

# General Engineering (GE)

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## **GE 1000. Introduction to the Study of Engineering. (1 Hour)**

Presents an introduction to the various disciplines of engineering and strategies for success in the classroom, within the profession, and within the University community. Provides an initial orientation to engineering cooperative education. Covers the support services provided by both college and University and explores the richness of our community's diversity. Defines diversity, and offers students the opportunity to study and understand diverse cultures and communities in the academic environment. Oral presentations are required.

## **GE 1110. Engineering Design. (4 Hours)**

Seeks to develop problem-solving skills used in engineering design, using case studies for a variety of engineering disciplines. Introduces students to the use of spreadsheet tools to solve engineering problems, including data reduction and visualization of data and functions. Design topics include problem formulation and specification, creativity, evaluation tools, patents, ergonomics, system design, manufacturing, ethics in engineering, and presentation techniques. Presents engineering graphics focusing on developing 3D visualization skills and computer-aided design (CAD) application. Students develop an original design solution to a technical problem as a term project. Requires students to have a laptop computer that meets the specifications of the College of Engineering.

**Attribute(s):** NUpath Ethical Reasoning

## **GE 1111. Engineering Problem Solving and Computation. (4 Hours)**

Uses a structured approach to solve engineering problems. Draws applications from a variety of engineering disciplines, which serve as a tool for introducing students to engineering analysis and design. Introduces a math application package for matrix applications and various real-life engineering problems. Includes the design of problem-solving algorithms using a high-level programming language. Requires students to have a laptop computer that meets the specifications of the College of Engineering.

**Attribute(s):** NUpath Formal/Quant Reasoning

## **GE 1201. Alternative Energy Technologies Abroad. (4 Hours)**

Offers an interdisciplinary course that seeks to build an understanding of alternative energy systems and technologies and how they can impact the environment. Emphasizes how energy resources are being utilized currently in the United States and abroad and shows the need for new alternative energy technologies and their impact on sustainability. Introduces a variety of alternative/renewable energy technologies and their environmental impact. Lecturers include industry leaders in the field. Offers students an opportunity to visit companies to learn how these engineering technologies are being implemented. Aims to explain relevant alternative energy technologies in an interactive environment, where students engage in the field and examine their impact on society. May be repeated without limit.

## **GE 1210. Scientific Revolutions Abroad. (4 Hours)**

Studies two revolutions in scientific thought—the Scientific Revolution of the seventeenth and eighteenth centuries and the computational revolution of the twentieth century. The Scientific Revolution gave scientists optimism that, in principle, they could understand everything about the world around them. In contrast, the revolutions in complexity, logic, computation, mathematics, and physics of the twentieth century put fundamental limits on what scientists could know and understand. Taught abroad, this course explores the natural connections between the history of science and scientific sites, including local museums, observatories, universities, laboratories, and archaeological sites. This material is contrasted with key results from chaos theory, computational complexity, logic, physics, quantum mechanics, and the theory of computation, all developed in the twentieth century.

**Attribute(s):** NUpath Societies/Institutions

## **GE 1501. Cornerstone of Engineering 1. (4 Hours)**

Introduces students to the engineering design process and algorithmic thinking using a combination of lectures and hands-on projects and labs while encouraging critical thinking. Offers students an opportunity to develop creative problem-solving skills used in engineering design, to structure software, and to cultivate effective written and oral communication skills. Topics include the use of design and graphics communication software, spreadsheets, a high-level programming language, programmable microcontrollers as well as various electronic components, and 3-D printing. Requires students to develop an original design solution to a technical problem as a final term project. Requires students to have a laptop computer that meets the specifications of the College of Engineering.

## **GE 1502. Cornerstone of Engineering 2. (4 Hours)**

Continues GE 1501 using a project-based approach under a unifying theme. Covers topics that introduce students to engineering analysis and design. Uses a math application package for matrix applications along with various real-life engineering problems solved using programming. Considers ethical reasoning in design and analysis, including ethical theories, professional codes, and emerging micro/macro issues in engineering. Introduces quantitative tools and ethical topics separately and weaves them into all design and problem-solving stages of the student projects. Covers 3-D assembly drawings and modeling, along with review and further work in design. Students work on open-ended design problems, developing working models and prototypes to demonstrate and present their designs. Requires students to have a laptop computer that meets the specifications of the College of Engineering.

**Prerequisite(s):** GE 1501 (may be taken concurrently) with a minimum grade of D-

**Attribute(s):** NUpath Ethical Reasoning

## **GE 1990. Elective. (1-4 Hours)**

Offers elective credit for courses taken at other academic institutions. May be repeated without limit.

**GE 2010. Introduction to Customer-Driven Technical Innovation: Silicon Valley. (4 Hours)**

Studies the role of engineering innovation in addressing customer needs in early startups and the need to conceive successful innovative engineering design as part of a commercialization strategy. Emphasizes understanding how engineering innovation can meet real technical market needs and how to gather the necessary, relevant technical information early in the innovation process to produce a successful engineering design. Uses a series of practical engineering design projects to demonstrate how students can assess the technical capabilities of the startup in producing an innovative design, how to communicate with customers in an iterative engineering design process, and how to correspondingly design and innovate to meet customer technical requirements. Taught in Silicon Valley.

**GE 2030. Introduction to Product Prototyping: Silicon Valley. (4 Hours)**

Seeks to develop in-depth knowledge and experience in prototyping by focusing on engineering processes and instrumentation that are used in different industries. Studies the prototyping cycle from initial process flow and sketching, to prototype development, to testing and analysis, with an emphasis on iteration. Analyzes how different kinds of engineering prototypes can address design and user-interface needs vs. functional needs, such as looks-like and works-like prototypes. Offers students an opportunity to obtain operating knowledge of methods including 3-D printing, SolidWorks, off-the-shelf hardware-software interfaces, simulation, embedded systems, product testing, prototype analysis, and prototype iteration. Taught in Silicon Valley.

**GE 2300. Engineering Structure and Function: Principles of Design in Nature. (4 Hours)**

Explores principles of design that are found in nature. Studies evolutionary constraints in design, materials used in nature, structural designs that include hierarchy and multiscale components, methods of motion and how they evolved in nature, biological sensing structures, and ability to adapt. These natural design concepts are related to designs used in buildings, products, and machines. Offered in Oxford, England, a center for learning and evolutionary principles (from Darwin to Dawkins). Site visits include botanic gardens, the Natural History Museum, the Darwin collection, and Royal Veterinary College. A background in biology or engineering is not required; the course is intended for an interdisciplinary group of students (engineering, biology, architecture, product design, health sciences, innovation and entrepreneurship, anthropology) who are interested in exploring natural design.

**Attribute(s):** NUpath Natural/Designed World

**GE 2310. Engineering and Technological Innovations Abroad. (4 Hours)**

Introduces students to the fundamental engineering and technological principles underlying major technical advances throughout history in a specific international context. Investigates how these significant technical innovations impacted local culture, industry, and institutions. Classroom introductory material is complemented by visits to local museums, university and government laboratories, observatories, archaeological sites, and companies. Taught in a study-abroad format.

**GE 2361. Mathematical Methods for Engineers. (4 Hours)**

Covers applications to applied mechanics, thermofluids, and dynamics/control problems relevant to engineering. Topics include differential equations applied to modeling and characterization of processes, linear algebra used for multidimensional and complex system computations and modeling, and statistics and probability used for controls and signal analysis, among other applications. Introduces the foundational basis for approximate methods of engineering analysis, including its application to finite element analysis.

**Prerequisite(s):** MATH 1342 with a minimum grade of D-

**GE 2500. Design Analysis and Innovation. (4 Hours)**

Introduces various analytical and computational techniques. Course content is delivered through a series of modeling and analysis projects, design innovations and improvements, and design testing—including not only the technical performance but also commercialization potential by developing and presenting a business plan. Offers students an opportunity to design a representative model, implement the model through their design, verify and validate using analysis techniques, develop a business plan, report on the design and modelling, and suggest improvements for a revised design and model. Design projects and topics are expanded or reduced depending on class interest.

**Prerequisite(s):** (GE 1501 with a minimum grade of D- ; GE 1502 with a minimum grade of D- ) or (GE 1110 with a minimum grade of D- ; GE 1111 with a minimum grade of D- )

**GE 2990. Elective. (1-4 Hours)**

Offers elective credit for courses taken at other academic institutions. May be repeated without limit.

**GE 2992. Research. (0 Hours)**

Offers an opportunity to document student contributions to research projects or creative endeavors.

**GE 3300. Energy Systems: Science, Technology, and Sustainability. (4 Hours)**

Offers students an opportunity to obtain a sound scientific, technological, and economic understanding of our modern energy system and the challenge of energy sustainability. Covers principles of energy, work, and thermodynamics; technologies from supply and demand side, including extraction of primary energy, conversion into fuels and electricity, important energy end-uses, and energy losses; fossil, nuclear power plants, and renewable energy technologies (wind, solar, wave, hydro, geothermal, biofuels); transmission and distribution for electricity and fossil fuels; energy demand by buildings, transportation, and industry, emphasizing efficient technologies; sustainability concepts, including net energy/exergy analysis and life-cycle assessment, energy-related emissions, decentralized generation, smart grids, district heating, and net-zero energy facilities.

**Prerequisite(s):** (MATH 1241 with a minimum grade of D- or MATH 1250 with a minimum grade of D- or MATH 1341 with a minimum grade of D- ); (PHYS 1151 with a minimum grade of D- or PHYS 1161 with a minimum grade of D- or PHYS 1171 with a minimum grade of D- )

**GE 3990. Elective. (1-4 Hours)**

Offers elective credit for courses taken at other academic institutions. May be repeated without limit.

**GE 4892. Engineering Product Design and Prototyping Challenge Project. (4 Hours)**

Offers students an opportunity to prepare detailed engineering designs and physical prototypes of technology-based products based on real-world specifications. Projects are carried out under the umbrella of the Generate organization within the Sherman Center for Engineering Entrepreneurship Education. Project proposals are developed in collaboration with the center director, including learning outcomes, project goals, and anticipated results/products. May be repeated up to nine times.

**GE 4900. Career Management. (1 Hour)**

Provides an interactive course designed to enhance an engineering student's professional and career-related education through a series of classes taught by managers, engineers, and other professionals with industry experience. Topics include career services resources, developing skills to be an effective manager, the balance between personal and professional life, mentors, making career choices, time management vs. energy management, and others. May be repeated without limit.

**GE 4990. Elective. (1-4 Hours)**

Offers elective credit for courses taken at other academic institutions. May be repeated without limit.

**GE 4993. Independent Study. (1-4 Hours)**

Focuses on a subject that crosses traditional engineering boundaries. May be repeated without limit.

**GE 4998. Research. (0 Hours)**

Offers an opportunity to document student contributions to research projects or creative endeavors.

**GE 5000. Special Topics in Engineering. (1-4 Hours)**

Offers a course in which content is determined by the instructor. May be repeated up to three times.

**GE 5010. Customer-Driven Technical Innovation for Engineers. (4 Hours)**

Studies the role of engineering innovation in addressing customer needs in early start-ups and the need to conceive successful innovative engineering design as part of a commercialization strategy. Emphasizes understanding how engineering innovation can meet real technical market needs and how to gather the necessary, relevant technical information early in the innovation process to produce a successful engineering design. Uses a series of practical engineering design projects to demonstrate how students can assess the technical capabilities of the start-up in producing an innovative design, how to communicate with customers in an iterative engineering design process, and how to correspondingly design and innovate to meet customer technical requirements.

**GE 5020. Engineering Product Design Methodology. (4 Hours)**

Explores the iterative product development process, with a focus on user-centered design techniques. Employs generative and evaluative user research methods to set product requirements and end-user technical specifications and inform the product development decision-making process. Expects students to develop a simple product, device, or tool in a team-based workshop environment, through a project spanning opportunity recognition, concept generation, prototyping and testing, concept selection, and engineering design, all informed by the needs of the intended user population. Includes discussions of industrial design, sketching, design thinking, prototyping and manufacturing processes, and product development consulting.

**GE 5030. Iterative Product Prototyping for Engineers. (4 Hours)**

Seeks to develop in-depth knowledge and experience in prototyping by focusing on engineering processes and instrumentation that are used in different industries. Studies the prototyping cycle, from initial process flow and sketching to prototype development to testing and analysis, with an emphasis on iteration. Analyzes how different kinds of engineering prototypes can address design and user-interface needs vs. functional needs, such as looks-like and works-like prototypes. Offers students an opportunity to obtain operating knowledge of methods including 3D printing, SolidWorks, off-the-shelf hardware-software interfaces, simulation, embedded systems, product testing, prototype analysis, and prototype iteration.

**GE 5100. Product Development for Engineers. (4 Hours)**

Focuses on the main processes needed to develop a complex, high-technology product. Emphasizes the most important techniques and approaches used in a startup environment. Seeks to benefit students of all engineering disciplines including computer science and biomedical, industrial, electrical, mechanical, computer, and chemical engineering. Includes a running practical project in which a new product is designed and executed through a series of small projects for each phase of the product development process. Topics include the product life cycle, new product development processes, project planning and management, new product idea generation, the systems approach to product development, design for manufacturing, market testing and launch, and escalation to manufacturing.