BIOLOGICAL ENGINEERING (BE)

BE 142 Introduction to Biological Engineering
2 credits
An introduction to biological engineering and the engineering principles used to solve biological engineering problems. Fields of study within biological engineering will be discussed including agricultural, bioenergy, biomedical, bioprocess, ecohydrological and environmental engineering. Students will work on a team-based engineering project. One lecture and one 3-hour lab per week.

BE 204 (s) Special Topics
Credit arranged

BE 242 Biological Engineering Analysis and Design
3 credits
Methods of analyzing and solving engineering problems; introduction to elements of biological engineering design; use of computers in engineering problem solving.
Prereq: MATH 170
Coreq: MATH 175

BE 299 (s) Directed Study
Credit arranged

BE 361 Biotransport Processes
3 credits
The course will familiarize students with transport phenomena processes involved in bio-related fields spanning from agricultural to environmental and medical to pharmaceutical.
Prereq: ENGR 320 and ENGR 335

BE 398 (s) Engineering Cooperative Internship
Credit arranged
Supervised internship in professional engineering settings, integrating academic study with work experience; details of the co-op to be arranged with supervising professor before the start of the co-op; requires written report. Graded P/F. Cannot be used for technical elective.
Prereq: Permission

BE 404 (s) Special Topics
Credit arranged

BE 411 Energy and Environmental Auditing
3 credits
Joint-listed with BE 511
This course provides an understanding of energy usage, energy management, and impact of industrial processes on environment. The course covers instrumentation for measuring energy and emissions, diagnostics for energy wastage, environmental life cycle analysis, assessment tools, and writing recommendations. The graduate version of the course includes a case study and in-depth analysis of uncommon energy saving recommendations.
Prereq: ENGR 240 and (ENGR 320 or ME 322), or Permission

BE 421 Image Processing and Computer Vision
3 credits
Joint-listed with BE 521
Fundamentals of digital image processing, analysis, feature recognition, and computer vision applied to areas of Biological Engineering including agricultural, environmental and biomedical applications. This course covers camera model, digital image processing and image analysis techniques for computer vision. Additional project components required for graduate credit.
Prereq: (BE 242 and MATH 275) or permission

BE 422 Tissue Biomechanics
3 credits
Joint-listed with BE 522
This course explores the structure and mechanical properties of hard and soft tissues. The main focus will be on musculoskeletal tissues and may include topics in bone, skin, cartilage, muscle, tendon and ligament. Structure-function relationships at a range of anatomical levels, from the cell to the whole tissue, will be examined. Journal articles will be used to discuss current research in tissue biomechanics. Additional projects/assignments are required for graduate credit. Recommended Preparation: Mechanics of Materials
Prereq: Junior or Senior standing; or Instructor Permission

BE 423 Tissue Engineering and Regenerative Medicine
3 credits
Joint-listed with BE 523
This course explores the principles, strategies, and tools used in the field of tissue engineering and regenerative medicine. Topics may include the application of biomaterials, stem cells, and bioreactors for restoring, maintaining and improving tissue function. Journal articles will be used to discuss current research in tissue engineering and regenerative medicine. Additional projects/assignments are required for graduate credit.
Prereq: Junior or Senior standing; or Instructor Permission

BE 426 Medical Imaging Techniques and Applications
3 credits
Joint-listed with BE 526
This course studies the physical and mathematical principles of diagnostic medical imaging systems and may include: X-ray, CT, nuclear medicine (PET and SPECT), ultrasound, MRI, and others. Applications of imaging techniques will be discussed with respect to medical uses. Basic principles of image processing will be discussed and applied using computer programming software. Additional work is required for graduate credit.
Prereq: MATH 275, PHYS 212, Junior or Senior standing; or Instructor Permission. Math 310 recommended but not required.

BE 433 Bioremediation
3 credits
Joint-listed with BE 533
Theory and practice of bioremediation as applied to toxic and hazardous wastes, including reaction kinetics, reaction stoichiometry, microbiology, and design of ex- and in-situ processes. Graduate credit requires additional design project. One or two field trips.
Prereq: BIOL 115, BIOL 115L, and MATH 170, or Permission
BE 441 Instrumentation and Measurements  
3 credits  
Joint-listed with BE 541  
Sensing elements, signal conditioning, data output, and control.  
Additional projects/assignments required for graduate credit. Two  
lectures and one 3-hour lab per week. Cooperative: open to WSU degree-  
seeking students.  
Prereq: ENGR 240  
Coreq: STAT 301

BE 450 Environmental Hydrology  
3 credits  
Carries no credit after BE 355 or CE 325. The objective of this course  
is to provide a comprehensive understanding of the hydrologic  
processes associated with the environmental processes. Includes  
components of the hydrologic cycle, analysis of precipitation and run  
off, evapotranspiration, routing, peak flow, infiltration, soil and water  
relationships, snowmelt, and frequency analysis. (Spring only)  
Prereq: MATH 170

BE 453 Northwest Climate and Water Resources Change  
3 credits  
Joint-listed with BE 553  
Examines the relationship between climate and water resources in the  
Northwest, including historical and potential changes, and comparisons  
with other US regions. Scientific literature is read and discussed.  
Quantitative tools are developed for modeling the process physics and  
conducting statistical analyses. Historical data are analyzed. Additional  
project components required for graduate credit.  
Prereq: STAT 301 or permission

BE 461 Bioprocess Engineering  
3 credits  
Joint-listed with BE 561  
This course covers advanced applications of biological sciences,  
processing principles applied to the analysis and design of handling,  
processing, and separation of bioproducts. Students complete several  
hands-on laboratory modules in addition to a bioprocess design project.  
Additional work required for graduate credit.  
Prereq: Permission

BE 462 Electric Power and Controls  
3 credits  
Design, selection, and use of electrical equipment and electric power  
systems for application to biological systems; design and use of  
electrical, electronic, and other feedback control systems for use with  
biological systems. Course includes advanced biological sciences  
applications. Two lectures and one 3-hour lab per week.  
Prereq: ENGR 240  
Coreq: MATH 310

BE 478 Engineering Design I  
3 credits  
Gen Ed: Senior Experience  
The capstone design sequence for biological and agricultural  
engineering majors. Course topics include research, design, experimental  
methods, specifications, prototyping, and verification; report writing,  
documentation and oral presentations. Topics, from industrial  
sponsorship, are considered in the context of a major design project  
involving a team of students. Projects incorporate realistic engineering  
constraints including environmental concerns, sustainability, ethical,  
safety, manufacturability, social and political considerations.  
Prereq: BE 242, ENGR 320, ENGR 335, and ENGR 350

BE 479 Engineering Design II  
3 credits  
Gen Ed: Senior Experience  
Continuation of the capstone design sequence for biological and  
aricultural engineering majors. Course topics include research, design,  
experimental methods, specifications, prototyping, and verification; report  
writing, documentation and oral presentations. Topics, from industrial  
sponsorship, are considered in the context of a major design project  
involving a team of students. Projects incorporate realistic engineering  
constraints including environmental concerns, sustainability, ethical,  
safety, manufacturability, social and political considerations  
Prereq: BE 478

BE 485 Fundamentals of Bioenergy and Bioproducts  
3 credits  
Joint-listed with BE 585  
Review of current technology for producing energy and products from  
biological materials. Discussion of economic, social, and political aspects  
and future prospects for petroleum displacement. Additional projects/  
assignments required for graduate credit. Recommended Preparation:  
Organic Chemistry.  
Prereq: CHEM 111, CHEM 111L  
Coreq: ENGR 320 or Permission

BE 491 Senior Seminar  
1 credit  
Gen Ed: Senior Experience  
Cross-listed with CHE 491  
Professional aspects of the field, employment opportunities, and  
preparation of occupational inventories. Graded P/F.  
Prereq: Senior standing.

BE 492 Biofuels  
3 credits  
Joint-listed with BE 592  
Basic principles for the production and utilization of biobased fuels;  
processing techniques and chemistry; fuel properties and utilization.  
Additional projects/assignments required for graduate credit.  
Recommended Preparation: Organic Chemistry.  
Prereq: CHEM 111, CHEM 111L  
Coreq: ENGR 320 or Permission

BE 494 Thermochemical Technologies for Biomass Conversion  
3 credits  
Joint-listed with BE 594  
Introduce the fundamentals of biomass conversion technologies for  
biofuels and bioenergy. Specific topics include biomass preparation/  
pretreatment, pyrolysis, gasification, direct liquefaction, and economic  
factors in thermochemical conversion of biomass. Advances of the  
technologies will be brought to current through literature reviews. A  
semester long course project is required if taken as a graduate level  
course. Recommended Preparation: Organic Chemistry, Chemical  
Reaction Engineering, Engineering Thermodynamics.  
Prereq: CHEM 277 and CHEM 278  
Coreq: ENGR 320 or Permission

BE 499 (s) Directed Study  
Credit arranged

BE 500 Master's Research and Thesis  
Credit arranged
BE 501 (s) Seminar
1 credit
Cross-listed with BE 501
Graded P/F.
Prereq: Permission

BE 502 (s) Directed Study
Credit arranged

BE 504 (s) Special Topics
Credit arranged

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BE 556 Bioprocess Engineering
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Joint-listed with BE 461
This course covers advanced applications of biological sciences, processing principles applied to the analysis and design of handling, processing, and separation of biomaterials. Students complete several hands-on laboratory modules, in addition to a bioprocess design project. Additional work is required for graduate credit.
Prereq: Permission

BE 585 Fundamentals of Bioenergy and Bioproducts
3 credits
Joint-listed with BE 485
Prereq: CHEM 111, CHEM 111L
Coreq: ENGR 320 or Permission
BE 592 Biofuels
3 credits
Joint-listed with BE 492
Basic principles for the production and utilization of biobased fuels; processing techniques and chemistry; fuel properties and utilization. Additional projects/assignments required for graduate credit. Recommended Preparation: Organic Chemistry.
Prereq: CHEM 111, CHEM 111L
Coreq: ENGR 320 or Permission

BE 594 Thermochemical Technologies for Biomass Conversion
3 credits
Joint-listed with BE 494
Introduce the fundamentals of biomass conversion technologies for biofuels and bioenergy. Specific topics include biomass preparation/pretreatment, pyrolysis, gasification, direct liquefaction, and economic factors in thermochemical conversion of biomass. Advances of the technologies will be brought to current through literature reviews. A semester-long course project is required if taken as a graduate-level course. Recommended Preparation: Organic Chemistry, Chemical Reaction Engineering, Engineering Thermodynamics.
Prereq: CHEM 277 and CHEM 278
Coreq: ENGR 320 or Permission

BE 598 (s) Internship
Credit arranged

BE 599 (s) Non-thesis Master's Research
Credit arranged
Research not directly related to a thesis or dissertation.
Prereq: Permission

BE 600 Doctoral Research and Dissertation
Credit arranged