Environmental Engineering

Chair: Dr. John Harris

One of the newest additions to the quality educational programs at Saint Francis University is a major in Environmental Engineering along with a possible concentration in Renewable Energies. Environmental engineers work to protect and manage our air, water, and energy resources. They measure, quantify and analyze the environmental changes that inevitably result from human endeavors. They design strategies to remediate problems, minimize impacts, and measurably improve environmental quality. Environmental engineers focus on developing devices, techniques and solutions that can effectively address a variety of real-world environmental problems. Environmental engineers achieve their aims by the utilization and conversion of the many energy resources that surround us - the fossil fuels and the renewable energies. There is a growing awareness that the quality of life must be balanced by the conservation of these resources and the protection of the environment. Environmental engineers understand this balance and seek to harness energy resources in an environmentally-friendly manner.

The Environmental Engineering profession is expected to be the fastest growing engineering profession for many years to come. The burgeoning need for energy from traditional (e.g., fossil fuels) as well as non-tradition sources (e.g., renewable energy) will only intensify the need for environmental engineers, particularly those with specialized training in energy conversion, storage, and transmission technologies.

An Overview of the Major:

The Environmental Engineering curriculum at Saint Francis University prepares the student for a challenging and rewarding career through five major curricular means:

- a vibrant General Education program, a keystone of Saint Francis University
- a robust foundation in mathematics and the basic sciences
- a well founded core of engineering course work with a Renewable Energies emphasis
- a specific sequence of specialized environmental laboratory work
- a significant Environmental Engineering Design capstone

Saint Francis University has a strong General Education program core that includes two courses each in philosophy, English, religion, history and fine arts, as well as a single course in macroeconomics, speech, language, psychology, political science and sociology. Since a major goal of engineering is to contribute to the welfare of society, students are better prepared to meet such expectations when they have a broad liberal arts education that helps the student develop an understanding of world history; political and economic systems; the ethnic, cultural, and religious diversity of the peoples of the earth, as well as provide them excellent skills in written communication and public speaking.

The Environmental Engineering curriculum is built on a solid foundation of basic mathematics and science, which are mainly taken in the first two years at the University. The course work provides the student with the breadth necessary to solve the multidisciplinary problems faced everyday in the life of an Environmental Engineer. Most of the science courses

include an extensive laboratory component. General chemistry, Organic Chemistry, Physics, and Microbiology are some of the basic science classes. In addition students take Ordinary Differential Equations, Statistics and three semesters of Calculus to provide the mathematical underpinnings necessary to be successful and to handle the rigors of the engineering discipline.

Students enter the Environmental Engineering program as pre-engineering students. After successfully completing a prescribed set of course work, qualified students transfer into the Environmental Engineering major. Qualified students have a minimum GPA of 2.5 overall, a minimum GPA of 2.75 in Mathematics and Science, no grades lower than a C and have obtained a faculty letter of recommendation supporting transfer into the program

Coursework in environmental engineering begins in the student's junior year after the necessary foundation in mathematics and basic sciences has been achieved. Lecture-based courses prepare students to apply basic principles of science and mathematics in the context of environmental systems while a series of project-based courses give students hands-on experiences where they use the skills they have learned to solve real engineering problems. The culmination of the students' design experience is a capstone design course in which students are required to see a project through all phases from the initial proposal to the final design.

A unique focus of Saint Francis University's program is the Renewable Energies Concentration. Students will take specialized course work in energy conversion, storage, and distribution and will have opportunities for internships and other interactions with SFU's Renewable Energy Center..

Bachelor of Science in Environmental Engineering
Major Requirements

Chemistry 101, 102, 201, 251; Biology 302; Mathematics 121, 122, 221, 304, 306; General Physics 121, 122, 301; Engineering 101, 102, 201, 202, 301; Environmental Engineering 311, 312, 313, 321, 322, 411, 412, 413, 414, 415, 498, 499. (34 credits in Environmental Engineering, 12 credits in Engineering, 46 credits collateral, 49 credits Gen Ed; 141 total credits)

Bachelor of Science in Environmental Engineering: Renewable Energies Concentration
Major Requirements

Chemistry 101, 102, 201, 251; Biology 302; Mathematics 121, 122, 221, 304, 306; General Physics 121, 122, 301; Engineering 101, 102, 201, 202, 301; Environmental Engineering 311, 312, 313, 321, 322, 411, 412, 413, 414, 415, 421, 422, 498, 499. (40 credits in Environmental Engineering, 12 credits in Engineering, 46 credits collateral, 49 credits Gen Ed; 147 total credits)

ENVIRONMENTAL ENGINEERING COURSE DESCRIPTIONS:

311. Fundamentals of Environmental Engineering I: Aquatic and Atmospheric Chemistry
(3 Credits)

Acid/Base equilibria and solubility of metal oxides in natural waters. Kinetics of environmentally relevant reactions (esp. redox reactions) in natural waters and in the atmosphere. *Prerequisite: CHEM 301 concurrent, MATH 306. Fall.*

312. Fundamentals of Environmental Engineering II: Transport Processes
(3 Credits)

Application of the conservation (of mass, energy, and momentum) equations to the fate and transport of molecules and particles in ground water, surface waters, and the atmosphere. *Prerequisite: ENGR 301 concurrent, MATH 306. Spring.*

313. Modeling and Simulation of Environmental Systems
(3 Credits)
Development of probability/statistics, calculus, and differential equations based models of the natural and engineered environment. Emphasis on numerical methods and scientific programming. *Prerequisite: MATH 306. Spring.*

321. Environmental Engineering Measurements I
(3 Credits)
Field sampling techniques (e.g., saprolite sampling with hand auger, operation of surface hydrology instrumentation), laboratory analyses, and statistical data analysis. To include an open ended design project. *Prerequisite: CHEM 251, ENVE 311 concurrent. Fall.*

322. Environmental Engineering Measurements II
(3 Credits)
Design and analysis of bench-scale models of environmental systems. To include an open ended design project. *Prerequisite: ENVE 312 concurrent, ENVE 321. Spring.*

411. Chemical and Biological Reactor Design
(3 Credits)
Principles of unit processes engineering. Applications include water and wastewater treatment, passive treatment systems (e.g., constructed wetlands for acid mine drainage remediation), and industrial ecology. To include an open ended design project. *Prerequisite: ENVE 311, BIOL 302. Fall.*

412. Mechanics of Soils and Geological Materials
(3 Credits)
Stress-strain behavior of rocks and soils. *Prerequisite: ENGR 201*, ENVE 312. Fall.*
*ENGR 201, Statics, should be adjusted to include an introduction to the mechanics of materials since we do not have a separate course in the subject and have no plans to develop one.

413. Environmental Hydraulics and Hydrology
(3 Credits)
Flow in open channels (natural and engineered). Response of rivers, lakes, and wetlands to rain events. Sediment transport and design of canals, reservoirs, and other water resources management technologies. *Prerequisite: ENVE 311, ENVE 312. Spring.*

414. Hazardous Materials Engineering
(3 Credits)
Containment of polluted soils and waters and remediation of uncontained pollution. Design of landfills, groundwater monitoring well networks, and both in-situ and ex-situ remediation technologies. To include an open ended design project. *Prerequisite: ENVE 311, ENVE 312. Spring.*

415. Senior Lab
(3 Credits)
Open ended design project focused on scaling up from laboratory results to pilot scale system or analysis of field data. *Prerequisite: ENVE 322. Fall.*

421. Energy Conversion Engineering I: Mechanical and Nuclear Methods
(3 Credits)
Application of the principles of thermodynamics and heat transfer to the design of conventional energy conversion technologies and alternative "sources" of energy. Focusing on turbine (steam, wind, hydraulic), combustion, and nuclear driven technologies. *Prerequisite: CHEM 301, ENGR 301. Fall.*

422. Energy Conversion Engineering II: Electro-Chemical Methods
(3 Credits)
Application of the principles of thermodynamics and heat transfer to conventional energy conversion technologies and alternative "sources" of energy. Focusing on fuel cells, photovoltaics, and biofuels. *Prerequisite: ENVE 421. Spring.*

498. Capstone Design Proposal
(1 Credit)
Formal proposal of the capstone design project to be completed in the final semester of the Senior year. *Prerequisite: ENVE 322, ENVE 415 concurrent. Fall.*

499. Capstone Design
(3 Credits)
Complete engineering design addressing a real environmental problem drawn from industry or an environmental design competition. *Prerequisite: ENVE 415, ENVE 498. Spring.*