

Environmental Science and Engineering Course Descriptions

EnSE 201. Air and Water Quality (3-0-3) Introduction to outdoor and indoor air quality, measurement systems, fate of contaminants, air pollution control systems, gas and particle transport on multiple scales. Introduction to water quality, effluent, chemical elements, salinity. Physical, chemical and biological treatment processes for drinking, industrial and waste water.

EnSE 202. Environmental Chemistry (2-1-3) Chemistry of processes and behavior in air and aquatic systems. Acid-base and redox chemistry, carbonate system, precipitation. Chemical thermodynamics including quantitative assessment of chemical composition and fate of contaminants using equilibrium calculations.

EnSE 203. Environmental Microbiology (2-1-3) Fundamentals of microbiology for the environment, physiology, microbial metabolism, basics of genetics, microbial growth processes, introduction to molecular biology. Illustrations from microbiology and pollutants, microbiology and disease, microbiology of bioremediation, wastewater treatment, microbial fuel cells.

EnSE 204. Environmental Transport Processes (3-0-3) Movement and fate of chemicals and contaminants in air, water and soil. Mass balance and transfer, hydrodynamic transport, environmental sources and sinks.

EnSE 205. Principles of Environmental Sustainability (3-0-3) Fundamental aspects of sustainability, energy cycles and accounting. Carbon cycle, emissions and sequestration. Concepts of green design. Life-cycle analysis.

EnSE 211. Atmospheric Chemistry (3-0-3) Chemistry of atmospheric constituents, photochemistry and oxidation, chemistry of airborne pollutants.

EnSE 213. Environmental Organic Chemistry (3-0-3) Behavior and fate of organic compounds in the environment. Chemical properties, mechanisms, kinetics and reaction products in air, water and soils; photochemical and biochemical transformation reactions.

EnSE 221. Environmental Fluid Mechanics (3-0-3) Principles of fluid flow in natural systems including the atmosphere, rivers, lakes and oceans, and engineered systems such as in wastewater treatment. Roles of density variation and stratification, diffusion and turbulence.

EnSE 222. Surface Hydrology (3-0-3) Fundamentals of surface hydrology, the hydrologic cycle, hydrologic processes.

EnSE 223. Groundwater Hydrology (3-0-3) Groundwater hydrology, subsurface flow, geological considerations, aquifers and wells.

EnSE 225 Water Desalination (3-0-3) Theoretical and practical aspects of seawater/brackish water desalination technologies, including thermal-based (MSF, MED, VC) and membrane-based (RO, NF, ED/EDR) desalination processes; process design and system performance; fouling, scaling (including bio-fouling) and cleaning; product water quality and post-treatment.

EnSE 297. MSc Thesis (6 units total) Master-level research leading to a formal written thesis and oral defense thereof.

EnSE 298. Graduate Seminar (variable credit) Master-level seminar focusing on special topics within the field.

EnSE 299. Directed Research (variable credit) Master-level supervised research.

EnSE 302. Atmospheric Transport (3-0-3) *Prerequisites: EnSE 201, EnSE 204.* Contaminant transport in the atmosphere, mathematical models of pollutant dispersal, plumes, meteorology and climate change.

EnSE 303. Climate Change (3-0-3) *Prerequisite: EnSE 204.* Fundamentals of global climate change, inputs and assumptions in climate change models, modeling and simulation of the carbon cycle and CO₂ sequestration.

EnSE 304. Water Resource Engineering (3-0-3) *Prerequisite: EnSE 201.* Planning and management of water resources. Water supply, flood control, irrigation, mathematical modeling and optimization techniques.

EnSE 305. Air Quality Control Processes (3-0-3) *Prerequisite: EnSE 201.* Indoor and outdoor air quality control processes. Theory and practice of air pollution control. Sources, transport, fate, impacts, characteristics and control of air contaminants; design of control technologies for particulate, gaseous and VOC emissions.

EnSE 311. Molecular Biology and Microbial Ecology (2-1-3) *Prerequisites: EnSE 202, EnSE 203.* Principles of molecular biology in environmental science and engineering. Research methods, engineering tools. Principles of microbiological systems, genomics, microbial evolution, microbial diversity, the biogeochemical cycle.

EnSE 312. Advanced Aquatic and Soil Chemistry (3-0-3) *Prerequisite: EnSE 202.* Biogeochemistry, colloids, soil and gas or liquid interfaces, oxidation/reduction reactions and adsorption processes. Chemistry and properties of soil and soil processes.

EnSE 321. Numerical Modeling of Environmental Flows (3-0-3) *Prerequisite: EnSE 204.* Advanced numerical methods for environmental transport processes, multi-scale and multi-physics issues.

EnSE 331. Advanced Topics in Sustainability (3-0-3) *Prerequisite: EnSE 205.* Topic 1: Assessment of Energy and Resource Needs. Topic 2: Materials, Environment and Sustainability. Topic 3: Sustainable Engineering Systems.

EnSE 341. Processes in Environmental Biotechnology (3-0-3) *Prerequisite: EnSE 311.* Principles of molecular biology and microbiology applied to the design and operation of engineered environmental systems: treatment of wastewater, bioremediation, energy conversion.

EnSE 342. Physical/Chemical Treatment Processes (3-0-3) *Prerequisite: EnSE 201.* Water-treatment processes, membranes, advanced oxidation, principles and techniques of water desalination.

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EnSE 350. Hazardous Waste Management (3-0-3) *Prerequisites: EnSE 201, EnSE 204.* Legal and technological approaches to control and management of hazardous wastes and contaminated sites to protect human health and the environment: fate and transport of contaminants; physical, chemical and biological treatment; environmental monitoring systems; medical waste and treatment options; toxicology; storage tanks; landfills.

EnSE 397. PhD Dissertation (increments of 3 units) PhD-level research leading to a formal written dissertation and oral defense thereof.

EnSE 398. Graduate Seminar (variable credit) Doctoral-level seminar focusing on special topics within the field.

EnSE 399. Directed Research (variable credit) Doctoral-level supervised research.