# General Engineering Program

*Director of General Engineering*: Jessica Kuczenski

*Lecturers*: Jessica Kuczenski, Matthew Gaudet

The School of Engineering, under the leadership of the director of general engineering, offers a major in general engineering, a minor in general engineering, and a minor in technical innovation, design thinking, and the entrepreneurial mindset. The bachelor of science degree in general engineering is designed to provide students a technical degree with concentrations designed to meet the needs of the individual student. Not intended for a student who plans to work as a professional engineer, the general engineering degree allows a student to earn a technical degree while preparing for work or graduate study in fields such as law, medicine, business, or education.

## Requirements for the Major

In addition to fulfilling the undergraduate Core Curriculum requirements for the bachelor of science degree in engineering, students majoring in engineering must complete the minimum number of units and the specified requirements for their concentration.

Students majoring in engineering must complete a minimum of 189 units and the following requirements:

**English**

* ENGL 181

**Mathematics and Natural Science**

* MATH 11, 12, 13, 14
* AMTH 106 or MATH 22
* AMTH 108 or other approved upper-division mathematics elective
* CHEM 11 or 11T, 11L
* PHYS 31, 31L, 32, 32L, 33, 33L

**Engineering**

* ENGR 1, 1L
* ENGR 110
* BIOE 10
* CENG 41, 43, 43L
* COEN 10 and 10L (or other approved programming course and lab including COEN 11, CSCI 10, OMIS 30)
* ELEN 21, 21L, 50, 50L, 115, 115L
* MECH 10, 10L, 11, 15, 15L, 121

**Design Sequence**

* ENGR 193
* ENGR 163 A&B
* ENGR 194, 195, 196

With permission, you may alternatively choose from one of the following options:

* BIOE 194, 195, 196
* CENG 192A, 192B, 192C, 193, 194
* COEN 194, 195, 196
* ELEN 194, 195, 196
* MECH 194, 195, 196

**Electives**

* 36 upper-division units defining a coherent concentration, selected in consultation with an academic advisor

## Requirements for the Minor in General Engineering

Students must fulfill the following requirements for a minor in general engineering:

* One course selected from COEN 10, 11, CSCI 10, OMIS 30, or other approved programming course together with the associated lab
* CENG 41
* ELEN 50, 50L
* MECH 10, 10L, 121
* Two courses selected from BIOE 10, CENG 10, CENG 43, COEN 12, ELEN 21, ELEN 33, ELEN 115, MECH 11, MECH 15, MECH 140, together with associated labs
* A two-course sequence selected from BIOE 153 and BIOE 154, CENG 115 and CENG 118, CENG 121 and CENG 143, COEN 79 and any upper-division COEN course, ELEN 100 and ELEN 110, ELEN 115 and (ELEN 116, 127, or 164), MECH 122 and MECH 132, MECH 123 and MECH 125, together with associated labs

## Minor in Technical Innovation, Design Thinking, and the Entrepreneurial Mindset

*Program Coordinator:* Christopher Kitts

To solve the complex and interdisciplinary technical challenges of the modern world, students must understand the entrepreneurial methods appropriate for harnessing technical innovation in order to create value through new devices, products, systems, processes, services, and ecosystems. This minor addresses this need by providing students with learning experiences that address product innovation, business fundamentals, and entrepreneurial thinking; in doing so, it leverages themes and concepts promoted through movements such as design thinking, lean development, and business modeling. In addition, an experiential learning activity in the context of the entrepreneurial development of a real engineering system is required. Participation in an elective component is also required.

This minor program is suitable for undergraduates in a wide variety of disciplines. It places an emphasis on an understanding of the user and the business environment for the design and implementation of technologies and solutions that are appropriate, affordable, and accessible for consumers in a variety of markets. Students who complete the program will be able to adapt both themselves and the organizations in which they work in a way that will allow them to remain competitive and relevant as global consumer trends continue to evolve.

## Requirements for the Minor in Technical Innovation, Design Thinking, and the Entrepreneurial Mindset

The minor includes requirements in the areas of Product Innovation and Prototyping, Business and Commercialization, and Design Thinking and Entrepreneurial Fundamentals. Students are also required to complete an experiential project putting these concepts into practice as well as participation in two elective activities. Multiple options are available for each of these requirements, affording students a great deal of flexibility in completing the minor.

Currently, the Minor offers an optional BioInnovation and Design track to provide students with an opportunity to focus their study of innovation and design/entrepreneurial thinking to medical and health care applications.

Completion of the minor requires satisfying the requirements listed below. Track-specific requirements are noted in each requirement category.

**Product Innovation and Prototyping (5 units minimum)**

Select one of the following options:

* Option A: MECH 144/L. Smart Product Design (5 units)
* Option B: Complete courses listed below (6 units):
  + ENGR 2. Introduction to Engineering Design and Prototyping (2 units)
  + ENGR 121. BioInnovation I (2 units)
  + ENGR 122. BioInnovation II (2 units)

BioInnovation and Design Track: Must complete Option B.

**Business and Commercialization Fundamentals (4 units minimum)**

Select one of the following options:

* Option A: BUSN 70. Contemporary Business Issues (4 units) or BUSN 170. Contemporary Business for Nonmajors (5 units)
* Option B: ENGR 173. Introduction to Business Fundamentals (1 unit) plus any three additional 1-unit courses from the approved Business and Commercialization Fundamentals list below:
  + ENGR 152. Regulatory Pathways for Medical Devices and Technologies (1 unit)
  + ENGR 156. Conceptualizing Innovations in Health Care (1 unit)
  + ENGR 164. Financing New Ventures (1 unit)
  + ENGR 167. Go To Market Strategy (1 unit)
  + ENGR 168. Legal Considerations for New Ventures (1 unit)
  + ENGR 174. Financial Statements and Decision Making (1 unit)
  + ENGR 175. Business Model and Plan Development (1 unit)
  + ENGR 176. Introduction to Technical Marketing (1 unit)
  + ENGR 178. Intellectual Property for Engineers (1 unit)

BioInnovation and Design Track: Must complete Option B, including ENGR 152 and ENGR 156.

**Design Thinking and Entrepreneurship Fundamentals (4 units minimum)**

Select one of the following options:

* Option A: MGMT 164. Introduction to Entrepreneurship (5 units)
* Option B: Four 1-unit courses from the approved Design/Entrepreneurial Thinking list below:
  + ENGR 151. Design Controls for the Medical Device Industry (1 unit)
  + ENGR 153. Risk Management during Medical Device Design and Development (1 unit)
  + ENGR 154. Usability Engineering for Medical Devices (1 unit)
  + ENGR 162. Thinking in Systems (1 unit)
  + ENGR 165. Creativity: The Art of Innovation (1 unit)
  + ENGR 166A/B. Introduction to Design Thinking (1 unit each)
  + ENGR 169. Social Entrepreneurship (1 unit)
  + ENGR 171A/B. Opportunity Recognition I and II (1 unit each)
  + ENGR 172A/B. Applied Entrepreneurship I and II (1 unit each)
  + ENGR 177. Customer Ethnography (1 unit)
  + ENGR 179. Corporate Intrapreneurship (1 unit)

BioInnovation and Design Track: Must complete Option B, including ENGR 151, ENGR 153, and ENGR 154.

**Experiential Activity (5 units minimum)**

An academically supervised, hands-on engineering activity that includes entrepreneurially oriented tasks relating to the development of an appropriate business/enterprise model for a real engineering product/system.

Select one of the following options:

* Option A: ENGR 163A&B. Engineering and the Entrepreneurial Mindset (total of 1 unit over 2 quarters), performed in conjunction with a senior project course sequence (6–10 units)
* Option B: ENGR 163A&B. Engineering and the Entrepreneurial Mindset (total of 1 unit over 2 quarters), performed in conjunction with ENGR 199. Directed Research (6 units) performed with a hands-on engineering component
* Option C: BUSN 145. Entrepreneurship Practicum (5 units) performed as part of a placement that includes a significant technology focus relating to design/development, approved by the minor program coordinator

BioInnovation and Design Track: May complete any Option. Experiential activity must involve a relevant medical device or health care innovation project approved by minor and track program coordinator(s).

**Elective Component**

Participation in additional Pathway, course, or co-/extra-curricular activities within the School of Engineering’s program in innovation and entrepreneurial thinking. Complete any two of the following program opportunities:

* Option A: Complete the Design Thinking Pathway with an essay theme that specifically emphasizes a topic relating to developing a deep understanding of customer/market needs and opportunities and capitalizing on this to create value through the design of a technical system.
* Option B: Participate in selected co-extracurricular activities approved in advance by the minor program coordinator. These may include experiences such as two significant extra-curricular design challenges, a workshop, a mini-course, etc. (such activities may not have been used for credit in any other course).
* Option C: Complete an independent study project relating to technical entrepreneurship, supervised by a faculty member and approved in advance by the minor program coordinator.
* Option D: Complete an additional 2 units of coursework from approved courses in the Engineering Innovation and Entrepreneurship program (shown below). Courses chosen from this list cannot be doubly used to satisfy the Design Thinking pathway
  + ENGR 19. Ethics in Technology (4 units)
  + ENGR 110. Community-Based Engineering Design (3 units)
  + ENGR 140. Diversity and Innovation in STEM (4 units)
  + ENGR 141. Innovation Theology (4 units)
  + ENGR 145. Innovation, Entrepreneurship, and the Evolution of Silicon Valley (4 units)
  + ENGR 161. Globalization and the Cultures of Innovation and Entrepreneurship (4 units)
  + BUSN 6/6H. Business Ethics (4 units)
  + PHIL 26. Ethics in Business (4 units)

## Combined Bachelor of Science and Master of Science Program

General Engineering offers a combined degree program leading to a bachelor of science and a master of science. Under the combined degree program, an undergraduate student begins taking courses required for a master’s degree before completing the requirements for a bachelor’s degree and typically completes the requirements for a master of science within a year of completing the bachelor’s degree.

Undergraduate students admitted to the combined degree program are required to enroll in the program between February of their junior year and December of their senior year. Students in this program will receive their bachelor’s degree after satisfying the standard undergraduate degree requirements. To earn a master’s degree, students must fulfill all requirements for the degree, including the completion of 46 units of coursework beyond that applied to the bachelor’s degree. The program of studies for the master’s degree may include up to 20 units taken while enrolled as an undergraduate student; however, no individual course can be used to satisfy requirements for both the bachelor’s degree and master’s degree.

## Lower-Division Courses

### 1. Introduction to Engineering

This course provides an introduction to engineering, including fundamentals of engineering study, different engineering disciplines, and interdisciplinary aspects of engineering. This course investigates the connection between science, technology, and society, and also illustrates the extent to which engineering impacts the world. The course also exposes students to entrepreneurship, engineering professionalism, the growth mindset, emerging markets, ethics, and civic engagement. ENGR 1 and ENGR 1L together fulfill the Science, Technology & Society core requirement. (1 unit)

### 1L. Introduction to Engineering Laboratory

The laboratory will provide students with hands-on experience of engineering design and open-ended problem solving. The lab focuses on introducing aspects of the different engineering disciplines and allows students to gain experience with each of the engineering disciplines and reflect on learning gains with teamwork, communication, and engineering skills. Engineering designs will be framed to include the impact of design solutions/technologies on society and will be developed in a team-based environment utilizing visuals, written text, and oral presentation. ENGR 1 and ENGR 1L together fulfill the Science, Technology & Society core requirement. (1 unit)

**2. Introduction to Engineering Design and Prototyping**

Introduction to prototyping in the engineering design framework. Students will work to design and prototype projects on four major pieces of Maker Lab equipment, which they will be trained to use. Prerequisite: ENGR 1L. (2 units)

### 15. Environmental Quality Engineering

Behavior of chemicals in the environment. Environmental protection strategies. Environmental impact assessment. Risk analysis and economic considerations. Discussion of local, regional, and global environmental problems, and alternative solutions. For non-engineering majors. Prerequisite: MATH 6 or equivalent. (4 units)

### 19. Ethics in Technology

Making the case for constructive ethical application of the most powerful technologies of the 21st century. Normative, principle-based ethical analysis of current and emerging technology in arenas including information, energy, biotech/medicine, military science, robotics, and agriculture. ENGR 19 satisfies the Ethics Core requirement. (4 units)

### 20. Topics in Robotics

Participate in a project-based, hands-on engineering project in a team-based environment. Gain exposure to sensing, actuation, and control techniques and components in the process of developing a robotic system or subsystem. Prerequisite: Instructor permission required. (1 unit)

### 25. Sustainable Energy Projects

Students learn the fundamentals of sustainable energy in a wide range of fields and carry out projects in these areas. Activities are normally associated with the Latimer Energy Scholars Program. May be repeated for credit. Prerequisite: Instructor permission required. (1–2 units)

### 60. Sustainable Electric Energy

This course explores the twofold 21st-century challenges of the use and conservation of electric energy, and the sustainable generation of electric energy, primarily through the use of photovoltaic cells. The course includes a study of issues relating to the environment, economics, politics, and societal impact. Although physical and mathematical studies and analyses are a part of the course, no background in these areas is required beyond algebra. ENGR 60 satisfies the Science, Technology & Society Core requirement. (4 units)

### 85. Special Topics in Engineering

Subjects of current interest. May be taken more than once if topics differ. (1–4 units)

### 90. Engineering Competition Workshop

Workshop to develop aspects of an engineering school sponsored entry into an external competition (examples include Solar Decathlon and Tiny House). May include design, communication, construction, research, analysis, planning, documentation, fundraising, and other activities. Students will meet together to share information, brainstorm, collaborate, and make decisions, and will also work independently or in small teams in focused areas. (1 unit)

### 91. Architecture Workshop

Students will explore aspects of architecture with a particular emphasis on design related to an external contest. General topics may include design principles; form and function; space utilization; natural and artificial lighting; BIM and architectural documentation; and texture and color. Special topics may include sustainable building materials, LEED certification process, passive solar design, building integrated photovoltaics, and modular building techniques. (2 units)

### 98. Independent Study

Independent study of an approved engineering problem and preparation of a suitable project report. (1–4 units)

## Upper-Division Courses

### 110. Community-Based Engineering Design

Student teams are partnered with a local community business or organization and complete a design project from problem identification through final prototype. Course focuses on “hands-on” experience in project management, building cross-disciplinary team skills, and prototyping (training and use of the SCU Maker Lab included). This course is open to students at all levels and all majors (engineering or non-engineering). Come make a real difference in a real community! Satisfies the Civic Engagement Core requirement. (2 units)

### 111. STEM Outreach in the Community

This course examines challenges surrounding STEM (Science, Technology, Engineering, and Math) education such as funding, diversity, and accessibility. Students develop or enhance STEM curricular materials and explore pedagogical techniques specific to working with youth from marginalized communities. Students taking ENGR111 and ENGR 111L will satisfy the ELSJ Core requirement. Corequisite: ENGR 111L. (2 units)

### 111L. STEM Outreach in the Community Lab

Students lead engineering-focused STEM activities with K–12 students at a community partner’s off-campus site. No specific engineering expertise is required or expected. Corequisite: ENGR 111. (1 unit)

### 121. BioInnovation I: Opportunity Identification and Concept Generation

First course of the two-course sequence introduces students to health care and medical device technology innovation for advanced and emerging markets. Students work in teams on problem identification and assessment as well as scrutinization of clinical impact, product feasibility, and commercial viability to define the needs and requirements of new technology products to address unmet or poorly met health care needs. Prerequisite: sophomore to senior standing or instructor consent. ENGR 121 and ENGR 122 together satisfy the Science, Technology & Society Core requirement. (2 units)

### 122. BioInnovation II: Product Development Strategy and Prototyping

Second course of the two-course sequence takes students through the product development stage of medical device innovation process. Students work in teams on the design, development, and prototyping of engineering solutions that satisfy the needs identified in ENGR 121, as well as formulation of strategies to ensure regulatory compliance and commercialization success. ENGR 121 and ENGR 122 together satisfy the Science, Technology & Society Core requirement. Prerequisite: ENGR 121. (2 units)

### 125. Advanced Sustainable Energy Projects

Students study advanced concepts in sustainable energy and carry out complex projects, typically in a team environment. Activities are normally associated with the Latimer Energy Scholars Program. May be repeated for credit. Prerequisites: ENGR 25 and instructor permission required. (1–2 units)

### 135. Humanitarian Engineering

Engineering for social benefit. Introduction to the following concepts: humanitarian and frugal innovation, design for empathy, needs assessment, impact evaluation, and social entrepreneurship. (1 unit)

### 136. Frugal Innovation Projects for Social Benefit

Students explore and apply the 10 core competencies of frugal innovation through case studies applied to mobile applications, low-cost diagnostics, frugal habitat, last-mile distribution and micro entrepreneurship, and learn how to design technologies and business models for social benefit. Student projects focus on real-world implementations with social enterprises in emerging markets. Prerequisite: Junior standing or sophomores with instructor consent. (2 units)

### 140. Diversity and Innovation in STEM

This course focuses on the intersection of diversity, inclusion, and product or service innovation. Build understanding and skills to work with diverse perspectives and competencies from intersectionalities of race, gender, religion, region, and other dimensions of diversity, and derived from historical American systemic ideologies of individual freedom and success within a hierarchy as an individualistic mindset and of social responsibility with justice for all as a relational mindset in oneself, and in other individuals, organizations, systems, and cultures. Learn entrepreneurship and design thinking prototyping techniques while working in teams on innovation challenges that can change the world. Students will explore user-centered design by developing and applying design processes and strategies in hands-on exercises, design critiques, discussions, lectures, and readings. ENGR 140 satisfies the Diversity Core requirement. (4 units)

### 141. Innovation Theology: An Introduction

The course equips future innovators with the ability to discern more compelling answers to where innovations and value are needed and why by cultivating confidence in applying theological inquiry to innovation. ENGR 141 satisfies the Religion, Theology & Culture 2 Core requirement. (4 units)

### 143H. Science, Religion, and the Limits of Knowledge

The limits of scientific knowledge are examined in the framework of nonlinear system theory, metamathematics, and modern physics. The technical background developed in the course is used as a basis for exploring the relationship between science, aesthetics, and religion. Particular emphasis is placed on the rationality of faith, and on controversial questions where the views of scientists and theologians appear to conflict. ENGR 143 satisfies the Religion, Theology & Culture 2 core requirement. Prerequisite: MATH 12 or 31. (4 units)

### 145. Innovation, Entrepreneurship, and the Evolution of Silicon Valley

This course will explore technological innovation by studying the evolution of technologies and industries in Silicon Valley. We will review the development of fundamental technologies such as vacuum tubes, semiconductors, and biotechnology, and systems such as radar, communications, aerospace, personal computing, the internet, social media and platforms. This approach will help students to understand 1) the defining features of this region and how it has continued to lead in global technology development even as the fundamental technologies have changed, and 2) the complexity of the innovation process and the influence of the public sector, academia, investors, and other entities on innovation and entrepreneurship. (4 units)

### 151. Design Controls for the Medical Device Industry

Introduces process-based frameworks required in the design and development of biomedical products to ensure that they meet user requirements and safely perform their intended use. Student teams use real-world medical device examples to examine product requirements, and apply agile/lean engineering methods to product verification and validation test planning. Frameworks mastered through this course will give students a practical toolkit of robust methods to ensure product quality and regulatory compliance. Prerequisite: sophomore to senior standing. (1 unit)

### 152. Regulatory Pathways for Medical Devices and Technologies

Introduces U.S. FDA and European regulatory pathways for medical device and diagnostic products. Students will explore regulatory requirements for devices including software and for drug-device or biologic-device combination products. Examples of FDA-industry collaboration in the advancement of regulatory science will be provided from the emerging fields of personalized medicine and devices using artificial intelligence. Student teams will classify a medical device, assess its U.S. FDA regulatory pathway, and estimate the development program that will be required to gain regulatory approval or clearance. Prerequisite: sophomore to senior standing. (1 unit)

### 153. Risk Management During Medical Device Design and Development

This course introduces a process-based approach for risk management applied to medical devices. Students will explore different types of risk analysis and their applicability. While the regulatory requirements for risk management are explained, the course focus is to provide students with perspective on the value that an effective, compliant risk management program brings to all stakeholders throughout the product life cycle. Student teams will participate in a simulated medical device development project, and conduct the appropriate risk management activities during the simulation. Prerequisite: sophomore to senior standing. (1 unit)

### 154. Human Factors and Usability Engineering for Medical Devices

Introduces human factors/usability engineering principles imperative to the evaluation of user interfaces (UI) in medical devices. Students will explore medical device use error case studies to learn how to assess the ways people perceive, interpret, and manipulate devices, as well as how the device receives user input and responds. Student teams will conduct a Usability Engineering Validation Study project, in which a device is assessed using various analytical techniques. Frameworks applied through this course will give students a practical tool kit of robust methods to evaluate product safety and effectiveness. Prerequisite: sophomore to senior standing. (1 unit)

### 156. Conceptualizing Innovations in Health Care

While the rewards of innovative health care products and services are lucrative, new product development for the health care industry is inherently complex and resource intensive, and often fraught with risks. Using relevant case studies, this course introduces students to the processes and strategies used by health care firms to develop new product innovations that efficiently address user needs and pain points, and thereby enjoy a higher degree of commercialization success. Prerequisite: sophomore to senior standing. (1 unit)

### 160. Nanotechnology and Society

This course examines the fundamental scientific and technological underpinnings of the important new field of nanotechnology; how both the understanding and the technological capabilities have evolved over the past century; and how nanotechnology proposes new applications that can address social and economic goals. An appreciation of the interaction between these goals and the evolution of the technology will be central to the course. Students will develop critical thinking about the prospects for nanotechnology in order to be able to assess the relevant ethical and social issues, and also the possibility and/or likelihood of the development of specific applications. ENGR 160 satisfies the Science, Technology & Society Core requirement. (4 units)

### 161. Globalization and the Cultures of Innovation and Entrepreneurship

This course introduces students to the skills, practices, and processes for understanding and managing innovation and entrepreneurship activities that span cultures throughout the world. These cultural challenges include developing a deep understanding of the needs of customers in emerging markets, producing goods and services with global teams, and outsourcing manufacturing operations. ENGR 161 satisfies the Cultures & Ideas 3 Core requirement. (4 units)

**162. Thinking in Systems**

Systems thinking represents an important tool for analysis and problem-solving, especially when collaborating with others from diverse perspectives, both within and outside of engineering disciplines. The course will introduce students to basic concepts of thinking in systems by providing exposure to and experience with modeling methods from both systems dynamics and general systems theory. (1 unit)

**163A. Engineering and the Entrepreneurial Mindset I**

This is the first course in a two-course sequence taken in conjunction with a senior capstone course and relates elements of the capstone experience to themes that are fundamental to entrepreneurial thinking. Activities are framed from the point of view of a business model in which explicit elements of an engineering enterprise are defined, such as customer segments, the value proposition, etc. To be immediately followed with ENGR 163B. (0.5 unit)

**163B. Engineering and the Entrepreneurial Mindset II**

This is the second course in a two-course sequence taken in conjunction with a senior capstone course and relates elements of the capstone experience to themes that are fundamental to entrepreneurial thinking. Activities are framed from the point of view of a business model in which explicit elements of an engineering enterprise are defined, such as customer segments, the value proposition, etc. Taken immediately following ENGR 163A. (0.5 unit)

**164. Financing New Ventures**

An introduction to the basics of obtaining initial and early-stage financial support for a new entrepreneurial venture. The course reviews financial sources, pitch decks, term sheets, negotiation tactics, and how to create the perfect pitch for obtaining financing. (1 unit)

**165. Creativity: The Art of Innovation**

Creative confidence is foundational to human-centered design thinking, innovation, and entrepreneurship. In this interdisciplinary course, students strengthen skills in creativity and innovation through empathy gathering, photography, storytelling, improvisation, music, art, and prototyping. (1 unit)

**166. Introduction to Design Thinking A**

The basic principles of design thinking, especially as applied to the three essentials for innovating success - user desirability, technical feasibility and business/economic viability. Explores techniques relating to themes such as deep customer understanding, creative brainstorming, and active prototyping. These topics are applied in the context of a team-based project conducted through the ENGR 166 A and B course sequence (1 unit).

**166. Introduction to Design Thinking B**

The basic principles of design thinking, especially as applied to the three essentials for innovating success - user desirability, technical feasibility and business/economic viability. Explores techniques relating to themes such as deep customer understanding, creative brainstorming, and active prototyping. These topics are applied in the context of a team-based project conducted through the ENGR 166 A and B course sequence. Prerequisite: ENGR 166A (1 unit).

### 167. Go To Market Strategy

This course for engineering undergraduate students reviews essential concepts for new entrepreneurial ventures to include the customer discovery phase, channels of distribution, strategic partners, and monetary metrics. (1 unit)

### 168. Legal Considerations for New Ventures

This course for engineering undergraduate students identifies legal risks facing new ventures and reviews techniques and approaches on how to reduce these risks while accomplishing business or engineering goals. (1 unit)

**169. Social Entrepreneurship**

This course examines social entrepreneurship through the intersection of technology and social innovation. Technical considerations include design of total solutions and for affordability and low cost manufacturing; social considerations include developing deep empathy and an understanding of local circumstances particularly for those suffering extreme poverty. (1 unit)

### 170. Improv for Engineers

Through theatre games, improvisation, warm-up exercises, monologues, and scenes, students will learn the basics of Stanislavski’s method of physical actions to learn the basic principles of acting and in the process increase self-confidence and the ability to collaborate. (1 unit)

### 171A. Product Opportunity Assessment

This course focuses on identifying and assessing opportunities for new products and services. Based on the principles of design thinking, it addresses the identification of problems by reviewing methods for understanding the needs and motivations of the customer. It also reviews the development of a validated and solution-independent need statement. (1 unit)

### 171B. Product Prototype to Test

This course introduces product prototyping strategies to allow students to test their design concepts with customers with the objective of validating assumptions regarding customer need and desired functionality/features. Prerequisite: ENGR 171A or instructor permission. (1 unit)

### 172A. Applied Entrepreneurship I

This is the first course in a two-course sequence in which students will explore an emerging technical market and develop specific viable business models to execute within the SCU educational program. Students will explore applications for the selected technology, identify customers/markets, and define a sustainable business model. Preferential admission may be given to students who have taken other courses in the school’s innovation and entrepreneurship program. Prerequisites: sophomore standing or above, and instructor permission required. (1 unit)

### 172B. Applied Entrepreneurship II

This is the second course in a two-course sequence in which students will explore an emerging technical market and develop specific viable business models to execute within the SCU educational program. Students will explore applications for the selected technology, identify customers/markets, and define a sustainable business model. Prerequisites: ENGR 172A and instructor permission. (1 unit)

### 173. Introduction to Business Fundamentals

This course serves as an introduction to fundamental business topics, to include basic economics, business forms and functions, reading simple financial statements, basic marketing concepts, and management concepts. The course includes participation in an online business simulation. Prerequisite: sophomore to senior standing only. (1 unit)

### 174. Financial Reporting and Decision-Making

This course develops an understanding of financial statements and how they may be analyzed to assess the performance of an enterprise. The course also reviews capital markets and associated decision making for corporate operation. A business simulation allows students to apply principles of management, operations, marketing, and accounting to a business scenario. Prerequisite: ENGR 173 or instructor permission. (1 unit)

### 175. Business Model and Plan Development

This course introduces students to the Business Model Canvas as a framework for describing and organizing the operational elements of a functional enterprise, whether it is a commercial or nonprofit entity. Topics include identifying customers and explicitly stating the value proposition, identifying value delivery mechanisms, articulating strategic partnerships, identifying key resources, and describing anticipated cash flow. (1 unit)

### 176. Marketing Strategy

This course reviews the strategic segmenting/targeting/positioning and practical messaging skills used in product marketing and thought leadership positions, which are core to entrepreneurial technology ventures. Specific topics include an overview of core marketing skill sets, practical examples of successful market segmentation and target selection, best practices for positioning and messaging creation, competitive landscape modeling and developing differentiation, translating customer requirements into effective positioning/messaging, and wholesale market (re-)definition. (1 unit)

### 178. Intellectual Property for Engineers

This course for engineering undergraduate students provides an overview of United States intellectual property (IP) laws, focused specifically on how those laws impact and apply to engineers. (1 unit)

### 179. Intrapreneurship

Intrapreneurship is a form of corporate entrepreneurship, and it focuses on the needs of an established organization (unlike a startup) to create an innovative business opportunity within the existing structure of the organization. (1 unit)

### 180. Marine Operations

Introduction to the design, operation, deployment, piloting, and safety issues involving the use of underwater robots. Prerequisite: Instructor permission required. (1 unit)

### 181. Advanced Marine Operations

Technical operation, maintenance, and advanced piloting of underwater robots. Crew management. Operational and safety procedures. Prerequisite: Instructor permission required. (1 unit)

### 185. Special Topics in Engineering

Subjects of current interest. May be taken more than once if topics differ. (1–4 units)

### 188. Co-op Education

Practical experience in a planned program designed to give students practical work experience related to their academic field of study and career objectives. Satisfactory completion of the work assignment includes preparation of a summary report on co-op activities. P/NP grading. May not be taken for graduate credit. (2 units)

### 189. Co-op Technical Report

Credit given for a technical report on a specific activity such as a design or research project, etc., after completing the co-op assignment. Approval of department advisor required. Letter grades based on content and quality of report. May be taken twice. May not be taken for graduate credit. Prerequisite: COEN 188. (2 units)

### 193. Introduction to Senior Design Project

Junior preparation for senior project. An introduction to project requirements, team management, and project management. Consideration of career documentation and networking. Tentative project selection. (1 unit)

### 194. Senior Design Project I

Specification and initial investigation of an engineering project, selected with the mutual agreement of the student and the project advisor. The design process begins, including problem formulation, research, and preliminary design and analysis. Initial draft of the project report with oral presentation. (2 units)

### 195. Senior Design Project II

Continued design and construction of the project, system, or device. The design process continues, including design analysis, testing, and iteration. Second draft of the project report with oral presentation. (2 units)

### 196. Senior Design Project III

Completion of design and construction of the project, system or device. Design process concludes with formal communication of project details and specifications. Final project report and formal presentation of results. (2 units)

### 199. Directed Research/Reading

Investigation of an approved engineering problem and preparation of a suitable project report. Conferences with faculty advisor are required. Prerequisite: Instructor permission required. (1–6 units)