# 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 Resources Engineering** (3). Case studies in water quality, water resources, energy resources, and geotechnical resources. [Prereq: MATH 115 (C) or MATH 114 or MATH 109. Open to environmental resources engineering majors. 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. [Prereq: MATH 109 or completed Calculus I. 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. [Prereq: MATH 110, ENGR 210, ENGR 215 (C). For engineering majors, this is prerequisite 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 or completed Calculus I (C). Open to environmental resources engineering majors. 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. [Prereq: ENGR 115, and MATH 109 or completed Calculus I. Recommended prereq: ENGR 210. 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 topics.]

**ENGR 299. Directed Study** (1-3). Directed (independent) undergraduate study or research at the lower division level. [Rep; multiple enrollments in term.]

## 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: ENGR 114 or PHYX 106 or PHYX 109 or ENST 123 (2 units, each unit must be a different topic). Rec: lower division science GE. 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** (3). 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. Weekly: 2 hrs lect, 3 hrs lab.]

**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 and 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 and MATH 110. 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: ENGR 325, and ENGR 331 or ENGR 333. 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. ERE majors are strongly encouraged to complete this course before starting their 400-level ENGR courses. [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 110, MATH 210 and ENGR 211. 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 211, ENGR 325, MATH 210. Weekly: 3 hrs lect, 3 hrs lab.]

**ENGR 351. Introduction to Water Quality** (4). Analytical methods for water quality assessment. Physical, chemical, and biological factors of water quality. Introduction to environmental risk assessment and water/wastewater treatment processes. ERE majors are strongly encouraged to complete this course before starting their 400-level ENGR courses. [Prereq: ENGR 115, CHEM 110, BIOL 105. Weekly: 3 hrs lect, 3 hrs lab.]

**ENGR 371. Energy Systems & Technology** (3). Introduction to key topics and technologies associated with modern energy systems. Covers principles of thermodynamics and electricity and their application to energy systems. [Prereq: MATH 105, CHEM 107 or CHEM 109, PHYX 107 or PHYX 110.]

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

**ENGR 410. Environmental Health & Impact Assessment** (3). Legislative and regulatory foundations for Environmental Impact Statements and their preparation, life cycle principles, sustainability, professional ethics, risk analysis, collecting data and evaluating its adequacy and accuracy, interpreting data, and predicting impacts associated with proposed activities. Engineering aspects of communicable disease control and exposure to toxic materials. [Prereqs: ENGR 313, ENGR 351, 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, ENGR 326, ENGR 331, ENGR 333, ENGR 351. 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 and 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 and ENGR 326. Weekly: 2 hrs lect, 3 hrs lab.]

**ENGR 434. 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,

*sustainability-focused; sustainability-related; activ activity; (C) may be concurrent; coreq corequisite(s); CR/NC mandatory credit/no credit; DA dept approval; disc discussion;*

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, 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 416 (C) and ENGR 440 (C). 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, 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 416 (C). Weekly: 3 hrs lect, 3 hrs lab.]

**ENGR 452. Design of Water Treatment & Reuse Systems** (3). Physico-chemical water treatment technologies and state-of-the-art technologies for potable reuse and desalination. High-quality reuse, strategic decentralization, and low energy consumption water supply systems. [Prereq: ENGR 416(C).]

**ENGR 455. Engineered Natural Treatment Systems** (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, ENGR 416 (C) and ENGR 440 (C); or IA.]

**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 322, ENGR 331, 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 331, ENGR 333, PHYX 110. 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, 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: PHYX 110, ENGR 322, 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 topics.]

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

**ENGR 492. Capstone Design Project** (3). Culminating ERE design experience based on knowledge gained from previous coursework. 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). Open to senior and grad level ERE students only.* Prereq: ENGR 313, ENGR 322, ENGR 326, ENGR 330, ENGR 331, ENGR 333, ENGR 351.]

**ENGR 496. FE (EIT) Review** (1). Review topics for National Fundamentals of Engineering (FE or EIT) Exam. [Mandatory CR/NC. Not allowed for credit toward major in engineering. Prereq: ENGR 330 (C), ENGR 333.]

**ENGR 498. Directed Design Project** (1-3). Directed (independent) application of engineering design process to develop a system, process or management plan. *May be taken only once for credit.* [Prereq: IA.]

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

## GRADUATE

**ENGR 518. Applied Hydraulics** (3). Pipe networks; transient pipe flow; open flow; irrigation, drainage, and flood control; numerical methods for hydraulic analysis. Engineering design applications. [Prereq: ENGR 326 and ENGR 333. Weekly: 2 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 and 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 and ENGR 532, or IA.]

**ENGR 534. 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 and ENGR 416. Weekly: 2 hrs lect, 3 hrs lab.]

**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 416 (C) and ENGR 440 (C). 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 548. River Hydraulics** (3). River morphology; water and sediment transport; channel formation; river restoration. Design applications. [Prereq: ENGR 351 and ENGR 416. Weekly: 2 hrs lect, 3 hrs lab.]

**ENGR 551. Water & Wastewater Treatment Engineering** (4). Water and wastewater treatment systems; bench-scale treatment operations. Engineering design applications. [Prereq: ENGR 351 and ENGR 416; both with passing grades of C. Weekly: 3 hrs lect, 3 hrs lab.]

**ENGR 555. Engineered Natural Treatment Systems** (3). Use and design of free surface constructed wetlands and vegetated gravel beds

*DCG diversity & common ground; d domestic, n non-domestic; F fall, S spring, Su summer; GE general ed; IA instructor approval; lect lecture; prereq prerequisite; rec recommended preparation; rep repeatable*

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, BIOL 105, ENGR 115; or IA.]

**ENGR 571. Advanced Thermodynamics & Energy Systems** (3). Continues ENGR 331. Application of 2nd law of thermodynamics; irreversibility, availability, power and refrigeration cycles, combustion, and phase equilibria. Engineering design applications. [Prereq: CHEM 110, PHYX 110, ENGR 331, ENGR 333; all with passing grades of C. Weekly: 2 hrs lect, 3 hrs lab.]

**ENGR 573. 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 331, ENGR 333; all with passing grades of C. Weekly: 2 hrs lect, 3 hrs lab.]

**ENGR 575. Renewable Energy Power Systems** (3). Principles of hydro, wind, and photovoltaic power production and systems. Engineering design applications. [Prereq: ENGR 322, ENGR 331, ENGR 333, PHYX 315; all with passing grades of C. Weekly: 2 hrs lect, 3 hrs lab.]

**ENGR 577. 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, ENGR 331, ENGR 333; all with passing grades of C. Weekly: 2 hrs lect, 3 hrs lab.]

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

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

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

**ENGR 700. Professional Development in Engineering** (1-3). Directed study for engineering professionals desiring advanced or specialized instruction, especially that leading to credentialing/certification. [Prereq: IA. Rep.]