

# Biological Systems Engineering (BSE)

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Courses primarily for undergraduates:

## **BSE 110. Experiencing Biological Systems Engineering.**

(0-2) Cr. 1. S.

Laboratory-based, team-oriented experiences in a spectrum of topics common to the practice of biological systems engineering. Report writing, co-ops, internships, careers, registration planning.

## **BSE 170. Engineering Graphics and Introductory Design.**

(Cross-listed with A E). (2-2) Cr. 3. F.S. *Prereq: Satisfactory scores in math placement assessments; credit or enrollment in MATH 142.*

Applications of multi-view drawings and dimensioning. Techniques for visualizing, analyzing, and communicating 3-D geometries. Application of the design process including written and oral reports.

## **BSE 201. Preparing for Workplace Seminar.**

(Cross-listed with A E, TSM). (1-0) Cr. 1. F.S. *Prereq: Sophomore classification in A E, AST, BSE or ITec*

8 week course. Professionalism in the context of the engineering/technical workplace. Development and demonstration of key workplace competencies: teamwork, initiative, communication, and engineering/technical knowledge. Resumes, interviewing, preparation for internship experiences, professional portfolios.

## **BSE 216. Fundamentals of Agricultural and Biosystems Engineering.**

(Cross-listed with A E). (2-2) Cr. 3. F. *Prereq: A E 110, ENGR 160, credit or enrollment in MATH 166*

Application of mathematics and engineering sciences to mass and energy balances in agricultural and biological systems. Emphasis is on solving engineering problems in the areas of heat and mass transfer, air and water vapor systems; animal production systems, grain systems; food systems, hydrologic systems, and bioprocessing.

## **BSE 218. Project Management & Design in Agricultural and Biosystems Engineering.**

(Cross-listed with A E). (1-2) Cr. 2. S. *Prereq: A E 216*

Project management - critical path, Gantt charts, resource allocations, basic project budgeting, and project management software. Engineering design approaches. Open-ended design projects to demonstrate the preceding principles through application of technical concepts taught in prerequisite coursework.

## **BSE 298. Cooperative Education.**

Cr. R. F.S.SS. *Prereq: Permission of department and Engineering Career Services*

First professional work period in the cooperative education program. Students must register for this course before commencing work. Offered on a satisfactory-fail basis only.

## **BSE 316. Applied Numerical Methods for Agricultural and Biosystems Engineering.**

(Cross-listed with A E). (2-2) Cr. 3. F. *Prereq: ENGR 160, Math 266*

Computer aided solution of agricultural engineering problems by use of numerical techniques and mathematical models. Systems analysis and optimization applicable to agricultural and biological systems.

## **BSE 325. Biorenewable Systems.**

(Cross-listed with A E, AGRON, AN S, TSM, BUSAD, ECON). (3-0) Cr. 3. F. *Prereq: ECON 101, CHEM 163 or higher, MATH 140 or higher*

Converting biorenewable resources into bioenergy and biobased products. Biorenewable concepts as they relate to drivers of change, feedstock production, processes, products, co-products, economics, and transportation/logistics.

## **BSE 380. Principles of Biological Systems Engineering.**

(3-0) Cr. 3. S. *Prereq: BSE 216, CH E 357 or M E 436*

Unit-operation analysis of biological systems, through the study of mass, energy, and information transport in bioresource production and conversion systems. Quantification and modeling of biomass production, ecological interactions, and bioreactor operations.

## **BSE 388. Sustainable Engineering and International Development.**

(Cross-listed with A E, E E, M E, MAT E, C E). (2-2) Cr. 3. F. *Prereq: Junior classification in engineering*

Multi-disciplinary approach to sustainable engineering and international development, sustainable development, appropriate design and engineering, feasibility analysis, international aid, business development, philosophy and politics of technology, and ethics in engineering. Engineering-based projects from problem formulation through implementation. Interactions with partner community organizations or international partners such as nongovernment organizations (NGOs). Course readings, final project/design report. Meets International Perspectives Requirement.

## **BSE 396. Summer Internship.**

Cr. R. Repeatable. SS. *Prereq: Permission of department and Engineering Career Services*

Summer professional work period. Offered on a satisfactory-fail basis only.

## **BSE 397. Engineering Internship.**

Cr. R. Repeatable. F.S. *Prereq: Permission of department and Engineering Career Services*

One semester maximum per academic year professional work period. Offered on a satisfactory-fail basis only.

## **BSE 398. Cooperative Education.**

Cr. R. F.S.SS. *Prereq: BSE 298, permission of department and Engineering Career Services*

Second professional work period in the cooperative education program. Students must register for this course before commencing work. Offered on a satisfactory-fail basis only.

## **BSE 403. Modeling and Controls for Agricultural Systems.**

(Dual-listed with BSE 503). (Cross-listed with A E). (2-2) Cr. 3. Alt. S., offered 2013. *Prereq: A E 363, MATH 266*

Modeling dynamic systems with ordinary differential equations. Introduction to state variable methods of system analysis. Analysis of mechanical, electrical, and fluid power systems. Analytical and numerical solutions of differential equations. Introduction to classical control theory. Feedback and stability examined in the s domain. Frequency response as an analytical and experimental tool. MATLAB will be used throughout the course for modeling.

## **BSE 411. Bioprocessing and Bioproducts.**

(Dual-listed with BSE 511). (Cross-listed with A E, BIOE, C E). (3-0) Cr. 3. F. *Prereq: A E 216, C E 326 or equivalent, MATH 160 or MATH 165, CHEM 167 or higher, BIOL 173 or BIOL 211 or higher, senior or graduate classification*

Sustainability, cleaner production. Taxonomy, kinetics, metabolism, microbial cultivation, aerobic and anaerobic fermentation. Antibiotics, food supplements, fermented foods, vitamin production. Biofuels, bioenergy and coproducts. Mass/energy balances, process integration, pretreatment, separation. Membrane reactors, bioelectrolysis, microbial fuel cells, nanotechnology, genetic engineering, mutagenesis.

## **BSE 415. Agricultural Engineering Design I.**

(Cross-listed with A E). (1-2) Cr. 2. F.S. *Prereq: A E 271 or A E 272, E M 324*

Identification of current design problems in agricultural engineering. Development of alternate solutions using creativity and engineering analysis and synthesis techniques. Nonmajor graduate credit.

## **BSE 416. Agricultural Engineering Design II.**

(Cross-listed with A E). (1-2) Cr. 2. F.S. *Prereq: A E 415*

Selection of promising solutions to design problems identified in 415 for development by design teams. Presentation of designs through oral and written reports and prototypes. Nonmajor graduate credit.

## **BSE 469. Grain Processing and Handling.**

(Dual-listed with BSE 569). (Cross-listed with A E). (2-3) Cr. 3. S. *Prereq: A E 216* Cereal grain and oilseed properties, quality measurement, processing, and end-use value. Design of drying systems using computer simulation. Corn wet and dry milling. Soybean oil extraction. Grain handling systems.

## **BSE 480. Engineering Analysis of Biological Systems.**

(Cross-listed with ENSCI). (2-2) Cr. 3. F. *Prereq: BSE 216; MATH 266; BIOL 211 or BIOL 212; M E 231*

Systems-level engineering analysis of biological systems. Economic and life-cycle analysis of bioresource production and conversion systems. Global energy and resource issues and the role of biologically derived materials in addressing these issues. Nonmajor graduate credit.

## **BSE 490. Biological Systems Engineering Independent Study.**

Cr. 1-4. Repeatable. F.S.SS.

Faculty-guided independent study in topics relevant to biological systems engineering.

**BSE 490B. Biological Systems Engineering Independent Study:**

**Biorenewable Resources.**

Cr. 1-4. Repeatable. F.S.SS.

**BSE 490E. Biological Systems Engineering Independent Study:**

**Environmental Bioprocessing.**

Cr. 1-4. Repeatable. F.S.SS.

**BSE 490F. Biological Systems Engineering Independent Study: Food**

**Engineering.**

Cr. 1-4. Repeatable. F.S.SS.

**BSE 490G. Biological Systems Engineering Independent Study: General**

**Topics.**

Cr. 1-4. Repeatable. F.S.SS.

**BSE 490H. Biological Systems Engineering Independent Study: Honors.**

Cr. 1-4. Repeatable. F.S.SS.

**BSE 496. Agricultural and Biosystems Engineering Travel Course.**

(Cross-listed with A E). Cr. 1-4. Repeatable. F.S.SS. *Prereq: Permission of instructor*

Limited enrollment. Tour and study of international agricultural and biosystems engineering as applied to biorenewable and food systems. Location and duration of tours will vary. Travel expenses paid by students. Course requires completion of options A, B, and C or option D.

Meets International Perspectives Requirement.

**BSE 496A. Agricultural and Biosystems Engineering Travel Course: Pre-departure.**

(Cross-listed with A E). Cr. 1-4. Repeatable. F.S.SS. *Prereq: Permission of instructor*

Limited enrollment. Tour and study of international agricultural and biosystems engineering as applied to biorenewable and food systems. Location and duration of tours will vary. Travel expenses paid by students. Course requires completion of options A, B, and C or option D.

Meets International Perspectives Requirement.

**BSE 496B. Agricultural and Biosystems Engineering Travel Course: Travel (R credit).**

(Cross-listed with A E). Cr. 1-4. Repeatable. F.S.SS. *Prereq: Permission of instructor*

Limited enrollment. Tour and study of international agricultural and biosystems engineering as applied to biorenewable and food systems. Location and duration of tours will vary. Travel expenses paid by students. Course requires completion of options A, B, and C or option D.

**BSE 496C. Agricultural and Biosystems Engineering Travel Course: Post-travel.**

(Cross-listed with A E). Cr. 1-4. Repeatable. F.S.SS. *Prereq: Permission of instructor*

Limited enrollment. Tour and study of international agricultural and biosystems engineering as applied to biorenewable and food systems. Location and duration of tours will vary. Travel expenses paid by students. Course requires completion of options A, B, and C or option D.

Meets International Perspectives Requirement.

**BSE 496D. Agricultural and Biosystems Engineering Travel Course: Combination (A/B/C).**

(Cross-listed with A E). Cr. 1-4. Repeatable. F.S.SS. *Prereq: Permission of instructor*

Limited enrollment. Tour and study of international agricultural and biosystems engineering as applied to biorenewable and food systems. Location and duration of tours will vary. Travel expenses paid by students. Course requires completion of options A, B, and C or option D.

Meets International Perspectives Requirement.

**BSE 498. Biological Systems Engineering Cooperative Education.**

Cr. R. Repeatable. F.S.SS. *Prereq: BSE 398, permission of department and Engineering Career Services*

Third and subsequent professional work periods in the cooperative education program. Students must register for this course before commencing work. Offered on a satisfactory-fail basis only.