2 hrs lect, 3 hrs lab.]

**ENGR 448. River Hydraulics** (3). River morphology; water and sediment transport; channel formation; river restoration. Design applications. [Prereq: ENGR 351 or ENGR 350, ENGR 440. Weekly: 2 hrs lect, 3 hrs lab.]

**ENGR 451. Water & Wastewater Treatment Engineering** (4). Water and wastewater treatment systems; bench-scale treatment operations. Engineering design applications. [Prereq: ENGR 351 or ENGR 350, ENGR 416. Weekly: 3 hrs lect, 3 hrs lab.]

**ENGR 455. Constructed Wetlands for Water Quality Management** (3). Use and design of free surface constructed wetlands and vegetated gravel beds for treating wastewater. For design engineers and wetland scientists involved in the planning, sizing, designing, and/or management of wetlands used to treat a wide range of wastewater problems. [Prereq: BIOL 105, ENGR 115, and ENGR 451 or IA.]

**ENGR 461. Environmental Geotechnology** (3). Municipal solid waste, and hazardous waste landfills; soil and groundwater contamination and remediation. Engineering design applications. [Prereq: ENGR 330, ENGR 333. Weekly: 2 hrs lect, 3 hrs lab.]

**ENGR 466. Earthquake Engineering** (3). Site-

specific safety analysis; seismic risk; material response; earthquake loading on soils and structures. Engineering design applications. [Prereqs: ENGR 322 or ENGR 323, ENGR 325, ENGR 330. Weekly: 2 hrs lect, 3 hrs lab.]

**ENGR 471. Thermodynamics & Energy Systems II** (3). Continues ENGR 331. Applications of 2nd law of thermodynamics. Irreversibility, availability, power and refrigeration cycles, combustion, and phase equilibria. Engineering design applications. [Prereq: CHEM 110, PHYX 110, ENGR 333. Weekly: 2 hrs lect, 3 hrs lab.]

**ENGR 473. Building Energy Analysis** (3). Thermodynamics applied to energy analysis of buildings. Heating and ventilating systems; lighting; building envelopes; process loads. Analyze campus buildings. Engineering design applications. [Prereq: ENGR 326, ENGR 333. Weekly: 2 hrs lect, 3 hrs lab.]

**ENGR 475. Renewable Energy Power Systems** (3). Principles of hydro, wind, and photovoltaic power production and systems. Engineering design applications. [Prereqs: ENGR 322 or ENGR 324, ENGR 331, ENGR 333, PHYX 315. Weekly: 2 hrs lect, 3 hrs lab.]

**ENGR 477. Solar Thermal Engineering** (3). Analyze and design solar thermal systems. Availability of solar radiation; collector operation; system performance; simulation models. Engineering design applications. [Prereq: ENGR 322 or ENGR 324, ENGR 331, ENGR 333. Weekly: 2 hrs lect, 3 hrs lab.]

**ENGR 480. Selected Topics in Engineering** (1-3). Offered as demand warrants. Lect/lab as appropriate. [Prereq: vary with topic. Rep with different topic.]

**ENGR 481. Selected Topics with Engineering Design** (3). Selected topics as demand warrants. [Prereq: ENGR 322 or ENGR 323. Weekly: 2 hrs lect, 3 hrs lab.]

**ENGR 492. Capstone Design Project** (3). Culminating ERE design experience based on knowledge gained from previous course work. Application of the engineering design process to develop a system, process or management plan to solve a significant, open-ended ERE problem. To be taken final senior semester (within 16 units of graduation). [IA. Open to Senior and Grad level ERE students only.]

**ENGR 496. FE (EIT) Review** (2). Review topics for National Fundamentals of Engineering (FE or EIT) Exam. [Mandatory CR/NC. Not allowed for credit toward major in engineering. Prereq: PHYX 315 (C); ENGR 330, ENGR 333.]

**ENGR 498. Directed Design Project** (1-3). Directed (Independent) application of engineering design process to develop a system, process or management plan. [IA.]

**ENGR 499. Directed Study** (1-3). Directed (independent) undergraduate study or research. [IA.]

## GRADUATE

**ENGR 501. Environmental Systems Analysis I** (4). Operations research and system analysis techniques to plan, manage, and design environ-

mental systems. Nonlinear and integer programming methods; multiobjective analysis. Stochastic optimization modes for environmental systems analysis; decomposition principles for large-scale systems; dynamic programming. [Prereq: ENGR 313, ENGR 322 or ENGR 323, ENGR 326. Weekly: 3 hrs lect, 3 hrs lab.]

**ENGR 521. Advanced Numerical Methods for Engineers I** (3). Finite difference and finite element methods for linear and nonlinear partial differential equations; simulation of flow, mass and energy transport in environmental systems; large scale parameter estimation methods. Engineering design applications. [Prereq: ENGR 313, ENGR 326. Weekly: 2 hrs lect, 3 hrs lab.]

**ENGR 532. Energy, Environment, & Society** (4). This interdisciplinary graduate level course emphasizes technical, environmental, and socio-economic dimensions of energy utilization in contemporary society. Covers technology and policy issues related to conventional and alternative energy resources. [Prereq: graduate standing, working knowledge of introductory physics, chemistry, and statistics, or IA.]

**ENGR 533. Energy & Climate Change** (4). This interdisciplinary graduate level course provides a rigorous introduction to the science and policy dimensions of global climate change, as well as the prospects for climate change mitigation. [Prereq: graduate standing, ENGR 532, or IA.]

**ENGR 535. Development Technology** (4). Technologies important in international development, including energy production, habitat design, waste recovery, water acquisition, and agriculture. [Weekly: 3 hrs lect, 3 hrs lab.]

**ENGR 541. Hydrology II** (3). Rainfall runoff processes; infiltration and groundwater vadose zone; water quality models and operational (stochastic) hydrology; groundwater quality. Engineering design applications. [Prereq: ENGR 440. Weekly: 2 hrs lect, 3 hrs lab.]

**ENGR 543. Groundwater Hydrology** (3). Groundwater and vadose zone hydrology; well hydraulics; introduction to groundwater planning, management, and remediation; large-scale flow and mass transport simulation models. [Prereq: ENGR 313 and ENGR 325. Weekly: 2 hrs lect, 3 hrs lab.]

**ENGR 545. Water Resources Planning & Management** (3). Engineering applications of economics, risk analysis, and mathematical simulation and optimization models to water resource planning; multiobjective and sequential decision problems in reservoir operation and water quality management. Engineering design applications. [Prereq: ENGR 440. Weekly: 2 hrs lect, 3 hrs lab.]

**ENGR 555. Constructed Wetlands for Water Quality Management** (3). Use and design of free surface constructed wetlands and vegetated gravel beds for treating wastewater. For design engineers and wetland scientists involved in the planning, sizing, designing, and/or management of wetlands used to treat a wide range of wastewater problems. [Prereq: ENGR 351 or ENGR 350, BIOL 105, ENGR 115, or IA.]

**ENGR 597. Mentoring & Teaching Associate**

**Training** (1-4). Training in course preparation and delivery. Advanced majors and grad students take this course prior to or concurrent with teaching-assistant or teaching-associate assignments. No credit toward graduate degree. [Rep.]

**ENGR 680. Selected Topics in Environmental Systems** (1-3). [Rep.]

**ENGR 690. Thesis** (1-6). Prepare written thesis as required for grad degree. [Prereq: SCI 501, SCI 530. Rep.]

**ENGR 699. Independent Study in Environmental Systems** (1-3). Conference, reading, and research. [Prereq: SCI 530. Rep.]