ENGINEERING (ENGR)

ENGR 1001 IGNATIAN SEMINAR I: Laudato Si' 0 Credits
This course provides foundational knowledge in sustainability and the urgent environmental challenges faced by humanity. It intends to cultivate ethical and spiritual reflection that raise ecological awareness, stimulate greater commitment to care for creation, and train for global environmental citizenship. This course is framed by institutional positions such as Laudato Si' , the analysis of the common good as explained in Rerum Novarum , and the Care for the Common Home found in the Jesuit Universal Apostolic Preferences (UAPs). Topics such as anthropogenic activities and their impact on the environment, environmental stressors, sustainability and the triple bottom line, industrial ecosystems and materials flows and cycles, design for the environment, life cycle assessment (LCA), energy and water systems, and ecological spirituality. These themes will be explored with regards to Environmental Justice and environmental racism.

ENGR 1031 Fundamentals of Engineering 3 Credits
Course Tags: Magis Core: Writing in the Discipline
This course provides core engineering knowledge and competencies in a highly interactive class format. Topics include professional skills such as technical writing and presentation, guidelines for professional engineering practice, and career preparation. Introduction to the fields, roles, and industries of engineering also serves as a basis for selection of engineering major field. Hands-on team projects are core learning experiences. They form a structured introduction to the implementation of principles of design and engineering methodologies, system engineering management, and presentation skills. Guest presenters and field trips augment this course, which is taught by interdisciplinary faculty teams.

ENGR 1060 Science, Technology, Engineering, and Mathematics of the Guitar 3 Credits
This course looks at the design elements, manufacturing and assembly of solid-body electric guitars. Science, technology, engineering, and mathematics (STEM) concepts that relate directly to guitars are used to help students make an applied learning connection. Each student will construct their own electric guitar. Course will cover wood species and the environment, guitar headstock design features, chemistry of finishes, math applications in a guitar, physical science aspects of the guitar such as mechanical systems, concepts of sound waves, string tension, fretboard layout, intonation, and electronics. Studio-style class, lecture, and lab time combined throughout course. A lab fee applies to cover materials.

ENGR 2001 IGNATIAN SEMINAR II: Reflection 0 Credits
Prerequisite(s): ENGR 1001.
This course addresses the aspects of Experience and Reflection found within the Ignatian Pedagogical Paradigm (IPP) by exposing the student to the Jesuit history and tradition, as well as some tools for interior life and self-awareness. The main goal for this course is for students to see themselves as valuable contributors, with a unique set of gifts, who have the responsibility to use their skills and talents to serve others and society. Some of the topics include: a brief history of the Society of Jesus, Loyola's Autobiography, a brief history of Jesuit universities and institutions (the apostolate of higher education), spiritual direction and the daily examen, movements of consolation and desolation, fundamentals of discernment and its rules, Ignatian indifference, resume virtues versus eulogy virtues, grit, mattering and self-mattering, happiness and negativity bias, metacognition, and heroic leadership.

ENGR 2130 Engineering Graphics I 3 Credits
This is a basic course in engineering graphics principles and is taught simultaneously with SolidWorks, a 3-D modeling design application. Using computer design, the course stresses orthographic projection, dimensioning, sectional views, 3-D part modeling, assembly modeling, drafting and engineering drawings, fits and limits, and geometric tolerance representation. Students will gain a working knowledge of SolidWorks in engineering design. Course requires a personal laptop running a 64-bit Windows 10 operating system.

ENGR 2145 Mathematical Analysis 3 Credits
Course Tags: Environmental Studies Elective, Environmental Studies: Applied Professional Skills
Corequisite(s): ENGR 2145P.
Prerequisite(s): MATH 1142.
In this course, as you reflect on the question of "Who Am I Called to be?" in your mentoring groups this semester, you will learn mathematical and numerical methods such as root finding, differentiation, integration, solving a system of linear equations and through weekly reflection exercises (modeled on the Ignatian Examen) you will understand how to apply these methods to solve scientific problems. Additionally, the course will cover statistics including data analysis, data fitting, and interpolation. The programming language that will be used in this course is MATLAB.

ENGR 2145P Mathematical Analysis PLG 0 Credits
Peer learning group for ENGR 2145.

ENGR 3001 IGNATIAN SEMINAR III: Social Action 0 Credits
Prerequisite(s):ENGR 2001.
This course invokes the Jesuit charisma and thus seeks to educate and form students so that they discern the unique ways in which they are called to be in service for and with others. This course is anchored in the Rerum Novarum themes of human dignity, subsidiarity, and the preferential option for the poor. With this framework, students will analyze the role of engineering and technology in social justice, and engage the world through a careful analysis of context and experience, evaluated through reflection, for the sake of action (GC35 decree 6). In this course, students will experience an encounter with a societal reality and use their engineering and computing skills to develop an actionable idea, prototype solution, or plan to address a problem and make society more equitable. There is potential for some projects to be done in collaboration with community partners. A project defense will be scheduled against an opposing team of students for a thorough debate on the merits and assessed through the lens of Eloquentia Perfecta : effective communication, ethical reasoning, and personal development for the common good.

ENGR 3260 Robots 3 Credits
Prerequisite(s): ELEG 2213, ELEG 2213L.
Introductory course in robotics develops understanding of how robotic systems integrate sensors, actuators, and control systems to achieve specific goals. Principles of autonomy, programming, wireless communications, sensor applications, mechatronics, electrical power, electric motors, pneumatics, structure, and locomotion will be understood and applied. Design of robotic subsystems will utilize multiple areas of knowledge. Students will understand degrees of freedom of a robotic arm and their safety parameters through demonstration and use of Fanuc Robot. Service learning is an integral part of the course. All students will participate in mentoring of youth to put into practice the principles learned in class, and gain communication skills through community interaction. Particularly they will participate in mentoring to build small robots to accomplish different feats, for example obstacle avoidance by a mobile robot.

ENGR 4301 Feedback Control Systems 3 Credits
Prerequisite(s): MATH 2251.
This course emphasizes analysis and synthesis of closed loop control systems using both classical and state-space approaches with an emphasis on electro-mechanical systems. The mathematical requirements include the Laplace transform methods of solving differential equations, matrix algebra, and basic complex variables. The discussion of classical control system design includes the modeling of dynamic systems, block diagram representation, time and frequency domain methods, transient and steady state response, stability criteria, controller action [Proportional (P); proportional and integral (PI); Proportional, integral, and derivative (PID); and pseudo-derivatives feedback], root locus methods, the methods of Nyquist and Bode, and dynamics compensation techniques. The discussion of state-space methods includes formulation and solution (analytical and computer-based) of the state equations and pole-placement design. The course integrates the use of computer-aided analysis and design tools (MATLAB) so as to ensure relevance to the design of real world controlled electro-mechanical systems using case studies and applications to electrical and mechanical systems. Includes lab (hardware-based) exercises. Graduate equivalent: MEEG 5301.

ENGR 4303 Industrial Automation 3 Credits
This hands-on course teaches students about components in automation systems and automated production lines. Students learn and practice with industrial sensors, actuators, PLCs, robot arms, pneumatics devices, and electro-pneumatic components. Students create, simulate, and assemble pneumatics, electric, electronics, and electro-pneumatic control circuits. Automation software, ladder logic programming, and robot programming are also discussed. The course comprises lectures, an automation lab, individual assignments, two group projects, and an individual project. Graduate equivalents: ECEG 5303, MEEG 5303.

ENGR 4305 Design of Mechatronics Systems 3 Credits
Prerequisite(s): Senior standing.
This course covers development of mechatronics theory and applications to systems dependent upon the integration of mechanical, electrical and computer engineering. Students assemble hardware components to create a product design that fulfills a specified task in a mechatronics system. Students develop design skills in mechanisms, electrical devices, and software to create, test, and verify system function. Graduate equivalent: MEEG 5305.

ENGR 4308 Autonomous Mobile Robots 3 Credits
Prerequisite(s): ELEG 2213, ELEG 2213L.
In this course, students will design and construct functional autonomous robots using provided hardware and electronics to implement multiple "simultaneous" behaviors: position control, obstacle avoidance, and objective completion. Students will focus on programming multi-behavior capability on a robot. In doing so, students will become familiar with microcontroller programming, data acquisition, motors, and sensor characterization for different sensors, such as inertial measurement units, timers, distance sensors / rangefinders, cameras, and beacons. This course will cover the fundamentals of robotic architecture: low-level and high-level control. For low level control, students will implement feedback controllers for orientation and displacement. For high level control, students will program or teach decision-making capabilities for their robot. Robots may complete specific high-level tasks, such as snow removal, lawn mowing, parcel delivery, and a tank battle. Ultimately, students will learn to fuse multiple, simultaneous robot behaviors to produce a functioning, "thinking" autonomous mobile robot with natural behavior. Students may use premade robotic chasses if preferred. Graduate equivalent: ENGR 5308.

ENGR 4310 Industrial Quality Control 3 Credits
Prerequisite(s): MATH 2217.
This course presents an introduction to and a survey of statistical methods for managing quality and continuous process improvements. The course objective is to develop an operational familiarity with contemporary methods found to be effective. This course is intended for those students who do not plan to specialize in quality management. Topics include: statistical process control, quality function deployment, the house of quality, the Taguchi method, Six Sigma, lean and others. The course also covers continuous process improvement methodologies and techniques.

ENGR 4315 Mathematical Programming and Optimization 3 Credits
Prerequisite(s): MATH 2235.
This course is an introduction to combinatorial and integer and non-linear mathematical programming techniques for optimization. The course focuses on mathematical programming and optimization techniques to solve real-life industry problems and support managerial decision making. The course will cover basic deterministic methods of operations research including linear programming, network flow, integer programming, transportation, assignment and trans-shipment problems, decision making under uncertainty and their applications. The emphasis is on mathematical formulation of real-world industry problems, interpretation of computer solutions, and sensitivity analysis of optimal solutions.

ENGR 4330 Engineering Graphics II 3 Credits
This course introduces CATIA Version 5, the leading CAD/CAM/CAE application used by automotive, aerospace, shipbuilding, and consumer goods industries. It provides mechanical, electrical, automotive, aerospace, and marine engineers and architects with the design tools to take products from concept to completion in one seamless application. This course covers basic solid modeling concepts of individual sheet metal and machined parts from detailed drawings. Complex Shape Modeling using wireframe concepts and surface-based modeling is covered. Building of assemblies of components and control of their positioning and orientation, as well as motion simulation is covered. Fully detailed production drawings of components and assemblies are also covered.

ENGR 4334 Unmanned Aerial Vehicles: Design, Navigation, and Control 3 Credits
Prerequisite(s): ELEG 2213; CPSC 1121 or ENGR 2145.
This course provides an in-depth exploration of unmanned aerial vehicles (UAVs), focusing on their design, navigation, and control. Students will learn the fundamental principles of UAVs, how to design and build basic drones, and apply advanced control and sensor fusion techniques for effective navigation and stabilization. The course also covers the use of UAVs in various applications like photogrammetry and payload delivery, along with a thorough understanding of the regulatory and ethical issues surrounding drone operations. Graduate Equivalent: ECEG 5334.

ENGR 4360 Engineering Project Management 3 Credits
Course Tags: Humanitarian Action Minor Skills/Method Course
This course concentrates on the general methodology of managing an engineering project from concept to operational use with emphasis on the functions, roles, and responsibilities of the project manager. Study of the basic principles and techniques related to controlling resources (i.e. people, materials, equipment, contractors, and cash flow) to complete a project on time and within budget while meeting the stated technical requirements. Through group and individual activities, including case study review and field work, students will learn to apply project management tools and techniques. The course will be taught by teaching each phase of project management as we complete the relevant aspects of the project in the field. There will be some classroom time for introducing concepts, and planning. However, the majority of time each day will be spent in the field executing the project, putting into practice the phases of project management. The course will prepare students with the ability to learn the necessary background information and hands-on technical skills, to be flexible and adaptable in difficult environments. These skills will be valuable in many areas, particularly in the planning and execution of humanitarian action and engineering in developing countries. Enrollment by permission only. Students must be able to study abroad.

ENGR 4415 Engineering Applications of Numerical Methods 3 Credits
Prerequisite(s): CPSC 1131.
Topics include root-finding, interpolation, linear algebraic systems, numerical integration, numerical solution of ordinary and partial differential equations, modeling, simulation, initial boundary value problems, and two point boundary value problems. Graduate equivalents: ECEG 5415, MEEG 5415.

ENGR 4961 Senior Design Project I 3 Credits
Prerequisite(s): Completion of all non-elective program courses; completion of other program requirements to enable graduation within the year of completion of ENGR 4962.
In this capstone course, students work in teams on advanced projects that emphasize engineering design with due attention to design constraints and engineering standards. The overarching scope of this course is to transform engineering students to practicing engineers. Under the guidance of a faculty instructor and a mentor, each team conducts literature searches, write a technical proposal and its members develop skills in information analysis and synthesis; they model and test prototypes of their devices, and make frequent oral and poster presentations of their work to faculty and peers, and submit timely progress reports. In the process, they receive instruction in effective communication and presentation practices, and develop an appreciation of teamwork and collective success. This two-semester sequence of courses begins in the fall of the academic year and concludes at the end of the spring term with a final team oral presentation and a final written report, and a working prototype of the team's project. It also includes sample hardware fabrication in the machine laboratory.

ENGR 4962 Senior Design Project II 3 Credits
Prerequisite(s): ENGR 4961.
In this capstone course, students work in teams on advanced projects that emphasize engineering design with due attention to design constraints and engineering standards. The overarching scope of this course is to transform engineering students to practicing engineers. Under the guidance of a faculty instructor and a mentor, each team conducts literature searches, write a technical proposal and its members develop skills in information analysis and synthesis; they model and test prototypes of their devices, and make frequent oral and poster presentations of their work to faculty and peers, and submit timely progress reports. In the process, they receive instruction in effective communication and presentation practices, and develop an appreciation of teamwork and collective success. This two-semester sequence of courses begins in the fall of the academic year and concludes at the end of the spring term with a final team oral presentation and a final written report, and a working prototype of the team's project. It also includes sample hardware fabrication in the machine laboratory.

ENGR 4980 Internship 0-3 Credits
Internships are off-campus experiential learning activities designed to provide students with opportunities to make connections between the theory and practice of academic study and the practical application of that study in a professional work environment. Internships offer the opportunity to "try out" a career while gaining relevant experience and professional connections. Internships are completed under the guidance of an on-site supervisor and a faculty member, who in combination with the student will create a framework for learning and reflection.

ENGR 4990 Independent Study 1-3 Credits
This course is an individualized study under the supervision of a faculty member. Undergraduate students work with a faculty mentor in studying and investigating topics of current interest in engineering or computer science. Students are required to conduct research independently or in collaboration with a faculty member, write a research report or create a poster and present the research in an annual research symposium at the university or elsewhere. Enrollment by departmental approval only.

ENGR 5308 Autonomous Mobile Robots 3 Credits
In this course, students will design and construct functional autonomous robots using provided hardware and electronics to implement multiple “simultaneous” behaviors: position control, obstacle avoidance, and objective completion. Students will focus on programming multi-behavior capability on a robot. In doing so, students will become familiar with microcontroller programming, data acquisition, motors, and sensor characterization for different sensors, such as inertial measurement units, timers, distance sensors / rangefinders, cameras, and beacons. This course will cover the fundamentals of robotic architecture: low-level and high-level control. For low level control, students will implement feedback controllers for orientation and displacement. For high level control, students will program or teach decision-making capabilities for their robot. Robots may complete specific high-level tasks, such as snow removal, lawn mowing, parcel delivery, and a tank battle. Ultimately, students will learn to fuse multiple, simultaneous robot behaviors to produce a functioning, “thinking” autonomous mobile robot with natural behavior. Students may use premade robotic chasses if preferred. Students select a related research topic, identify a technical paper to review, and provide a presentation. Undergraduate equivalent: ENGR 4308.

ENGR 5980 Internship 0-3 Credits
Internships are off-campus experiential learning activities designed to provide students with opportunities to make connections between the theory and practice of academic study and the practical application of that study in a professional work environment. Internships offer the opportunity to "try out" a career while gaining relevant experience and professional connections. Internships are completed under the guidance of an on-site supervisor and a faculty member, who in combination with the student will create a framework for learning and reflection.

ENGR 5990 Independent Study 1-3 Credits
This course is an individualized study under the supervision of a faculty member. Graduate students work with a faculty mentor in studying and investigating topics of current interest in engineering or computer science. Students are required to conduct research independently or in collaboration with a faculty member, write a research report or create a poster and present the research in an annual research symposium at the university or elsewhere. Enrollment by departmental approval only.