Engineering (ENGR)

Courses

ENGR 1240 Technology 21: Energy Requirements, Concerns, and Alternatives for the 21st Century (4 Credits)
Technology 21 is a three course sequence designed to provide students with an awareness of the technological challenges of the twenty-first century and an understanding of the scientific principles upon which the technology is based. The first quarter begins with a review of numeracy, the language of science and technology. The course explores our dependency on energy, the amount we consume is staggering and most comes from non-renewable fossil fuels. The second and third quarters are concerned with information technology and the relation between technology and global issues. This course counts toward the Scientific Inquiry: The Natural and Physical World requirement.

ENGR 1241 Technology 21: Climate Science and Policy for the Twenty-First Century (4 Credits)
Technology 21 is a three course sequence designed to provide students with an awareness of the technological challenges of the twenty-first century and an understanding of the scientific principles upon which the technology is based. The first quarter begins with a review of numeracy, the language of science and technology. The course explores our dependency on energy, the amount we consume is staggering and most comes from non-renewable fossil fuels. The second and third quarters are concerned with information technology and the relation between technology and global issues. This course counts toward the Scientific Inquiry: The Natural and Physical World requirement.

ENGR 1242 Technology 21: Information Theory and Technology (4 Credits)
Technology 21 is a three course sequence designed to provide students with an awareness of the technological challenges of the twenty-first century and an understanding of the scientific principles upon which the technology is based. The first quarter begins with a review of numeracy, the language of science and technology. The course explores our dependency on energy, the amount we consume is staggering and most comes from non-renewable fossil fuels. The second and third quarters are concerned with information technology and the relation between technology and global issues. This course counts toward the Scientific Inquiry: The Natural and Physical World requirement.

ENGR 1511 Engineering Connections (1 Credit)
This is the first course in a three course sequence designed to help students bridge the gap from high school to a college environment in a very challenging major. Topics and activities include academic success strategies; interviewing engineering alumni; the ethics of the profession; visits to industry sites; seminars by industry and academic experts; establishing the relationships between math, science, and engineering courses with design projects; critical and creative thinking activities; tours of the research labs of the engineering professors; disseminating information on the dual degree programs, the MBA programs, the honor code, and engineering program structures; and readings from and discussions about articles from professional publications. Membership in a professional society is a required course component.

ENGR 1572 Applied MATLAB Programming (3 Credits)
The MATLAB programming environment is used to introduce engineering applications programming. It includes high performance numerical computation and visualization. Programming topics include an overview of an interactive programming environment, generation of m-files, variables and data types, arithmetic operators, mathematical functions, symbolic mathematics, graphic generation, use of programs in application specific toolboxes, embedding and calling C programs in m-files, file input/output, and commenting. Programming is oriented toward engineering problem solving. Prerequisites: COMP 1571, MATH 1951 and MATH 1952.

ENGR 1611 Introduction to Mechanical Systems with CAD (4 Credits)
Introduction to concepts and practice in computer, electrical and mechanical engineering including engineering ethics. Engineering problem-solving as it applies to engineering analysis, synthesis and design. Students practice structured teamwork and program management skills in the context of projects. Emphasis on computer tools with immediate application to engineering practice.

ENGR 1622 Introduction to Mechatronic Systems I with MultiSim and MathCAD (4 Credits)
Introduction to elementary concepts and practices in mechatronic systems engineering, in particular electrical engineering concepts including current and voltage and basic electrical circuit analysis, interfacing electrical circuits with mechanical systems, and assembly and testing of mechatronics subsystems. Students are required to complete simple projects including mechanical and electrical components during which they practice teamwork while gaining skills in electrical and mechatronic systems troubleshooting. Introduction to Multiscan circuit analysis software and Mathcad are among other topics covered in this course. Prerequisite: ENGR 1511, ENGR 1611.

ENGR 1632 Introduction to Mechatronic Systems II with LabView (4 Credits)
Study of fundamentals of computer-based systems and electromechanical systems controlled by microprocessors or microcontrollers. Introduction to digital logic and electronics. Introduction to LabView and use of LabView to build and evaluate circuits and simple electromechanical systems. Use of logic circuits to build analog to digital converters. Program microcontrollers. Study of autonomous vehicles as mechatronic systems and the ability to control them (small cars, robots, helicopters, quadrotors, etc.). Course requirements include a report with detailed analysis of the vehicle control system, flow charts, and program documentation. Prerequisites: ENGR 1611, ENGR 1622.

ENGR 1700 Machine Shop Practice (1 Credit)
Introduction to concepts and practice in basic machine tool work (i.e. mill, lathe, welding etc.). The course provides the necessary information for majors and non-majors to gain access to the DU Engineering Machine Shop. Class size is limited to 5 students per quarter. Enrollment priority will be given to engineering majors.
ENGR 1911 Introduction to CAD (2 Credits)
This course is intended for transfer students who have had an introduction to engineering, but who need to learn certain techniques and software typically dealt with in ENGR 1611 including engineering ethics.

ENGR 1921 Introduction in Engineering II (1 Credit)
This course is intended mainly for transfer students who have had an introduction to engineering, but who need to learn certain techniques and software typically dealt with in ENGR 1621 including engineering ethics.

ENGR 1931 Introduction to Engineering III (1 Credit)
This course is intended mainly for transfer students who have had an introduction to engineering, but who need to learn certain techniques and software typically dealt with in ENGR 1631 including engineering ethics.

ENGR 1992 Directed Study (1-10 Credits)

ENGR 2610 Engineering Integration I (3 Credits)
Interdisciplinary course combining topics from computer, electrical and mechanical engineering including engineering ethics, with emphasis on laboratory experience and the design, analysis and testing of interdisciplinary systems. Manufacture of mechanical systems and/or circuit boards. Team project work on interdisciplinary "design-and-build" projects. Prerequisites: ENGR 2035 and junior standing in the appropriate engineering discipline. Corequisite: enrollment in appropriate junior-level engineering courses.

ENGR 2620 Engineering Integration II (3 Credits)
Interdisciplinary course combining topics from computer, electrical and mechanical engineering including engineering ethics, with emphasis on laboratory experience and the design, analysis and testing of interdisciplinary systems. Manufacture of mechanical systems and/or circuit boards. Team project work on interdisciplinary "design-and-build" projects. Prerequisite: ENGR 2610. Corequisite: enrollment in appropriate junior level engineering courses.

ENGR 2905 Engineering Cooperative Education (0-12 Credits)
For students on full-time cooperative educational employment. This course may be taken up to four times. Any and all credits will not count toward your degree and you will receive a grade of NC (no credit) for all enrollments. You will choose between a residential and non-residential section.

ENGR 2910 Engineering Economics (3 Credits)
This course focuses on the practical application of economics to engineering. It explains concepts in accounting and finance and applies them to engineering situations. Topics that are discussed include: economic decision making, engineering cost and estimates, interest, inflation, depreciation, income taxes, minimum attractive rate of return, economic viability of projects, and the economic advantages of "green" technology.

ENGR 2950 Engineering Assessment I (0 Credits)
Examination covering basic mathematics, science and sophomore-level engineering topics. Must be taken prior to obtaining senior status in engineering. Prerequisites: ENEE 2021, ENME 2520, COMP 1572. Corequisites: ENGR 2035, ENCE 2101, ENME 2710.

ENGR 2992 Directed Study (1-10 Credits)

ENGR 3100 Instrumentation and Data Acquisition (4 Credits)
This course examines different instrumentation techniques and describes how different measurement instruments work. Measurement devices include length, speed, acceleration, force, torque, pressure, sound, flow, temperature, and advanced systems. This course also examines the acquisition, processing, transmission and manipulation of data. Cross listed with ENGR 4100. Prerequisite: PHYS 1214.

ENGR 3200 Introduction to Nanotechnology (4 Credits)
In this highly interdisciplinary series of lectures spanning across engineering, physics, chemistry and Biology, an introduction to the subject of nanotechnology is provided. The most important recent accomplishments so far in the application of nanotechnology in several disciplines are discussed. Then a brief overview of the most important instrumentation systems used by nanotechnologists is provided. The nature of nanoparticles, nanoparticle composites, carbon nanostructures, including carbon nanotubes and their composites is subsequently discussed. The course also deals with nanopolymers, nanobiological systems, and nanoelectronic materials and devices. The issues of modeling of nanomaterials and nanostructures are also covered in this class. Multiscale modeling based on finite element simulations, Monte Carlo methods, molecular dynamics and quantum mechanics calculations is briefly addressed. Most importantly, students should obtain appreciation of developments in nanotechnology outside their present area of expertise. Cross listed with ENGR 4200. Prerequisite: ENME 2410.

ENGR 3210 Intro Nano-Electro-Mechanics (4 Credits)
Familiarize science and engineering students with the electromechanical aspects of the emerging field of Nanotechnology (NEMS). NEMS is a relatively new and highly multidisciplinary field of science and technology with applications to state of the art and future sensors, actuators, and electronics. Starting with an overview of nanotechnology and discussion on the shifts in the electromechanical behavior and transduction mechanisms when scaling the physical dimensions from centimeters to micro-meters and then down to nanometers. Several electromechanical transduction mechanisms at the micro and nanoscale are presented and discussed in an application based context. New electromechanical interactions appearing in the nano and molecular scale, such as intra-molecular forces and molecular motors, are discussed. A detailed discussion and overview of nanofabrication technologies and approaches are also provided. Cross listed with ENGR 4210. Prerequisite: must be an engineering or science major of at least junior standing.
ENGR 3215 NEMS and Nanofabrication Lab (4 Credits)
This course provides science and engineering students with comprehensive hands-on experience in design, fabrication and characterization of Nanoscale Electromechanical Systems (NEMS). This laboratory-based course starts with a number of sessions including brief lectures reviewing the fundamentals and theories followed by pre-designed lab experiments. The students are then provided with a choice of different comprehensive design and implementation examples. The examples include design, layout, fabrication, and characterization of the devices. Prerequisite: ENGR 3210.

ENGR 3220 Introduction to Micro-Electro-Mechanical-Systems and Microsystems (4 Credits)
This course introduces students to the multi-disciplinary field of Micro-Electro-Mechanical-Systems (MEMS) technology. MEMS and Microsystem technology is the integration of micro-scale electro-mechanical elements, sensors, actuators, and electronics on a common substrate or platform through semiconductor microfabrication technologies. The course gives a brief overview of the involved physical phenomena, electromechanical transduction mechanisms, design principles, as well as fabrication and manufacturing technologies. Cross listed with ENGR 4220.

ENGR 3313 Engineering Design Project I (2 Credits)
Planning, development and execution of an engineering design project. The project may be interdisciplinary, involving aspects of computer, electrical and mechanical engineering. Projects have economic, ethical, social and other constraints, as appropriate. Design activities include 1) preparation and presentation of proposals in response to requests-for-proposals from "customers," including problem description, quantitative and qualitative criteria for success, alternate designs and project plans; 2) generation and analysis of alternate designs, and choice of best design; 3) formulation of test procedures to demonstrate that the design chosen meets the criteria for success, and testing of the completed project where feasible; 4) reporting on the design and testing. Cross listed with ENGR 3314. Prerequisite: senior standing in engineering.

ENGR 3314 Honors Thesis I (2 Credits)
Honors equivalent of ENGR 3313. Required of students in the Honors Program and of students graduating summa cum laude, in place of ENGR 3313. In addition to the requirements given for ENGR 3313, the student must submit a copy of the final report on the project to the engineering department. Cross listed with ENGR 3313.

ENGR 3323 Engineering Design Project II (3 Credits)
Planning, development and execution of an engineering design project. The project may be interdisciplinary, involving aspects of computer, electrical and mechanical engineering. Projects have economic, ethical, social and other constraints, as appropriate. Design activities include 1) preparation and presentation of proposals in response to requests-for-proposals from "customers," including problem description, quantitative and qualitative criteria for success, alternate designs and project plans; 2) generation and analysis of alternate designs, and choice of best design; 3) formulation of test procedures to demonstrate that the design chosen meets the criteria for success, and testing of the completed project where feasible; 4) reporting on the design and testing. Cross listed with ENGR 3324. Prerequisite: ENGR 3313.

ENGR 3324 Honors Thesis II (3 Credits)
Honors equivalent of ENGR 3323. Required of students in the Honors Program and of students graduating summa cum laude in place of ENGR 3323. In addition to requirements given for ENGR 3323, the student must submit a copy of the final report on the project to the engineering department. Cross listed with ENGR 3323.

ENGR 3333 Engineering Design Project III (3 Credits)
Planning, development and execution of an engineering design project. The project may be interdisciplinary, involving aspects of computer, electrical and mechanical engineering. Projects have economic, ethical, social and other constraints, as appropriate. Design activities include: 1) preparation and presentation of proposals in response to requests-for-proposals from "customers," including problem description, quantitative and qualitative criteria for success, alternate designs and project plans; 2) generation and analysis of alternate designs, and choice of best design; 3) formulation of test procedures to demonstrate that the design chosen meets the criteria for success, and testing of the completed project where feasible; 4) reporting on the design and testing. Cross listed with ENGR 3334. Prerequisite: ENGR 3323.

ENGR 3334 Honors Thesis III (3 Credits)
Honors equivalent of ENGR 3333. Required of students in the Honors Program and of students graduating summa cum laude in place of ENGR 3333. In addition to the requirements given for ENGR 3333, the student must submit a copy of the final report on the project to the engineering department. Cross listed with ENGR 3333.

ENGR 3350 Reliability (4 Credits)
An overview of reliability-based design. Topics include fundamentals of statistics, probability distributions, determining distribution parameters, design for six sigma, Monte Carlo simulation, first and second order reliability methods (FORM, SORM), Most Probable Point (MPP) reliability methods, sensitivity factors, probabilistic design. Cross listed with ENGR 4350.

ENGR 3510 Renewable and Efficient Power and Energy Systems (4 Credits)
This course introduces the current and future sustainable electrical power systems. Fundamentals of renewable energy sources and storage systems are discussed. Interfaces of the new sources to the utility grid are covered. Prerequisite: ENEE 2021.

ENGR 3520 Introduction to Power Electronics (4 Credits)
This covers fundamentals of power electronics. We discuss various switching converters topologies. Basic knowledge of Efficiency and small-signal modeling for the DC-DC switching converters is covered. Furthermore, magnetic and filter design are introduced. Prerequisites: ENEE 2211 and ENGR 3722.
ENGR 3525 Power Electronics and Renewable Energy Laboratory (1 Credit)
In this course the fundamentals of switching converters and power electronics in a real laboratory set-up are covered. The course incorporates hardware design, analysis, and simulation of various switching converters as a power processing element for different energy sources. The energy sources are power utility, batteries, and solar panels. Prerequisite: ENGR 3520.

ENGR 3530 Introduction to Power and Energy Conversion Systems (3 Credits)
Basic concepts of AC systems, single-phase and three-phase networks, electric power generation, transformers, transmission lines, and electric machinery. Cross listed with ENGR 4530. Prerequisite: ENEE 2021.

ENGR 3535 Electric Power Engineering Laboratory (1 Credit)
In this laboratory, the magnetic circuits, single phase transformers, power quality and harmonics synchronous machines, Induction machines and DC machines are studied and tested in a real physical setup. Prerequisite: ENGR 3530.

ENGR 3540 Electric Power Systems (4 Credits)
This course covers methods of calculation of a comprehensive idea on the various aspects of power system problems and algorithms for solving these problems. Prerequisite: ENGR 3530.

ENGR 3545 Electric Power Economy (3 Credits)
This course covers economy aspects of electric power industry and the implications for power and energy engineering in the market environment. Cross listed with ENGR 4545. Prerequisite: ENGR 3530.

ENGR 3550 Introduction to Machine Drive Control (4 Credits)
This course provides the basic theory for the analysis and application of adjustable-speed drive systems employing power electronic converters and ac or dc machines. Prerequisites: ENGR 3520 and ENGR 3530.

ENGR 3560 Engineering Analysis (3 Credits)
Applied mathematics for engineers. Generalized Fourier analysis, complex variables, vector calculus, introduction to Bessel functions, and applied probability and statistics. Cross listed with ENGR 3620. Prerequisites: MATH 2070, MATH 2080.

ENGR 3620 Advanced Engineering Mathematics (4 Credits)

ENGR 3630 Finite Element Methods (4 Credits)
Introduction to the use of finite element methods in one or two dimensions with applications to solid and fluid mechanics, heat transfer and electromagnetic fields; projects in one or more of the above areas. Prerequisite: ENGR 3610 or equivalent.

ENGR 3721 Controls (3,4 Credits)
Modeling, analysis and design of linear feedback control systems using Laplace transform methods. Techniques and methods used in linear mathematical models of mechanical, electrical, thermal and fluid systems are covered. Feedback control system models, design methods and performance criteria in both time and frequency domains. A linear feedback control system design project is required. Prerequisites: ENEE 2021, ENGR 3610 or permission of instructor.

ENGR 3722 Control Systems Laboratory (1 Credit)
This laboratory course serves as supplement to ENGR 3721. It aims at providing “hands on” experience to students. It includes experiments on inverted pendulum, gyroscopes, motor control, feedback controller design, time-domain and frequency domain. Corequisite: ENGR 3721.

ENGR 3730 Robotics (3 Credits)
Introduction to the analysis, design, modeling and application of robotic manipulators. Review of the mathematical preliminaries required to support robot theory. Topics include forward kinematics, inverse kinematics, motion kinematics, trajectory control and planning, and kinetics. Cross listed with ENGR 4730. Prerequisites: ENME 2520 and MATH 2060 or MATH 2200 or permission of instructor.

ENGR 3731 Robotics Lab (1 Credit)
Laboratory that complements the analysis, design, modeling and application of robotic manipulators. Implementation of the mathematical structures required to support robot operation. Topics include forward kinematics, inverse kinematics, motion kinematics, trajectory control and planning and kinetics. Applications include programming and task planning of a manufacturing robot manipulator. Corequisite: ENGR 3730 or permission of instructor.

ENGR 3735 Linear Systems (4 Credits)
This course focuses on linear system theory in time domain. It emphasizes linear and matrix algebra, numerical matrix algebra and computational issues in solving systems of linear algebraic equations, singular value decomposition, eigenvalue-eigenvector and least-squares problems, linear spaces and linear operator theory. It studies modeling and linearization of multi-input/multi-output dynamic physical systems, state-variable and transfer function matrices, analytical and numerical solutions of systems of differential and difference equations, structural properties of linear dynamic physical systems, including controllability, observability and stability. It covers canonical realizations, linear state-variable feedback controller and asymptotic observer design, and the Kalman filter. Cross listed with ENGR 4735. Prerequisites: ENGR 3610, ENGR 3721/3722, or permission of the instructor.
ENGR 3742 LabVIEW Programming, a primer for certification as an Applicaitons Developer (4 Credits)
The LabVIEW course covers numeric, Boolean, and string controls; programming structures include loops, sequences, formula, and case structures. VISA (virtual instrumentation and software structure) and SCPI (standard commands for programmable instruments) are used to control test equipment and acquire data via the GPIB (general purpose interface bus, IEEE488 standard). Vis (virtual instruments) for data acquisition and analysis are developed utilizing mathematical, signal processing, and statistical LabVIEW programming modules. LabVIEW structures will be used to mathematically model and solve second order differential equations and Laplace transforms.

ENGR 3800 Topics (ENGR) (1-4 Credits)
Special topics in engineering as announced. May be taken more than once. Prerequisite: varies with offering.

ENGR 3900 Engineering Internship (0-4 Credits)
Students in engineering may receive elective credit for engineering work performed for engineering employers with the approval of the chair or associate chair of the department. At the end of the term, a student report on the work is required, and a recommendation will be required from the employer before a grade is assigned. Junior, senior, or graduate status in engineering is normally required. May not be used to satisfy technical requirements. May be taken more than one for a maximum of 6 quarter hours. Prerequisite: permission of instructor.

ENGR 3951 Engineering Assessment II (0 Credits)
Students in Mechanical Engineering must register for and take the Fundamentals of Engineering Examination (FE). All students must complete an engineering exit interview and other assessment related tasks. To be taken in the last quarter of attendance.

ENGR 3970 Entrepreneurship for Engineers and Computer Scientists (4 Credits)
The course presents an overview of fundamentals of understanding entrepreneurship and entrepreneurial characteristics; the focus is on aspects of engineering entrepreneurship, technology-based innovation and new product development. Topics to be covered: learning an industry; recognizing and creating opportunities; new product development process, phases and cycle, risks and benefits; ‘testing’ of an engineering-focused business concept; marketing, organizational plan strategies and financing for new start ups. Special attention is given to technological innovation, considering both incremental or routine innovation, and more radical or revolutionary changes in products and processes. Prerequisite: ENGR 3610 or permission of the instructor.

ENGR 3991 Independent Study (1-5 Credits)
Topics in engineering investigated under faculty supervision. May be taken more than once. Students must obtain and complete an Independent Study form from the Office of the Registrar. Prerequisite: permission of instructor.

ENGR 3992 Directed Study (1-10 Credits)
ENGR 3995 Independent Research (1-10 Credits)