Fall 2020 Course Descriptions as of 04/05/2020 08:11 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**.

Engineering (ENGR)

ENGR 100AX: Introduction to 3D Spatial Visualization (1 unit)
Description: Spatial ability is the skill to depict, manipulate and recall symbolic, nonlinguistic information, such as sketches and drawings. Spatial ability includes spatial perception and visualization. Spatial visualization involves multi-step manipulations of spatially presented information. Visual spatial skills are essential for success in engineering and can be learned. The 3D spatial visualization course is intended to improve spatial skills through a series of exercises related to nine different topics: surfaces and solids of revolution; isometric drawing and coded plans; orthographic drawings; inclined and curved surfaces; flat patterns; rotation of objects about a single axis; rotation of objects about two or more axes; object reflections and symmetry; cutting planes and cross-sections.
Grading basis: Developmental No GPA: ABCDE
Career: Undergraduate
Course Components: Seminar Required
Course typically offered:
Main Campus: Fall

Enrollment requirement: Wildcat Engineering Academy; MATH 111, MATH 112 or MATH 120R or higher Math course.

ENGR 100BX: Engineering Leadership Practice (1 unit)
Description: This course is designed to support first year engineering students in the Wildcat Engineering Academy and Engineering Leadership Community as they develop in key areas of leadership, including their ability to work effectively in teams, to manage conflict, and to inspire a shared vision. Students will develop an E-Portfolio to showcase their knowledge, skills, and engagement with engineering clubs, undergraduate research, and class projects. By the end of the semester students will learn and practice the strategies essential for paving a successful path in engineering.
Grading basis: Developmental No GPA: ABCDE
Career: Undergraduate
Course Components: Seminar Required
Course typically offered:
Main Campus: Fall

Field trip: Students are required to attend the University of Arizona Challenge Course. This program is funded by the College of Engineering. Transportation to and from the course is provided.
Enrollment requirement: Must be in the Wildcat Engineering Academy or Engineering Leadership Community. Majors: all undergraduate College of Engineering majors acceptable.
Success Course: Success Course

ENGR 102: Introduction to Engineering (3 units)
Description: Engineering design, effective team participation and career preparation. Students are expected to participate in hands-on design projects, develop education/career plans and initiate development of the personal and management skills necessary for life long learning.
Grading basis: Regular Grades
Career: Undergraduate
Course Components: Lecture Required
Course typically offered: Community Campus: Fall, Spring
Recommendations and additional information: Must have permission of partnering High School.
Enrollment requirement: College of Engineering major.
Shared Unique Number: SUN# EGR 1102

ENGR 102A: Introduction to Engineering Lecture Series (1 unit)
Description: Students will attend a series of 50-minute lectures. Lecture topics will include contemporary technical challenges in engineering, engineering ethics and engineering teamwork. Students will complete a Career Plan, which involves preparation of a resume and development of an academic plan. Students will attend the UA Career Fair and participate in the College of Engineering New Student Welcome and Departmental Open Houses.
Grading basis: Regular Grades
Career: Undergraduate
Course Components: Lecture Required
Course typically offered:
Main Campus: Fall

Enrollment requirement: This course is open to Freshmen and Sophomores in the College of Engineering. The course requires Math 112 (or an ALEKS score of 60) or a Math SAT score of 640 (or Math ACT score of 26). This course is also open to all Catapult students.
Shared Unique Number: SUN# EGR 1102

ENGR 102B: Introduction to Engineering Design (2 units)
Description: Introduction to the engineering design process, effective team participation and career preparation. Students are expected to participate in hands-on design projects, understand the nature of engineering design challenges and initiate development of the personal and management skills necessary for lifelong learning.
Grading basis: Regular Grades
Career: Undergraduate
Course Components: Lecture Required
Course typically offered:
Main Campus: Fall, Spring

Enrollment requirement: Freshman and Sophomore status. College of Engineering major, pre- or co-requisite of MATH 122B, 125, 129, 223, or 254.
Shared Unique Number: SUN# EGR 1102

ENGR 195: Engineering Design Thinking (1 unit)
Description: Students will have discussions with successful designers and entrepreneurs, observe the Hack Arizona event, develop a project concept, and develop idea-pitching skills. By the end of the course, students will be able to produce a short video in which they identify a need or opportunity, document the iterative design process they used to address the identified need, and pitch their proposed product or system design. Students will compete for prizes and awards.
Grading basis: Regular Grades
Career: Undergraduate
Course Components: Colloquium Required
Course typically offered:
Main Campus: Fall, Spring

Field trip: No offsite field trips scheduled.
Enrollment requirement: This course is open to Freshmen and Sophomores.
Freshman Colloquia: Freshman Colloquia

ENGR 195E: Foundations in Engineering Leadership (1 unit)
Description: This course is designed to support first year engineering students in the Engineering Leadership Community as they develop in key areas of leadership, including their ability to work effectively in teams, to manage conflict, and to inspire a shared vision. Topics covered include team building, ethics, networking, strengths assessment and service. By the end of the semester students will have a leadership plan completed.
Grading basis: Alternative Grading: S, P, F
Career: Undergraduate
Course Components: Colloquium Required
Course typically offered:
Main Campus: Fall, Spring

Field trip: None
Enrollment requirement: Reserved for students currently attending orientation.
Success Course: Success Course

ENGR 195S: Academic Success in the First Year (1 unit)
Description: This course will help first-year engineering students to build their tool box for academic success by introducing them to college and campus resources, learning strategies and study skills, and focusing on teamwork and collaboration.
Grading basis: Alternative Grading: S, P, F
Career: Undergraduate
Course Components: Colloquium Required
Course typically offered:
Main Campus: Fall

Field trip: none
Enrollment requirement: Reserved for students currently attending orientation. Majors: all undergraduate College of Engineering majors acceptable.
Success Course: Success Course

ENGR 196A: Survey of Engineering Professions (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: Undergraduate
Course Components: Seminar Required
Course typically offered:
Main Campus: Fall

ENGR 196B: Planning Engineering Design (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: Undergraduate
Course Components: Seminar Required
Course typically offered:
Main Campus: Spring

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

ENGR 196C: Grand Challenges for Engineering (1 unit)
Description: Grand Challenges for Engineering, a report issued by the National Academy of Engineering in 2009, identifies 14 challenges facing our engineers and scientists. This course encourages students to survey a variety of engineering fields and the challenges that face them in the 21st century.
Grading basis: Regular Grades
Career: Undergraduate
Course Components: Seminar Required
Course typically offered:
Main Campus: Fall, Spring

ENGR 196D: Introduction to Engineering Lecture Series (1 unit)
Description: This course is intended for students who have completed Introduction to Engineering in high school (ENGR 102 HS). Students will attend a series of 50-minute lectures. Lecture topics will include contemporary technical challenges in engineering, engineering ethics and engineering teamwork. Students will complete a Career Plan, which involves preparation of a resume and development of an academic plan. Students will attend the UA Career Fair and participate in the College of Engineering New Student Welcome and Departmental Open Houses.
Grading basis: Student Option ABCDE/PF
Career: Undergraduate
Course Components: Lecture Required
Course typically offered:
Main Campus: Fall

Enrollment requirement: Engineering majors who have completed ENGR 102 in high school. concurrently enrolled in: MATH 124 or MATH 125.

ENGR 196H: Honors Proseminar (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: Undergraduate
Course Components: Seminar Required
Course typically offered:
Main Campus: Spring

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

ENGR 197A: What is Engineering (1 unit)
Description: Students will be introduced to the various engineering disciplines with particular focus on non-traditional application areas. Student will learn what engineers do upon graduation, will learn about student professional societies, student projects, and clubs. What are the expectations and challenges in completing an engineering degree? By the end of the semester, students should have a clear picture of what engineers do and should be able to choose a degree program within college or within the university.
Grading basis: Pass/Fail
Career: Undergraduate
Course Components: Workshop Required
Course typically offered:
Main Campus: Fall

Success Course: Success Course

ENGR 211C: Engineering Science Module - Statics (1 unit)
Description: The course is offered over the web and has a complete set of materials including pre-requisite review material, course content, quiz problems, and exercise problems. There will be scheduled instructor office hours and scheduled chat sessions for students to obtain help with the material. The students work at their own pace during the 5 week session and then take a final exam at the end. Statics - forces, moments, equivalent force systems, support conditions, freebody diagrams, equilibrium equations, and applications areas.
Grading basis: Regular Grades
Career: Undergraduate
Course Components: Lecture Required
Course typically offered:
Main Campus: Fall, Spring

Recommendations and additional information: PHYS 141, MATH 129.
Enrollment requirement: Majors: all undergraduate College of Engineering majors acceptable.

ENGR 211E: Engineering Science Module - Mechanics of Solids (1 unit)
Description: The course is offered over the web and has a complete set of materials including pre-requisite review material, course content, quiz problems, and exercise problems. There will be scheduled instructor office hours and scheduled chat sessions for students to obtain help with the material. The students work at their own pace during the 5 week session and then take a final exam at the end. Mechanics of Solids - relationship between external forces acting on elastic and inelastic bodies and the resulting behavior; normal and shear stresses, applications to bars, beams, shafts and columns, and combined stresses.
Grading basis: Regular Grades
Career: Undergraduate
Course Components: Lecture Required
Course typically offered:
Main Campus: Fall, Spring

Recommendations and additional information: ENGR 211C.

ENGR 211F: Engineering Science Module - Fluid Mechanics (1 unit)
Description: The course is offered over the web and has a complete set of materials including pre-requisite review material, course content, quiz problems, and exercise problems. There will be scheduled instructor office hours and scheduled chat sessions for students to obtain help with the material. The students work at their own pace during the 5 week session and then take a final exam at the end. Fluid Mechanics - fluid properties, hydrostatics, conservation of mass, energy, and momentum, pressurized systems and open channel flow.
Grading basis: Regular Grades
Career: Undergraduate
Course Components: Lecture Required
Course typically offered:
Main Campus: Fall, Spring

Recommendations and additional information: MATH 223, ENGR 211C.

ENGR 211I: Engineering Science Module - Dynamics (1 unit)
Description: The course is offered over the web and has a complete set of materials including pre-requisite review material, course content, quiz problems, and exercise problems. There will be scheduled instructor office hours and scheduled chat sessions for students to obtain help with the material. The students work at their own pace during the 5 week session and then take a final exam at the end. Dynamics - dynamics of particles and rigid bodies as applied to mechanical systems; introduction to mechanical vibrations.
Grading basis: Regular Grades
Career: Undergraduate
Course Components: Lecture Required
Course typically offered:
Main Campus: Fall, Spring, Summer

Recommendations and additional information: MATH 254, CE 214.
Enrollment requirement: CE 214 and MATH 254.

ENGR 211K: Engineering Science Module - Thermodynamics (1 unit)
Description: The course is offered over the web and has a complete set of materials including pre-requisite review material, course content, quiz problems, and exercise problems. There will be scheduled instructor office hours and scheduled chat sessions for students to obtain help with the material. The students work at their own pace during the 5 week session and then take a final exam at the end. Thermodynamics - system definitions, properties and evaluation, 1st and 2nd law theory (open and closed systems) and applications.
Grading basis: Regular Grades
Career: Undergraduate
Course Components: Lecture Required
Course typically offered:
Main Campus: Fall, Spring

Recommendations and additional information: MATH 223, PHYS 241.

ENGR 211M: Engineering Science Module - Circuits (1 unit)
Description: The course is offered over the web and has a complete set of materials including pre-requisite review material, course content, quiz problems, and exercise problems. There will be scheduled instructor office hours and scheduled chat sessions for students to obtain help with the material. The students work at their own pace during the 5 week session and then take a final exam at the end. Circuits - gain a fundamental working knowledge of basic DC and AC circuits, learn how to solve DC, AC, and power related questions on electric circuits, identify electrical devices in an everyday setting and be able to describe their basic operating characteristics.
Grading basis: Regular Grades
Career: Undergraduate
Course Components: Lecture Required
Course typically offered:
Main Campus: Fall, Spring

Recommendations and additional information: MATH 254, PHYS 241.
Enrollment requirement: PHYS 241

ENGR 211P: Engineering Science Module - Engineering Economics (1 unit)
Description: The course is offered over the web and has a complete set of materials including pre-requisite review material, course content, quiz problems, and exercise problems. There will be scheduled instructor office hours and scheduled chat sessions for students to obtain help with the material. The students work at their own pace during the 5 week session and then take a final exam at the end. Engineering Economics - methods and modern techniques of engineering economic analysis for decision making, cost estimation, cash flow evaluation, taxes and depreciation, percent value, annual equivalent, internal rate of return, cost/benefit analysis, sensitivity analysis.
Grading basis: Regular Grades
Career: Undergraduate
Course Components: Lecture Required
Course typically offered:
Main Campus: Fall, Spring

Recommendations and additional information: MATH 129.

ENGR 211R: Engineering Science Module - Materials Science for Engineers (1 unit)
Description: The course is offered over the web and has a complete set of materials including pre-requisite review material, course content, quiz problems, and exercise problems. There will be scheduled instructor office hours and scheduled chat sessions for students to obtain help with the material. The students work at their own pace during the 5 week session and then take a final exam at the end. Materials Science for Engineers -atomic structure, arrangement, defects, and mobility diffusion, phase diagrams, ferrous metallurgy and corrosion, electrical, mechanical, and magnetic properties of materials.
Grading basis: Regular Grades
Career: Undergraduate
Course Components: Lecture Required
Course typically offered:
Main Campus: Fall, Spring

Recommendations and additional information: CHEM 103A.

ENGR 225: Energy Systems and Sustainability (3 units)
Description: If historical trends continue, by the end of this century the world's population will have nearly doubled, and the demand for energy will have quadrupled. How are we going to maintain that growth? Are we going to do it safely, cleanly, and sustainably? These issues, explored in this class, are a window on our future, our lifestyle, employment opportunities, and our national security.
Grading basis: Regular Grades
Career: Undergraduate
Course Components: Lecture Required
Equivalent to: ENGR 225
Also offered as: MSE 225
Course typically offered:
Main Campus: Fall, Spring

Recommendations and additional information: Admission to UA.
Home department: Materials Science & Engineering
General Education: Tier 2 Natural 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.

ENGR 257A: The Organic Chemistry and Materials Science of Art and Archaeological Objects (3 units)
Description: We explore the roles of organic chemistry and materials science in the formulation, ageing and conservation of art and archaeological objects. Topics include color and bonding theories, and the organic molecules in paints, paper, gels, dyes, textiles, adhesives and polymers.
Grading basis: Regular Grades
Career: Undergraduate
Course Components: Lecture Required
Equivalent to: ANTH 257A, CHEM 257A, ENGR 257A
Also offered as: ANTH 257A, CHEM 257A, MSE 257A
Course typically offered:
Main Campus: Fall

Home department: Materials Science & Engineering
General Education: Tier 2 Natural Sciences
Honors Course: Honors Contract
Honors Course: Honors Contract

ENGR 257B: Materials Science of Art and Archaeological Objects (3 units)
Description: The methods, content and practice pertinent to the study of art and archaeology. Materials science provides one of the keys for interpreting objects in their historical and cultural context.
Grading basis: Regular Grades
Career: Undergraduate
Course Components: Lecture Required
Equivalent to: ANTH 257B, ENGR 257B
Also offered as: ANTH 257B, MSE 257B
Course typically offered:
Main Campus: Fall

Recommendations and additional information: Two courses from Tier One, Natural Sciences (Catalog numbers 170A, 170B, 170C). An optional lab: MSE 258, ANTH 258, or ENGR 258. May be taken concurrently.
Home department: Materials Science & Engineering
General Education: Tier 2 Natural Sciences

ENGR 258: Laboratory for Materials Science of Art and Archaeological Objects (1 unit)
Description: Laboratory exercises involving the materials science of art and archaeological objects.
Grading basis: Regular Grades
Career: Undergraduate
Course Components: Laboratory Required
Equivalent to: ANTH 258, ENGR 258
Also offered as: ANTH 258, MSE 258
Course typically offered:
Main Campus: Spring

Recommendations and additional information: Two courses from Tier One, Natural Sciences (Catalog numbers 170A, 170B, 170C). Concurrent registration, MSE 257B, ANTH 257B, or ENGR 257B.
Home department: Materials Science & Engineering
General Education: Tier 2 Natural Sciences

ENGR 265: Engineering Management I (3 units)
Description: Fundamentals of economic analysis and the time value of money for engineers. Construction of financial models in EXCEL including Income, Cash Flow, and Balance Sheet. Estimation of required capital and project acceptance criteria.
Grading basis: Regular Grades
Career: Undergraduate
Course Components: Lecture Required
Equivalent to: ENGR 265
Also offered as: SIE 265
Course typically offered:
Main Campus: Fall, Spring
Distance Campus: Fall, Spring

Home department: Systems & industrial Engineering
Enrollment requirement: MATH 122B or MATH 124 or MATH 125

ENGR 297D: Meeting Community Needs with Engineering Design (3 units)
Description: In this course, students will gain first hand design experience as a member of an interdisciplinary team. Teams will work on a community project that requires application of the design thinking process to: understand and clearly define the community partner's true need (Empathize and Define); explore design options/concepts (Ideate); analyze options; pitch/present design recommendations (Prototype and Pitch); and implement the chosen design (Implement and Test).
Grading basis: Regular Grades
Career: Undergraduate
Course Components: Workshop Required
Course typically offered:
Main Campus: Spring

Field trip: None
Enrollment requirement: Major or minor: AEE, MEE, BME, BE, CHE, CVE, ECE, ELE, COE, EMG, MSE, MNE, OSE, SYE, INE, or NMS.

ENGR 367: Engineering Management II (3 units)
Description: Strategic, tactical and operational planning; innovation and technological cycles; the elements of entrepreneurship, and human relations topics for technical managers.
Grading basis: Regular Grades
Career: Undergraduate
Course Components: Lecture Required
Equivalent to: ENGR 467
Also offered as: SIE 367
Course typically offered:
Main Campus: Spring

Recommendations and additional information: SIE 265.
Home department: Systems & industrial Engineering
Enrollment requirement: Adv Stdg: Engineering.

ENGR 391: Catapult Engineering Program: Peer Mentor Preceptorship (1 - 4 units)
Description: The Catapult Engineering Program, Peer Mentor Preceptorship is a class designed to support students who are actively practicing their mentorship skills and pass along valuable social capital to incoming first year students in the Catapult Engineering Program. Students will meet primarily to develop existing skills and reflect with one another on what they have found to be effective mentoring techniques. Students will be responsible for mentoring 4-6 first-year students throughout the semester.
Grading basis: Alternative Grading: S, P, F
Career: Undergraduate
Course Components: Independent Study Required
Repeatable: Course can be repeated a maximum of 8 times.
Course typically offered:
Main Campus: Fall, Spring

Student Engagement Activity: Leadership
Student Engagement Competency: Professionalism

ENGR 414: Law for Engineers and Scientists (3 units)
Description: Topics covered in this course include patents, trade secrets, trademarks, copyrights, product liability contracts, business entities, employment relations and other legal matters important to engineers and scientists.
Grading basis: Regular Grades
Career: Undergraduate
Course Components: Lecture Required
Equivalent to: CHE 454, ENGR 454
Also offered as: SIE 414
Co-convened with: ENGR 554
Course typically offered:
Main Campus: Spring
Distance Campus: Spring

Home department: Systems & industrial Engineering
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.

ENGR 420L: Innovation Principles and Environments Laboratory (1 unit)
Description: Lab course for ENTR 420R/520R. This course will develop an innovation-specific feasibility study or business plan that will be discussed in ENTR 420R/520R. This course may be taken either concurrent or subsequent to ENTR 420R/520R.
Grading basis: Regular Grades
Career: Undergraduate
Course Components: Laboratory Required
Equivalent to: ENGR 420L
Also offered as: ENTR 420L
Co-convened with: ENGR 520L
Course typically offered:
Main Campus: Spring

Recommendations and additional information: Prerequisite or concurrent registration, ENTR 420R.
Home department: McGuire Center for Entrepreneurship

ENGR 420R: Innovation Principles and Environments (3 units)
Description: Overview of entrepreneurial approach, strategies, and skills within a range of environments to advance technology and innovations. Students can pair ENTR 420R/520R with lab course to develop innovation-specific feasibility study or business plan.
Grading basis: Regular Grades
Career: Undergraduate
Course Components: Lecture Required
Equivalent to: ENGR 420R
Also offered as: ENTR 420R
Co-convened with: ENGR 520R
Course typically offered:
Main Campus: Spring, Summer

Home department: McGuire Center for Entrepreneurship

ENGR 422: Engineering Sustainable Development (3 units)
Description: This course is for students who wish to learn and engage in modern sustainable development practices with respect to engineering projects that have three areas of impact: economic, environmental and societal. The course will provide background for an understanding of the complexities and inter-relations of sustainable development issues. The focus will be on the minerals development industry, and the impacts in industrialized and developing nations, communities and the environment.
Grading basis: Regular Grades
Career: Undergraduate
Course Components: Lecture Required
Equivalent to: ENGR 422
Also offered as: MNE 422
Co-convened with:
Course typically offered:
Main Campus: Fall

Field trip: Field trips
Home department: Mining & Geologicl Engineering
Enrollment requirement: Adv Stdg: Engineering.

ENGR 423: Customer Driven Product Development and Lean Startups (3 units)
Description: Course is a team-based, laboratory-like experience for teaching engineering and technical students how their professional peers develop new products and/or launch real startup companies. We will take an engineering-based approach to teaching these essential skills by applying fundamental techniques like requirements gathering, hypothesis development, experimentation, testing and validation.
Grading basis: Regular Grades
Career: Undergraduate
Course Components: Lecture Required
Co-convened with: ENGR 523
Course typically offered:
Main Campus: Spring

Field trip: Students will be expected to attend one of any number of available community events in a related field.
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.

ENGR 432: Sports Analytics (3 units)
Description: This course provides fundamental analytical skills necessary to analyze data and make decisions using sports examples. These skills include critical thinking, statistical analysis, computer programming, and data visualization which are generally applicable to other areas of engineering and business.
Grading basis: Regular Grades
Career: Undergraduate
Course Components: Lecture Required
Also offered as: SIE 432
Co-convened with: SIE 532
Course typically offered:
Main Campus: Fall, Summer
Distance Campus: Fall, Summer

Field trip: none
Home department: Systems & industrial Engineering
Enrollment requirement: Adv Stdg: Engineering and SIE 305 or equivalent or instructor permission.

ENGR 435: Corrosion and Degradation (3 units)
Description: The science of corrosion and degradation reactions and its application to engineering problems.
Grading basis: Regular Grades
Career: Undergraduate
Course Components: Lecture Required
Equivalent to: CHE 435, CHEE 435, ENGR 435
Also offered as: CHEE 435, MSE 435
Course typically offered:
Main Campus: Fall (odd years only)

Recommendations and additional information: MSE 331R; MSE 412; or CHEM 480B.
Home department: Materials Science & Engineering
Enrollment requirement: Adv Stdg: Engineering.

ENGR 436: Engineering Innovation (3 units)
Description: Many small advances often create major technological breakthroughs that are commercial successes: integrated circuits, DNA sequencing, and charge-coupled devices are some examples. This course will examine engineering innovation in three stages by 1) dissecting past breakthroughs to show how they work and how they came into existence at a particular time and place, 2) preparing a case study on a current technology to build a framework of what to look for, and 3) applying this framework to a technology on the horizon to determine what its potential might be. The course will be of interest to students from all of the engineering and science disciplines as well as students in the humanities who have some science background and a strong interest in how technological innovation happens.
Grading basis: Regular Grades
Career: Undergraduate
Course Components: Lecture Required
Also offered as: CHEE 436, ENTR 436
Course typically offered:
Main Campus: Fall

Home department: Chemical & Environmental Engineering
Enrollment requirement: Adv Stdg: Engineering.

ENGR 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
Equivalent to: ENGR 452
Also offered as: BE 452
Co-convened with: ENGR 552
Course typically offered:
Main Campus: Spring

Home department: Biosystems Engineering
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.

ENGR 481A: Innovation, Translation and Entrepreneurship (2 units)
Description: Where do new medical devices and therapeutic systems come from? In this course students will learn how one Innovates in the medical arena and how you take a concept of potential practical value and make it real. All the critical steps in medical innovation will be discussed.
Grading basis: Regular Grades
Career: Undergraduate
Course Components: Lecture Required
Equivalent to: ENGR 481, ENGR 481A, ENTR 481, MED 481, MED 481A, OPTI 481, OPTI 481A, PATH 481, PATH 481A
Also offered as: BME 481A, ENTR 481A, LAW 481A, MED 481A, OPTI 481A, PATH 481A, SOC 481A
Co-convened with: ENGR 581A
Course typically offered:
Main Campus: Spring

Home department: McGuire Center for Entrepreneurship

ENGR 488: Scanning Electron Microscopy (3 units)
Description: Theoretical and practical aspects of electron-beam microanalysis. Lab emphasizes projects and independent research using scanning electron microscopy and energy dispersive X-ray analysis.
Grading basis: Regular Grades
Career: Undergraduate
Flat Fee: $100
Course Components: Lecture Required
Also offered as: MSE 488
Course typically offered:
Main Campus: Spring

Recommendations and additional information: Consult department before enrolling.
Home department: Materials Science & Engineering
Enrollment requirement: Adv Stdg: Engineering.

ENGR 493: Engineering Internship (1 - 3 units)
Description: Specialized work on an individual basis, consisting of training and practice in actual service in a technical, business, or governmental establishment. A technical report detailing the work is required.
Grading basis: Alternative Grading: S, P, F
Career: Undergraduate
Course Components: Independent Study Required
Course typically offered:
Main Campus: Fall, Spring, Summer

Field trip: Working at the sites of the sponsors of the projects is required.
Enrollment requirement: Adv Stdg: Engineering. Senior status only.
Student Engagement Activity: Professional Development
Student Engagement Competency: Professionalism

ENGR 495: Topics in Engineering Leadership (1 unit)
Description: Colloquium covering a range of leadership topics geared toward career preparation for young engineers. Sequence of lectures and possible work sessions to learn leadership principles and developing a career leadership plan.
Grading basis: Regular Grades
Career: Undergraduate
Course Components: Colloquium Required
Enrollment requirement: Adv Stdg: Engineering.
Student Engagement Activity: Leadership
Student Engagement Competency: Professionalism

ENGR 495A: Science, Health and Engineering Policy and Diplomacy (3 units)
Description: This course will introduce general themes related need and incorporation of science, health and engineering in development and application of diplomacy and, to a degree, policy making. Modules focus on background on this emerging field and a numerous speakers discussing various aspects and applications of science diplomacy. Grading is based on weekly assignments and a semester long project.
Grading basis: Regular Grades
Career: Undergraduate
Course Components: Colloquium Required
Co-convened with:
Course typically offered:
Main Campus: Fall

Enrollment requirement: Adv Stdg: Engineering and Senior only

ENGR 498A: Cross-disciplinary Design (3 units)
Description: Students will work in cross-disciplinary teams to solve industry-sponsored real-world design problems using the design process. Teaming, design process, design concept, design proposal. ENGR 498A and ENGR 498B must be taken in consecutive semesters. Usually offered in the Fall.
Grading basis: Student Option ABCDE/PF
Career: Undergraduate
Course Components: Independent Study Required
Equivalent to: ENGR 498C
Course typically offered:
Main Campus: Fall

Recommendations and additional information: Senior status required.
Enrollment requirement: Consult the College of Engineering website at http://engr.arizona.edu/undergrad/engr498 for specific course requisites for your engineering major.
Student Engagement Activity: Discovery
Student Engagement Competency: Innovation and Creativity

ENGR 498B: Cross-disciplinary Design (3 units)
Description: Students will work in cross-disciplinary teams to solve industry-sponsored real-world design problems using the design process. Construction, testing and evaluation of prototype design; design iteration to arrive at a final working system. Major design project. ENGR 498A and ENGR 498B must be taken in consecutive semesters. Usually offered in the Spring.
Grading basis: Student Option ABCDE/PF
Career: Undergraduate
Flat Fee: $75
Course Components: Independent Study Required
Equivalent to: ENGR 498D
Course typically offered:
Main Campus: Spring

Recommendations and additional information: Senior status required.
Enrollment requirement: List of pre-requisites may be found online at:https://www.engr.arizona.edu/undergrad/engr498.
Student Engagement Activity: Discovery
Student Engagement Competency: Innovation and Creativity

ENGR 498C: Cross-disciplinary Design (1 - 3 units)
Description: Students will work in cross-disciplinary teams to solve industry-sponsored real-world design problems using the design process. Teaming, design process, design concept, design proposal. For non-majors only.
Grading basis: Student Option ABCDE/PF
Career: Undergraduate

Course Components:	Independent Study	Required
	Lecture	May Be Offered
	Studio	May Be Offered

Equivalent to: ENGR 498A
Recommendations and additional information: Credit will be given for ENGR 498A or ENGR 498C, but not for both. Excluded majors: AME, ECE, CHEE, SIE, MSE, OSE, MGE, ABE.
Enrollment requirement: Adv Stdg: Engineering.
Honors Course: Honors Contract
Honors Course: Honors Contract

ENGR 498D: Cross-disciplinary Design (1 - 3 units)
Description: Students will work in cross-disciplinary teams to solve industry-sponsored real-world design problems using the design process. Construction, testing and evaluation of prototype design; design iteration to arrive at a final working system. Major design project. For non-majors only.
Grading basis: Student Option ABCDE/PF
Career: Undergraduate

Course Components:	Independent Study	Required
	Lecture	May Be Offered
	Studio	May Be Offered

Equivalent to: ENGR 498B
Recommendations and additional information: Credit will be given for ENGR 498B or ENGR 498D, but not for both. Excluded majors: AME, ECE, CHEE, SIE, MSE, OSE, MGE, ABE.
Enrollment requirement: Adv Stdg: Engineering.
Honors Course: Honors Contract
Honors Course: Honors Contract

ENGR 502: Research Proposal Preparation (3 units)
Description: Organization and planning of a specific research initiative in consultation with a potential advisor.
Grading basis: Regular Grades
Career: Graduate
Course Components: Lecture Required
Repeatable: Course can be repeated a maximum of 2 times.
Equivalent to: ENGR 502
Also offered as: MSE 502
Course typically offered:
Main Campus: Spring
Online Campus: Spring

Home department: Materials Science & Engineering

ENGR 512B: Management of Technology II (3 units)
Description: To provide and practical and in depth understanding of management at the first and second levels, the integration of product to market requirements and synchronization of organizations in the challenging and complex world of technology management. The course will include team role playing, in depth (deep dive) analysis of product and organizational process which have insured the sustained and successful performance of technology companies. The content will include lectures, seminars, shared personal experience from senior managers of technology-based enterprises, course specific academic literature, and guest speakers.
Grading basis: Regular Grades
Career: Graduate
Course Components: Discussion May Be Offered
Independent Study May Be Offered
Lecture Required
Equivalent to: MAP 512B, MGMT 512B, MIS 512B
Also offered as: MGMT 512B, MIS 512B
Course typically offered:
Main Campus: Fall, 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.

ENGR 514: Law for Engineers/Scientists (3 units)
Description: Topics covered in this course include patents, trade secrets, trademarks, copyrights, product liability contracts, business entities, employment relations and other legal matters important to engineers and scientists. Graduate-level requirements include an in-depth research paper on a current topic.
Grading basis: Regular Grades
Career: Graduate
Course Components: Lecture Required
Equivalent to: CHE 554, ENGR 554
Also offered as: SIE 514
Co-convened with: ENGR 414
Course typically offered:
Main Campus: Spring
Online Campus: Spring
Distance Campus: Spring

Home department: Systems & industrial Engineering

ENGR 520L: Innovation Principles and Environments Laboratory (1 unit)
Description: Lab course for ENTR 420R/520R. This course will develop an innovation-specific feasibility study or business plan that will be discussed in ENTR 420R/520R. This course may be taken either concurrent or subsequent to ENTR 420R/520R. Graduate-level requirements include graduate students serving as team leaders.
Grading basis: Regular Grades
Career: Graduate
Course Components: Laboratory Required
Equivalent to: ENGR 520L
Also offered as: ENTR 520L
Co-convened with: ENGR 420L
Recommendations and additional information: This course may be taken either concurrent or subsequent to ENTR 420R/520R.
Home department: McGuire Center for Entrepreneurship

ENGR 520R: Innovation Principles and Environments (3 units)
Description: Overview of entrepreneurial approach, strategies, and skills within a range of environments to advance technology and innovations. Students can pair ENTR 420R/520R with lab course to develop innovation-specific feasibility study or business plan. Graduate-level requirements include a final exam.
Grading basis: Regular Grades
Career: Graduate
Course Components: Lecture Required
Equivalent to: ENGR 520R
Also offered as: ENTR 520R
Co-convened with: ENGR 420R
Home department: McGuire Center for Entrepreneurship

ENGR 522: Engineering Sustainable Development (3 units)
Description: This course is for students who wish to learn and engage in modern sustainable development practices with respect to engineering projects that have three areas of impact: economic, environmental and societal. The course will provide background for an understanding of the complexities and inter-relations of sustainable development issues. The focus will be on the minerals development industry, and the impacts in industrialized and developing nations, communities and the environment. Graduate-level requirements include project management duties, where graduate students are expected to manage groups of undergraduates in the design of the final term project. Additional graduate projects and assignments will have requirements for type and quantity of work.
Grading basis: Regular Grades
Career: Graduate
Course Components: Lecture Required
Equivalent to: ENGR 522
Also offered as: MNE 522
Co-convened with: ENGR 422
Course typically offered:
Main Campus: Fall
Online Campus: Fall

Field trip: Field trips
Home department: Mining & Geologicl Engineering

ENGR 523: Customer Driven Product Development and Lean Startups (3 units)
Description: Course is a team-based, laboratory-like experience for teaching engineering and technical students how their professional peers develop new products and/or launch real startup companies. We will take an engineering-based approach to teaching these essential skills by applying fundamental techniques like requirements gathering, hypothesis development, experimentation, testing and validation. Graduate-level requirements include additional project.
Grading basis: Regular Grades
Career: Graduate
Course Components: Lecture Required
Co-convened with: ENGR 423
Course typically offered:
Main Campus: Spring

Field trip: Students will be expected to attend one of any number of available community events in a related field.

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ENGR 532: Sports Analytics (3 units)
Description: This course provides fundamental analytical skills necessary to analyze data and make decisions using sports examples. These skills include critical thinking, statistical analysis, computer programming, and data visualization which are generally applicable to other areas of engineering and business.
Grading basis: Regular Grades
Career: Graduate
Course Components: Lecture Required
Also offered as: SIE 532
Co-convened with: SIE 432
Course typically offered:
Main Campus: Fall, Summer
Online Campus: Fall, Summer
Distance Campus: Fall, Summer

Recommendations and additional information: Statistics
Field trip: none
Home department: Systems & industrial Engineering

ENGR 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: BE 552
Co-convened with: ENGR 452
Course typically offered:
Main Campus: Spring

Home department: Biosystems Engineering

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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.

ENGR 565: Financial Management for Engineers (3 units)
Description: This course will provide the business financial knowledge and skills required for the technical professional to become an effective business manager and executive. Fundamentals of accounting, finance, financial analysis and decision making will be covered.
Grading basis: Regular Grades
Career: Graduate
Course Components: Lecture Required
Course typically offered:
Main Campus: Fall, Spring

ENGR 581A: Assessing Early Stage Medical Technologies for Commercial Potential (2 units)
Description: Where do new medical devices and therapeutic systems come from? In this course students will learn how one Innovates in the medical arena and how you take a concept of potential practical value and make it real. All the critical steps in medical innovation will be discussed. Graduate-level requirements include graduate students serving as team leaders.
Grading basis: Regular Grades
Career: Graduate
Course Components: Lecture Required
Equivalent to: ENGR 581, ENGR 581A, ENTR 581, MED 581, MED 581A, OPTI 581, OPTI 581A, PATH 581, PATH 581A
Also offered as: ENTR 581A, LAW 581A, MED 581A, OPTI 581A, PATH 581A
Co-convened with: ENGR 481A
Course typically offered:
Main Campus: Spring

Home department: McGuire Center for Entrepreneurship

ENGR 595A: Science, Health and Engineering Policy and Diplomacy (3 units)
Description: This course will introduce general themes related need and incorporation of science, health and engineering in development and application of diplomacy and, to a degree, policy making. Modules focus on background on this emerging field and a numerous speakers discussing various aspects and applications of science diplomacy. Grading is based on weekly assignments and a semester long project.
Grading basis: Regular Grades
Career: Graduate
Course Components: Colloquium Required
Co-convened with:
Course typically offered:
Main Campus: Fall

ENGR 596S: Technology and Social Theory (3 units)
Description: Seminar in technology and social theory.
Grading basis: Regular Grades
Career: Graduate
Course Components: Seminar Required
Equivalent to: ANTH 596S, ENGR 596S, MSE 596S, SOC 596S
Also offered as: ANTH 596S, GWS 596S, MSE 596S, SOC 596S
Course typically offered:
Main Campus: Fall

Home department: Gender and Women's Studies

ENGR 696H: Science and Social Theory (3 units)
Description: Science and technology are prominent features of contemporary society. The sociology of knowledge, science, and technology are rapidly growing and increasingly important areas of inquiry in the social and behavioral sciences, arts, and humanities. This seminar will be an opportunity to read very broadly across social and political theory and its relations to science (both the natural and social) and knowledge. The goals of the course are to expose students to the various schools of thought, methodologies, and themes in the sociology of science and knowledge and the interdisciplinary field of science and technology studies, and to explore resources from which to develop research questions in these areas.
Grading basis: Regular Grades
Career: Graduate
Course Components: Seminar Required
Equivalent to: ANTH 696H, ENGR 696A, ENGR 696H, MSE 696H, SOC 696A, SOC 696H
Also offered as: ANTH 696H, GWS 696H, SOC 696H
Course typically offered:
Main Campus: Spring

Home department: Gender and Women's Studies