Energy, Environmental & Chemical Engineering

Phone: 314-935-5545
Website: https://eece.wustl.edu/academics/undergraduate-programs/index.html

Courses

EECE 1000 Introduction to Energy, Environmental and Chemical Engineering
Key technical issues that face our society and some of the emerging technologies that hold promise for the future are examined and discussed. Relationship to chemical engineering principles is emphasized.
Credit 3 units.
Typical periods offered: Fall

EECE 1010 Topics in Energy, Environmental and Chemical Engineering
Key technical issues that face our society and some of the emerging technologies that hold promise for the future are examined and discussed. Emphasizes providing a broader context for content delivered in concurrent core chemical and environmental engineering courses.
Credit 1 unit.
Typical periods offered: Fall

EECE 1999 Independent Study
Independent investigation on topic of special interest. Interested students are encouraged to approach and engage faculty to develop a topic of interest. A form declaring the agreement must be filed in the departmental office. Petitions are generally considered in the semester preceding the independent study experience.
Credit 3 units.
Typical periods offered: Fall, Spring

EECE 2000 Process Analysis and Thermodynamics
This course is an introduction to the use of mathematics and methods of engineering in the analysis of chemical and physical processes. It will address the use of balances (e.g., mass, energy, entropy) to describe processes with and without chemical reactions in both transient and steady-state conditions as well as classical thermodynamics focused on processes, first and second laws, and properties of pure substances.
Credit 4 units.
Typical periods offered: Fall

EECE 2020 Computational Modeling in Energy, Environmental and Chemical Engineering
Computational tools to solve engineering, design and scientific problems encountered in thermodynamics, transport phenomena, separation processes and reaction kinetics. Introduction to programming skills in MATLAB and use of various MATLAB toolboxes. Theory and application of numerical methods for solution of common problems, including methods for root-finding/optimization, curve fitting (regression, interpolation, and spline), integration, differentiation, and ordinary differential equations and boundary value problems. Illustrative application examples.
Credit 3 units.
Typical periods offered: Spring

EECE 2100 Introduction to Environmental Engineering
The objective of this course is to introduce students to the field of environmental engineering. The course will emphasize basic principles of mass and energy conservation which govern physical, chemical and biological processes. Applications include the estimation of contaminant concentrations and the design of environmental controls.
Credit 3 units.
Typical periods offered: Spring

EECE 2510 Thermodynamics II in EECE
Molecular motions, kinetic theory of gases, kinetic theory of dense phases, chemical kinetics.
Credit 3 units.
Typical periods offered: Spring

EECE 2999 Independent Study
Independent investigation on topic of special interest. Interested students are encouraged to approach and engage faculty to develop a topic of interest. A form declaring the agreement must be filed in the departmental office. Petitions are generally considered in the semester preceding the independent study experience.
Credit 3 units.
Typical periods offered: Fall, Spring

EECE 3000 Transport Phenomena I: Basics and Fluid Mechanics
Engineering principles involved in the exchange of heat and matter in chemical processes. Laws governing the flow of liquids and gases in laboratory and plant equipment.
Credit 3 units.
Typical periods offered: Spring

EECE 3100 Water Resources Engineering
This course further develops student knowledge of water resources engineering specific to the movement of water through natural and built environments. Combines existing fluid mechanics knowledge with hydrology and hydrogeology to introduce students to the design and analysis of surface water, open channel flow, pipe flow, and groundwater systems. Students will have an opportunity to describe, model, and calculate surface water and stormwater runoff hydrology; design and analyze open channel flow; quantify flow in partially full pipes; predict and analyze groundwater flow conditions for confined and unconfined aquifers using hydrogeology; and calculate groundwater flow and well drawdown.
Credit 3 units.
Typical periods offered: Fall

EECE 3110 Green Engineering
Strategies and methods for waste minimization and pollutant emission reduction. Principles of green engineering. Environmental transport and fate modeling. Design of heat and mass exchange networks for energy and waste reduction.
Credit 3 units.
Typical periods offered: Fall

EECE 3120 Air Quality Engineering With Lab
Introduction to air quality and pollution control. Pollutant emissions, atmospheric chemistry, and fate. Air pollution meteorology and atmospheric dispersion. Application of chemistry, thermodynamics, and fluid mechanics in the selection and design of air pollution control equipment. Labs to measure air quality and demonstrate control principles.
Credit 4 units.
Typical periods offered: Fall

EECE 3130 Environmental Engineering Fate and Transport
The objective of this course is to introduce students to the fundamental processes that control contaminant fate and transport in the natural and built environment. The course will highlight mass transport and transformation in surface water, soil and groundwater, and atmosphere. Students will be introduced to environmental transport modeling software to solve applied problems.
Credit 3 units.
Typical periods offered: Spring

EECE 3510 Transport Phenomena II: Energy and Mass Transfer
This course covers introductory treatment of the principles of heat transfer by conduction, convection, and radiation; mathematical analysis of steady and unsteady conduction along with numerical methods; analytical and semi-empirical methods of forced and natural convection systems; boiling and condensation heat transfer; and principles of mass transfer (diffusion and convection) introduced by analogy to heat transfer.
Credit 4 units.
Typical periods offered: Fall

EECE 3520 Materials Science
Introduces the chemistry and physics of engineering materials. Emphasis on atomic and molecular interpretation of physical and chemical properties, the relationships between physical and chemical properties, and performance of an engineering material.
Credit 3 units.
Typical periods offered: Fall

EECE 3530 Chemical Reaction Engineering
Introduction to chemical reaction engineering principles and applications in process and product development. Evaluation of reaction rates from mechanisms and experimental data, quantification of pertinent transport effects and application to reactor and product design.
Credit 3 units.
Typical periods offered: Fall

EECE 3540 Mass Transfer Operations
Stagewise and continuous mass transfer operations, including distillation, gas absorption, humidification, leaching, liquid extraction, and membrane separations.
Credit 3 units.
Typical periods offered: Spring

EECE 3550 Biology in EECE
The course provides an introduction to molecular biology, biochemistry, microbiology, and biotechnology. The course focuses on an engineering approach to microbiology and molecular biology. Topics include basics of molecular biology, mathematical analysis of biological systems, genetic engineering, and biotechnological applications.
Credit 3 units.
Typical periods offered: Spring

EECE 3999 Independent Study
Independent investigation on topic of special interest. Interested students are encouraged to approach and engage faculty to develop a topic of interest. A form declaring the agreement must be filed in the departmental office. Petitions are generally considered in the semester preceding the independent study experience.
Credit 3 units.
Typical periods offered: Fall, Spring, Summer

EECE 4000 Process Design, Economics and Simulation
This is a lecture and computer lab-based course covering engineering science and design, fundamentals of process and product development, process safety and sustainability, computational techniques, and economic principles used for the design of chemical, biological, and environmental processes and procedures. A guided design project is included.
Credit 2 units.
Typical periods offered: Fall

EECE 4010 Advanced Energy Lab
Laboratory experiments to illustrate the application of engineering fundamentals to the study of advanced energy generation, storage, distribution, and delivery systems. Modules include both lecture and laboratory components and explore topics such as fossil fuel combustion, solar PV and solar thermal systems, wind-derived energy, biofuels production, electrochemical energy storage. Extensive metering of energy use in Brauer Hall will be used to study systems performance including energy efficiency.
Credit 3 units.
Typical periods offered: Fall

EECE 4020 Aerosol Science and Engineering Summer School
Aerosol science and engineering encompasses the basic principles that describe the formation, growth, and evolution of a system of particles suspended in a gaseous medium, and the measurement, characterization, and modeling of their properties. Advances in this cross-disciplinary area of research are pivotal for improving our understanding and estimation of climate change; ensuring air quality protection; assessment of health impacts; and enablement of advanced material synthesis. This course will review the current knowledge on measurement, modeling, and characterization techniques for aerosols. It is team-taught and will involve participation by leading scholars across the country with expertise in aerosol science and engineering. This is a broad, introductory course for beginning graduate students and junior and senior undergraduates.
Credit 3 units.
Typical periods offered: Summer

EECE 4060 Energy Conversion and Storage
Renewable electricity from solar and wind will be the primary energy source for our future distributed energy and mobility system. At the foundation of that energy system are the electrochemical energy devices including fuel cells, electrolyzers and batteries. The objectives of this course are to introduce basic concepts and principles of electrochemistry as well as their potential applications. The chemical engineering fundamentals (e.g., mass & energy balances, thermodynamics, and mass & heat transport) will be applied to describe in mathematical terms the catalytic and mass transport processes.
Credit 3 units.
Typical periods offered: Fall

EECE 4070 Industrial Process Safety
This course covers the analysis and management of fire and explosion hazards; control of human exposure to toxic materials; codes, standards, and regulations; transportation and disposal of noxious substances; analysis of drift from clouds, flares, and stacks; venting of pressure vessels; hazard evaluation and safety review of processes; and emergency plans for accidents and disasters.
Credit 3 units.
Typical periods offered: Spring

EECE 4080 Introduction Into Zymurgy
Students will be introduced to the engineering principles and key chemical and physical processes of beer brewing. This course combines lectures with hands-on brewing, laboratory testing, and tours of breweries across multiple scales. Topics include fermentation, mash kinetics, water chemistry, heat transfer, and measurement of off-flavor compounds. By the conclusion of the course, students will be able to independently design and craft their own beers. Students will be required to schedule brewing times with instructors which may fall outside of listed lab hours. Must be 21 or older or receive instructor approval. Due to space limitations, students must complete this application to be considered for enrollment: https://wustl.az1.qualtrics.com/jfe/form/SV_0rEzAlBjOGYGVX8
Credit 3 units.
Typical periods offered: Spring

EECE 4090 Entrepreneurial Engineering
Quality education with a background in engineering and science can lead engineers to create innovations with high potential value. Nevertheless, unlocking value from innovation is not an entirely intuitive enterprise, and success is not guaranteed. This course is created to better prepare students for a future of innovation and entrepreneurial success. The course outline comprises three phases of entrepreneurship: the creative phase, the critical phase, and the crusader phase. It endeavors to provide students with useful skills and practical experiences that are relevant to each phase. Each week will include a brief presentation to set the direction, followed by short discussions of the assigned case studies and a review of fundamental principles from the core text. Student teams will regularly present work to the group, create success metrics, and chart progress. The Creative Phase: The class will work in small groups to create a new business concept. Students will learn brainstorming techniques, leadership, teamwork, and business model innovation. With core values set as a foundation, teams will present their proposed business models and rational basis for income forecasting. The Critical Phase: The class will identify and challenge assumptions to assess commercial viability. Students will find third-party market research to size up the opportunity and gather real customer feedback to refine their strategy. Skills gaps will be appreciated and negotiated solutions sought. Financial and growth metrics will be established to measure success, and threats will be faced. Students will present their SWOT analysis (strengths, weaknesses, opportunities, and threats) and link this to their revised strategy (business model). The Crusader Phase: Students will learn what is acceptable risk and develop a growth mindset (in contrast with fixed mindset), gain power from emotional intelligence, deal with failures (decide to pivot or punt), and learn the difference between ideation and implementation. Students will make progress and get the word out, and they will prepare a short proposal for grant funding or investment with a suitable income stream. By the end of the semester, students will know how to create business model, how to work with teams, how to assess commercial viability, how to establish a rationale for financial forecast, how to assess skills and resource gaps, how to negotiate to fill in gaps, and how to write high-level proposals. Students will demonstrate their knowledge through written submissions and oral presentations.
Credit 3 units.

EECE 4100 Environmental Engineering Laboratory
This course includes laboratory experiments to illustrate the application of engineering fundamentals to environmental systems. Applications of experimental design and data analysis principles are also included, and relevant analytical instrumentation and laboratory techniques are introduced. Laboratory work supported by theoretical analysis and modeling is performed as appropriate.
Credit 3 units.
Typical periods offered: Spring

EECE 4110 Environmental Biotechnology
This course aims to provide students with a background in current environmental biotechnology and to stimulate ideas about future potential new technologies. Students will gain qualitative and quantitative skills related to bioreactor designs in environmental applications (e.g., activated sludge, anaerobic digester, membrane bioreactors). Special focus will be placed on the application of mathematical models that are currently widely used in wastewater engineering, such as the International Water Association models. Hands-on experience with biological water treatment process modeling will be provided. Finally, students will be encouraged to explore links between environmental biotechnologies and a one health approach to public health.
Credit 3 units.
Typical periods offered: Fall

EECE 4510 Chemical Process Dynamics and Control
A state-of-the-art industrial virtual plant is used for the development of dynamic simulations, selection of instrumentation, statistical analysis of variability, and implementation of process control to improve process operation and efficiency.
Credit 3 units.
Typical periods offered: Fall

EECE 4511 Digital Process Control Laboratory
Applications of digital control principles to laboratory experiments supported by a networked distributed control system. Lecture material reviews background of real-time programming, data acquisition, process dynamics, and process control. Exercises in data acquisition and feedback control design using simple and advanced control strategies. Experiments in flow, liquid level, temperature, and pressure control. Term project.
Credit 3 units.
Typical periods offered: Spring

EECE 4520 Unit Operations Laboratory
This course involves laboratory projects focused on the application of chemical engineering principles (e.g., transport, thermodynamics, separations). Student teams design multi-week experiments using unit operations equipment to solve realistic engineering problems, including the analysis of safety and instrumentation. The course has one laboratory period each week, with supplemental lecture sessions. Emphasis is on independent learning, teamwork, and technical communication skills.
Credit 4 units.
Typical periods offered: Fall

EECE 4971 Environmental Engineering Capstone
Methodology for formulating and solving open-ended design problems. The methodology is illustrated through a series of team projects drawn from multiple areas of environmental engineering practice. Topics addressed include the design process, cost estimation, consideration of codes and regulations, sustainability, and reliability. The course also provides content on professional practice, ethics, and professional licensure.
Credit 3 units.
Typical periods offered: Spring

EECE 4975 ChE Capstone
Application of engineering science and design, fundamentals of process and product development, computational techniques and economic principles to design of chemical and biological processes and procedures. A design project and/or an AIChE national design contest is included.
Credit 3 units.
Typical periods offered: Spring

EECE 4979 Senior Thesis
Research project to be selected by the student in senior standing with the permission and recommendation of a faculty supervisor and the approval of the department chair. At conclusion of project, student prepares a report in the form of a senior thesis.
Credit 6 units.
Typical periods offered: Fall, Spring

EECE 4980 ChE Honors Design Project for Aiche Student Contest Problem
Application of engineering science and design, fundamentals of process and product development, computational techniques and economic principles to design of chemical and biological processes and procedures in solving the AIChE national student contest problem. Up to two single and up to two group (2-3 per group) solutions may be chosen for national competition.
Credit 1 unit.
Typical periods offered: Spring

EECE 4993 International Experience in EECE
This course will provide undergraduate students with an international experience related to energy, environmental and/or chemical engineering. The country visited will vary from year to year with one or more EECE faculty members developing the program in collaboration with McDonnell Global Energy and Environment Partnership (MAGEEP) universities. Example activities include conducting field or laboratory research, attending short courses taught by MAGEEP university faculty members, and visiting attractions relevant to the course focus (e.g., industrial facilities). Students will also gain an understanding of the local culture and history of the country visited. Course content will include a seminar series in the spring semester prior to the international experience, a two-to-three week visit to the location of study, and a follow-up student project and presentations during the fall semester which draws upon the experience. Students will enroll in EECE 411 for the fall semester following the trip.
Credit 3 units.
Typical periods offered: Fall

EECE 4999 Independent Study
Independent investigation on topic of special interest. Interested students are encouraged to approach and engage faculty to develop a topic of interest. A form declaring the agreement must be filed in the departmental office. Petitions are generally considered in the semester preceding the independent study experience.
Credit 6 units.
Typical periods offered: Fall, Spring, Summer