BIOLOGICAL SYSTEMS ENGINEERING, PHD

Graduate work in the Department of Biological Systems Engineering (BSE) leads to the master of science and doctor of philosophy degrees. Graduates of the program help fill the need for highly educated engineers in industry, consulting firms, government agencies, and educational institutions.

Students who undertake graduate studies in BSE normally have as their goal a better understanding of the current theories, principles, issues, and problems in biological systems. They desire to learn how knowledge is generated, how it is critically evaluated, and how solutions to problems are generated and applied. Graduate studies improve the ability of students to think critically and creatively, and to synthesize, analyze, and integrate ideas for decision making and problem solving.

The department offers students an opportunity to undertake research and advanced study in different specializations such as biological systems, environmental quality and natural resource engineering, waste management, food and bioprocess engineering, nanotechnology and biosensing, machinery systems, bio-resources and bio-refining, and agricultural safety and health.

Graduate research assistantships, project assistantships, and fellowships are available on a highly competitive basis.

ADMISSIONS

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Please consult the table below for key information about this degree program's admissions requirements. The program may have more detailed admissions requirements, which can be found below the table or on the program's website.

Graduate admissions is a two-step process between academic programs and the Graduate School. ***Applicants must meet* the minimum requirements *(https://grad.wisc.edu/apply/requirements/) of the Graduate School as well as the program(s).*** Once you have researched the graduate program(s) you are interested in, apply online (https://grad.wisc.edu/apply/).

Requirements	Detail
Fall Deadline	February 1
Spring Deadline	September 1
Summer Deadline	November 1
GRE (Graduate Record Examinations)	Not required.
English Proficiency Test	Every applicant whose native language is not English, or whose undergraduate instruction was not exclusively in English, must provide an English proficiency test score earned within two years of the anticipated term of enrollment. Refer to the Graduate School: Minimum Requirements for Admission policy: https://policy.wisc.edu/library/UW-1241 (https://policy.wisc.edu/library/UW-1241/).
Other Test(s) (e.g., GMAT, MCAT)	n/a
Letters of Recommendation Required	3

All science, technology, engineering, and mathematics (STEM) background applicants are invited to apply. The Biological Systems Engineering Department stipulates that applicants should have a BS degree or MS degree in engineering. Applicants who have a BS or MS degree in a field other than engineering may be eligible for admission if they have completed the following basic engineering coursework. Individuals who do not hold these qualifications at the time of admission will be required to complete any remaining coursework from the following list during their graduate program of study as supplemental coursework. This supplemental coursework is not eligible to satisfy program requirements.

- **Twelve** credits of college-level mathematics (e.g., calculus, linear algebra, analytical geometry, differential equations, and numerical methods.)
- **Nine** credits of physical sciences, biological sciences, computational, data, and information sciences (e.g., biochemistry, analytical, organic, and physical chemistry, microbiology, physics, statics, dynamics, fluid dynamics, heat and mass transfer, fluid mechanics, material sciences, thermodynamics, computer programming, data sciences, geographic information systems, remote sensing).

FUNDING

FUNDING

GRADUATE SCHOOL RESOURCES

Resources to help you afford graduate study might include assistantships, fellowships, traineeships, and financial aid. Further funding information (https://grad.wisc.edu/funding/) is available from the Graduate School. Be sure to check with your program for individual policies and restrictions related to funding.

PROGRAM INFORMATION

Funding decisions are made by faculty supervisors of the admitted students based on the funding availability and project need.

REQUIREMENTS

MINIMUM GRADUATE SCHOOL REQUIREMENTS

Review the Graduate School minimum academic progress and degree requirements (http://guide.wisc.edu/graduate/#policiesandrequirementstext), in addition to the program requirements listed below.

MAJOR REQUIREMENTS

MODE OF INSTRUCTION

Face to Face	Evening/ Weekend	Online	Hybrid	Accelerated
Yes	No	No	No	No

Mode of Instruction Definitions

Accelerated: Accelerated programs are offered at a fast pace that condenses the time to completion. Students typically take enough credits aimed at completing the program in a year or two.

Evening/Weekend: Courses meet on the UW–Madison campus only in evenings and/or on weekends to accommodate typical business schedules. Students have the advantages of face-to-face courses with the flexibility to keep work and other life commitments.

Face-to-Face: Courses typically meet during weekdays on the UW-Madison Campus.

Hybrid: These programs combine face-to-face and online learning formats. Contact the program for more specific information.

Online: These programs are offered 100% online. Some programs may require an on-campus orientation or residency experience, but the courses will be facilitated in an online format.

CURRICULAR REQUIREMENTS

Requirement	Detail
Minimum Credit Requirement	51 credits
Minimum Residence Credit Requirement	32 credits
Minimum Graduate Coursework Requirement	26 credits must be graduate-level coursework. Refer to the Graduate School: Minimum Graduate Coursework (50%) Requirement policy: https://policy.wisc.edu/library/UW-1244 (https://policy.wisc.edu/library/UW-1244/).
Overall Graduate GPA Requirement	3.00 GPA required. Refer to the Graduate School: Grade Point Average (GPA) Requirement policy: https://policy.wisc.edu/library/UW-1203 (https://policy.wisc.edu/library/UW-1203/).
Other Grade Requirements	Graduate students in Biological Systems Engineering must maintain a minimum overall B average (3.0 GPA) during their graduate studies. Seminars, research, or other special problems credits may not be used to offset BC or C grades. No grade below a C will be accepted for fulfilling course work requirements for the degree.
Assessments and Examinations	Doctoral students are required to take a comprehensive preliminary/oral examination after they have cleared their record of all Incomplete and Progress grades (other than research and thesis). Deposit of the doctoral dissertation in the Graduate School is required.
Language Requirements	n/a
Graduate School Breadth Requirement	All doctoral students are required to complete a doctoral minor or graduate/professional certificate. Refer to the Graduate School: Breadth Requirement in Doctoral Training policy: https://policy.wisc.edu/library/UW-1200 (https://policy.wisc.edu/library/UW-1200/).

REQUIRED COURSES

Code	Title	Credits
Biological Systems Engineering Graduate Instruction and Research Committee approved Science and Engineering coursework [1]		30
Research Credits		**16**
BSE 990	Research (Thesis)	
Graduate Seminars [2]		**2**
BSE 900	Seminar	
BSE 901	Graduate Research Seminar	
Teaching Practicum/Studies [3]		**3**
BSE 799	Practicum in Agricultural Engineering Teaching	
or E P D 654	Teaching in Science and Engineering	
Total Credits [4]		**51**

Footnotes

1 All courses for the "Biological Systems Engineering Graduate Instruction and Research Committee approved Science and Engineering" requirement should be selected in consultation with your advisor to create a cohesive program of study.
- These courses must be numbered 300 or above and letter graded with A-F. A minimum of 15 credits must hold the "Grad 50%" attribute.
- If a course is offered for credit/no-credit only, prior approval from an advisor may be given for a student to complete no more than 1 credit for credit/no-credit.
- BSE 900, BSE 901, BSE 990, and BSE 999 may not be used to meet this requirement.

2 BSE 900 is offered in the fall semester only. It is be taken during the first fall semester of graduate study. BSE 901 is offered in the spring semester and can be taken each spring. During a student's last spring semester, they give a presentation in BSE 901 to meet the second seminar credit requirement.

3 Teaching Practicum Experience: Some possible courses are E P D 654 Teaching in Science and Engineering or BSE 799 Practicum in Agricultural Engineering Teaching. Other course options need to be pre-approved by student's advisor and the Graduate Instruction and Research Committee chair.

4 BSE 999 credits are limited to 3 credits and are required to be separate from the work the student is doing for BSE 990 credit and shall be taken under the direction of an instructor other than the major advisor.

POLICIES

GRADUATE SCHOOL POLICIES

The Graduate School's Academic Policies and Procedures (https://grad.wisc.edu/acadpolicy/) provide essential information regarding general university policies. Program authority to set degree policies beyond the minimum required by the Graduate School lies with the degree program faculty. Policies set by the academic degree program can be found below.

MAJOR-SPECIFIC POLICIES

PRIOR COURSEWORK

Graduate Credits Earned at Other Institutions

For well-prepared advanced students, the program may accept prior graduate coursework from other institutions toward the minimum graduate degree credit and minimum graduate coursework (50%) requirement.

The minimum graduate residence credit requirement can be satisfied only with courses taken as a graduate student at UW–Madison. Coursework earned ten or more years prior to admission to a doctoral degree is not allowed to satisfy requirements. Up to 6 research credits received for the master's degree may be transferred from another accredited institution. No other research credit may be transferred. Eighteen (18) master's course credits earned from another institution may be transferred towards the PhD. Additional credits need to be approved by the Biological Systems Engineering Graduate Instruction and Research committee.

Undergraduate Credits Earned at Other Institutions or UW-Madison

Refer to the Graduate School: Transfer Credits for Prior Coursework (https://policy.wisc.edu/library/UW-1216/) policy.

Credits Earned as a Professional Student at UW-Madison (Law, Medicine, Pharmacy, and Veterinary careers)

Refer to the Graduate School: Transfer Credits for Prior Coursework (https://policy.wisc.edu/library/UW-1216/) policy.

Credits Earned as a University Special Student at UW–Madison

Refer to the Graduate School: Transfer Credits for Prior Coursework (https://policy.wisc.edu/library/UW-1216/) policy.

PROBATION

Refer to the Graduate School: Probation (https://policy.wisc.edu/library/UW-1217/) policy.

ADVISOR / COMMITTEE

Refer to the Graduate School: Advisor (https://policy.wisc.edu/library/UW-1232/) and Graduate School: Committees (Doctoral/Master's/MFA) (https://policy.wisc.edu/library/UW-1201/) policies. In addition, members of the Committee must hold a PhD.

CREDITS PER TERM ALLOWED

15 credits

TIME LIMITS

Refer to the Graduate School: Time Limits (https://policy.wisc.edu/library/UW-1221/) policy.

GRIEVANCES AND APPEALS

These resources may be helpful in addressing your concerns:

- Bias or Hate Reporting (https://doso.students.wisc.edu/bias-or-hate-reporting/)
- Graduate Assistantship Policies and Procedures (https://hr.wisc.edu/policies/gapp/#grievance-procedure)
- Hostile and Intimidating Behavior Policies and Procedures (https://hr.wisc.edu/hib/)
  - Office of the Provost for Faculty and Staff Affairs (https://facstaff.provost.wisc.edu/)
- Employee Assistance (http://www.eao.wisc.edu/) (for personal counseling and workplace consultation around communication and conflict involving graduate assistants and other employees, post-doctoral students, faculty and staff)
- Employee Disability Resource Office (https://employeedisabilities.wisc.edu/) (for qualified employees or applicants with disabilities to have equal employment opportunities)
- Graduate School (https://grad.wisc.edu/) (for informal advice at any level of review and for official appeals of program/departmental or school/college grievance decisions)
- Office of Compliance (https://compliance.wisc.edu/) (for class harassment and discrimination, including sexual harassment and sexual violence)
- Office Student Assistance and Support (OSAS) (https://osas.wisc.edu/) (for all students to seek grievance assistance and support)
- Office of Student Conduct and Community Standards (https://conduct.students.wisc.edu/) (for conflicts involving students)
- Ombuds Office for Faculty and Staff (http://www.ombuds.wisc.edu/) (for employed graduate students and post-docs, as well as faculty and staff)
- Title IX (https://compliance.wisc.edu/titleix/) (for concerns about discrimination)

College of Agricultural and Life Sciences: Grievance Policy

In the College of Agricultural and Life Sciences (CALS), any student who feels unfairly treated by a member of the CALS faculty or staff has the right to complain about the treatment and to receive a prompt hearing. Some complaints may arise from misunderstandings or communication breakdowns and be easily resolved; others may require formal action. Complaints may concern any matter of perceived unfairness.

To ensure a prompt and fair hearing of any complaint, and to protect the rights of both the person complaining and the person at whom the complaint is directed, the following procedures are used in the College of Agricultural and Life Sciences. Any student, undergraduate or graduate, may use these procedures, except employees whose complaints are covered under other campus policies.

1. The student should first talk with the person at whom the complaint is directed. Most issues can be settled at this level. Others may be resolved by established departmental procedures.
2. If the student is unsatisfied, and the complaint involves any unit outside CALS, the student should seek the advice of the dean or director of that unit to determine how to proceed.
   a. If the complaint involves an academic department in CALS the student should proceed in accordance with item 3 below.
   b. If the grievance involves a unit in CALS that is not an academic department, the student should proceed in accordance with item 4 below.
3. The student should contact the department's grievance advisor within 120 calendar days of the alleged unfair treatment. The departmental administrator can provide this person's name. The grievance advisor will attempt to resolve the problem informally within 10 working days of receiving the complaint, in discussions with the student and the person at whom the complaint is directed.
   a. If informal mediation fails, the student can submit the grievance in writing to the grievance advisor within 10 working days of the date the student is informed of the failure of the mediation attempt by the grievance advisor. The grievance advisor will provide a copy to the person at whom the grievance is directed.
   b. The grievance advisor will refer the complaint to a department committee that will obtain a written response from the person at whom the complaint is directed, providing a copy to the student. Either party may request a hearing before the committee. The

grievance advisor will provide both parties a written decision within 20 working days from the date of receipt of the written complaint.

c. If the grievance involves the department chairperson, the grievance advisor or a member of the grievance committee, these persons may not participate in the review.

d. If not satisfied with departmental action, either party has 10 working days from the date of notification of the departmental committee action to file a written appeal to the CALS Equity and Diversity Committee. A subcommittee of this committee will make a preliminary judgement as to whether the case merits further investigation and review. If the subcommittee unanimously determines that the case does not merit further investigation and review, its decision is final. If one or more members of the subcommittee determine that the case does merit further investigation and review, the subcommittee will investigate and seek to resolve the dispute through mediation. If this mediation attempt fails, the subcommittee will bring the case to the full committee. The committee may seek additional information from the parties or hold a hearing. The committee will present a written recommendation to the dean who will provide a final decision within 20 working days of receipt of the committee recommendation.

4. If the alleged unfair treatment occurs in a CALS unit that is not an academic department, the student should, within 120 calendar days of the alleged incident, take his/her grievance directly to the Associate Dean of Academic Affairs. The dean will attempt to resolve the problem informally within 10 working days of receiving the complaint. If this mediation attempt does not succeed the student may file a written complaint with the dean who will refer it to the CALS Equity and Diversity Committee. The committee will seek a written response from the person at whom the complaint is directed, subsequently following other steps delineated in item 3d above.

OTHER

n/a

PROFESSIONAL DEVELOPMENT

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GRADUATE SCHOOL RESOURCES

Take advantage of the Graduate School's professional development resources (https://grad.wisc.edu/pd/) to build skills, thrive academically, and launch your career.

LEARNING OUTCOMES

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1. Articulates research problems, potentials, and limits with respect to theory, knowledge, or practice within the field of study.
2. Formulates ideas, concepts, designs, and/or techniques beyond the current boundaries of knowledge within the field of study.
3. Creates research, scholarship, or performance that makes a substantive contribution.
4. Demonstrates breadth within their learning experiences.
5. Advances contributions of the field of study to society.
6. Communicates complex ideas in a clear and understandable manner.
7. Fosters ethical and professional conduct.

PEOPLE

PEOPLE

FACULTY

Dr. Neslihan Akdeniz

Developing climate-smart technologies to improve the profitability of livestock producers; finding alternative ways of utilizing co-products of animal agriculture; assessing air quality inside livestock buildings for improved occupational health; exploring strategies to minimize the impacts of foreign animal diseases; organizing extension activities to deliver on-farm research knowledge. I make every attempt to include graduate students in my extension program to enhance their networking opportunities.

Dr. Robert Anex

Biological systems analysis and assessment; life cycle assessment; techno-economic analysis

Dr. Christopher Choi

Heat and mass transfer and computational fluid dynamics (CFD); controlled environments – livestock housing and greenhouse; water distribution system modeling and water quality; experimental methods, data acquisition, and systems optimization in biological systems

Dr. Matthew Digman

Impact of autonomy on agricultural machine forms; application of sensors to predict chemical and physical properties of agricultural materials

Dr. Sundaram Gunasekaran

Engineering properties and quality of food and biomaterials; rheology of food and other macromolecular systems and hydrogels; structure function relationships in foods; novel and value-added bioprocess engineering

Dr. Margaret Kalcic

Watershed modeling; watershed management; conservation practice effectiveness; agricultural hydrology; nutrient transport; water quality; land use change; climate change

Dr. K.G. Karthikeyan

Fate, removal, and transport of nutrients and contaminants in surface/subsurface environments; water quality chemistry; land application of agricultural/municipal/industrial waste; applications of GIS/water quality models; physical and chemical processes for water, wastewater, and waste treatment; soil decontamination

Dr. Brian Luck

Machine management, variable rate technology; agricultural “Big Data” management; remote sensing

Dr. Mallika Nocco

Evapotranspiration; regenerative irrigation; deficit irrigation; drought resilience; managed aquifer recharge; precision agriculture; transpiration & distribution uniformity; soil-plant-water relations; feedbacks between irrigation and climate; aerial remote sensing; soil and water conservation; soil health; agrohydrology; science communication and extension

Dr. Xuejun Pan
Development of innovative biorefining process for producing energy, fuels, chemicals, and materials from renewable resources (biomass) with specific research interests in pretreatment and fractionation of lignocellulosic biomass for bioconversion to chemicals and fuels; enzymatic and non-enzymatic saccharification of cellulose and lignocellulose; catalytic conversion of lignocellulose to drop-in hydrocarbon fuel; platform chemicals from biomass; functional materials from cellulose, lignin, hemicellulose, and extractives.

Dr. Douglas Reinemann
Biomechanics of machine milking; sustainable development of bio-energy systems; renewable energy technology and policy; biosensors for milk quality analysis; effects of the electrical environment on farm animals; integral thought and philosophy

Dr. Troy Runge
Bioenergy – biomass composition impact on bioprocessing systems, including anaerobic digestion, combustion, gasification, and catalysis; Biomaterials – pulp, paper, bio-based chemicals, cellulose composites and nonwoven structures

Dr. John Shutske
Safety engineering and education related to occupational and public health hazards in agricultural and food systems; multidisciplinary approaches for solving complex risk-related problems; design and evaluation of sensors and control systems to mitigate environmental and machine risks; risk communication methods and limitations.

Dr. Paul Stoy
Surface-atmosphere exchange; ecosystem ecology; natural resource management; water resource management; remote sensing.

Dr. Anita Thompson
Hydrologic implications of land use change; urban hydrology and stormwater management; water quality impacts of biofuel crop production; cold regions hydrology; hydrologic modeling; sediment, nutrient and pathogen transport; polyacrylamides and biosolids for fertilizer and erosion management

Dr. Zhou Zhang
Multi-source remote sensing data fusion (e.g., hyperspectral, LiDAR, RGB); machine learning for high dimensional data analysis; UAV-based imaging platform developments for precision agriculture; crop yield prediction using remote sensing and machine learning; high-throughput image-based plant phenotyping.

AFFILIATE FACULTY
Dr. Grace Bulltail - Nelson Institute
Dr. Joao Dorea - Dept. of Animal and Dairy Sciences
Dr. Awad Hanna - Dept. of Civil Engineering
Dr. Richard Hartel - Dept. of Food Engineering
Dr. John Ralph - Dept. of Biochemistry