SCHOOL OF ENGINEERING AND COMPUTING

A Message from the Dean

Welcome to the School of Engineering and Computing at Fairfield University. We are devoted to serving students as they successfully pursue undergraduate and graduate engineering degrees. The School provides opportunities for students to combine study with experience and professional practice through classroom instruction, industrial internships, and experiential learning offering the prospect for the best in engineering education.

The School of Engineering and Computing strives to maintain the highest level of instructional integrity and remains committed to the Ignatian pedagogical ideals.

We provide a learning environment that produces engineers and computer scientists that will use their talents and skills to promote social justice and pursue technological solutions to the most pressing societal problems. This is a true reflection on our ongoing mission to graduate *engineers with a higher purpose*.

On our website, you will find detailed listings of the educational objectives of each of the programs offered in the School of Engineering and Computing. The curricula and degree requirements are linked to the objectives through student learning outcomes leading to national accreditation. The engineering curricula include the University's *Magis* Core - the hallmark of Fairfield's education - that aims to help transform our students into critical thinkers.

On behalf of the entire School of Engineering and Computing, welcome!

Andres Leonardo Carrano, PhD
Dean, School of Engineering and Computing

School Overview

Vision

To become the most emblematic Jesuit Engineering and Computer Science program in the U.S.

Mission

To provide every student with a rigorous technical education, infused with humanities and liberal arts, anchored on the principles of Ignatian Pedagogy (IPP), and aimed at forming individuals who will lead purposeful lives with a sense of social justice and a strong interior life.

Purpose

To help our students on their path to a better future and towards becoming the best version of themselves, in service to one another and for the greater good.

Mentoring

Entering and continuing students meet with academic advisors to design jointly their schedule of courses. Students review their academic records before course registration each semester with assistance from advisors to keep abreast of their progress. The school provides counseling to students upon request so that their academic goals can be achieved. Department chairs and program directors are actively involved in student advising and mentoring. Practicing engineers are often invited to participate in mentoring of interdisciplinary teams in the final senior design project.

Tutoring

Out-of-classroom assistance, provided by engineering professionals, and peer tutors is available in the school's tutorial center on a daily basis. A schedule of tutorial/mentoring services is distributed to all students in the beginning of each term.

Facilities

The offices of the School of Engineering and Computing, along with classrooms, primary laboratory and computer facilities are located in the Bannow Science Center. The engineering reference and circulating collection is housed in the University's DiMenna-Nyselius Library. The School's laboratories are equipped with modern instrumentation and are improved annually with financial assistance of the university, the alumni and private foundations. In order to provide an environment for experiential learning that is closely integrated with classroom learning, the School of Engineering and Computing laboratories provide the capability for demonstration of phenomena, simulation of processes, measurements, and data management. Finally, a growing number of engineering courses are offered online as needed. The School's website offers information on the School, its programs, courses, and faculty.

Transfer Admission

General Transfer

Students with previous studies at other accredited institutions may apply for transfer to the School of Engineering and Computing. Credit for work completed elsewhere, with a grade of C or better, will be granted for equivalent Fairfield courses, in accordance with Fairfield University guidelines. The transfer student must provide an official transcript of all academic work and a catalog with course descriptions from each institution previously attended.

School Activities/Relationships with Area Industry

Engineering students at Fairfield University may join the Engineering Student Society (ESS), an umbrella organization that embraces student chapters of the American Society of Mechanical Engineers, Society of Automotive Engineers, the Institute of Electrical and Electronics Engineers, and the Society of Women Engineers. Students are encouraged to join ESS and profit from events sponsored by the chapters. Engineering students initiated an Engineers Without Borders student chapter in 2015.

The School of Engineering and Computing maintains direct relations with area industries and manufacturers. Students are encouraged to post their resumes on the University's Career Development site, Stage4Hire, and to visit the site often to check for jobs and internships. These open lines of communication encourage the flow of information and support that keeps the engineering curriculum current and relevant to the environment in industry. These contacts are particularly useful to students in the senior design project course where they tackle real-life engineering problems encountered by practicing engineers and become involved in the mainstream of engineering activity.

School of Engineering and Computing Executive Advisory Board

The School of Engineering and Computing (SOEC) receives philanthropic support and strategic guidance from the SOEC Advisory Board, a group of men and women in leading positions in industry and education.

Additionally, each program area in the SOEC receives program development guidance from its program advisory board.

Degrees

Bachelor of Science

The School of Engineering and Computing offers undergraduate programs leading to the Bachelor of Science in the following fields:

- Biomedical Engineering
- Computer Science
- Electrical Engineering
- Mechanical Engineering
- Mechatronics Engineering

Students in these programs complete 126 to 135 credit hours. Students begin their studies with ENGR 1031 Fundamentals of Engineering or CPSC 1101 Introduction to Computing and complete the degree requirements with the team-based Senior Design Project. ENGR 1031 is designed to introduce first-year students to important design elements and the tools of engineering and develop their skills in analysis and synthesis, and in teamwork. It further provides the basis for students to select the engineering discipline most suitable to their skills and career objectives. The Senior Design Project caps students' engineering education by implementing engineering design principles and associated skills in designing for functionality, reliability, sustainability and economy in real-world projects undertaken by multidisciplinary teams. All School of Engineering programs include experiential learning in laboratory courses and culminate with the Senior Design Project. Students can avail themselves of opportunities for independent study and for internships in local industry. The undergraduate curriculum may be completed as a full-time traditional 4-year program or part time.

Part-Time Program

This program allows fully employed students to pursue engineering degrees on a part-time basis at a pace suited to their circumstances. Many employers provide tuition reimbursement. The curriculum requirements for the BS degrees through this program are the same as those for the full-time traditional programs. Engineering courses are available through evening and hybrid study courses. Advanced engineering classes, offered in the evening, are subscribed by both full-time and part-time students.

General and Major Electives

Major electives are chosen from the engineering department. The courses may be chosen with the approval of the student's advisor from among other courses offered in the School of Engineering.

General Electives may be chosen from any courses offered at the university and are frequently chosen to help fulfill requirements toward a selected minor.

Major Areas of Study

Specific program objectives and curriculum requirements are provided in the sections that follow each engineering discipline. In general, the curricula consist of four areas:

- major field requirements
- major field electives
- general education core curriculum courses
- general electives

Concentration within Majors

Certain major fields of study have specialized options that can be taken to fulfill special career plans, under advisement from the department chair. Numerous elective courses afford opportunities for students to gain deeper knowledge and skills in areas of their interest.

Minor Areas of Study

The School of Engineering offers minors in the following fields:

- Computer Science
- Engineering

Minors in Other Fields of Study

Engineering students are eligible for a mathematics minor with the completion of five mathematics courses. In addition, engineering majors can opt to fulfill the requirements for other minors.

Independent Study

Undergraduate and graduate independent studies are designed to allow students to pursue topics not offered through a traditional course. Independent studies may involve laboratory or research-based work in which the student investigates a research problem with a supervising professor.

A student wishing to pursue an independent study must prepare the Independent Study Request containing the information shown below and have it approved by the supervising professor, department chair and the dean's office

1. All undergraduate courses require the approval of the department and the Dean's office.
2. A student may take a maximum of one Independent Study course per semester.
3. An undergraduate Independent Study course may be for one or two credits. With department approval and only under special circumstances, an independent study course may be for three credits.
4. Undergraduate students may enroll in a maximum of six Independent Study courses.
5. Independent Study courses may not replace core or major elective courses for undergraduate students.
6. A student may take an Independent Study only from a Supervising Professor. A Supervising Professor must be a School of Engineering faculty member.
7. Before a student may register for an Independent Study course, the student must submit a written course proposal to the Supervising Professor. The course proposal must state the student's goals for the course. The Supervising Professor must approve the course proposal.
8. Each Supervising Professor sets his or her standards and expectations that each student must satisfy for course credit. A Supervising Professor may not award credit for an Independent Study unless the student produces a written final paper or poster paper that reflects learning and achievement that merit the award of course credit.

Independent Study Course Proposal Contents

1. Description of the proposed course - Describe the general theme and scope of the independent study. This may be stated as a problem to be investigated, an issue to be explored, or an argument to be defended. The description might indicate where the student is starting out and where the student would like to get in terms of answering a question, exploring a phenomenon, understanding a theory, building a skill or other goal
2. Clearly state the number of credits for this course. As a basis of comparison, one college credit represents approximately one hour spent in a classroom and 2 to 3 hours spent on homework or laboratory activities each week.
3. Together with the supervising professor, the student should identify the course's *Student Learning Outcomes*. Relate the student outcomes to the ABET student outcomes.
4. The supervising professor and the student should prepare a syllabus. Include the schedule that the supervising professor will meet with the student
5. Articulate the work to be completed by the student and evaluated by the instructor. Identify the major assignments, which may include the following
   a. Literature search
   b. Readings
   c. Written work
   d. Lab work
   e. A final paper which includes a problem statement, a possible solution to the problem, describes why the work is significant, and how the student will use this learning.
6. Evaluation – The supervising professor will create a grading rubric to evaluate the student's submittals based on the following:
   a. What was learned? What skills did the student gain from this course (e.g., problem solving, critical thinking, tools, etc.)?
   b. How the information was learned. For example, homework, lab assignments, quizzes, exams, reports, essays, research projects, presentations, case study analysis.
   c. The supervising professor will identify the criteria for assessing oral and other performances.

Core Curriculum

Students are obligated to complete the course of studies as described in the catalog used during the year they enter Fairfield University. A new set of core requirements has been designated for students entering the University during the 2019-2020 academic year. Students who entered Fairfield University prior to Fall 2019 must complete the previous core requirements, which may be found by referencing the Catalog Archive.

University Honors Program

The School of Engineering participates in the University Honors Program, an interdisciplinary course of study (23 credits) open to invited first-years and sophomores and devoted to intellectual history, interdisciplinary studies, and advanced work in the student's major field.

Five-Year Pathways to Bachelor's and Master's Degrees

- Biomedical Five-Year Accelerated Degree Program
- Data Science Five-Year Accelerated Degree Program
- Electrical and Computer Engineering Five-Year Accelerated Degree Program
- Management of Technology Five-Year Accelerated Degree Program
- Mechanical Engineering Five-Year Accelerated Degree Program
- Software Engineering Five-Year Accelerated Degree Program

A master's degree in engineering is becoming more commonly seen as the entry level degree in the workplace. A master's level engineering education gives a great return on your investment as well as a more focused and satisfying career.

Students can now complete a five-year pathway to both BS and MS degrees in Electrical and Computer Engineering, Mechanical Engineering. Computer Science (BA) students have an accelerated five-year pathway for Data Science MS, and our Computer Science (BS) students have an accelerated five-year pathway for Software Engineering. Additionally, in five years, students can also complete a BS degree in any of the undergraduate engineering programs followed by an MS in Management of Technology. Typically students should meet with their advisor during their junior year and complete detailed planning for the specific requirements for the bachelors and masters degrees that they are interested in. Students will have the opportunity to apply for the graduate portion of the program the summer before their senior year. All accelerated programs allow students to take two graduate courses during their senior year. All of the five-year pathways require a minimum of 3.00 GPA.

Courses

General Engineering

ENGR 1031 Fundamentals of Engineering **3 Credits**

Attributes: MWID 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**

Fee: $250 Engineering Lab Fee

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 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**
Attributes: EVAP Environmental Studies: Applied Professional Skills , EVPE Environmental Studies Elective
Corequisite: ENGR 2145P.
Prerequisite: 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 3260 Robots **3 Credits**
Prerequisite: 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**
Prerequisites: 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: 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: 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: 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: 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: ELEG 2213, CPSC 1131 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**
Attributes: HASM 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: 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: 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: 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.

Other Subjects

Consult the pages for each department for courses in the following fields:

- Bioengineering
- Computer Science and Software Engineering
- Electrical and Computer Engineering
- Mechanical Engineering