

# BIOLOGICAL AND ECOLOGICAL ENGINEERING

The Department of Biological and Ecological Engineering at OSU is involved in teaching, research and extended education relevant to the application of engineering analysis to biological, ecological and hydrological systems. The department has strength in graduate training and research and offers both an MS and PhD degree in Biological and Ecological Engineering. The graduate degree program is focused on the professional development of engineers and the analysis of environmental systems, hydrology and water resources. Activities within the department include water resource analysis, fate and transport of biologically relevant chemicals, bioreactor design and analysis, watershed analysis and resource management, simulation modeling of ecological and biological systems, regional and global hydrology, geographical information systems for environmental modeling, and the development of bio-based products and fuels.

For more information, contact:

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## Undergraduate Programs

### Major

- Ecological Engineering (BS, HBS) (<http://catalog.oregonstate.edu/college-departments/engineering/biological-ecological-engineering/ecological-engineering-bs-hbs>)  
Pre-Ecological Engineering (<http://catalog.oregonstate.edu/college-departments/engineering/biological-ecological-engineering/pre-ecological-engineering>)

### Minor

- Irrigation Engineering (<http://catalog.oregonstate.edu/college-departments/engineering/biological-ecological-engineering/irrigation-engineering-minor>)

## Graduate Programs

### Major

- Biological and Ecological Engineering (MEng, MS, PhD) (<http://catalog.oregonstate.edu/college-departments/engineering/biological-ecological-engineering/biological-ecological-engineering-meng-ms-phd>)

### Minor

- Biological and Ecological Engineering (<http://catalog.oregonstate.edu/college-departments/engineering/biological-ecological-engineering/biological-ecological-engineering-graduate-minor>)

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## Faculty

**Professors** Bolte, Godwin, Liu, Murthy, Selker, Tullos  
**Associate Professors** Bachelet, Chaplen<sup>1</sup>, Ely<sup>1</sup>, Higgins  
**Assistant Professors** Good, Jones, Udell, Vache

<sup>1</sup> Licensed Professional Engineer.

## Biological and Ecological Engineering

### BEE 101. ECOLOGICAL ENGINEERING I. (3 Credits)

Introduction to engineering at OSU and the emerging field of ecological engineering. Topics include engineering analysis and problem solving, professional ethics, the design process and teamwork.

### BEE 102. ECOLOGICAL ENGINEERING II. (3 Credits)

Introduction to common problems and solutions in ecological engineering, emphasizing the multiplicity of approaches to constraining, analyzing, and resolving challenges of ecosystem management. Two overnight field trips to local ecological monitoring and engineering sites will be required.

### BEE 199. SPECIAL TOPICS. (1-16 Credits)

*This course is repeatable for 16 credits.*

### BEE 221. FUNDAMENTALS OF ECOLOGICAL ENGINEERING. (3 Credits)

Introduction to the concepts and practice of ecological engineering including characteristics, classification, and modeling of ecosystems; ecosystem protection; and sustainable uses of ecosystems, including treatment wetlands, land treatment systems, and ecologically sensitive stormwater management, to meet the needs of human societies.

**Prerequisites:** (BI 211 with C or better or BI 211H with C or better) and (MTH 256 [C] or MTH 256H [C])

### BEE 222. ECOLOGICAL ENGINEERING COMPUTATION. (3 Credits)

Programming methods relevant to ecological engineering, including hardware/software integration.

### BEE 299. SPECIAL TOPICS. (1-16 Credits)

*This course is repeatable for 16 credits.*

### BEE 311. ECOLOGICAL FLUID MECHANICS. (4 Credits)

Fluid properties, fluid statics, fluid motion, conservation of mass, momentum and energy for incompressible fluids, dimensional analysis, ecological engineering applications. Lec/rec.

### BEE 312. ECOHYDRAULICS. (4 Credits)

Theory and design of hydraulic systems for ecological engineering applications. Lec/rec.

**Prerequisites:** BEE 311 with C or better or CE 311 with C or better or CHE 331 with C or better or CHE 331H with C or better

### BEE 313. ECOHYDROLOGY. (4 Credits)

Provides quantitative description of fundamental hydrologic processes and the hydrologic cycle, the interactions of water between atmosphere, soils, and plants, and models for estimating the generation and transport of water in the environment. Lec/rec.

**Prerequisites:** BEE 312 with C or better

### BEE 320. BIOSYSTEMS ANALYSIS AND MODELING. (4 Credits)

An introduction to simulation modeling and analysis of a variety of biological and ecological systems. Systems approaches to describing ecological systems.

**Prerequisites:** BEE 222 with C or better

**BEE 322. ECOLOGICAL ENGINEERING THERMODYNAMICS AND TRANSFER PROCESS. (4 Credits)**

A study of the transport processes of fluid flow, heat transfer and mass transfer applied to biological organisms and ecological systems.

**Prerequisites:** BEE 320 with C or better

**BEE 361. ECOLOGICAL ENGINEERING LABORATORY. (3 Credits)**

Introduction to modern measurement methods for ecological and environmental applications includes sensors and systems for measuring soil, water and atmospheric properties. No final exam; field trip required. Lec/lab.

**BEE 399. SPECIAL TOPICS. (0-16 Credits)**

*This course is repeatable for 16 credits.*

**BEE 401. RESEARCH. (1-16 Credits)**

*This course is repeatable for 16 credits.*

**BEE 405. READING AND CONFERENCE. (1-16 Credits)**

*This course is repeatable for 16 credits.*

**BEE 407. SEMINAR. (1-16 Credits)**

Departmental seminars. Graded P/N.

**Equivalent to:** BEE 407H

*This course is repeatable for 16 credits.*

**BEE 407H. SEMINAR. (1-16 Credits)**

Departmental seminars. Graded P/N.

**Attributes:** HNRS – Honors Course Designator

**Equivalent to:** BEE 407

*This course is repeatable for 16 credits.*

**BEE 410. ECOLOGICAL ENGINEERING INTERNSHIP. (1-12 Credits)**

Internship in ecological engineering to provide students with an opportunity to apply course work and theory to the real world. Requires internship opportunity identification by student.

*This course is repeatable for 12 credits.*

**BEE 411. GLOBAL ENVIRONMENTAL CHANGE: USING DATA TO INFORM DECISIONS. (3 Credits)**

Empowers students interested in global change research to focus on the interactions between changes in human land use and climate. Using an innovative online data and mapping tool called Data Basin, students will explore topics accessing the highest quality datasets available in an all-in-one platform.

**BEE 415. PROFESSIONAL DEVELOPMENT. (1 Credit)**

Preparation for student professional careers. Students will interact with and hear seminars from professionals working in the ecological engineering field to learn from their experiences.

**BEE 433. IRRIGATION SYSTEM DESIGN. (4 Credits)**

Principles of soil physics and plant water use applied to irrigation system design. Design of gravity, pressurized, and trickle irrigation systems, improving on-farm water management, performance characteristics of pumps and other irrigation equipment. Lec/lab. Offered alternate years.

**BEE 439. IRRIGATION PRINCIPLES AND PRACTICES. (4 Credits)**

Survey of irrigation systems, system configurations, factors that influence irrigation efficiency, crop water requirements, energy requirements, pumps, irrigation scheduling. For non-engineers. Lec/lab/ rec.

**Prerequisites:** MTH 111 with C or better

**BEE 446. RIVER ENGINEERING. (4 Credits)**

Multipurpose river use; natural physical processes in alluvial rivers; channel modification practices; river structures; design practices; impact of river modification; problem analysis; and impact minimization. Offered alternate years.

**BEE 458. NONPOINT SOURCE POLLUTION ASSESSMENT AND CONTROL. (3 Credits)**

Problem solving in nonpoint source pollution. Methods for evaluating the extent, rate, timing, and fate of Non-Point Source (NPS) pollutants in agricultural and urban environments.

**BEE 468. BIOREMEDIATION ENGINEERING. (4 Credits)**

Examines strategies for using a variety of biological processes for treating municipal, agricultural and industrial contaminants. Lec/lab.

**BEE 469. ^ECOLOGICAL ENGINEERING DESIGN I. (4 Credits)**

Engineering design processes for ecological engineering applications, including specifications, performance criteria, timelines, and project logistics, principles and practices of working in engineering teams. (Writing Intensive Course)

**Attributes:** CWIC – Core, Skills, WIC

**Prerequisites:** BEE 322 with C or better

**BEE 470. ECOLOGICAL ENGINEERING DESIGN II. (4 Credits)**

Engineering design processes for ecological engineering applications, including specifications, performance criteria, timelines, and project logistics, principles and practices of working in engineering teams.

**BEE 472. INTRODUCTION TO FOOD ENGINEERING PRINCIPLES. (5 Credits)**

Fundamental engineering principles for scientists and non-process engineers. Topics include fluid flow, mass and energy transfer, and material and energy balances. Directed at food scientists and other majors who need or would like a working knowledge of food engineering principles.

**Prerequisites:** MTH 112 with C- or better and (MTH 227 [C-] or MTH 251 [C-] or MTH 251H [C-]) and PH 201 [C-]

**BEE 473. INTRODUCTION TO FOOD ENGINEERING PROCESS DESIGN. (3 Credits)**

Fundamental engineering process design principles for food scientists and non-process engineers. Directed at those who need or would like a working knowledge of applied food engineering process design. Lec/rec.

**BEE 499. SPECIAL TOPICS. (0-16 Credits)**

**Equivalent to:** BEE 499H

*This course is repeatable for 16 credits.*

**BEE 499H. SPECIAL TOPICS. (1-16 Credits)**

**Attributes:** HNRS – Honors Course Designator

**Equivalent to:** BEE 499

*This course is repeatable for 16 credits.*

**BEE 501. RESEARCH. (1-16 Credits)**

*This course is repeatable for 16 credits.*

**BEE 503. THESIS. (1-16 Credits)**

*This course is repeatable for 999 credits.*

**BEE 505. READING AND CONFERENCE. (1-16 Credits)**

*This course is repeatable for 16 credits.*

**BEE 506. PROJECTS. (1-16 Credits)**

*This course is repeatable for 16 credits.*

**BEE 507. SEMINAR. (1 Credit)**

Section 1: Graduate Student Orientation Seminar to acquaint new graduate students with graduate school and departmental requirements, policies and expectations, and departmental research programs. Section 2: Graduate Research Publication Seminar to expose students to requirements for successful proposals and publication of research results. Section 3: Oral Presentation Improvement—A highly participatory educational effort designed to improve performance in presenting research reports, technical papers and in responding to oral examination questions. Graded P/N.

*This course is repeatable for 99 credits.*

**BEE 511. GLOBAL ENVIRONMENTAL CHANGE: USING DATA TO INFORM DECISIONS. (3 Credits)**

Empowers students interested in global change research to focus on the interactions between changes in human land use and climate. Using an innovative online data and mapping tool called Data Basin, students will explore topics accessing the highest quality datasets available in an all-in-one platform.

**BEE 512. PHYSICAL HYDROLOGY. (3 Credits)**

Principles of hydrologic processes and the integration of these processes into the hydrologic cycle. Topics include atmospheric processes, precipitation and runoff, storm response in streamflow on a watershed scale, and major concepts in groundwater systems.

**BEE 525. STOCHASTIC HYDROLOGY. (3 Credits)**

Study the elements of randomness embedded in the hydrological processes with emphasis on time series analysis, stationarity, periodic/trend component, stochastic component, time series synthesis, ARMA model, spatial sampling and scale variability. Offered alternate years.

**BEE 529. BIOSYS MODELING TECHNIQUES. (3 Credits)**

Development of mathematical models of biological and ecological systems; linear and nonlinear systems analysis; stochastic modeling and random processes; model solution and analysis techniques.

**BEE 533. IRRIGATION SYSTEM DESIGN. (4 Credits)**

Principles of soil and plant water use applied to irrigation system design. Design of gravity, pressurized, and trickle irrigation systems, improving on-farm water management, performance characteristics of pumps and other irrigation equipment. Lec/lab. Offered alternate years.

**BEE 542. VADOSE ZONE TRANSPORT. (4 Credits)**

Introduction to the physical and hydraulic properties involved in flow from the soil surface to groundwater. Classical infiltration equations will be derived and presented with exact and approximate solutions. Attention is focused on application to pollutant transport and recent advances in non-ideal flow.

**BEE 544. OPEN CHANNEL HYDRAULICS. (4 Credits)**

Steady, uniform, and nonuniform flow in natural and artificial open channels; unsteady flow; interaction of flow with river structures; and computational methods. Offered alternate years.

**Equivalent to:** CE 544

**BEE 545. SEDIMENT TRANSPORT. (4 Credits)**

Principles of sediment erosion, transportation and deposition in rivers, reservoirs, and estuaries; measurement, analysis, and computational techniques. Offered even years in winter term. **CROSSLISTED** as FE 545.

**Equivalent to:** FE 545

**BEE 546. RIVER ENGINEERING. (4 Credits)**

Multipurpose river use; natural physical processes in alluvial rivers; channel modification practices; river structures; design practices; impact of river modification; problem analysis; and impact minimization. Offered alternate years.

**BEE 549. REGIONAL HYDROLOGIC MODELING. (3 Credits)**

Challenges in regional-scale water resource analysis and management with emphasis on application to production agriculture. Application of geostatistical techniques to spatially variable systems and remote sensing to large-scale water resource systems. Development of soil-water-atmosphere-plant models. Analysis of evapotranspiration estimating methods. Offered alternate years.

**BEE 558. NONPOINT SOURCE POLLUTION ASSESSMENT AND CONTROL. (3 Credits)**

Problem solving in nonpoint source pollution. Methods for evaluating the extent, rate, timing, and fate of Non-Point Source (NPS) pollutants in agricultural and urban environments.

**BEE 568. BIOREMEDIATION ENGINEERING. (4 Credits)**

Examines strategies for using a variety of biological processes for treating municipal, agricultural and industrial contaminants. Lec/lab.

**BEE 572. INTRODUCTION TO FOOD ENGINEERING PRINCIPLES. (5 Credits)**

Fundamental engineering principles for scientists and non-process engineers. Topics include fluid flow, mass and energy transfer, and material and energy balances. Directed at food scientists and other majors who need or would like a working knowledge of process engineering principles.

**BEE 573. INTRODUCTION TO FOOD ENGINEERING PROCESS DESIGN. (3 Credits)**

Fundamental engineering process design principles for food scientists and non-process engineers. Directed at those who need or would like a working knowledge of applied food engineering process design. Lec/rec.

**BEE 585. METABOLIC SYSTEMS ENGINEERING. (3 Credits)**

Quantitative and experimental approaches for describing and engineering biological networks and an introduction to the principles and methodologies of metabolic engineering and synthetic biology.

**BEE 586. PROBLEM SOLVING FOR METABOLIC SYSTEMS ENGINEERING. (1 Credit)**

Matrix algebra and linear optimization for engineers and life scientists who lack linear algebra, linear optimization, and differential equations. Real-world analysis and optimization problems applied to the design and engineering of biological networks. Lab.

**Corequisites:** BEE 585

**BEE 599. SPECIAL TOPICS. (0-16 Credits)**

*This course is repeatable for 16 credits.*

**BEE 601. RESEARCH. (1-16 Credits)**

*This course is repeatable for 16 credits.*

**BEE 603. THESIS. (1-16 Credits)**

*This course is repeatable for 999 credits.*

**BEE 605. READING AND CONFERENCE. (1-16 Credits)**

*This course is repeatable for 16 credits.*

**BEE 606. PROJECTS. (1-16 Credits)**

*This course is repeatable for 16 credits.*

**BEE 607. SEMINAR. (1-16 Credits)**

Graded P/N.

*This course is repeatable for 16 credits.*

**BEE 699. SPECIAL TOPICS. (1-16 Credits)**

*This course is repeatable for 16 credits.*