Biological Systems Engineering Major

Undergraduate Student Handbook

Biological Systems Engineering
UNIVERSITY OF WISCONSIN–MADISON

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460 Henry Mall - Home of the BSE Department

Introduction

Welcome to the University of Wisconsin-Madison and the Department of Biological Systems Engineering (BSE). The faculty and staff are committed to enabling you to have an enriching, rewarding, and professional experience at UW-Madison.

This manual provides background information on the Biological Systems Engineering degree program and guidance for meeting the major's requirements. Specific curriculum information is located in the Undergraduate Academic Guide on the UW-Madison website.

All students are assigned an academic advisor when they enter the department. Your advisor will counsel you on the academic requirements of the major and serve as a resource to answer other academic concerns.

Prior to registration, the Department places an academic advising hold on each student. This hold prevents you from registering until you have met with your academic adviser. Consequently, you must contact your academic adviser at least once per semester prior to registering for next semester's classes. Your adviser will look over your proposed course selections to make sure you're on track for your chosen academic path. If your adviser approves of your course selection, they will notify Betsy Wood who will then remove your registration hold. If you have seen your advisor but are still unable to register, check to see details of the hold, and contact Betsy Wood (betsy.wood@wisc.edu, 262-3310).

The Biological Systems Engineering Department is committed to providing a stimulating education for all students. Please inform the Department Chair immediately of any barriers that create problems or limitations in the educational opportunities for you or other students in the department.

For further information about the Biological Systems Engineering major, please contact:

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Program Overview

Biological Systems Engineering is the application of engineering principles to biological and agricultural systems which impact our food, fiber, and renewable energy resources. Since biological systems engineering programs focus heavily on the protection and conservation of natural resources, it is common for them to be described as sustainable engineering programs.

Within the BSE program a student will choose to enroll in either the *General Program* area or in one of the following three specialization areas: *Machinery Systems Engineering, Natural Resources and Environmental Engineering,* and *Food and Bioprocess Engineering*. The specialization in Food and Bioprocess Engineering is split into a Food Engineering track and a Bioprocess Engineering track. These areas are described in more detail in Section D.

Students who complete all degree requirements are awarded a *Bachelor of Science Degree in Biological Systems Engineering*. A student who completes one of the three program specializations will have the area of specialization identified on their official transcript.

The BSE program, like all undergraduate engineering programs on the UW-Madison campus, is accredited by ABET (Accreditation Board for Engineering & Technology). Accreditation by ABET is an indication of program quality and has major benefits for individuals seeking registration as a licensed professional engineer.

A UW-Madison BSE graduate may apply for licensure as a registered professional engineer once they have passed the Fundamentals of Engineering (FE) exam, obtained four years of qualifying engineering work experience, and have passed the Professional Engineering (PE) exam. Job opportunities for BSE graduates remain plentiful and show no signs of decreasing given (1) the increase in world population and corresponding increasing need for food, fiber, and renewable energy, (2) the measurable shortage of highly trained technical personnel in the United States, and (3) the constantly expanding emphasis on protection and conservation of natural resources.

The UW-Madison BSE program is traditionally known for its emphasis on undergraduate education reflected in outstanding one-on-one advising and smaller class sizes.

An excellent way for students to learn about biological systems engineering is to become active in the Pre-Professional Club. The Pre-Professional club is a student branch of the American Society of Agricultural and Biological Engineers (ASABE), the national society for engineering in agricultural, food and biological systems. This is an excellent way to meet practicing engineers and to develop a professional network. This club is supported by the department and all students are encouraged to participate. All students in the Biological Systems Engineering major receive announcements of meetings and other activities of the Pre-Professional Club. Additional student groups on campus exist to support engineering students holding underrepresented identities, and students are encouraged to explore those options too.

Mission and Objectives

Mission

The mission of the Biological Systems Engineering Undergraduate Program is to provide a technology-advanced, biology-based engineering education that will enable students to design and implement efficient and environmentally sensitive methods of producing and processing food, fiber, and renewable energy resources for an ever-increasing world population.

Program Objectives

The Biological Systems Engineering Department recognizes that our graduates will choose to use acquired knowledge and skills to pursue a wide variety of career and life goals. Whether they choose a professional career, pursue further education, or engage in volunteer work, our graduates will:

1. Develop exceptional problem-solving, leadership, teamwork, and communication skills in the intersecting fields of biological systems and engineering, covering various scales, from microbial to global.
2. Utilize skills to make meaningful contributions to communities in addressing pressing societal and ecological challenges.
3. Be prepared for professional licensure and career development in the public, private, or nonprofit sectors.

Learning Outcomes

Undergraduate educational objectives and learning outcomes are available on the BSE departmental website and as part of The Undergraduate Guide on the UW-Madison website. The BSE departmental student learning outcomes are also listed below:

At the time of graduation, UW-Madison BSE students will have attained:

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
3. an ability to communicate effectively with a range of audiences.
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgements, which must consider the impact of engineering solutions, in global, economic, environmental, and societal contexts.
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgement to draw conclusions.
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Areas of Specialization

Within the BSE program, a student can choose the General Program area or one of the following three specialization areas: Machinery Systems Engineering, Natural Resources and Environmental Engineering, or Food and Bioprocess Engineering.

Machinery Systems Engineering

Engineers in the Machinery Systems Engineering specialization work in a variety of industries applying mechanical technology and knowledge of biological systems to solve equipment-related problems. From design and construction to testing and evaluation and to sales and support, engineers in Machinery Systems Engineering provide the technical expertise to get the job done. They work for small and large companies that produce machines and systems for agriculture, food and fiber processing, construction, mining, lawn and ground care, materials handling, and forestry and paper industries.

Natural Resources and Environmental Engineering

Engineers in the Natural Resources and Environment Engineering specialization area combine engineering with agricultural and environmental sciences to solve problems related to our environment and natural resources. Engineers in this field evaluate, design, modify, and improve erosion control and runoff systems, animal and human waste handling and treatment systems, irrigation and drainage systems, and water quality management practices. They find most career opportunities within government agencies and environmental consulting firms.

Food and Bioprocess Engineering

Food and Bioprocess engineers evaluate, design, modify, improve, and economize the processing and distribution of food, feed, fiber, and energy. This growing field also includes the new world of biotechnology and bioprocessing. They work in companies large and small that are involved in one or more of the following: processing, packaging and distributing meat, poultry and seafood products; canning and freezing fruits and vegetables; producing ethanol and other fuels from biological materials; drying and storing grains and other food stuffs; designing and testing machines and instruments; sensing and controlling temperature, pressure and moisture during processing; and developing new foods and processes.

Students who choose the Food & Bioprocess Engineering Specialization will complete one of two tracks: food engineering or bioprocess engineering.

General Program Option

The General Program option is for those students who are interested in a combination of the three BSE specialization areas, and/or are interested in a specialization area outside of the identified three. Examples of others specialization areas include structural engineering, aquaculture engineering, forest engineering, manufacturing engineering, and biomaterials engineering.

Students who complete the requirements of one of the three specialization areas will have that area of specialization identified on their official transcript. There is no such identification on the transcript of a student enrolled in the General Program option.

Entrance and Degree Requirements

Student Classification

This major is a "Limited Enrollment Major" because students must meet specific criteria for full admission. Within the undergraduate BSE program, there are two levels. Incoming first-year students and transfers new to UW Madison have their major listed as "Intended- BSE." Once full admission criteria are met, the word "intended" is removed and your specialization (if chosen) appears. You cannot receive a degree in BSE without full admission status. The requirements for full admission into the degree granting program are listed later in this section.

Entering the BSE Program as a New First-Year Student

There are two ways to enter the BSE program, as a new first-year student, or as a transfer from another program either on or off-campus.

Admission to the UW Madison campus as a first-year student is controlled by the UW-Madison Office of Admissions and Recruitment. The BSE department is not involved in, nor does it have any control over this process. However, any student can declare BSE as their major once admitted.

Individuals who desire a degree in Biological Systems Engineering but are denied entry into UW-Madison as a first-year student, should consider transferring into the BSE program after beginning their college education elsewhere.

Transferring into the BSE Program

The BSE program is the oldest accredited biological engineering program in the State of Wisconsin and many students will transfer into the program after beginning their studies elsewhere.

Students transfer into the BSE program as "intended" biological systems engineering students. Students with less than thirty (30) credits at the time of transfer must achieve full admission classification within three (3) regular semesters from the time of transfer. Transfer students with thirty (30) or more credits must achieve full admission within two (2) regular semesters of transferring into the program. Students who do not meet full admission criteria in a timely manner will not be allowed to continue in the BSE program.

Students at other UW institutions or technical colleges planning to transfer to UW-Madison to obtain a BSE degree should work with the UW-Madison BSE department advisor to ensure that the courses they are taking will meet BSE degree requirements.

Curriculum Updates

The curriculum for the BSE major is updated on an annual or biennial basis. Students who plan on obtaining a BSE degree, but who begin working on BSE degree requirements prior to officially transferring into the program, should be aware of this since they will be required to meet the requirements of the curriculum in effect on the date of their official transfer into the program (i.e., they will not be allowed to use a curriculum previously in effect). Once enrolled in the program, they may (like all other enrolled students) elect to use a more current (i.e., updated) curriculum, but then must complete all requirements of the newer curriculum.

Admission to Degree-Granting Program

To be fully admitted to the Biological Systems Engineering program, a student must have the following:

1. A minimum of 24 degree credits.
2. A minimum of 17 graded credits of calculus, statistics, chemistry, computer science, biological science, statics and physics courses required for a BSE degree. High school grades from AP courses or pass-fail (disrupted grading) credits are not included.
3. A BSE *Math and Science Grade Point Average* (MSGPA) of at least 2.65 with a minimum grade of C in every course used to calculate the MSGPA. See the following section for calculation of this average.
4. Successful completion of introductory chemistry (Chem 103/104 or 109 or equivalent) and math through Math 222.

As soon as you have simultaneously met all four of the preceding requirements, you are guaranteed full admission. Admission is not competitive. However, this change does not become official until the department advisor has notified the CALS Office of Academic Affairs and they process the update. It is the student's responsibility to notify the advisor when they meet all requirements for full admission.

BSE students can retake as many courses as needed, as many times as needed, to meet the requirements for full admission. Classes may be repeated at another college, and we can still use those new grades. Also, there is no time limit for students who join the department as first-year students as to when this requirement must be met. However, full admission is required for enrollment access to most upper-level BSE classes.

BSE Math and Science GPA Calculation

This *BSE Math and Science GPA* (MSGPA) is based on the following (and only the following) courses:

- All math courses 217 and above (excluding Math 228),
- Statistics courses 224 and above,
- All chemistry courses,
- All biology courses (i.e., all courses with a UW-Madison "Biological" breadth designation), maximum of three courses, required courses must be included if taken,
- Computer science courses 302 and above (excluding Comp Sci 402),
- BSE 380,
- EMA 201,
- Physics courses 201 and above.

Four important conditions associated with the BSE Math and Science GPA calculation are:

1. You must have a grade of C or better in any course that has been completed and is included in the MSGPA calculation list.
2. For any course that a student repeats, only the most recent grade will be used in the calculation.
3. Any transfer course from another university included in the course list must be included in the GPA calculation.
4. There is no limit on the number of courses a student can retake or on the number of times a student can retake a specific course.

To assist students in the BSE Math and Science GPA calculation, a spreadsheet has been developed and placed on the BSE website for download. See the “Student Resources” section under “Undergraduate Academics” on the BSE website for this spreadsheet.

Graduation Requirements

Students must maintain a 2.0 GPA or better to remain in the program, have at least a 2.0 GPA for the last semester in attendance and for the combined last two semesters in attendance, and must have a 2.0 GPA or better for all courses designated as BSE.

The Fundamentals of Engineering Exam is a national exam. It is to your advantage to take this exam as it is a precursor for the Professional Engineering (PE) Examination which can be taken after gaining the prerequisite amount of professional work experience. In some areas it is essential to have a PE license.

Students are asked to complete surveys from campus, CALS, the College of Engineering (a nationwide survey for all engineering graduates), and the BSE department just prior to graduation. Your survey responses are part of a continual program assessment process.

Official Curriculum and Checklists

The most current curriculum is available online in the UW-Madison Undergraduate Guide. The BSE Department developed a curriculum checklist for each track available on the department website under Degree Requirements.

All UW-Madison undergraduate curricula can be broken into four sets of requirements based on who established and thus controls the requirements. For BSE, these four groups are:

1. University of Wisconsin-Madison requirements
2. College of Agricultural and Life Science (CALS) requirements
3. Biological Systems Engineering major requirements
4. Free electives

The UW-Madison and CALS requirements appear on the first page of the curriculum checklist, BSE core requirements (requirements that apply to all BSE students) appear on the second page of the checklist, the next page contains BSE specialty requirements, and the last page of the curriculum checklist is used to identify free electives. Specialty requirements are the 43 course credits required for each of the four specialization areas and the general program option. This 43-credit total includes a block of technical elective credits, the requirements of which are the same for all specialty areas.

Understanding this classification of requirements is important because multiple counting of courses between (but not within) these categories is allowed, and exceptions to requirements within a category can only be approved at the level that established the requirements. The latter means the Biological Systems Engineering Department cannot approve course substitutions for University and CALS level requirements.

To simplify checklists, University and CALS requirements are not included on the checklists if the requirements are automatically met with BSE major requirements. Such is the case with the University's "Quantitative Reasoning Part A" and "Quantitative Reasoning Part B" requirements, and the CALS "physical and biological science fundamentals" requirements.

Testing out the ASABE ¼-scale pulling tractor at the West Madison Agricultural Research Station

Multiple Counting of Courses

Multiple counting occurs when a student uses the same course to meet a requirement in more than one of the three major categories: University requirements, CALS requirements, and BSE major requirements. The same course can be counted once in each of these three main categories, but never more than once in the same category. This means, for example, that you cannot use the same course to meet two different University requirements (Ethnic Studies and Humanities, or Comm B and Social Science).

Multiple counting enables more students to graduate without excess credits. By multiple counting courses, students increase the number of free elective courses they can take, or students are better able to complete the requirements of a certificate program without extending their time to degree.

It is important to understand that double counting a course does not double the credit value of the course. For example, if a 3-credit course is used to meet the University Comm B requirement and is also counted as a Category D Technical Elective, it still only counts as 3 credits toward the 125-credit minimum.

To make use of multiple counting, a student should clearly understand the specific University requirements, CALS requirements, and BSE major requirements. Most important is to be familiar with the following BSE technical elective requirements, as students can potentially double count many University and CALS requirements as BSE technical electives.

BSE Technical Elective Definitions

- **Category A Technical Electives. Introduction to Engineering Course:** BSE 170 (2), INTEREGR 170 (3). Transfer students may request to count Introduction to Engineering courses from other schools.
- **Category B Technical Electives. Independent Study/Instruction Courses:** CALS or CoE courses with a 001, 299, 399, or 699 course number. No more than 3 credits of coursework in this category can be used to meet technical elective requirements.
- **Category C Technical Electives. Upper-Level Engineering and Science Courses:** Upper-level engineering courses includes engineering courses with a 300 or greater course number, any BSE courses not taken to meet other curricular requirements, and EMA 202 (or ME 240) when not taken to meet another curricular requirement. Upper-level science courses include all **advanced** biological, natural, and physical science courses (i.e., courses with a B, N or P breadth designation and an advanced level designation) plus CHEM 341, 342, 343, 344, 345, 421 and AGRONOMY/ASM OCN/SOIL SCI 532. Independent study/instruction courses (BSE or otherwise) cannot be included in this category.
- **Category D Technical Electives. Lower-Level Science and Engineering Courses, Breadth Courses:** Elementary and intermediate level biological, natural, and physical science courses except elementary and intermediate math courses; College of Engineering courses with a 100 or 200 level designation; College of Agricultural and Life Science courses, Institute of Environmental Studies courses, and/or School of Business courses. Independent study/instruction courses cannot be counted here. A maximum of 12 credits of coursework are allowed in this category.

University Requirements

The University requirements include:

1. Communications Part A (2-3 credits).
2. Communications Part B (2-3 credits. INTEREGR 397 can be double counted as a **Category C** Technical Elective.
3. Ethnic studies (3 credits).
4. Social science (3 credits).
5. Humanities (6 credits).

For details, see the Undergraduate Guide. You can use search filters in Course Search & Enroll to find options.

CALS Requirements

Although there are several CALS requirements, most are automatically met when BSE major requirements are completed. Therefore, a significant amount of double counting automatically occurs. Two unique CALS requirements are (1) a minimum 1-credit first-year seminar course, and (2) a minimum 3-credit CALS International Studies course.

The first-year seminar course is only required of students enrolled in the BSE degree program during their first college year (students entering CALS after their first year are exempted from this requirement). First-year seminar course BSE 170 is preferred for BSE students. This or INTEREGR 170 can also be counted as **Category A** Technical Electives. Several other first-year seminar courses can be counted as **Category D** Technical Electives.

Courses that meet the CALS International Studies requirement can sometimes meet multiple other requirements (University, BSE major, certificate). To choose an International Studies course, see the list of courses in the Guide. These courses are not searchable in Course Search & Enroll and substitutions of alternate courses are rarely possible.

Professional Work Experience

The BSE department encourages students to obtain practical professional experience before graduation. In addition to the knowledge and skills to be gained from such experience, it demonstrates enthusiasm for your selected profession to potential employers.

Obtaining Credit for Work Experience

Although there is no requirement that students obtain professional work experience prior to graduation, you can receive up to a maximum of 3 credits of **Category B** technical elective credit for such experience. To receive technical elective credit for a particular work experience you must register for either BSE 001, BSE 299, BSE 399, or BSE 699. The type of work experience determines which of these four courses is appropriate and the number of credits earned.

BSE 001: *Cooperative Education Program*

A student who will be employed **full-time** (approximately 40 hours per week for 15 weeks) **off**-campus can enroll in BSE 001. Registration is for a single credit for each spring, summer or fall in which the student is employed. By registering for 1 credit of BSE 001 during the fall and/or spring semester, you retain your status as a full-time UW-Madison student for continual deferral of student loans.

To register for BSE 001, you must complete the BSE Internship/Cooperative Education Agreement Form prior to beginning your co-op. This form is available on the BSE website and must be signed by the student, their faculty advisor, and the supervisor to whom they will be reporting during their employment. You must submit monthly progress reports to your faculty advisor and a final written report of at least 1000 words.

Students who are on a co-op are not eligible for student loans or grants while on the co-op, and some scholarships may be deferred until the student returns to campus.

If their work schedule permits it, a student employed full-time off campus may opt to take one online course while on co-op. CALS will verify that you are enrolled in a fully online course.

BSE 399: *Coordinative Internship*

A student working **part-time** while attending UW-Madison may elect to enroll in BSE 399. The BSE Department policy is that a student may register for 1 credit of BSE 399 for each 150 hours of work. Although a student can register for more than one credit of BSE 399 during a particular spring, summer or fall, no more than two credits per semester can be used to meet technical elective requirements.

A student who registers for BSE 399 will not automatically be granted full-time status as a UW-Madison student unless they are registered for 12 or more credits. When a student is registered for less than 12 credits, and the combination of course work and professional work experience are deemed equivalent to full-time professional employment, the student is encouraged to apply for an academic load exception that grants fulltime student status. This exception must be obtained from an academic dean in the CALS Academic Affairs Office, 116 Ag Hall.

A student who registers for BSE 399 must also complete the BSE Internship/Cooperative Education Agreement Form before starting their internship. This form is available on the BSE website and must be signed by the student, their faculty advisor, and the supervisor to whom they will be reporting during their employment. You must submit monthly progress reports to your faculty advisor and a final written report of at least 1000 words for each academic credit you are enrolled in.

BSE 299: *Independent Study*

BSE 299 is for any **first-year student, sophomore** or **junior** who is engaged in one-on-one instructional sessions during which they work with and/or under the guidance of a faculty member on a specific project. Quite frequently, the project is associated with the faculty member's research, and the student is an employee of the faculty member.

The policy of the BSE Department is that a student work a minimum of 45 hours for each credit of BSE 299 for which they enroll. Each student who enrolls in BSE 299 must submit a final report with a minimum length of 1500 words. Additionally, each student must make a formal oral presentation of their work. This could be a "brown bag" presentation to faculty, staff and students, a presentation at an ASABE student chapter meeting, a presentation to a class of students enrolled in another course, or a presentation at a professional society meeting.

BSE 699: *Special Problems*

BSE 699 is for any senior engaged in one-on-one instructional sessions during which they work with and/or under the guidance of a faculty member on a specific project. Quite frequently, the project is associated with the faculty member's research, and the student is an employee of the faculty member.

The policy of the BSE Department is that a student work a minimum of 45 hours for each credit of BSE 699 for which they enroll. Each student who enrolls in BSE 699 must submit a final report with a minimum length of 1500 words. Additionally, each student must make a formal oral presentation of their work. This could be a "brown bag" presentation to faculty, staff and students, a presentation at an ASABE student branch meeting, a presentation to a class of students enrolled in another course, or a presentation at a professional society meeting.

Finding Employment

There are numerous sources available to students seeking co-ops and internships. The two primary sources for BSE students are the Engineering Career Service Office, and the CALS Career Services Office. Employers looking for BSE students will contact one or both of these offices directly or will be told by BSE staff to contact these offices. BSE students can also participate in programming offered by SuccessWorks for all campus students.

Handshake is an online system to connect students/alumni and employers. Students find internships, co-ops and full-time employment opportunities, sign-up for on-campus interviews, research employers, and find out about career events.

In addition to on-campus resources, students are encouraged to visit employer websites and on-line sources that specialize in job placement, contact their local chamber of commerce, browse newspapers and journals, attend local career fairs, and network with family, friends, relatives, fellow students, alumni, and professional associates. Badger Bridge is an online resource specifically for UW Madison students and graduates.

If you are interested in international work, note that many companies who recruit UW-Madison engineering students are multi-national. Another option is to contact IAESTE (International Association for the Exchange of Students for Technical Experience). IAESTE helps students locate jobs in more than 70 countries and will help a student with the required work authorization paperwork. IAESTE's annual registration deadline is January 1. Their website address is iaeste.org. Students may also consider the International Internship Program, which curates opportunities specifically for UW Madison students.

Benefits of Co-ops/Internships

Obtaining work experience prior to completing your degree requirements typically increases employment opportunities and starting salaries at graduation.

Companies may use co-ops/internships as an opportunity to screen potential employees. Through various work activities and assignments, an employer can assess critical personal characteristics and traits such as punctuality, enthusiasm, honesty, integrity, temperament, etc., in addition to teamwork and communication skills, basic knowledge, analytical skills and creativity. A successful co-op or internship experience can lead to an offer for full-time employment after graduation.

Semester-by-Semester Course Planning

The exact order in which you take courses is unlikely to match the four-year road map in The Academic Guide since the order in which you take courses will be influenced by success on advanced placement exams, choice of technical electives and occasional scheduling conflicts. When you are unsure of which courses to take during a particular semester and/or run into a scheduling conflict, it is always best to consult your academic advisor. In such situations, three good rules of thumb are to: (1) take first those courses that are prerequisites for other required courses (2) take required courses before electives, and (3) save your social science, humanities, and international studies courses for balance in your junior and senior years and/or a study abroad experience.

Students who plan to study abroad should avoid taking courses at UW-Madison that could be taken while studying abroad. This includes basic math, statistics, science courses, social sciences, and humanities. In many cases, the university attended abroad will have courses related to the major that can be counted for technical elective credit. Complete semester-by-semester course plans for each specialization can be found at the end of this section.

Frequency of BSE Course Offerings

When developing your semester-by-semester course plan, it is important to realize that most courses are only offered once a year. This is currently true of all BSE lecture courses except BSE 367 as the following lists confirm.

BSE courses taught during the fall semester: 249, 270, 301, 367, 372, 380, 461, 473, 475, and 509.

BSE courses taught during the spring semester: 308, 310, 349, 364, 365, 367, 405, 460, 464, 472, 476, 508 and 571.

Prerequisite of Full Admission

BSE 365, 461, 475, 476, 508 and 509, some Food Science courses, and many upper-level College of Engineering courses require that a student be fully admitted to BSE. This is to ensure that the student has the basic math and science knowledge required to successfully complete the course(s). For this reason, one of the primary goals of an “Intended” BSE student should be to achieve full admission in a timely manner.

Capstone Course Enrollment Requirement

BSE 508 *Biological Systems Engineering Design Practicum I* and BSE 509 *Biological Systems Engineering Design Practicum II* collectively comprise the Department's capstone design experience. BSE 509 is to be taken by students during their last fall semester of enrollment (and not before), with BSE 508 taken the previous spring. Students are assigned to a project and design team during BSE 508, and complete work on the project during BSE 509. The fixed sequence and timing (with respect to graduation) of BSE 508 and BSE 509 mean that they will occasionally conflict with a student's study abroad or internship experience. Planning as a first-year student can help ensure that all experiences can be scheduled appropriately.

Four Year Semester-by-Semester Course Plans: General Program

Yr	Sem.	Course	Credits	Sem. Total
1	Fall	MATH 221 *Calculus and Analytic Geometry I*	5	16
		Ethnic Studies/International Studies/Humanities/Social Science	3	
		CHEM 109 *Advanced General Chemistry*	5	
		Biological Science Course	3	
1	Spring	MATH 222 *Calculus and Analytic Geometry II*	4	15
		BSE 170 *Product Design Practicum*	2	
		Ethnic Studies/International Studies/Humanities/Social Science	3	
		LSC 100 *Science and Storytelling* or other Comm A course	3	
		BSE 310 *Project Economics and Decision Analysis*	4	
2	Fall	MATH 234 *Calculus – Functions of Several Variables*	4	16
		EMA 201 *Statics*	3	
		BSE 249 *Engineering Principles for Biological Systems*	3	
		BSE 270 *Introduction to Computer Aided Design*	3	
		BSE 380 *Intro Data Science for the Agricultural & Life Sciences*	3	
2	Spring	BSE 349 *Quantitative Techniques for Biological Systems*	3	15
		MATH 320 *Linear Algebra and Differential Equations*	3	
		PHYSICS 202 *General Physics*	5	
		BSE 308 *Career Management for Engineers*	1	
		ME 306 *Mechanics of Materials*	3	
3	Fall	STAT 324 Introductory Applied Statistics for Engineers	3	17
		Ethnic Studies/International Studies/Humanities/Social Science	3	
		ME 361 *Thermodynamics*	3	
		BSE Course	2	
		Technical Elective	3	
		300 level or higher non-BSE engineering course	3	
3	Spring	BSE 508 *Biological Systems Engineering Design Practicum I*	2	17
		ME 363 *Fluid Dynamics*	3	
		BSE Course	3	
		Ethnic Studies/International Studies/Humanities/Social Science	3	
		BSE 365: *Measurements and Instrumentation for Biological Systems*	3	
		InterEGR 397 *Engineering Communication* or other Comm B course	3	
4	Fall	BSE 509 *Biological Systems Engineering Design Practicum II*	3	15
		BSE Course	3	
		300 level or higher non-BSE course	3	
		Technical Elective	3	
		Ethnic Studies/International Studies/Humanities/Social Science	3	
4	Spring	BSE 464 *Heat and Mass Transfer in Biological Systems*	3	14
		Ethnic Studies/International Studies/Humanities/Social Science	3	
		300 level or higher non-BSE engineering course	3	

		Technical Elective	3	
		Free Elective	2	
			Total	125

Food Engineering Program Option

Yr	Sem.	Course	Credits	Sem. Total
1	Fall	MATH 221 *Calculus and Analytic Geometry I*	5	16
		Ethnic Studies/International Studies/Humanities/Social Science	3	
		CHEM 109 *Advanced General Chemistry*	5	
		LSC 100 *Science and Storytelling* or other Comm A course	3	
1	Spring	MATH 222 *Calculus and Analytic Geometry II*	4	15
		BSE 170 *Product Design Practicum*	2	
		Ethnic Studies/International Studies/Humanities/Social Science	3	
		MICROBIO 101 *Biology of Microorganisms*	3	
		BSE 310 *Project Economics and Decision Analysis*	3	
2	Fall	MATH 234 *Calculus – Functions of Several Variables*	4	16
		BSE 249 *Engr Princp for Bio Systems* or CBE 250 *Process Synthesis*	3	
		EMA 201 *Statics*	3	
		CHEM 343 *Introductory Organic Chemistry*	3	
		BSE 270 *Introduction to Computer Aided Design*	3	
2	Spring	BSE 349 *Quantitative Techniques for Biological Systems*	3	15
		PHYSICS 202 *General Physics*	5	
		BSE 308 *Career Management for Engineers*	1	
		MATH 320 *Linear Algebra and Differential Equations*	3	
		Technical Elective	3	
3	Fall	ME 361 *Thermodynamics* or CBE 310 *Chem Proc Thermodynamics*	3	15
		InterEGR 397 *Engineering Communication* or other Comm B course	3	
		BSE 380 *Intro Data Science for the Agricultural & Life Sciences*	3	
		STAT 324 *Introductory Applied Statistics for Engineers*	3	
		MICROBIO 325 *Food Microbiology*	3	
3	Spring	FOOD SCI 301 *Introduction to the Science & Technology of Food*	3	14/15
		BSE 364 *Engineering Properties of Food and Biological Materials*	3	
		BSE 508 *Biological Systems Engineering Practicum I*	2	
		ME 363 *Fluid Mechanics* or CBE 320 *Transport Phenomena*	3/4	
		BSE 365 *Measurements and Instrumentation for Biological Systems*	3	
4	Fall	BSE 509 *Biological Systems Engineering Practicum II*	3	16/17
		FOOD SCI 532 *Integrated Food Manufacturing*	4	
		Technical Elective(s)	3/4	
		BSE 461 *Food and Bioprocessing Operations*	3	
		Ethnic Studies/International Studies/Humanities/Social Science	3	
4	Spring	BSE Breadth Requirement Course	3	17
		BSE 464 *Heat and Mass Transfer in Biological Systems*	3	
		Technical Elective	3	
		Ethnic Studies/International Studies/Humanities/Social Science	6	
		Free Electives	2	
			Total	125

Bioprocess Engineering Program Option

Yr	Sem.	Course	Credits	Sem. Total
1	Fall	MATH 221 *Calculus and Analytic Geometry I*	5	16
		CHEM 109 *Advanced General Chemistry*	5	
		Ethnic Studies/International Studies/Humanities/Social Science	3	
		LSC 100 *Science and Storytelling* or other Comm A course	3	
1	Spring	MATH 222 *Calculus and Analytic Geometry II*	4	14
		Ethnic Studies/International Studies/Humanities/Social Science	3	
		BSE 170 *Product Design Practicum*	2	
		MICROBIO 101 *Biology of Microorganisms*	3	
		MICRIOBIO 102 *General Microbiology Laboratory*	2	
2	Fall	MATH 234 *Calculus – Functions of Several Variables*	4	15
		BSE 249 *Engineering Principles of Biological Systems* or CBE 250 *Process Synthesis*	3	
		EMA 201 *Statics*	3	
		BSE 270 *Introduction to Computer Aided Design*	2	
		CHEM 343 *Introductory Organic Chemistry*	3	
2	Spring	BSE 349 *Quantitative Techniques for Biological Systems*	3	15
		PHYSICS 202 *General Physics*	5	
		BSE 308 *Career Management for Engineers*	1	
		MATH 320 *Linear Algebra and Differential Equations*	3	
		InterEGR 397 *Engineering Communication* or other Comm B course	3	
3	Fall	ME 361 *Thermodynamics* or CBE 310 *Chemical Process Thermodynamics*	3	15
		STAT 324 *Introductory Applied Statistics for Engineers*	3	
		BSE 367 *Renewable Energy Systems*	3	
		BSE 380 *Intro Data Science for the Agricultural & Life Sciences*	3	
		BIOCHEM 501 *Introduction to Biochemistry*	3	
3	Spring	ME 363 *Fluid Mechanics* or CBE 320 *Transport Phenomena*	3/4	17/18
		BSE 364 *Engineering Properties of Food and Biological Materials*	3	
		BSE 365 *Measurements and Instrumentation for Biological Systems*	3	
		BSE 310 *Project Economics and Decision Analysis*	3	
		BSE 508 *Biological Systems Engineering Practicum I*	2	
		Ethnic Studies/International Studies/Humanities/Social Science	3	
4	Fall	BSE 509 *Biological Systems Engineering Practicum II*	3	17/18
		BSE 460 *Biorefining*	3	
		Technical Electives	2/3	
		Technical Electives	3	
		Ethnic Studies/International Studies/Humanities/Social Science	3	
		Ethnic Studies/International Studies/Humanities/Social Science	3	
4	Spring	BSE 464 *Heat and Mass Transfer in Biological Systems*	3	14
		Free Electives	2	
		BSE 461 *Food and Bioprocessing Operations*	3	
		BSE Breadth Requirement Course	3	
			Total	125

Machinery Systems Engineering Program Option

Yr	Sem.	Course	Credits	Sem. Total
1	Fall	MATH 221 *Calculus and Analytic Geometry I*	5	16
		Ethnic Studies/International Studies/Humanities/Social Science	3	
		CHEM 109 Advanced General Chemistry	5	
		LSC 100 *Science and Storytelling* or other Comm A course	3	
1	Spring	MATH 222 *Calculus and Analytic Geometry II*	4	15
		Biological Science Course	3	
		BSE 310 *Project Economics and Decision Analysis*	3	
		BSE 170 *Product Design Practicum*	2	
		Ethnic Studies/International Studies/Humanities/Social Science	3	
2	Fall	MATH 234 *Calculus – Functions of Several Variables*	4	18
		EMA 201 *Statics*	3	
		BSE 249 *Engineering Principles for Biological Systems*	3	
		PHYSICS 202 *General Physics*	5	
		BSE 380 *Intro Data Science for the Agricultural & Life Sciences*	3	
2	Spring	BSE 349 *Quantitative Techniques for Biological Systems*	3	17
		BSE 308 *Career Management for Engineers*	1	
		EMA 202 or ME 240 *Dynamics*	3	
		ME 361 *Thermodynamics*	3	
		ME 306 *Mechanics of Materials*	3	
		ME 307 *Mechanics of Materials Lab*	1	
		STAT 324 *Introductory Applied Statistics for Engineers*	3	
3	Fall	MATH 320 *Linear Algebra and Differential Equations*	3	15
		BSE 270 *Introduction to Computer Aided Design*	3	
		BSE 475 *Engineering Principles of Agricultural Machines*	3	
		ME 363 *Fluid Dynamics*	3	
		Ethnic Studies/International Studies/Humanities/Social Science	3	
3	Spring	InterEGR 397 *Engineering Communication* or other Comm B course	3	17
		BSE 476 *Engineering Principles of Off-Road Vehicles*	3	
		BSE 508 *Biological Systems Engineering Design Practicum I*	2	
		ME 310 or 311 *Manufacturing Processes*	3	
		ME 340 *Dynamic Systems*	3	
		BSE 365 *Measurements and Instrumentation for Biological Systems*	3	
4	Fall	BSE 509 *Biological Systems Engineering Design Practicum II*	3	15
		ME 342 *Design of Machine Elements*	3	
		Technical Electives	6	
		BSE Breadth Course Requirement	3	
4	Spring	Technical Electives	6	17
		Ethnic Studies/International Studies/Humanities/Social Science	6	
		BSE 405 *Intelligence and Automation in Agriculture*	3	
			Total	125

Natural Resources and Environmental Engineering Program Option

Yr	Sem.	Course	Credits	Sem. Total
1	Fall	MATH 221 *Calculus and Analytic Geometry I*	5	16
		Ethnic Studies/International Studies/Humanities/Social Science	3	
		CHEM 109 *Advanced General Chemistry*	5	
		LSC 100 *Science and Storytelling* or other Comm A course	3	
1	Spring	MATH 222 *Calculus and Analytic Geometry II*	4	15
		SOIL SCI 210 *Soil: Ecosystem and Resource*	3	
		BSE 170 *Product Design Practicum*	2	
		Ethnic Studies/International Studies/Humanities/Social Science	3	
		Biological Science Course	3	
2	Fall	MATH 234 *Calculus – Functions of Several Variables*	4	19
		EMA 201 *Statics*	3	
		BSE 301 *Land Information Management*	3	
		BSE 249 *Engineering Principles for Biological Systems*	3	
		BSE 270 *Introduction to Computer Aided Design*	3	
		BSE 380 *Intro Data Science for the Agricultural & Life Sciences*	3	
2	Spring	BSE 349 *Quantitative Techniques for Biological Systems*	3	15
		PHYSICS 202 *General Physics*	5	
		BSE 472 *Sediment & Bio-Nutrient Engineering and Management*	3	
		STAT 324 *Introductory Applied Statistics for Engineers*	3	
		BSE 308 *Career Management for Engineers*	1	
3	Fall	MATH 320 *Linear Algebra and Differential Equations*	3	17
		Ethnic Studies/International Studies/Humanities/Social Science	3	
		CIV ENGR 310 *Fluid Mechanics*	3	
		BSE 372 *On-Site Waste Water Treatment and Dispersal*	2	
		BSE 473 *Water Management Systems*	3	
		Technical Elective	3	
3	Spring	InterEGR 397 *Engineering Communication* or other Comm B course	3	17
		BSE 508 *Biological Systems Engineering Design Practicum I*	2	
		EMA 303 *Mechanics of Materials*	3	
		BSE 571 *Small Watershed Engineering*	3	
		BSE 365 *Measurements and Instrumentation for Biological Systems*	3	
		BSE 310 *Project Economics and Decision Analysis*	3	
4	Fall	BSE 509 *Biological Systems Engineering Design Practicum II*	3	15
		ME 361 *Thermodynamics*	3	
		Technical Elective	3	
		BSE Breadth Requirement Course	3	
		Ethnic Studies/International Studies/Humanities/Social Science	3	
4	Spring	Technical Electives	6	15
		Ethnic Studies/International Studies/Humanities/Social Science	6	
		Free Elective	3	
			Total	125

Programming Policies, Options and Recommendations

Mandatory Contact with Advisors

Each semester 3 to 4 weeks prior to enrollment for the following semester's courses the BSE Department places a hold on your registration. This hold is not removed until your advisor approves your proposed plan of study for the following semester. This process begins when you email an updated degree plan to your advisor. An updated degree plan is one that not only shows what courses you have completed and are currently taking, but also what courses you plan to take in future semester(s). You are encouraged to use the Degree Planner tool within Course Search & Enroll in conjunction with the curriculum checklist for your specialization.

Once your advisor is satisfied with your future plan of study, he/she will notify Betsy Wood who will remove your registration hold. *You will not be able to register until this hold is removed.* Not all departments use such registration holds, but we feel it is extremely important that you visit with your advisor each semester about your future class schedule.

If a hold still exists after you have talked to your advisor, please make sure the hold relates to the next semester and not a later semester. You may be able to register for the upcoming semester but not for semesters after that. Also, holds may be placed on your record that are not advising holds but relate to some other issue.

Course Substitutions

Students who transfer into the BSE program have often taken one or more courses prior to transfer that are similar, but do not carry the same course number(s) as the listed BSE curricular requirement. This is frequently the case with statistics and physics courses.

Regarding statistics, the BSE Department will approve as a substitution for STAT 324, any AP statistics or college level statistics course of three or more credits. This substitution recognizes the fact that on the UW-Madison campus, a student cannot receive degree credit for more than one introductory statistics course (i.e., a student can only receive credit one of the following courses: STAT 301, 302, 324, and 371).

The BSE Department does not allow a first semester physics course to be used to meet its statics requirement (i.e., EMA 201). Students who have taken a first semester physics course, whether calculus based or not, can count it as a Category D Technical Elective.

For its second semester physics requirement (i.e., Physics 202), the department will allow the substitution of any other calculus-based physics course of four or more credits. A non-calculus based physics course may be substituted for the calculus-based physics requirement provided it was taken prior to transfer into the BSE program and is equivalent to Physics 104 on the UW-Madison campus.

A student transferring into BSE does not have to take BSE 249 *Engineering Principles for Biological Systems* if they have already completed ME 361 *Thermodynamics* or CBE 310 *Chemical Process Thermodynamics*. Instead, in place of BSE 249 the student can substitute a course that would otherwise count as a Category C tech elective. Note that the course substituted for BSE 249 cannot also be counted as a Category C tech elective.

Semester Credit Load Recommendations

The number of credits you enroll in may be influenced by many factors, but typically the cost of college is significant. At UW-Madison, undergraduate tuition is the same for a student taking 12 credits as it is for a student enrolled in 18 course credits. Students taking fewer than 12 credits pay by the credit. There is a surcharge for credits over 18. In addition, any student who desires to enroll in more than 18 credits must obtain permission from their advisor and the CALS Office of Academic Affairs.

Given the fee structure, students are encouraged to enroll in ***at least*** 15 credits per semester. Note that it takes 2 extra semesters to accumulate 120 credits when you take 12 credits per semester instead of 15. Also keep in mind that educational expenses continually increase, and thus the last year you spend in school is likely to be the most expensive.

Students working on- or off-campus often reduce their academic load in proportion to the time they spend working. In some cases, students opt to enroll as part-time students. Since a student's earning power increases sharply once they obtain a professional engineering degree, it is often not in a student's long-term financial interest to work while attending school when such work results in a reduced academic workload which extends their time-to-degree. In many cases, it pays to take out a loan to complete school – a loan that can be rapidly repaid once a student is professionally employed.

Students who are struggling to meet the requirements for full admission may want to take a reduced course load that enables them to put extra effort into improving their GPA.

A student on academic probation is advised to carry no more than 14 credits per semester unless repeating a course. For every three credits being repeated, the student is advised to carry not more than one additional credit beyond 14, up to a maximum of 16 credits.

Taking Courses Pass/Fail

Only courses that will count as ***free*** electives under the BSE curriculum can be taken pass/fail. Courses graded with the pass/fail system cannot be used to satisfy any of the university, college, degree program, or major requirements. Continuing students with at least a 2.0 cumulative GPA, new first-year, and new transfer students may choose one pass/fail course each semester, with a maximum of eight courses prior to graduation.

After approval, the student cannot change the grading back to the conventional (A, AB, etc.) basis. The grade is excluded from the GPA. Students are cautioned that although a grade of D carries credit under the conventional system, it carries no degree credit when it is converted to a grade of U under the pass/fail privilege.

Double Majors and Dual Degrees

The difference between a “major” and a “degree” is not clear to most students and faculty and thus there is confusion between what it means to *double major* and what it means to *dual degree*. A *major* is defined as a field of academic study in which one concentrates or specializes. A *degree* is an award conferred by a college or university signifying that the recipient has satisfactorily completed a specific course of study.

At UW-Madison, students who specialize (i.e., major) in biological systems engineering receive a Bachelor of Science – Biological System Engineering degree when they complete all requirements for the degree. This is the only degree available to a student majoring in BSE. This B.S. in BSE is one of three professional degrees available in CALS, the other two being a B.S in Agricultural Business Management or a B.S. in Dietetics. All other CALS majors receive a Bachelor of Science degree.

A student who is *double majoring* is specializing in two different areas but receiving only one degree. The degree a student is pursuing dictates the areas where they can officially double major. Students majoring in BSE (and thus pursuing a B.S. in Biological Systems Engineering) cannot double major in another engineering field, nor can they double major in business or in another CALS discipline. BSE majors may earn an additional major in the College of Letters and Science and have the additional major noted on their transcript at the time of graduation. To qualify, the student must have approval in advance from both the department in the College of Letters and Science offering the major and the academic dean of the CALS and must satisfy all requirements for the Letters and Science major by the time the engineering degree is completed. Engineering students most often earn additional majors in subjects that overlap efficiently with engineering curricula. By working closely with academic advisers, students can incorporate majors in other interest areas but should be prepared to extend their time to graduation to accommodate the extra credits.

A dual-degree candidate is pursuing two different degrees. To obtain a second degree, all requirements for both degrees must be met, with the minimum total number of credits required equal to 30 more than the minimum number of credits required for the two degrees. This means if a student elects to complete a second degree that by itself requires a minimum of 120 credits (which is less than the 125 required for a B.S. in BSE), then the minimum total required for the dual degree would be 150 credits (120 + 30). A student must have an advisor in both major fields. To work on two degrees simultaneously within the college, a student should seek permission as *early as possible* to ensure that it is feasible to complete both degrees. If the two degrees to be earned are from two different colleges (one degree in Agricultural and Life Sciences and one degree in another school or college), the undergraduate dean in both colleges must approve the student's plan. Note that not all colleges will allow dual degrees.

Although BSE students can double degree if they choose, they are highly discouraged from doing so for two main reasons. First, the number of credits required for a second degree (25 to 30 credits for a BSE student) is similar to the 30 credits required for a master's degree, and (1) relative to a second undergraduate degree, a master's degree is typically looked upon more favorably by employers, and (2) the course of study for the typical master's degree is not as restrictive as it is for a bachelor's degree (meaning that you get to take more of the classes YOU want to take).

Certificate Programs

Certificate programs are sometimes called “minors” at other schools. These are small sets of courses, often from more than one department, which focus on a given topic. These programs are offered in addition to traditional major and degree programs, although the courses carried may also count toward the completion of major and degree requirements. The opportunity they provide to pursue an area of interest and to achieve recognition concurrently with a regular academic program also adds value to a student's educational experience. Nevertheless, certificate programs are not degree programs, and without careful planning they may prolong the time it takes to receive an undergraduate degree.

Several certificate programs are popular among BSE students. The certificate in Integrated Studies in Science, Engineering, and Society Undergraduate (ISSuES) was designed to help STEM-field majors fulfill their liberal arts requirements and offers undergraduate students an opportunity to explore the social sciences and humanities in a way that emphasizes the relationship between science, technology, medicine, engineering, and society. The College of Engineering offers certificates in Biology in Engineering, International Engineering, Energy Sustainability and Manufacturing Engineering, among others. The College of Agriculture and Life Sciences offers certificates in Business Management, Global Health, Science Communication and Food Systems, among others. The certificate in Environmental Studies is especially popular among students on the Natural Resources and Environmental Engineering track. The College of Letters and Sciences offers numerous certificate programs with varying degrees of overlap with major requirements. For more information on certificate programs, including a complete list of UW-Madison certificate programs, see the Undergraduate Guide.

Advanced Degrees

As the flagship institution in the UW-System, UW-Madison has a world-renowned graduate school that offers numerous advanced degrees. For this reason, few UW-Madison students pursue a second undergraduate degree. As previously noted, when compared to a second undergraduate degree, a Master's degree allows students greater flexibility with respect to course selection (i.e., Master’s students design their own curriculums whereas undergraduate degree programs are fairly rigid except with respect to technical elective selection) and is more prestigious/influential. Additionally, up to seven credits of science/engineering classes taken at 400-level and above as UW-Madison undergraduate can be counted toward meeting the requirements for a Master's degree. For more information on BSE graduate work see the BSE Graduate Student Handbook located at http://bse.wisc.edu/ under the Graduate tab.

Minimum requirements for graduate admission at UW-Madison include an undergraduate degree and a 3.0 GPA. Some programs will have higher minimum criteria for admission. The GRE exam is also required for some programs but not all. Students are encouraged to obtain research experience as undergraduates if graduate school is part of their future plans.

Scholarships and Financial Aid

The College of Agricultural and Life Sciences administers all scholarships awarded to students within its college. Application for scholarships within CALS is from late October to early February for the following academic year. By filling out one application, you will be eligible for all awards offered in CALS. This includes several scholarships that are only awarded to BSE students. Recipients of these BSE-only scholarships are selected by the BSE teaching faculty. It is important to emphasize that if you want to be eligible for one of these scholarships, you must complete the application found at Scholarships@UW-Madison by February 1. All students are encouraged to apply. students are encouraged to apply.

ASABE Pre-Professional Club

It is extremely beneficial for students to join student organizations to learn about their chosen profession and to develop leadership skills. This type of activity is highly regarded by potential employers. Without it you may be overlooked, even though you have a very good GPA. Joining and actively participating in the American Society of Agricultural and Biological Engineers (ASABE) Pre-Professional Club is an excellent way to meet other students and faculty, to learn about your profession, to meet people from industry, and to learn about job opportunities. The Club meets monthly with announcements posted in the Agricultural Engineering Building and sent to you via e-mail. Please participate. Your participation in the Pre-Professional Club will pay large dividends when applying for employment.

General Program Option Sample Curricula

The general program option was designed to enable students to put together specialty programs within the agricultural and biological systems engineering area that meet engineering program accreditation requirements.

One use of the General Program Option would be to assemble a curriculum that combines several courses from the three main specialization areas within the UW-Madison BSE program (i.e., Natural Resources and Environmental Engineering, Food and Bioprocess Engineering, and Machinery Systems Engineering). In this respect, the General Program Option provides a general study of Biological Systems Engineering.

The General Program Option can also be used to assemble a curriculum targeted at a specific occupation or area of study within the profession. This could be an occupation in an emerging area of study or a well-established and/or well-defined one.

Students may choose to build their General Program around one of the certificates offered by the College of Engineering or CALS. Manufacturing Engineering, Engineering for Energy Sustainability, Environmental Studies, Food Systems, or International Engineering are all good possibilities.

Following are suggested curricula (under the general program option) for structural engineering, construction engineering and management, and facilities operations engineering and management. Others will be added as they are formulated by faculty, students, and/or others interested in a specialty area within the program.

Structural Engineering

Structural Engineers are responsible for ensuring that buildings and other structures do not fail under imposed loads. This work includes (1) calculation of static and dynamic forces due to stored materials, material handling and processing equipment, snow, wind, earthquakes, soil, temperature and moisture content changes, rain, vehicles, etc., (2) foundation and structural frame analysis, (3) design of foundations, silos, bins, cooling towers, structural frames, and (4) selection, sizing, and connection detailing for wood, steel, reinforced concrete and masonry components.

The involvement of structural engineers in large building design is essential. Government-enforced codes require commercial building plans to be stamped/sealed by engineers that are professionally registered. Several states require that engineers who stamp/seal plans for larger structures be registered as *structural* engineers, which in turn requires that the engineers pass special structural engineering exams.

In addition to fundamental engineering courses, structural engineers must take courses in structural analyses; wood design, steel design, reinforced concrete design, soil mechanics, building materials, building codes and loads, seismic engineering, etc. Most registered structural engineers carry a master's degree in engineering.

General Program Option for Structural Engineering

Credits	Course Number	Course Title
Required Courses		
3	CIV ENGR 310 or ME 363	Fluid Mechanics/Dynamics
3	ME 361	Thermodynamics
3	BSE 464	Heat and Mass Transfer in Biological Systems
3	EMA 303 or ME 306	Mechanics of Materials
Minimum of Three BSE Courses (suggested)		
3	BSE 301	Land Information Management
2	BSE 372	On-Site Waste Water Treatment and Dispersal
3	BSE 367	Renewable Energy Systems
Minimum of Nine Credits of non-BSE Engineering Courses w/ 300 or higher course number (suggested)		
3	CIV ENGR 330	Soil Mechanics
3	CIV ENGR 340	Structural Analysis
3	CIV ENGR 442	Wood Structures I
3	CIV ENGR 447	Concrete Structures I
Category A Tech Elective - Intro to Engr Course (suggested)		
2	BSE 170	Product Design Practicum
Category C Tech Elective - Upper-Level Engineering and Science Courses (suggested)		
3	CIV ENGR 395	Materials for Constructed Facilities
2	CIV ENGR 392	Building Information Modeling
3	INTEREGR 397	Technical Communications
Category D Tech Elective - Lower-Level Engineering and Science Courses, Breadth Courses (suggested)		
3	CIV ENGR 290	Construction Systems
45	TOTAL	

Construction Engineering and Management

Construction Engineers and Managers handle the overall planning, coordination, and control of a construction project from beginning to completion. This involves (1) specifying project objectives and plans including budgeting, scheduling, establishing performance requirements, and selecting participating contractors, (2) maximizing the efficient use of available labor, materials and equipment, (3) implementation of various operations through proper coordination and control of planning, design, estimating, contracting and construction in the entire process, and (4) establishing effective lines of communication and effective mechanisms for conflict resolution.

With respect to agriculture, Construction Engineers and Managers get involved in both on-farm and post-harvest storage and/or processing facilities. The later can include port terminals, pet food processing plants, feed mills (general, bovine, fish, mink, swine, poultry, etc.), flour mills, grain handling and storage facilities, meat processing plants, canning factories, bottling plants (milk, soda, fruit juice, etc.), malting plants, breweries, sawmills, paper mills, ethanol and other biomass plants, textile mills, seed processing facilities, bakeries, confectionaries, cheese factories, and thousands of other food and bioprocessing facilities.

General Program Option for Construction Engineering and Management

Credits	Course Number	Course Title
Required Courses		
3	CIV ENGR 310 or ME 363	Fluid Mechanics/Dynamics
3	ME 361	Thermodynamics
3	BSE 464	Heat and Mass Transfer in Biological Systems
3	EMA 303 or ME 306	Mechanics of Materials
Minimum of Three BSE Courses (suggested)		
3	BSE 301	Land information Management
2	BSE 372	On-Site Waste Water Treatment and Dispersal
3	BSE 367	Renewable Energy Systems
Minimum of 9 Credits of non-BSE Engineering Courses w/ 300 or higher course number. (suggested)		
3	CIV ENGR 492	Integrated Project Estimating and Scheduling
3	CIV ENGR 496	Electrical Systems for Construction
3	CIV ENGR 497	Mechanical Systems for Constructions I
3	CIV ENGR 498	Construction Project Management
Category A Tech Elective - Intro to Engr Course (suggested)		
2	BSE 170	Product Design Practicum
Category C Tech Elective - Upper-Level Engineering and Science Courses (suggested)		
3	CIV ENGR 395	Materials for Constructed Facilities
2	CIV ENGR 392	Building Information Modeling
Category D Tech Elective - Lower-Level Engineering and Science Courses, Breadth Courses. Take enough Cat D tech electives to bring total specialization credits to 43. Suggested options listed.		
3	CIV ENGR 290	Construction Systems
3	GEN BUS 301	Business Law
3	GEN BUS 311	Fundamentals of Management and Marketing for Non-Business Majors (also counts as a social science course)
3	REAL EST 306	The Real Estate Process (also counts as a social science course)

Facilities Operations Engineering and Management

Facilities Operations Engineering and Management is focused on improving operational efficiencies, facility maintenance (e.g., inspection techniques and schedules, equipment replacement), and maintaining a safe working environment for all plant personnel. Specific working titles in this field include: operations engineer, maintenance engineer, quality control (QC) engineer, environmental health and safety (EH&S) engineer, and process electrical engineer. Operations engineers (which includes engineers with such titles as industrial engineer, process engineer, industrial process engineer, and manufacturing engineer) are responsible for continual adherence to good manufacturing practices (GMP's), total quality management (TQM), and statistical quality management (SQM) principles. They frequently get involved in time and yield/productivity studies for improved line efficiencies and reduced waste, determination of break-even points, internal rate of return (IRR), and return on investment (ROI) for manufacturing processes/equipment. They define and prioritize new projects, design in-house equipment/process modifications, select equipment vendors, and establish training program requirements for operations, maintenance, sanitation, and logistics.

General Program Option for Facilities Operations Engineering and Management

Credits	Course Number	Course Title
Required Courses		
3	CIV ENGR 310 or ME 363	Fluid Mechanics/Dynamics
3	ME 361	Thermodynamics
3	BSE 464	Heat and Mass Transfer in Biological Systems
3	EMA 303 or ME 306	Mechanics of Materials
Minimum of three BSE Courses (suggested)		
3	BSE 301	Land Information Management
2	BSE 372	On-Site Waste Water Treatment and Dispersal
3	BSE 461	Food and Bioprocessing Operations
Minimum of Nine Credits of non-BSE Engineering Courses w/ 300 or higher course number (suggested)		
3	CIV ENGR 492	Integrated Project Estimating and Scheduling
3	CIV ENGR 496	Electrical Systems for Construction
3	CIV ENGR 497	Mechanical Systems for Constructions I
3	CIV ENGR 498	Construction Project Management
Category A Tech Elective - Intro to Engr Course (suggested)		
2	BSE 170	Product Design Practicum
Category C Tech Elective - Upper-Level Engineering and Science Courses (suggested)		
3	CIV ENGR 395	Materials for Constructed Facilities
2	CIV ENGR 392	Building Information Modeling
Category D Tech Elective - Lower-Level Engineering and Science Courses, Breadth Courses. Take enough Cat D tech electives to bring total specialization credits to 43. Suggested options listed.		
3	CIV ENGR 290	Construction Systems
3	GEN BUS 301	Business Law
3	GEN BUS 311	Fundamentals of Management and Marketing for Non-Business Majors (also counts as a social science course)
3	OTM 300	Operations Management
3	OTM 654	Production Planning and Control