

Fall 2020 Course Descriptions as of 04/05/2020 08:10 PM

Information in Browse Course Catalog is subject to change. Information is term specific. Please refer to the appropriate term when searching for course content. Key to Course Descriptions may be found at: http://rcs.registrar.arizona.edu/course_descriptions_key.

Biosystems Engineering (BE)

BE 120: Basic Computer Skills for Office Applications (3 units)

Description: This course covers Microsoft Office 365 and more. Its major objective is to give students the learning experience developing skills in cyber competencies they need to enhance productivity in their tenure at the university and in the workplace after graduation. The introductory unit helps students become familiar with essential computing concepts, i.e., hardware and software, different apps, and the Windows operating system. Subsequently, they will learn file management and the basics of browsers and e-mail. The application units cover Microsoft Word, Excel, and PowerPoint taught at basic/intermediate levels. Introductory material for Microsoft Access is also presented.

Grading basis: Regular Grades

Career: Undergraduate

Flat Fee: \$32

Course Components: Laboratory May Be Offered
 Lecture Required

Equivalent to: ABE 220, ABT 220, AGTM 120, AGTM 220, ENGR 220, FCR 120, FCR 220, FCSC 120, NFS 220, N_SC 120, N_SC 220, PLS 120

Also offered as: AGTM 120, FCSC 120, NSC 120, PLS 120

Course typically offered:

Main Campus: Fall, Winter, Spring, Summer

Online Campus: Fall, Winter, Spring, Summer

Distance Campus: Fall, Winter, Spring, Summer

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

BE 170A1: Basic Concepts in Water-Related Applications (3 units)

Description: This course develops an understanding of natural science concepts and ideas and how they can be used to understand and analyze processes and objects in the every day world. Water is a central theme. Students examine how it is obtained, stored, distributed, used, polluted, and cleaned. They learn to estimate its quality, quantity, energy, and movement. It is a broad introductory course.

Grading basis: Regular Grades

Career: Undergraduate

Course Components:	Discussion	May Be Offered
	Lecture	Required

Course typically offered:

Main Campus: Fall, Winter, Spring, Summer

Distance Campus: Fall, Winter, Spring, Summer

Enrollment requirement: Enrollment not allowed if you have previously taken NATS 101 "Basic Concepts in Water-Related Applications" (Topic 2).

General Education: NATS 101

BE 170A2: Science, Technology and Environment (3 units)

Description: The environment, scientific method, technology, motion, energy, gases, heat, chemistry, and electricity and magnetism are covered within the context of natural history and technology development. Laboratories and field trips in the in-person sections include aquaponics, biofuels, solar pumping, and drip irrigation.

Grading basis: Regular Grades

Career: Undergraduate

Course Components:	Discussion	May Be Offered
	Lecture	Required

Equivalent to: CHEE 170A1, ENVS 170A1, GC 170A1, GEOG 170A1, MSE 170A2

Course typically offered:

Main Campus: Fall, Winter, Spring, Summer

Distance Campus: Fall, Winter, Spring, Summer

Enrollment requirement: Enrollment barred if you've taken NATS101 "Earth Envr:Intr Phys Geo", "Intro to Environ Sci", "Intro to Global Change", "Sci, Tech & Environ", "Sustain Society", or "Energy Sys & Sustainability", CHEE170A1, ENVS170A1, GC170A1, GEOG170A1, or MSE170A2.

General Education: NATS 101

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

BE 193: Internship (1 - 6 units)

Description: Specialized work on an individual basis, consisting of training and practice in actual service in a technical, business, or governmental establishment.

Grading basis: Alternative Grading: S, P, F

Career: Undergraduate

Course Components: Independent Study Required

Course typically offered:

Main Campus: Fall, Winter, Spring, Summer

BE 199: Independent Study (1 - 5 units)

Description: Qualified students working on an individual basis with professors who have agreed to supervise such work.

Grading basis: Alternative Grading: S, P, F

Career: Undergraduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 99 times.

Course typically offered:

Main Campus: Fall, Spring, Summer 1 and 2

BE 199H: Honors Independent Study (1 - 5 units)

Description: Qualified students working on an individual basis with professors who have agreed to supervise such work.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 99 times.

Course typically offered:

Main Campus: Fall, Spring, Summer 1 and 2

Enrollment requirement: Student must be active in the Honors College.

Honors Course: Honors Course

Honors Course: Honors Course

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

BE 201: Introduction to Biosystems Engineering (2 units)

Description: This course provides an introduction biosystems engineering with emphasis on biological laboratory skills and basic fabrication, foundations of modeling biological processes, team work and professional skills, and the societal and global context in which the profession is practiced. Discussion topics include internship opportunities, professionalism, engineering ethics, and the impact of engineering on society. Laboratory exercises include renewable energy production, device design and fabrication, and biological sensing. Presentations, discussions, and writing exercises will provide communication experiences.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Course typically offered:

Main Campus: Fall

Distance Campus: Fall

Recommendations and additional information: MATH 124.

Enrollment requirement: MATH 122B or MATH 124 or MATH 125 (or approved transfer coursework, or AP credit for Calculus AB or BC).

BE 205: Engineering Analytic Computer Skills (3 units)

Description: Introduction to Excel, Visual Basic in Excel, Python, and Matlab with an emphasis on statistics, regression, conditional statements, loops, functions and subroutines, forms, arrays, Euler method, data acquisition, numerical methods, and symbolic processing. Students can choose to work in Google Sheets/Appscript instead of Excel/VBA.

Grading basis: Regular Grades

Career: Undergraduate

Flat Fee: \$20

Course Components:	Laboratory Lecture	May Be Offered Required
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Course typically offered:

Main Campus: Spring

Distance Campus: Spring

Recommendations and additional information: College of Engineering majors only.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

Description: Introduction to hydroponics and hydroponic systems for various crops: an historical perspective and current trends; basic plant physiology and anatomy; general cultural practices; plant protection (insects and diseases); traditional and organic hydroponic production systems; pollination, fertilization and bee management; plant nutrition and disorders; irrigation systems and nutrients; transplant production; greenhouse site selection, structures and control systems; fruit harvest; food handling and safety; marketing and economics of a hydroponic business.

Career: Undergraduate

Course Components: Lecture Required

Also offered as: PLS 217

Course typically offered:

Main Campus: Fall

Description: This is a hands-on course, teaching hydroponic tomato production from seedling through harvest using commercial style high-wire production techniques. Students apply what they have learned in BE 217R Lecture to real plants in a greenhouse setting. Course covers plant cultivation techniques such as clipping, stem pruning, leaning and lowering, cluster pruning and clipping, leaf maintenance, and harvesting techniques. Course also includes gaining skills in plant spacing, making nutrient tanks, monitoring plant health, pollination, and irrigation and climate control factors important for a successful crop. Observations of other hydroponic production systems in use at the UA-CEAC facility are also included.

Career: Undergraduate

Flat Fee: \$50

Course Components: Laboratory Required

Also offered as: PLS 217L

Course typically offered:

Main Campus: Fall

Enrollment requirement: BE 217 is a Pre-requisite or Co-requisite.

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

Description: Introduction to computer aided design and drafting (CADD) concepts and techniques. Two-dimensional computer aided design and drafting techniques to construct basic shapes and make multi-view drawing. Aspects of the AutoCAD program's 2D tools from basic concepts to the most powerful tools used in design and engineering. Introduction to 3D printing.

Career: Undergraduate

Course Components:	Lecture	Required
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Main Campus: Fall, Spring, Summer

Description: Introduction to computer aided design concepts and techniques. Two and three-dimensional drawing presentation, methods of graphical communications, data analysis, design synthesis and production methods.

Career: Undergraduate

Course Components:	Lecture	Required
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Course typically offered:

Online Campus: Fall, Winter, Spring, Summer

Distance Campus: Fall, Winter, Spring, Summer

Description: This course provides an integrated introduction to basic thermal engineering topics. A structured problem-solving approach emphasizes the interrelated roles of Thermodynamics, Fluid Mechanics, and Heat and Mass Transfer relevant to real-world engineering analyses.

Career: Undergraduate

Course typically offered:

Main Campus: Fall

Recommendations and additional information: MATH 129, PHYS141.

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

BE 291: Preceptorship (1 unit)

Description: Specialized work on an individual basis, consisting of instruction and practice in actual service in the department.

Grading basis: Alternative Grading: S, P, F

Career: Undergraduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 6 times.

Course typically offered:

Main Campus: Fall, Winter, Spring, Summer

BE 293: Internship (1 - 6 units)

Description: Specialized work on an Individual basis, consisting of training and practice in actual service in a technical, business or governmental establishment.

Grading basis: Alternative Grading: S, P, F

Career: Undergraduate

Course Components: Independent Study Required

Course typically offered:

Main Campus: Fall, Winter, Spring, Summer

BE 297: Introduction to Fabrication for Engineers (1 unit)

Description: This course provides an integrated introduction to basic fabrication topics. An emphasis on the interrelated roles of precision measurement, materials selection and reading of technical drawings and specifications, to teach real-world engineering analyses of fabricated/manufactured objects, and the materials and processes used to make them. Students are presented with introductory skills and knowledge in fabrication, and will gain experience in handling and maintaining hand and power tools and equipment, basic fabrication methods, and safety in fabrication work place/environment.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Workshop Required

Course typically offered:

Main Campus: Fall, Spring

BE 299: Independent Study (1 - 5 units)

Description: Qualified students working on an individual basis with professors who have agreed to supervise such work.

Grading basis: Alternative Grading: S, P, F

Career: Undergraduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 99 times.

Course typically offered:

Main Campus: Fall, Winter, Spring, Summer

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

BE 299H: Honors Independent Study (1 - 5 units)

Description: Qualified students working on an individual basis with professors who have agreed to supervise such work.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 99 times.

Course typically offered:

Main Campus: Fall, Spring, Summer 1 and 2

Enrollment requirement: Student must be active in the Honors College.

Honors Course: Honors Course

Honors Course: Honors Course

BE 310: Introduction to Biosystems Analytics (3 units)

Description: Computers and data analysis are increasingly essential to the study of all aspects of science. Introduction to Biosystems Analytics is a three-unit course designed to develop computational skills for a variety of biological applications. In this course, you will learn how to interact with data including understanding data structure, database management systems, and introductory programming for data manipulation, analysis, and visualization. The course will use a student-centered teaching and active learning approach. Class will typically consist of short introductions to computational terms, concepts and techniques, and associated problems, followed by hands on computing exercises. By the end of the course, you will be able to create, enter, store, manipulate, analyze, and visualize various data types using the command line interface, databases, and R.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Course typically offered:

Main Campus: Spring

Recommendations and additional information: BE 120 and BE 205 (or equivalent) are recommended, but not required

Field trip: N/A

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

BE 334: Aquaponics Design (3 units)

Description: This course begins with an introduction into the field of aquaponics -- the culture of fish and plants together and then provides an in depth guide into designing and building aquaponics systems. Various types of aquaponics systems and their parts will be discussed in addition to learning about water pressure and flow in aquaponics systems. The course provides students with hands-on learning activities and offers students the opportunity to engage in an online, group project.

Grading basis: Regular Grades

Career: Undergraduate

Course Components:	Lecture	Required
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Course typically offered:

Main Campus: Summer

Online Campus: Summer

Distance Campus: Summer

Recommendations and additional information: There are no required prerequisites for this course, however Math 111 and Math 112 are recommended.

BE 350: Advanced Hydroponic Crop Production (3 units)

Description: This is an advanced level course, building on the basic principles covered in BE 217: Introduction to Hydroponics lecture. Students will gain experience in nutrient formulation, fertigation management, and plant health monitoring; design, operation, and cultivation of crops in various types of hydroponic systems and environments (ex. Nutrient Film Technique, Deep Water Culture, aeroponics, aquaponics, gourmet mushrooms, vertical farming, supplemental and sole source lighting); and understanding of the principles and challenges in developing organic hydroponic systems. Students will read and analyze primary literature involving hydroponic systems and develop the ability to troubleshoot and solve grower problems.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Course typically offered:

Main Campus: Fall, Spring

Distance Campus: Fall, Spring

Recommendations and additional information: Students should complete BE 217 (Lecture), prior to enrolling in this course.

Field trip: There will be one mandatory field trip.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

BE 350L: Advanced Hydroponic Crop Production (1 unit)

Description: This is an advanced level course, building on the basic principles covered in BE 217: Introduction to Hydroponics. Students will gain hands-on experience with various hydroponic and specialty crop production systems such as Nutrient Film Technique (NFT), Deep Water Culture (DWC), bag culture, aquaponics, and gourmet mushroom production. Course will cover nutrient and irrigation management, climate control, integrated pest management, crop scheduling, seeding, transplanting, harvesting, and packaging using GHP/GAP food safety protocols.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Laboratory Required

Course typically offered:

Main Campus: Fall, Spring

Recommendations and additional information: SPS- CEA Sub Plan majors must complete the PLS 217 Lecture, as well as co-enroll in BE 350. It is highly recommended that students, in other majors complete BE 350 along with BE350L.

Field trip: None

BE 385: Precision Observation with Drones (3 units)

Description: Precision Observation with Drones is an introductory course about the practical aspects of small-scale multirotor unmanned aerial system with a strong emphasis on quadcopters. The course aims at introducing the students to the new and evolving field of small multirotor Unmanned Aerial Vehicles/Systems (UAV, UAS, Drones), their electrical and electronics subsystems, how they work, to size and build a small drone, add useful sensors, use the system for observing the physical and biological environment, and how to manage and process some of the most common data collected by drones. Upon completing this course, the student should become familiar with small drone technology, be able to understand their potentials and limitations, add different sensors, collect and analyze data with the drones. The course is aimed at all students with basic science and engineering knowledge and a desire to observe, remotely sense, and collect data about the natural environment with high precision.

Grading basis: Regular Grades

Career: Undergraduate

Other Fee: This course is pending a course fee review from ABOR and the fee is subject to change if approved.

Course Components: Laboratory Required
 Lecture Required

Course typically offered:

Main Campus: Fall

Field trip: Two field trips Locations and Exact date/time TBD: First Trip-Test fly/Have fun with drones. Second Trip - Automatic mission plan and data collection.

Enrollment requirement: [Advanced Standing Engineering or (non-Engineering Junior/Seniors)] and [MATH 122B or MATH 124 or MATH 125].

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-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

BE 391: Preceptorship (1 unit)

Description: Specialized work on an individual basis, consisting of instruction and practice in actual service in the department.

Grading basis: Alternative Grading: S, P, F

Career: Undergraduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 6 times.

Course typically offered:

Main Campus: Fall, Winter, Spring, Summer

BE 393: Internship (1 - 6 units)

Description: Specialized work on an individual basis, consisting of training and practice in actual service in a technical, business, or governmental establishment.

Grading basis: Alternative Grading: S, P, F

Career: Undergraduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 99 times.

Course typically offered:

Main Campus: Fall, Winter, Spring, Summer

Enrollment requirement: Adv Stdg: Engineering.

Student Engagement Activity: Professional Development

Student Engagement Competency: Professionalism

BE 397A: Teaching Workshop (3 - 4 units)

Description: The practical application of theoretical learning within a group setting and involving an exchange of ideas and practical methods, skills, and principles.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Workshop Required

Repeatable: Course can be repeated for a maximum of 10 units.

Equivalent to: ABE 397A

Also offered as: ENVS 397A

Course typically offered:

Main Campus: Fall, Spring

Home department: Soil, Water, & Environmental Sciences

Student Engagement Activity: Professional Development

Student Engagement Competency: Sustainability

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

BE 399: Independent Study (1 - 5 units)

Description: Qualified students working on an individual basis with professors who have agreed to supervise such work.

Grading basis: Alternative Grading: S, P, F

Career: Undergraduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 99 times.

Course typically offered:

Main Campus: Fall, Winter, Spring, Summer

Enrollment requirement: Adv Stdg: Engineering.

BE 399H: Honors Independent Study (1 - 5 units)

Description: Qualified students working on an individual basis with professors who have agreed to supervise such work.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 99 times.

Course typically offered:

Main Campus: Fall, Spring, Summer 1 and 2

Enrollment requirement: Adv Stdg: Engineering. Honors active.

Honors Course: Honors Course

Honors Course: Honors Course

BE 413: Applied Biostatistics (3 units)

Description: Introductory and advanced statistical methods and their applications in ecology. Focuses on how research design dictates choice of statistical models; explores principles and pitfalls of hypothesis testing.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Co-convened with: BE 513

Course typically offered:

Main Campus: Fall

Recommendations and additional information: Recommend that students complete an introductory course on Statistics that covers probability distributions and hypothesis testing, e.g., MATH 163 or 263 prior to taking this course.

Enrollment requirement: Adv Stdg: Engineering.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

BE 422: Open-Channel Flow (3 units)

Description: [Usually offered every three semesters beginning Fall 2007] Differential equations governing unsteady flow in open channels. Simple surface waves in subcritical and supercritical flows. Introduction of kinematic, diffusion, and dynamic wave methods. Applications to reservoir routing, dam break flow, and overland flow.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Equivalent to: ABE 422

Also offered as: CE 422

Co-convened with: ABE 522

Course typically offered:

Main Campus: Fall, Spring

Recommendations and additional information: CE 323 or consent of instructor.

Home department: Civil and Architectural Engineering and Mechanics

Enrollment requirement: Adv Standing: Engineering. CE 323 or consent of instructor.

BE 423: Biosystems Analysis and Design (3 units)

Description: The objective of this course is to enable students to analyze biological systems with respect to economics, growth rate, environmental impact, optimization, sustainability, and nutrient scheduling. Students analyze algae/biofuel feedstock production, agriculture, aquaponics, disease models, and predator-prey models. Numerical methods and models in Matlab and Excel/VBA include Euler and Runge-Kutta methods, first-order growth rate equations, epidemiology models, linear programming, and Simulink.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Co-convened with: ABE 523

Course typically offered:

Main Campus: Spring

Distance Campus: Spring

Recommendations and additional information: Familiarity with statistics.

Enrollment requirement: Adv Stdg: Engineering.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

BE 426: Watershed Engineering (3 units)

Description: Design of waterways, erosion control structures and small dams. Methods for frequency analysis and synthetic time distribution of rainfall. Methods for estimating infiltration and runoff from small watersheds, flow routing and storm water management. Estimating erosion using the Revised Universal Soil Loss Equation.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Equivalent to: CE 426, WSM 426

Also offered as: CE 426, WSM 426

Co-convened with: ABE 526

Course typically offered:

Main Campus: Fall

Distance Campus: Fall

Enrollment requirement: Adv. Stdg: Engineering or WSM major or minor. CE 218 or AME 331.

BE 427: Computer Applications in Hydraulics (3 units)

Description: Computer modeling of surface water hydrology, flood plain hydraulics and water distribution systems. Theoretical basis. Application and design studies.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Equivalent to: ABE 427, HWRS 427

Also offered as: CE 427, HWRS 427

Co-convened with: ABE 527

Course typically offered:

Main Campus: Fall

Home department: Civil and Architectural Engineering and Mechanics

Enrollment requirement: Adv Standing: Engineering. CE 323 or consent of instructor.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

Description: According to the US environmental regulations, it is mandatory that everyone who disturbs the soil is responsible for the sediments generated from that site. For instance, knowledge of erosion/sediment processes and control is an important tool those days to avoid federal penalties. The course focuses on the types of soil erosion, factors affecting it, and how to estimate erosion rates. Also, the student will learn how to design erosion control practices, based on certain runoff.

Distance Campus: Summer

Enrollment requirement: Adv. Stdg: Engineering. MATH 124 or MATH 125.

Main Campus: Fall

Home department: School of Information

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

BE 434: Biosystems Analytics (3 units)

Description: This course provides a comprehensive introduction to Python for data analytics focused on the interpretation of biological data. The course is structured as a series of short lectures covering key concepts and analytical strategies using Python and cutting-edge open source packages for data analytics. The majority of the course focuses on hands-on exercises both in- and out- of class to develop practical coding skills for interpreting and analyzing high-dimensional biological data. Students work in a collaborative learning classroom to gain skills in (1) basic Unix and Python, (2) Python data structures functions, and files, and (3) data wrangling and visualization using IPython, NumPy, and pandas, and (4) analytics using machine-learning methods available in Scikit-Learn. These skills are taught by implementing real-world coding examples to manipulate and process biological data in Python, and effectively use data-oriented Python libraries to analyze and interpret data from biological systems.

Grading basis: Regular Grades

Career: Undergraduate

Course Components:	Lecture	Required
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Co-convened with: BE 534

Course typically offered:

Main Campus: Spring

Distance Campus: Spring

Recommendations and additional information: Introduction to Linux.Code academy's Intro to Unix, or Command line bootcampApple or Linux computer, or Windows machine with Putty.An introductory programming class in python is useful but not required.

BE 444: Aquaponics Engineering (3 units)

Description: This course begins with an overview of aquaponics "the culture of fish and plants together" and then provides an in depth guide into properly designing, building and troubleshooting aquaponics systems, especially on the commercial scale. Engineering aspects of aquaponics systems will be thoroughly discussed in addition to biochemical processes, filtration and designing for various flow rates, fish species and plants. The course provides students with numerous hands-on learning activities and offers students the opportunity to advance their knowledge of aquaponics well beyond the basics. Typically offered: Spring.

Grading basis: Regular Grades

Career: Undergraduate

Course Components:

Co-convened with:

Course typically offered:

Main Campus: Spring

Distance Campus: Spring

Recommendations and additional information: Math 111 and Math 112 are recommended
Fluid Dynamics

Field trip: Graduate Students must complete a field trip assignment.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

BE 447: Sensors and Controls (3 units)

Description: Principles of electric circuits. Selection, interfacing and calibration of digital and analog sensors to measure physical variables. Optical electrochemical and piezoelectric biosensors. Basic bioprocess control.

Grading basis: Regular Grades

Career: Undergraduate

Flat Fee: \$100

Course Components:	Laboratory	May Be Offered
	Lecture	Required

Also offered as: BME 447

Co-convened with: ABE 547

Course typically offered:

Main Campus: Fall

Enrollment requirement: Adv. Stdg: Engineering, and BE 201 or BME 210.

BE 452: Globalization, Sustainability and Innovation (3 units)

Description: Globalization, sustainability and innovation constitute the three principal forces that drive the world of the 21st century -- economically, politically, socially and culturally. Aimed at engineering and science students, the objective of the course is to foster among them global intelligence (or global smarts), defined as an inclusive and cross-disciplinary working knowledge of how the globe operates today - including (1) how global infrastructures in communication, transportation and information technology have transformed how nations and corporations conduct business, (2) how nurturing sustainability ensures competitive advantage while ignoring it imperils nations as well as the planet, and (3) how technological innovation is critical both in maintaining competitive advantage and in providing the essential sustainable solutions to many of our current global challenges. In a flat world, fostering global intelligence has become a vital component of a well-rounded engineering and science education.

Grading basis: Regular Grades

Career: Undergraduate

Course Components:	Lecture	Required
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Equivalent to: ENGR 452

Also offered as: ENGR 452

Co-convened with: ABE 552

Course typically offered:

Main Campus: Spring

Enrollment requirement: Adv Stdg: Engineering.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

BE 455: Soil and Water Resources Engineering (3 units)

Description: Introduction to soil and water relationships, irrigation systems, irrigation water supply, and irrigation management; basic designs.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Equivalent to: CE 455

Also offered as: CE 455

Co-convened with: ABE 555

Course typically offered:

Main Campus: Fall

Distance Campus: Fall

Enrollment requirement: Adv. Stdg: Engineering. Junior or Senior status. CE 218 or AME 331.

BE 456: Irrigation Systems Design (3 units)

Description: Design and operation of surface, sprinkler, and trickle irrigation systems based on economic and environmental criteria.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Equivalent to: CE 456

Also offered as: CE 456

Co-convened with: BE 556

Course typically offered:

Main Campus: Spring (odd years only)

Distance Campus: Spring (odd years only)

Field trip: Field trip.

Enrollment requirement: Adv. Stdg: Engineering. CE 218.

BE 458: Soils, Wetlands and Wastewater Reuse (3 units)

Description: Water quality and system design for agricultural drainage and waste-water systems.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Equivalent to: CE 458

Also offered as: CE 458

Co-convened with: BE 558

Course typically offered:

Main Campus: Spring (even years only)

Distance Campus: Spring (even years only)

Enrollment requirement: Adv. Stdg: Engineering. Junior or Senior status. CE 218 or AME 331.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

BE 459: Design of Onsite Wastewater Treatment and Dispersal Systems (3 units)

Description: This course will cover issues and concepts relating to the design of domestic and small commercial onsite wastewater treatment and recycling systems. This course is typically offered every even spring semester.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Co-convened with: ABE 559

Course typically offered:

Main Campus: Spring (even years only)

Distance Campus: Fall (even years only)

Enrollment requirement: Adv. Stdg: Engineering. Junior or Senior status.

BE 467: Computation in Biomedicine (3 units)

Description: In this course, students will study the basic relationship between biostatistics, experimental design and analysis to critically evaluate and understand the scientific literature. They will learn principles of data management, understand how public biomedical databases are designed and integrated to support knowledge generation and apply principles of statistical and experimental design to critically review scientific articles for their applicability to clinical, real-life scenarios. Students will gain a working knowledge of how data science affects traditional animal sciences, veterinary science and biomedicine.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Also offered as: ACBS 467

Co-convened with:

Course typically offered:

Main Campus: Fall

Home department: School of Animal & Comparative Biomedical Sciences

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

BE 475A: Applied Plant Physiology (3 units)

Description: Students will learn the major environmental factors affecting plant growth and development and will understand interactions between plants and their microenvironments, including light penetration and CO₂/H₂O diffusion. Students will learn energy and mass balance of leaves and canopy and correlate these phenomena with plant productivity and related plant physiological mechanisms. Lectures cover critical controlled environment issues and practices of plant production in greenhouse, plant production factory, tissue culture vessels and post-harvest storage, with an introduction to the current research status in these areas. This course will be offered in spring of even years.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Repeatable: Course can be repeated a maximum of 2 times.

Equivalent to: ABE 475A

Also offered as: PLS 475A

Co-convened with: ABE 575A

Course typically offered:

Main Campus: Spring

Distance Campus: Spring

Recommendations and additional information: Introductory plant physiology course.

Home department: School of Plant Science

BE 479: Applied Instrumentation for Controlled Environment Agriculture (3 units)

Description: Students will learn principles, methods, and techniques related to the measurement and control of environmental factors affecting plant growth and plants' surrounding climate under controlled environments. Light intensity, light quality, temperature (air, plant), relative humidity, carbon dioxide, water, air current, and related factors are important variables in controlled environment plant production systems to measure and control since they affect and determine plant growth and development and processes such as heating, ventilating and air conditioning, fertigation etc. Therefore, students will learn application of sensors, instrumentation and designing of a simple system to measure and control environments for plant production systems.

Grading basis: Regular Grades

Career: Undergraduate

Flat Fee: \$50

Course Components:	Laboratory Lecture	May Be Offered Required
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Equivalent to: PLS 479

Also offered as: PLS 479

Co-convened with: ABE 579

Course typically offered:

Main Campus: Spring

Enrollment requirement: Adv. Stdg: Engineering, or (PLS major or minor. Junior or Senior status. MATH 113 and PHYS 102).

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

BE 481A: Engineering of Biological Processes (3 units)

Description: To learn to apply to the design of biological systems principles of engineering, science and mathematics, including, but not limited to statistics, kinetics, sensors and bioreactor design and scale up. To explore and be familiar with the principal areas of biological engineering such as food process engineering, tissue engineering, and other large-scale fermentation processes.

Grading basis: Regular Grades

Career: Undergraduate

Course Components:

Equivalent to: ABE 481A

Also offered as: CHEE 481A

Co-convened with: ABE 581A

Course typically offered:

Main Campus: Fall

Recommendations and additional information: MATH 254 and MCB 182 or MIC 205A or CHEE 450 or instructor consent.

Home department: Chemical & Environmental Engineering

Enrollment requirement: Adv Stdg: Engineering.

BE 481B: Cell and Tissue Engineering (3 units)

Description: Development of biological engineering methods including applied genetics, metabolic regulation, and bioreactors employed in industrial processes for manufacture of pharmaceuticals and in the design of tissue engineered devices to replace normal physiological function.

Grading basis: Regular Grades

Career: Undergraduate

Flat Fee: \$100

Course Components:	Laboratory Lecture	May Be Offered Required
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Equivalent to: BME 481B, CHEE 481B

Also offered as: BME 481B, CHEE 481B

Co-convened with: ABE 581B

Course typically offered:

Main Campus: Spring

Home department: Biomedical Engineering

Enrollment requirement: Adv. Stdg: Engineering. Junior or Senior status. MATH 254

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

Description: Integrated engineered solutions in the Food-Water-Energy Nexus are transformational integrated designs -- drivers of change -- that are necessary to make feeding an increased global population this century possible, environmentally sustainable and cost-effective.

Career: Undergraduate

Co-convened with: ABE 582

Main Campus: Fall

BE 483: Controlled Environment Systems (3 units)

Grading basis: Regular Grades

Career: Undergraduate

	Lecture	Required
1. Introduction to the course		
2. The history of the course		
3. The structure of the course		
4. The objectives of the course		
5. The syllabus of the course		
6. The assessment of the course		
7. The resources of the course		
8. The contact information of the course		
9. The feedback of the course		
10. The conclusion of the course		

Equivalent to: PLS 483

Also offered as: PLS 483

Co-convened with: ABE 583

Course typically offered:

Main Campus: Fall

Enrollment requirement: Adv. Standing Engineering, BE minors, or majors/minors in the following areas: PLS, SPS, EWRE, EHY, or ENVS (Microbiology, Sustainable Land & Water Management, Water Resource Management, or Biosphere Science specializations only).

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

BE 485: Remote Sensing Data and Methods (3 units)

Description: This course provides an in depth overview of practical topics in land remote sensing with big data, data sourcing and provenance, characteristics, generating algorithms, data discovery, advanced analysis, and data limitations. Students will learn how to discover and acquire a variety of global to regional land remote sensing data, learn about the various sensors/platforms collecting these data, learn how to interpret and use these data emphasizing real-world applications and research topics. The course is aimed primarily at students of biosystems engineering, environmental sciences, and natural resources management, and aims at bridging the gap between the theoretical aspects of remote sensing and current Earth science data records, algorithms, and analytics.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Co-convened with: ABE 585

Course typically offered:

Main Campus: Spring

Recommendations and additional information: GIST 330 and GEOG 418 highly recommended.

Enrollment requirement: Senior status only.

BE 486: Biomaterial-Tissue Interactions (3 units)

Description: Biomaterials and their applications; protein-surface and blood-biomaterial interactions, inflammation, wound healing, biocompatibility, implants, and tissue engineering.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Equivalent to: BME 486

Also offered as: BME 486

Co-convened with: BME 586

Course typically offered:

Main Campus: Spring

Home department: Biomedical Engineering

Enrollment requirement: Adv. Standing Engineering. CHEM 151, or CHEM 103A, or CHEM 103A-CC, or CHEM 104A, or CHEM 105A, or CHEM 106A, or Approved Transfer Course.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

BE 487: Metagenomics: From Genes to Ecosystems (3 units)

Description: Environmental genomics is revolutionizing our understanding of microbes from the environment to human health, towards a holistic view of ecosystems or "One-Health". At its core are new molecular methods called metagenomics to sequence DNA directly from an environmental sample, thus capturing the whole microbial community and bypassing culture. Modern (Next-Gen) sequencing technologies offer vast new datasets of short sequence reads representing these microbial communities, however many hurdles exist in interpreting data with high species complexity and given specialized software for microbial metagenomic analyses. This course focuses on the science of metagenomics towards understanding (1) questions that metagenomics can address, (2) possible approaches for metagenomic sequencing and analysis, and (3) how genes, pathways, and environmental context are translated into ecosystem-level knowledge. This course alternates between traditional lectures and hands-on experience with programming, bioinformatics tools, and metagenomic analysis. The course concludes with several weeks of seminar-format discussions on current research in metagenomic data analysis and a final project of your choice analyzing real-world experimental data.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Co-convened with: ABE 587

Course typically offered:

Main Campus: Fall

Recommendations and additional information: MCB 416, ABE 201 and MIC 205 are recommended.

Enrollment requirement: Adv. Standing: Engineering, or College of Science Junior or Seniors with 2.0 GPA or higher, or College of Agricultural and Life Sciences Junior or Senior status with 2.0 GPA or higher.

-SA represents a Student Abroad & Student Exchange offering

-**CC** represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

BE 488: Micro and Nano Transducer Physics and Design (3 units)

Description: Principles, design, and performance of micro and nano transducers. Designing MEMS to be produced with both foundry and nonfoundry processes. Applications of unique properties of micro and nano transducers for biological and engineering problems. Associated signal processing requirements for these applications.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Equivalent to: ABE 488

Also offered as: AME 488

Co-convened with: ABE 588

Course typically offered:

Main Campus: Spring

Recommendations and additional information: Recommended: AME/ABE 489/589.

Home department: Aerospace & Mechanical Engineering

Enrollment requirement: Adv. Stdg: Engineering, or (Plant Sciences, Environmental Science, or Environmental and Resource Economics major with Junior or Senior status). (ECE 207 or ABE 447) and AME 250.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

BE 489A: Fabrication Techniques for Micro- and Nanodevices (3 units)

Description: This course tackles the techniques for the design, fabrication, and testing of traditional microelectromechanical systems (MEMS) and nanodevices. Each student will be required to participate in weekly laboratory sessions, to keep a laboratory notebook, and to submit a project report (25% Honors final grade; 15% Undergraduate final grade) focusing on the design, fabrication, and testing of a MEMS device. Honors students receive additional homework assignments typically involving derivation or proof of a theory presented in class. Additionally, Honors students are asked to complete an independent MEMS/NEMS design, while undergraduates can use an existing device design. Grading differences are reflected in the syllabus.

Grading basis: Regular Grades

Career: Undergraduate

Flat Fee: \$100

Course Components:	Laboratory Lecture	May Be Offered Required
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Equivalent to: ABE 489A

Also offered as: AME 489A

Co-convened with: ABE 589A

Course typically offered:

Main Campus: Fall

Recommendations and additional information: Completion of Laboratory Chemical Safety Course (see <http://risk.arizona.edu/training/index.shtml>).

Home department: Aerospace & Mechanical Engineering

Enrollment requirement: Adv. Stdg: Engineering, or (Plant Sciences, Environmental Science, or Environmental and Resource Economics major with Junior or Senior status). ECE 207 or ABE 447.

BE 492: Directed Research (1 - 3 units)

Description: Student will participate a faculty-led research within the University of Arizona as an individual or as a small group. The faculty member will provide clear objectives at the beginning of the class, and meet with the student on a regular basis to track his/her progress. Towards the end of the class, the student needs to make oral presentation(s) in laboratory meeting and submit a written report to the faculty member. Department Consent is required.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 4 times.

Course typically offered:

Main Campus: Fall, Winter, Spring, Summer

Student Engagement Activity: Discovery

Student Engagement Competency: Innovation and Creativity

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

BE 493: Internship (1 - 6 units)

Description: Specialized work on an individual basis, consisting of training and practice in actual service in a technical, business, or governmental establishment.

Grading basis: Alternative Grading: S, P, F

Career: Undergraduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 99 times.

Course typically offered:

Main Campus: Fall, Winter, Spring, Summer

Enrollment requirement: Adv. Stdg: Engineering. Junior or Senior status.

Student Engagement Activity: Professional Development

Student Engagement Competency: Professionalism

BE 496A: Seminar in Engineering Careers and Professionalism (1 unit)

Description: The seminar will focus on employment in agricultural and biosystems engineering and engineering professionalism. Topics will include how to find a job (finding opportunities, writing resumes, interviewing), continuing education (professional societies, schools, self-learning) and engineering ethics. Presentations and discussion will provide communication opportunities. Students will be required to registrar for the Fundamentals of Engineering Exam (FE).

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Seminar Required

Course typically offered:

Main Campus: Fall

Enrollment requirement: Adv. Stdg: Engineering. Junior or Senior status.

Student Engagement Activity: Professional Development

Student Engagement Competency: Professionalism

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

BE 497C: Controlled Environment Agriculture IPM (3 units)

Description: Integrated Pest Management Principles, methods, and practices commonly used in controlled environment agriculture operations. Includes hands on monitoring and identification of pests in the Controlled Environment Agriculture Center (CEAC) teaching/research greenhouses.

Grading basis: Student Option ABCDE/PF

Career: Undergraduate

Flat Fee: \$24

Course Components: Workshop Required

Equivalent to: ABE 497C, AGTM 497C

Also offered as: AGTM 497C, ENTO 497C

Co-convened with: BE 597C

Course typically offered:

Main Campus: Spring

Home department: Entomology

BE 498A: Senior Capstone: Biosystems Engineering Design I (3 units)

Description: A culminating experience for majors involving a substantive project that demonstrates a synthesis of learning accumulated in the major, including broadly comprehensive knowledge of the discipline and its methodologies.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 99 times.

Equivalent to: ABE 494A

Course typically offered:

Main Campus: Fall

Enrollment requirement: Adv. Stdg: Engineering. Senior status. ABE 221.

Student Engagement Activity: Discovery

Student Engagement Competency: Innovation and Creativity

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

BE 498B: Senior Capstone: Biosystems Engineering Design II (3 units)

Description: A culminating experience for majors involving a substantive project that demonstrates a synthesis of learning accumulated in the major, including broadly comprehensive knowledge of the discipline and its methodologies.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Independent Study Required

Equivalent to: ABE 494B

Course typically offered:

Main Campus: Spring

Recommendations and additional information: Students will be required to take the Fundamentals of Engineering Exam (FE).

Enrollment requirement: Adv. Stdg: Engineering. Senior status. ABE 498A.

Student Engagement Activity: Discovery

Student Engagement Competency: Innovation and Creativity

BE 498H: Honors Thesis (3 units)

Description: An honors thesis is required of all the students graduating with honors. Students ordinarily sign up for this course as a two-semester sequence. The first semester the student performs research under the supervision of a faculty member; the second semester the student writes an honors thesis.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Independent Study Required

Repeatable: Course can be repeated for a maximum of 9 units.

Course typically offered:

Main Campus: Fall, Spring

Enrollment requirement: Adv. Stdg: Engineering. Honors active. Senior status.

Honors Course: Honors Course

Honors Course: Honors Course

Student Engagement Activity: Discovery

Student Engagement Competency: Innovation and Creativity

Writing Emphasis: Writing Emphasis Course

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

BE 499: Independent Study (1 - 5 units)

Description: Qualified students working on an individual basis with professors who have agreed to supervise such work.

Grading basis: Alternative Grading: S, P, F

Career: Undergraduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 99 times.

Course typically offered:

Main Campus: Fall, Winter, Spring, Summer

Enrollment requirement: Adv. Stdg: Engineering. Junior or Senior status.

BE 499H: Honors Independent Study (1 - 5 units)

Description: Qualified students working on an individual basis with professors who have agreed to supervise such work.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 99 times.

Course typically offered:

Main Campus: Fall, Spring, Summer 1 and 2

Recommendations and additional information: Non-Engineering must have Faculty permission.

Enrollment requirement: Adv Stdg: Engineering. Honors active.

Honors Course: Honors Course

Honors Course: Honors Course

BE 501: Research Methods in Biosystems Engineering (2 units)

Description: To assist graduate students in planning and executing a research project, preparing a thesis or dissertation, and reporting research results in journal publications. Specifically, the course will guide students in the selection and statement of a graduate research project and the development of a research proposal, introduce proper research methods such as record keeping and intellectual property considerations, discuss ethical research methods and review written and oral methods for presentation of research.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Course typically offered:

Main Campus: Spring

Distance Campus: Spring

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

BE 502: Fundamentals of Computing in Biosystems Analytics (3 units)

Description: Computing skills are desired by many graduate programs, particularly for students lacking prior computer and programming experience. This course is aimed at students from non-informatics backgrounds and will bring them to a level that is required by various analytic and data science programs. The course will provide an in-depth overview of scientific computing by focusing on concepts in computer systems, operating systems, programming languages, and high-performance computing (e.g., cluster). The primary goal is to provide fundamental concepts in computing and programming so that graduate students can complete their research. This course is specifically designed for graduate students without basic computing and programming experience.

Grading basis: Regular Grades

Career: Graduate

Course Components:	Lecture	Required
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Course typically offered:

Main Campus: Fall, Spring

Distance Campus: Fall, Spring

Community Campus: Fall, Spring

Field trip: N/A

BE 506: Modeling of Mass and Energy Flow in Soils (3 units)

Description: Water flow in soils; closely related problems of solute, pollutant, and heat transfer; emphasis on current concepts and research.

Grading basis: Regular Grades

Career: Graduate

Course Components:	Lecture	Required
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Equivalent to: ABE 605, ABT 605, AEN 605, HWRS 605, HYDR 605, SW 605

Also offered as: ENVS 506, HWRS 506

Course typically offered:

Main Campus: Fall

Recommendations and additional information: MATH 254.

Home department: Soil, Water, & Environmental Sciences

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

BE 513: Applied Biostatistics (3 units)

Description: Introductory and advanced statistical methods and their applications in ecology. Focuses on how research design dictates choice of statistical models; explores principles and pitfalls of hypothesis testing.

Grading basis: Regular Grades

Career: Graduate

Course Components: Laboratory May Be Offered
 Lecture Required

Equivalent to: EIS 613, ENTO 613, INSC 613

Also offered as: EIS 513, RNR 513

Co-convened with: BE 413

Course typically offered:

Main Campus: Fall

BE 522: Open-Channel Flow (3 units)

Description: [Usually offered every three semesters beginning Fall 2007] Differential equations governing unsteady flow in open channels. Simple surface waves in subcritical and supercritical flows. Introduction of kinematic, diffusion, and dynamic wave methods. Applications to reservoir routing, dam break flow, and overland flow. Graduate-level requirements includes a project paper.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Equivalent to: ABE 522

Also offered as: CE 522

Co-convened with: ABE 422

Course typically offered:

Main Campus: Fall, Spring

Recommendations and additional information: CE 323 or consent of instructor.

Home department: Civil and Architectural Engineering and Mechanics

BE 523: Biosystems Analysis and Design (3 units)

Description: Application of systems analysis to biologically related problems; computer modeling and use of simulations, optimization methods, decision support systems. Graduate-level requirements include a simulation project.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Co-convened with: BE 423

Course typically offered:

Main Campus: Spring

Distance Campus: Spring

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

BE 526: Watershed Engineering (3 units)

Description: Design of waterways, erosion control structures and small dams. Methods for frequency analysis and synthetic time distribution of rainfall. Methods for estimating infiltration and runoff from small watersheds, flow routing and storm water management. Estimating erosion using the Revised Universal Soil Loss Equation. Graduate-level requirements include a special project.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Equivalent to: CE 526, WSM 526

Also offered as: CE 526, WSM 526

Co-convened with: BE 426

Course typically offered:

Main Campus: Fall

Distance Campus: Fall

BE 527: Computer Applications in Hydraulics (3 units)

Description: Computer modeling of surface water hydrology, flood plain hydraulics and water distribution systems. Theoretical basis. Application and design studies. Graduate-level requirements include a research paper or project.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Equivalent to: ABE 527, HWRS 527

Also offered as: CE 527, HWRS 527

Co-convened with: ABE 427

Course typically offered:

Main Campus: Spring

Home department: Civil and Architectural Engineering and Mechanics

BE 528: Control of Erosion Processes (3 units)

Description: Graduate-level requirements include a term paper on a topic related to soil erosion processes or erosion control plus additional questions on homework and exams.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Repeatable: Course can be repeated a maximum of 2 times.

Co-convened with: BE 428

Course typically offered:

Main Campus: Summer

Distance Campus: Summer

Recommendations and additional information: MATH 124 or MATH 125.

Field trip: To Walnut Gulch Experimental Watershed in Tombstone, AZ.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

BE 529: Applied Cyberinfrastructure Concepts (3 units)

Description: Students will learn from experts from projects that have developed widely adopted foundational Cyberinfrastructure resources, followed by hands-on laboratory exercises focused around those resources. Students will use these resources and gain practical experience from laboratory exercises for a final project using a data set and meeting requirements provided by domain scientists. Students will be provided access to computer resources at: UA campus clusters, iPlant Collaborative and at NSF XSEDE. Students will also learn to write a proposal for obtaining future allocation to large scale national resources through XSEDE. Graduate-level requirements include reading a paper related to cyberinfrastructure, present it to the class, and lead a discussion on the paper.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Also offered as: INFO 529, PLS 529

Co-convened with:

Course typically offered:

Main Campus: Fall

Home department: School of Information

BE 534: Biosystems Analytics (3 units)

Description: This course provides a comprehensive introduction to Python for data analytics focused on the interpretation of biological data. The course is structured as a series of short lectures covering key concepts and analytical strategies using Python and cutting-edge open source packages for data analytics. The majority of the course focuses on hands-on exercises both in- and out- of class to develop practical coding skills for interpreting and analyzing high-dimensional biological data. Students work in a collaborative learning classroom to gain skills in (1) basic Unix and Python, (2) Python data structures functions, and files, and (3) data wrangling and visualization using IPython, NumPy, and pandas, and (4) analytics using machine-learning methods available in Scikit-Learn. These skills are taught by implementing real-world coding examples to manipulate and process biological data in Python, and effectively use data-oriented Python libraries to analyze and interpret data from biological systems.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Co-convened with: BE 434

Course typically offered:

Main Campus: Spring

Distance Campus: Spring

Recommendations and additional information: Online introduction to Linux. Code academy's Intro to Unix or Command line bootcamp. Apple or Linux computer or Windows machine with Putty. An introductory programming class in python is useful but not required.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

BE 544: Aquaponics Engineering (3 units)

Description: This course begins with an overview of aquaponics the culture of fish and plants together and then provides an in depth guide into properly designing, building and troubleshooting aquaponics systems, especially on the commercial scale. Engineering aspects of aquaponics systems will be thoroughly discussed in addition to biochemical processes, filtration and designing for various flow rates, fish species and plants. The course provides students with numerous hands-on learning activities and offers students the opportunity to advance their knowledge of aquaponics well beyond the basics. Typically offered: Spring.

Grading basis: Regular Grades

Career: Graduate

Course Components:	Lecture	Required
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Co-convened with: BE 444

Course typically offered:

Main Campus: Spring

Distance Campus: Spring

Recommendations and additional information: Graduate student Math 111 and Math 112 are recommended Fluid Dynamics

Field trip: - Visit the Biosphere 2 - Develop a biosecurity plan for a commercial aquaponics operation- Create an energy balance aquaponics system

BE 547: Sensors and Controls (3 units)

Description: Principles of electric circuits. Selection, interfacing and calibration of digital and analog sensors to measure physical variables. Optical electrochemical and piezoelectric biosensors. Basic bioprocess control. Graduate-level requirements include a special project.

Grading basis: Regular Grades

Career: Graduate

Flat Fee: \$100

Course Components:	Laboratory Lecture	May Be Offered Required
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Also offered as: BME 547

Co-convened with: BE 447

Course typically offered:

Main Campus: Fall

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

BE 552: Globalization, Sustainability and Innovation (3 units)

Description: Globalization, sustainability and innovation constitute the three principal forces that drive the world of the 21st century -- economically, politically, socially and culturally. Aimed at engineering and science students, the objective of the course is to foster among them global intelligence (or global smarts), defined as an inclusive and cross-disciplinary working knowledge of how the globe operates today, including (1) how global infrastructures in communication, transportation and information technology have transformed how nations and corporations conduct business, (2) how nurturing sustainability ensures competitive advantage while ignoring it imperils nations as well as the planet, and (3) how technological innovation is critical both in maintaining competitive advantage and in providing the essential sustainable solutions to many of our current global challenges. In a flat world, fostering global intelligence has become a vital component of a well-rounded engineering and science education. Graduate-level requirements include a 20-page in-depth written analysis of a topic on globalization or sustainability.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Equivalent to: ENGR 552

Also offered as: ENGR 552

Co-convened with: BE 452

Course typically offered:

Main Campus: Spring

BE 555: Soil and Water Resources Engineering (3 units)

Description: Introduction to soil and water relationships, irrigation systems, irrigation water supply, and irrigation management; basic designs. Graduate-level requirements include a special project on a current irrigation topic.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Equivalent to: CE 555

Also offered as: CE 555

Co-convened with: BE 455

Course typically offered:

Main Campus: Fall

Distance Campus: Fall

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

BE 556: Irrigation Systems Design (3 units)

Description: Design and operation of surface, sprinkler, and trickle irrigation systems based on economic and environmental criteria. Graduate-level requirements include a special project.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Equivalent to: CE 556

Also offered as: CE 556

Co-convened with: ABE 456

Course typically offered:

Main Campus: Spring (odd years only)

Distance Campus: Spring (odd years only)

BE 558: Soils, Wetlands and Wastewater Reuse (3 units)

Description: Water quality and system design for agricultural drainage and waste-water systems. Graduate-level requirements include a special project.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Equivalent to: CE 558

Also offered as: CE 558

Co-convened with: ABE 458

Course typically offered:

Main Campus: Spring (even years only)

Distance Campus: Spring (even years only)

BE 559: Design of Onsite Wastewater Treatment and Dispersal Systems (3 units)

Description: This course will cover issues and concepts relating to the design of domestic and small commercial onsite wastewater treatment and recycling systems. Graduate-level requirements include an additional design project in order to receive graduate credit. This course is typically offered every even spring semester.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Course typically offered:

Main Campus: Spring (even years only)

Distance Campus: Spring (even years only)

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

BE 567: Computation in Biomedicine (3 units)

Description: In this course, students will study the basic relationship between biostatistics, experimental design and analysis to critically evaluate and understand the scientific literature. They will learn principles of data management, understand how public biomedical databases are designed and integrated to support knowledge generation and apply principles of statistical and experimental design to critically review scientific articles for their applicability to clinical, real-life scenarios. Students will gain a working knowledge of how data science affects traditional animal sciences, veterinary science and biomedicine.

Grading basis: Regular Grades

Career: Graduate

Course Components:	Lecture	Required
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Also offered as: ACBS 567

Co-convened with:

Course typically offered:

Main Campus: Fall

Home department: School of Animal & Comparative Biomedical Sciences

BE 575A: Physiology of Plant Production under Controlled Environment (3 units)

Description: Students will learn the major environmental factors affecting plant growth and development and will understand interactions between plants and their microenvironments, including light penetration and CO₂/H₂O diffusion. Students will learn energy and mass balance of leaves and canopy and correlate these phenomena with plant productivity and related plant physiological mechanisms. Lectures cover critical controlled environment issues and practices of plant production in greenhouse, plant production factory, tissue culture vessels and post-harvest storage, with an introduction to the current research status in these areas. This course will be offered in spring of even years. Graduate-level requirements include a research paper on a specific topic within plant physiology under controlled environment. The paper should be a critical review of the current literature on the topic chosen.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Repeatable: Course can be repeated a maximum of 2 times.

Equivalent to: ABE 575A

Also offered as: PLS 575A

Co-convened with: ABE 475A

Course typically offered:

Main Campus: Spring

Home department: School of Plant Science

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

BE 579: Applied Instrumentation for Controlled Environment Agriculture (3 units)

Description: Students will learn principles, methods, and techniques related to the measurement and control of environmental factors affecting plant growth and plants' surrounding climate under controlled environments. Light intensity, light quality, temperature (air, plant), relative humidity, carbon dioxide, water, air current, and related factors are important variables in controlled environment plant production systems to measure and control since they affect and determine plant growth and development and processes such as heating, ventilating and air conditioning, fertigation etc. Therefore, students will learn application of sensors, instrumentation and designing of a simple system to measure and control environments for plant production systems. Graduate-level requirements include higher grading percentages for midterm, design project, and final exams.

Grading basis: Regular Grades

Career: Graduate

Flat Fee: \$50

Course Components:	Laboratory Lecture	May Be Offered Required
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Equivalent to: PLS 579

Also offered as: PLS 579

Co-convened with: BE 479

Course typically offered:

Main Campus: Spring

BE 580: Introduction to Systems Biology (3 units)

Description: The proteins in a cell are organized into networks and circuits that act to process information and control cell activity. In this course we will explore the structure and function of these circuits through discussion of the relevant literature and by building and testing mathematical models of simple/toy circuits. Emphasis will be placed on key concepts such as hysteresis, ultrasensitivity, adaptation, robustness and noise propagation. Graduate-level requirements include more complex independent projects and a formal presentation to the class.

Grading basis: Regular Grades

Career: Graduate

Course Components:	Lecture	Required
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Equivalent to: CE 580

Also offered as: MCB 580

Co-convened with: ABE 480

Course typically offered:

Main Campus: Fall

Home department: Molecular & Cellular Biology

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

Description: To learn to apply to the design of biological systems principles of engineering, science and mathematics, including, but not limited to statistics, kinetics, sensors and bioreactor design and scale up. To explore and be familiar with the principal areas of biological engineering such as food process engineering, tissue engineering, and other large-scale fermentation processes. Graduate-level requirement includes an oral presentation and belonging to the Journal Club.

Career: Graduate

Equivalent to: ABE 581A

Also offered as: CHEE 581A

Course typically offered:

Main Campus: Fall

BE 581B: Cell and Tissue Engineering (3 units)

Description: Development of biological engineering methods including applied genetics, metabolic regulation, and bioreactors employed in industrial processes for manufacture of pharmaceuticals and in the design of tissue engineered devices to replace normal physiological function. Graduate-level requirements include two additional design projects, homework problems requiring a greater degree of mathematics, and exams containing questions which evaluate a higher level of thought processes.

Career: Graduate

Flat Fee: \$100

Equivalent to: BME 581B, CHEE 581B

Also offered as: BME 581B, CHEE 581B

Co-convened with: BME 481B

Course typically offered:

Main Campus: Spring

Home department: Biomedical Engineering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

Description: Integrated engineered solutions in the Food-Water-Energy Nexus are transformational integrated designs -- drivers of change -- that are necessary to make feeding an increased global population this century possible, environmentally sustainable and cost-effective. Graduate students and undergraduate students will be mixed in teams, and each team designs an integrated engineered solution in the Food-Water-Energy Nexus. Each graduate student will be further required to provide detailed design for a chosen specific component of his/her team's designed integrated engineered food-water-energy system. The grade for each graduate student for the Team Design (which accounts for 30% of the final grade as shown above) will be 50% of the team design grade and 50% of his/her individual component design grade.

Career: Graduate

Co-convened with: BE 482

Course typically offered:

Main Campus: Fall

Description: An introduction to the technical aspects of greenhouse design, environmental control, hydroponic crop production, plant nutrient delivery systems, intensive field production systems, and post-harvest handling and storage of crops. Graduate-level requirements include submission of a comprehensive report related to a specific greenhouse design project.

Career: Graduate

Equivalent to: PLS 583

Also offered as: PLS 583

Co-convened with: BE 483

Course typically offered:

Main Campus: Fall

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

Description: This course provides an in depth overview of practical topics in land remote sensing with big data, data sourcing and provenance, characteristics, generating algorithms, data discovery, advanced analysis, and data limitations. Students will learn how to discover and acquire a variety of global to regional land remote sensing data, learn about the various sensors/platforms collecting these data, learn how to interpret and use these data emphasizing real-world applications and research topics. The course is aimed primarily at students of biosystems engineering, environmental sciences, and natural resources management, and aims at bridging the gap between the theoretical aspects of remote sensing and current Earth science data records, algorithms, and analytics.

Career: Graduate

Co-convened with: BE 485

Course typically offered:

Main Campus: Spring

BE 586: Biomaterial-Tissue Interactions (3 units)

Description: Biomaterials and their applications; protein-surface and blood-biomaterial interactions, inflammation, wound healing, biocompatibility, implants, and tissue engineering. Graduate-level requirements include: Three(3) journal club presentations and peer reviews for all presentations. Term paper requires extensive theoretical background and should be formatted to a grant proposal to external funding agencies such as NSF or NIH.

Grading basis: Regular Grades

Career: Graduate

Equivalent to: BME 586

Also offered as: BME 586

Co-convened with: BME 486

Course typically offered:

Main Campus: Spring

Home department: Biomedical Engineering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

BE 587: Metagenomics: From Genes to Ecosystems (3 units)

Description: Environmental genomics is revolutionizing our understanding of microbes from the environment to human health, towards a holistic view of ecosystems or "One-Health". At its core are new molecular methods called metagenomics to sequence DNA directly from an environmental sample, thus capturing the whole microbial community and bypassing culture. Modern (Next-Gen) sequencing technologies offer vast new datasets of short sequence reads representing these microbial communities, however many hurdles exist in interpreting data with high species complexity and given specialized software for microbial metagenomic analyses. This course focuses on the science of metagenomics towards understanding (1) questions that metagenomics can address, (2) possible approaches for metagenomic sequencing and analysis, and (3) how genes, pathways, and environmental context are translated into ecosystem-level knowledge. This course alternates between traditional lectures and hands-on experience with programming, bioinformatics tools, and metagenomic analysis. The course concludes with several weeks of seminar-format discussions on current research in metagenomic data analysis and a final project of your choice analyzing real-world experimental data. Graduate Students are expected to work independently, and choose an original research article in metagenomics published within the last year, decompose the article based on engineering design elements, and present on it in class. Graduate students are required to submit a 10-page report that contrasts this article with literature in the same research area and describes the advances that this article makes. All graduate students will be required to present content from their report in class.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Co-convened with: BE 487

Course typically offered:

Main Campus: Fall

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

BE 588: Micro and Nano Transducer Physics and Design (3 units)

Description: Principles, design, and performance of micro and nano transducers. Designing MEMS to be produced with both foundry and nonfoundry processes. Applications of unique properties of micro and nano transducers for biological and engineering problems. Associated signal processing requirements for these applications. Graduate-level requirements include review and presentation on one of the following topics: AFM, Confocal Microscopy, FTIR, NSOM, Multi-photon Microscopy, SEM, SICM, STM, TEM, Ultrasound, and XPS.

Undergraduate students can choose to design and analyze a MEMS device as term project.

Grading basis: Regular Grades

Career: Graduate

Course Components:	Lecture	Required
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Equivalent to: ABE 588

Also offered as: AME 588

Co-convened with: ABE 488

Course typically offered:

Main Campus: Spring

Recommendations and additional information: Recommended: ABE 589 or AME 589.

Home department: Aerospace & Mechanical Engineering

-SA represents a Student Abroad & Student Exchange offering

-**CC** represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

BE 589A: Fabrication Techniques for Micro- and Nanodevices (3 units)

Description: This course tackles the techniques for the design, fabrication, and testing of traditional microelectromechanical systems (MEMS) and nanodevices. Each student will be required to participate in weekly laboratory sessions, to keep a laboratory notebook, and to submit a project report (25% Honors final grade; 15% Undergraduate final grade) focusing on the design, fabrication, and testing of a MEMS device. Honors students receive additional homework assignments typically involving derivation or proof of a theory presented in class. Additionally, Honors students are asked to complete an independent MEMS/NEMS design, while undergraduates can use an existing device design. Grading differences are reflected in the syllabus. Graduate-level requirements include additional homework assignments typically involving derivation or proof of a theory presented in class. Additionally, graduate students are asked to complete an independent MEMS/NEMS design, while undergraduates can use an existing device design. Grading differences are reflected in the syllabus.

Grading basis: Regular Grades

Career: Graduate

Flat Fee: \$100

Course Components:	Laboratory	May Be Offered
	Lecture	Required

Equivalent to: ABE 589A

Also offered as: AME 589A

Co-convened with: ABE 489A

Course typically offered:

Main Campus: Fall

Recommendations and additional information: ECE 207 OR ABE 447. Completion of Laboratory Chemical Safety Course (see <http://risk.arizona.edu/training/index.shtml>).

Home department: Aerospace & Mechanical Engineering

BE 589B: Bio Micro/Nanotechnology Applications (3 units)

Description: This course tackles the applications of modern micro/nano devices or systems including lab-on-a-chip, DNA/protein array, drug carriers and other therapeutic systems, neuroscience applications, and food/agricultural systems. Toward this end, three different topics will be covered in this class: (1) brief overview on modern micro- and nanofabrication technologies, (2) biophysics principles for analytes and its recognition, and (3) various sensing modalities specific to these systems. Graduates participate in a journal club.

Grading basis: Regular Grades

Career: Graduate

Course Components:	Lecture	Required
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Equivalent to: AME 589B

Also offered as: AME 589B

Co-convened with: ABE 489B

Course typically offered:

Main Campus: Spring

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

BE 592: Directed Research (1 - 6 units)

Description: Graduate student will participate a faculty-led research within the University of Arizona as an individual or as a small group. The faculty member will provide clear objectives at the beginning of the class, and meet with the student on a regular basis to track his/her progress. Towards the end of the class, the student needs to make oral presentation(s) in laboratory meeting and submit a written report to the faculty member. Department Consent is required.

Grading basis: Regular Grades

Career: Graduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 2 times.

Course typically offered:

Main Campus: Fall, Spring, Summer

South Campus: Fall, Spring, Summer

Distance Campus: Fall, Spring, Summer

Recommendations and additional information: This course is intended for BE and BAT Graduate Students or BE AMP students.

Field trip: No field trips.

BE 593: Internship (1 - 6 units)

Description: Specialized work on an individual basis, consisting of training and practice in actual service in a technical, business, or governmental establishment.

Grading basis: Alternative Grading: S, P, F

Career: Graduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 99 times.

Course typically offered:

Main Campus: Fall, Winter, Spring, Summer

BE 597A: Academic & Career Preparation for Graduate Students (1 unit)

Description: This 1-unit course will review the expectations for our graduate students, program procedures, and graduation requirements; survey the research conducted in the Biosystems Engineering Department; allow time to shadow research faculty; review presentation skills; and develop a curriculum vita.

Grading basis: Regular Grades

Career: Graduate

Course Components: Workshop Required

Repeatable: Course can be repeated a maximum of 1 times.

Course typically offered:

Main Campus: Fall

Distance Campus: Fall

Community Campus: Spring

Field trip: None

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

BE 597C: Controlled Environment Agriculture IPM (3 units)

Description: Integrated Pest Management Principles, methods, and practices commonly used in controlled environment agriculture operations. Includes hands on monitoring and identification of pests in the Controlled Environment Agriculture Center (CEAC) teaching/research greenhouses.

Grading basis: Regular Grades

Career: Graduate

Flat Fee: \$24

Course Components: Workshop Required

Equivalent to: ABE 597C, AGTM 597C, ENTO 597C

Also offered as: AGTM 597C, EIS 597C

Co-convened with: BE 497C

Course typically offered:

Main Campus: Spring

Home department: GIDP on Entomology and Insect Science

BE 599: Independent Study (1 - 5 units)

Description: Qualified students working on an individual basis with professors who have agreed to supervise such work. Graduate students doing independent work which cannot be classified as actual research will register for credit under course number 599, 699, or 799.

Grading basis: Alternative Grading: S, P, F

Career: Graduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 99 times.

Course typically offered:

Main Campus: Fall, Winter, Spring, Summer

BE 693: Internship (1 - 6 units)

Description: Specialized work on an individual basis, consisting of training and practice in actual service in a technical, business, or governmental establishment.

Grading basis: Alternative Grading: S, P, F

Career: Graduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 99 times.

Course typically offered:

Main Campus: Fall, Winter, Spring, Summer

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

BE 696A: Graduate Seminar I-Presenting (1 unit)

Description: The development and exchange of scholarly information, usually in a small group setting. The scope of work shall consist of research by course registrants, with the exchange of the results of such research through discussion, reports, and/or papers.

Grading basis: Regular Grades

Career: Graduate

Course Components: Seminar Required

Repeatable: Course can be repeated a maximum of 15 times.

Equivalent to: AEN 696A, SW 696A

Co-convened with: BE 696B

Course typically offered:

Main Campus: Fall, Spring

Distance Campus: Fall, Spring

BE 696B: Graduate Seminar II-Non Presenting (1 unit)

Description: The exchange of scholarly information, usually in a small group setting. The scope of work shall consist of participation in seminar by course registrants, with the exchange of ideas presented in such seminars through discussion. Registrants are not required to give a presentation in the ABE 696B course. Registrants will preside over one or more seminars and otherwise provide support to the speakers and attendees.

Grading basis: Alternative Grading: S, P, F

Career: Graduate

Course Components: Seminar Required

Repeatable: Course can be repeated a maximum of 50 times.

Co-convened with:

Course typically offered:

Main Campus: Fall, Spring

BE 699: Independent Study (1 - 5 units)

Description: Qualified students working on an individual basis with professors who have agreed to supervise such work. Graduate students doing independent work which cannot be classified as actual research will register for credit under course number 599, 699, or 799.

Grading basis: Alternative Grading: S, P, F

Career: Graduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 99 times.

Course typically offered:

Main Campus: Fall, Spring, Summer 1 and 2

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

BE 908: Case Studies (1 - 5 units)

Description: Individual study of a particular case, or report thereof.

Grading basis: Alternative Grading: S, P, F

Career: Graduate

Course Components: Independent Study Required

BE 909: Master's Report (1 - 8 units)

Description: Individual study or special project or formal report thereof submitted in lieu of thesis for certain master's degrees.

Grading basis: Alternative Grading: S, P, F

Career: Graduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 99 times.

Course typically offered:

Main Campus: Fall, Spring, Summer

Distance Campus: Fall, Spring, Summer

BE 910: Thesis (1 - 16 units)

Description: Research for the master's thesis (whether library research, laboratory or field observation or research, artistic creation, or thesis writing). Maximum total credit permitted varies with the major department.

Grading basis: Alternative Grading: S, P, F

Career: Graduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 99 times.

Course typically offered:

Main Campus: Fall, Spring, Summer

Distance Campus: Fall, Spring, Summer

BE 920: Dissertation (1 - 9 units)

Description: Research for the doctoral dissertation (whether library research, laboratory or field observation or research, artistic creation, or dissertation writing).

Grading basis: Alternative Grading: S, P, F

Career: Graduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 99 times.

Course typically offered:

Main Campus: Fall, Spring, Summer

Distance Campus: Fall, Spring, Summer

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.