ENGR 100 Engineering Design Fundamentals (1 Credit Hour)
Restricted to students transferring into Engineering Science. This course provides an introduction to engineering design for students transferring into Engineering Science, who have completed an external Engineering Graphics course. Major topics include engineering estimation, 2k factorial design, teamwork, engineering ethics, and requirement specifications. Outcomes:
- Demonstration of proficiency in engineering design

ENGR 101 Introduction to Engineering Design (4 Credit Hours)
Restricted to School of Engineering students. This course is the first of four engineering design courses in the Engineering Science curriculum. Major topics in this course include engineering estimation, three dimensional computer-aided design, 2k factorial design, teamwork, engineering ethics, requirement specifications, and design iteration. 2. Application of teamwork principles to an open-ended design project. Outcomes:
- Demonstration of proficiency in engineering design

ENGR 102 Engineering Science Freshman Seminar (1 Credit Hour)
This seminar offers a shared learning experience with an assignment of a service project and exposure to Industrial Advisory Board members and Loyola administrators and faculty. In addition to providing intellectual enhancement to the program, these seminars give us a time and place to regularly interact. This class is restricted to Engineering Science freshman. Outcomes:
- Encourage bonding through a service project, stimulate thoughtful interaction, provide connections with the faculty, and connect to the broader industry community

ENGR 201 Experiential Engineering (3 Credit Hours)
This course introduces students to environmental, biomedical and computer engineering-based sensors and signal analysis techniques. Major topics in this course include an introduction to common biomedical sensors, electronics, signals, sampling, analog-to-digital conversion, c programming, microcontroller system architectures, and microcontroller programming. Restricted to Applied Mathematics majors OR restricted to Engineering Science majors with prerequisites (minimum C-) ENGR 101, COMP 170, PHYS 112K, and concurrent enrollment in CHEM 171. Introduce complex devices and systems to understand, measure and analyze signals. Outcomes:
- Provide an experiential environment to learn about instrumentation and sensors in biomedical, computer and environmental engineering

ENGR 311 Engineering Systems I (3 Credit Hours)
Pre-requisites: ENGR 201 with a minimum grade of C-
ENGR 311 covers the fundamentals of signal and system analysis, focusing on representations of discrete-time and continuous-time signals and representations of linear, time-invariant systems. Major topics in this course include convolution, Fourier series, Fourier Transform, and unit impulse and unit step functions. Applications are drawn broadly from engineering and physics. Restricted to Applied Mathematics and Engineering Science majors. Concurrent enrollment in MATH 266 (Engineering Science majors only). Outcome: Understand basic concepts of discrete and continuous time signals. Employ Fourier analysis to analyze simple LTI systems. Proficiently use MATLAB as a numerical analysis tool.

ENGR 312 Engineering Systems II (3 Credit Hours)
Pre-requisites: ENGR 311 with a minimum grade of C-
ENGR 312 introduces numerical methods and control systems theory. Students are exposed to root finding, numerical integration and differentiation, numerical solutions to ODEs, curve fitting and regression techniques, classical control system theory methods (Laplace transforms and transfer functions, root locus design, Routh-Hurwitz stability analysis, Bode and Nyquist plots) and the state variable method (controllability and observability). Restricted to Engineering Science and Applied Mathematics majors. Use MATLAB as a numerical analysis tool. Apply Laplace transforms and transfer functions. Employ the state variable method. Outcomes:
- Understand the concepts of numerical methods, their strengths and weaknesses

ENGR 313 Engineering Systems III (3 Credit Hours)
Pre-requisites: ENGR 312 with a minimum grade of C-
This course is an introduction to discrete-time signal processing and system identification. Major topics include the z-transform, infinite/finite impulse response filters, discrete/fast Fourier transform, models of linear time-invariant systems, and parameter estimation methods. Restricted to Applied Math and Engineering Science majors. Execute discrete-time signal processing techniques. Solve real-world problems through use of modeling, prediction, and estimation methods. Outcomes:
- Reinforce fundamental knowledge of signal processing concepts

ENGR 321 Electronic Circuits and Devices (2 Credit Hours)
This course is an introduction to electronic circuits and devices. Major topics in this course include an introduction to Ohm's Law, Kirchhoff's Voltage Law, Kirchhoff's Current Law, Kirchhoff's Voltage Law, Nodal and Loop analysis, Thevenin's and Norton's Theorems, and alternating current steady-state analysis. Restricted to Engineering Science majors. ENGR 201, PHYS 112K with a minimum grade of C-, concurrent enrollment in ENGR 311, MATH 266. Identify and solve linear circuits utilizing the most appropriate method for the analysis. Outcomes:
- Define and explain the terminology associated with linear circuit theory

ENGR 322 Chemical & Thermal Processes (3 Credit Hours)
Pre-requisites: MATH 266, CHEM 171, ENGR 321, each with a minimum grade of C-
This course provides an introduction to basic chemical and thermal processes. Major topics include open and closed systems, control volumes, microscopic vs. macroscopic, mass and energy balances, first and second laws of thermodynamics, entropy balance, exergy balance, thermodynamic cycles, thermodynamic property relations, gas laws, and chemical thermodynamics. Restricted to Engineering Science majors. Concurrent enrollment in ENGR 324L. Outcomes:
- Describe engineering systems and cycles using mass and energy conservation laws, quantify chemical and thermodynamic properties of pure substances, and analyze thermodynamics cycles and processes
ENGR 323 Digital Electronic & Computer Engineering (2 Credit Hours)
Pre-requisites: ENGR 321 with a minimum grade of C-
This course is an introduction to digital design. Major topics in this course include, but is not limited to, binary conversions, logic gates, combinational logic design, sequential logic design, microprocessor architecture, and an introduction to hardware description languages. Restricted to Engineering Science majors. Concurrent enrollment in ENGR 324L Understand and apply knowledge in the implementation and design of digital circuits.
Outcomes:
Understand the fundamental building blocks of digital systems

ENGR 324 Mechanics (3 Credit Hours)
Mechanics covers the fundamentals of modeling continuous media. Major topics include stress, strain, and constitutive relations; elements of tensor analysis; basic applications of solid and fluid mechanics; and application of conservation laws to control volumes. PREREQUISITES: ENGR 311 with a minimum grade of C-, concurrent enrollment in ENGR 324L Apply the laws of conservation to solve engineering problems.
Outcomes:
Construct free-body diagrams to undertake structural analysis

ENGR 324L Core Engineering Lab (1 Credit Hour)
Pre-requisites: ENGR 311 with a minimum grade of C-
This lab course enables students to experiment with concepts learned in concurrently taken core engineering courses ENGR 322, ENGR 323 and ENGR 324. Restricted to Engineering Science majors. Concurrent enrollment in ENGR 322, ENGR 323, and ENGR 324. Apply Thermodynamic and Flow principles in an experimental context.
Outcomes:
Understand, apply and create an assembly-based program for ARM-based microprocessors

ENGR 325 Materials Engineering (3 Credit Hours)
Pre-requisites: ENGR 322, ENGR 323, ENGR 324, ENGR 324L, each with a minimum grade of C-
This course introduces concepts related to the structure, properties, and processing of materials commonly used in engineering applications. Major topics include material structure, bonding, crystalline and non-crystalline structures, imperfections, properties of metals, metal alloys, ceramics and polymers, phase transformation, and material failures. Restricted to Engineering Science majors.
Outcomes:
Describe the microscale structure of metals, ceramics, polymers, and composites; quantify and describe relationships among structure, processing, and properties; understand the role of material selection in contemporary engineering design applications

ENGR 341 Medical Device Systems (3 Credit Hours)
The relevant physiology, clinical need, history, and system descriptions of eighteen fundamental medical devices are discussed and analyzed. Students are also introduced to several medical device systems, including medical instruments, electrical stimulators, and combination products. These topics provide a foundational background for medical device product development and regulation. Restricted to Engineering Science majors. PREREQUISITES: MATH 266 with a minimum grade of C-, concurrent enrollment in ENGR 313 and ENGR 341L. Evaluate the battery requirements for commonly implantable medical devices.
Outcomes:
Understand and analyze the clinical need and common subsystems underlying eighteen fundamental medical devices

ENGR 341L Medical Device Systems Laboratory (1 Credit Hour)
Introduction to the graphical user interface, data acquisition, and sensors of common medical devices. The lab experiments are synchronized with the presentation of medical device topics in ENGR 341. Students also create a software application for a Sponsor from the School of Nursing. Restricted to Engineering Science majors. Concurrent enrollment in ENGR 341. Apply FDA design control principles for creation of a nursing software application and accompanying requirement and design specifications.
Outcomes:
Use common medical devices subsystems

ENGR 342 Medical Device Software Development I (3 Credit Hours)
Pre-requisites: ENGR 341 and ENGR 341L, each with a minimum grade of C-
This is the second semester of a three-semester Specialty course series for students specializing in Biomedical Engineering. During the first four weeks, students increase their programming skills through exposure to recurrence solving, sorting, and data structures. Then they learn how design and verify medical device software using model-based engineering. Restricted to Engineering Science majors. Concurrent enrollment in ENGR 381.
Outcomes:
Design a medical device through model-based engineering concepts

ENGR 343 Medical Device Software Development II (3 Credit Hours)
This is the third semester of a three-semester Specialty course series for students specializing in Biomedical Engineering. During four weeks, students increase their programming skills through exposure to advanced data structures and graph algorithms. Separately, software issues that the Food and Drug Administration considers during medical device submissions are highlighted. Restricted to Engineering Science majors. ENGR 342 with a minimum grade of C-, concurrent enrollment in ENGR 391. Create user interface and cybersecurity code, according to Requirements Specifications provided by the instructor.
Outcomes:
Analyze software issues that the FDA considers during medical device submissions

ENGR 351 Electronic Circuit Analysis and Design (3 Credit Hours)
Pre-requisites: ENGR 321, ENGR 323, MATH 266 with minimum grades of C-, concurrent enrollment in ENGR313, ENGR 351L Outcomes: Understand and apply fundamental concepts of semiconductor physics A course for engineering science students (computer engineering) that introduces advanced topics in the design and analysis of analog and digital electronic circuits. Areas of emphasis include an introduction to semiconductor physics, diodes, BJTs transistors, CMOS devices, advanced operational amplifier circuits and frequency response fundamentals. Restricted to Engineering Science majors. Understand and apply complex models to analyze analog and digital microelectronic circuits.

ENGR 351L Circuit Design Laboratory (1 Credit Hour)
A lab for engineering science students (in the computer engineering specialization) to provide a first experience working with semiconductor devices (such as diodes, BJTs, MOSFETs, and Operational Amplifiers) for the design, creation and analysis of microelectronics using lab instruments. Concurrent enrollment in ENGR 351. Apply advanced principles in analog circuit design, creation and analysis.
Outcomes:
Identify integrated circuit design issues and develop applicable solutions
ENGR 352 Methods and Algorithms for Computer Engineers (3 Credit Hours)

**Pre-requisites:** ENGR 351, ENGR 351L, each with minimum grade of C, concurrent enrollment in ENGR 382

ENGR 352 is the second semester course of a three-semester Speciality course series for students specializing in Computer Engineering. The areas of emphasis are the analysis of the methods and algorithms used in computer engineering. The course includes hands-on experiments and a design project related to the computing performance and efficiency improvement of engineering systems Restricted to Engineering Science majors. Analyze the performance, efficiency and computational complexities of algorithms using the time-and-space tradeoff.

**Outcomes:**
Evaluate the design and implementation of methods and algorithms in computer engineering

ENGR 353 Programmable Systems (3 Credit Hours)

**Pre-requisites:** ENGR 352 with minimum grade of C, concurrent enrollment in ENGR 392

ENGR 353 is the third semester course of a three-semester Specialty course series for students specializing in Computer Engineering. The course consists of an introduction to programmable logic controllers, relays, timers, counters, shift registers, human-machine interfaces and programmable embedded systems. The course includes hands-on experiments and a design project to evaluate the performance and efficiency of programmable systems, related safety issues and hardware troubleshooting for control and automation systems. Restricted to Engineering Science majors. Design modern engineering tools to integrate hardware and software components, and input-output devices used in industries.

**Outcomes:**
Evaluate the performance and efficiency of programmable controllers, embedded systems and processors

ENGR 361 Fundamentals of Environmental Engineering (3 Credit Hours)

**Pre-requisites:** MATH 266 and ENGR 322, each with a minimum grade of C

This is the first of three Specialization courses in Environmental Engineering. Topics include aquatic chemistry, chemical thermodynamics and kinetics, environmental soil and biogeochemistry, environmental organic chemistry, surface and groundwater hydrology, atmospheric processes, and fate and transport modeling of contaminants in natural and engineered systems. Restricted to Engineering Science majors. Concurrent enrollment in ENGR 313 and ENGR 361L.

**Outcomes:**
Apply principles of environmental engineering to describe and quantify key physical, biological and chemical phenomena in natural and engineered systems

ENGR 361L Fundamentals of Environmental Engineering Lab (1 Credit Hour)

This laboratory course introduces students to the analytical techniques such as mass spectrometry and titration, relevant to environmental engineering practice. This course emphasizes the design of field sampling campaigns of water and soil environments and the statistical data analysis of experimentally estimated water and soil parameters. Restricted to Engineering Science majors. Concurrent enrollment in ENGR 361. Design and conduct a field sampling campaign.

**Outcomes:**
Quantify fundamental environmental parameters with emphasis on water quality

ENGR 362 Water and Wastewater Engineering (3 Credit Hours)

Theoretical and conceptual design of systems for treating municipal wastewater and drinking water which include reactor theory, process kinetics, and models. Physical, chemical, and biological processes are presented, including sedimentation, filtration, biological treatment, disinfection, and sludge processing. Re-use of water and waste products are also covered. Restricted to Engineering Science majors.

**Pre-requisites:** ENGR 361, ENGR 361L, each with a minimum grade of C. Concurrent enrollment in ENGR 383.

**Outcomes:**
Undertake calculations related to unit processes and Undertake the required calculations to design a municipal water and wastewater treatment facility

ENGR 363 Contemporary Environmental Engineering Challenges (3 Credit Hours)

This is the third semester of a three-semester Specialty course series for students specializing in Environmental Engineering. Overview of engineering solutions to present day environmental issues. Technologies focused on the mitigation and adaptation to climate change, the modeling and design of best management practices Overview of engineering solutions to present day environmental issues. Technologies focused on the mitigation and adaptation to climate change, the modeling and design of best management practices for stormwater management, an exploration of conventional and renewable energy technologies and the design of green infrastructure. Restricted to Engineering Science majors. PREREQUISITES: ENGR 362 with a minimum grade of C. Concurrent enrollment in ENGR 393. Understand the current methods being employed to tackle current environmental issues.

**Outcomes:**
Make aware of present and future environmental challenges

ENGR 381 Biomedical Engineering Capstone Design I (4 Credit Hours)

A major design experience based on the knowledge and skills acquired in earlier course work and incorporating appropriate engineering standards and multiple realistic constraints. Each group is assigned an industry-sponsored medical device software problem to solve. Each week, a medical device product development or regulation topic is also introduced. Restricted to Engineering Science majors. ENGR 341

**Outcomes:**
ABET Student Outcome (2): An ability to apply engineering design to produce medical device solutions that meet specified needs with consideration for public health, safety, welfare, and other factors

ENGR 382 Computer Engineering Capstone Design I (4 Credit Hours)

First part of the team-based Capstone Design series for Computer Engineering students. Students focus on the design of an industry-sponsored project with practical, economic, and ethical constraints. They learn the fundamentals of product development, quality, reliability, ethics and project management as it relates to the field of computer engineering. Restricted to Engineering Science majors. ENGR 351

**Outcomes:**
ABET Student Outcome (2): An ability to apply engineering design to produce microelectronic solutions that meet specified needs with consideration for public health, safety, welfare, and other factors.
ENGR 383 Environmental Engineering Capstone Design I (4 Credit Hours)
A major design experience based on the knowledge and skills acquired in earlier course work and incorporating engineering standards and multiple realistic constraints. Each group is assigned an environmental engineering industry-sponsored design problem to solve. During the semester, specific environmental design and regulation case studies will be introduced. Restricted to Engineering Science majors. ENGR 361
Outcomes:
ABET Student Outcome (2): An ability to apply engineering design to produce environmental engineering solutions that meet specified needs with consideration for public health, safety, environmental and other factors

ENGR 391 Biomedical Engineering Capstone Design II (3 Credit Hours)
Second semester of a major design experience based on knowledge and skills acquired in earlier course work and incorporating appropriate engineering standards and multiple realistic constraints. Each group continues work on the industry-sponsored medical device projects assigned in ENGR 381. Medical device product development or regulation topics are also introduced. Restricted to Engineering Science majors. ENGR 381 during the same academic year, ENGR 342, concurrent enrollment in ENGR 343. This course satisfies the Engaged Learning requirement.
Outcomes:
ABET Student Outcome (2): An ability to apply engineering design to produce medical device solutions that meet specified needs with consideration for public health, safety, welfare, and other factors

ENGR 392 Computer Engineering Capstone Design II (3 Credit Hours)
Second semester of a major design experience based on knowledge and skills acquired in earlier course work and incorporating appropriate engineering standards and multiple realistic constraints. Each group continues work on the industry-sponsored design projects assigned in ENGR 382. Computer engineering or professional development topics are also introduced. Restricted to Engineering Science majors. ENGR 382 during the same academic year, ENGR 352, concurrent enrollment in ENGR 353. This course satisfies the Engaged Learning requirement.
Outcomes:
ABET Student Outcome (2): An ability to apply engineering design to produce computer engineering solutions that meet specified needs with consideration for public health, safety, welfare, and other factors

ENGR 393 Environmental Engineering Capstone Design II (3 Credit Hours)
Second semester of a major design experience based on knowledge and skills acquired in earlier course work and incorporating appropriate engineering standards and multiple realistic constraints. Each group continues work on the industry-sponsored design projects assigned in ENGR 383. Environmental engineering or professional development topics are also introduced. Restricted to Engineering Science majors. ENGR 383 during the same academic year, ENGR 361, ENGR 361L, ENGR 383, concurrent enrollment in ENGR 363. This course satisfies the Engaged Learning requirement.
Outcomes:
ABET Student Outcome (2): An ability to apply engineering design to produce environmental engineering solutions that meet specified needs with consideration for public health, safety, welfare, and other factors

ENGR 398 Independent Study (1-3 Credit Hours)
The course enables independent study of selected topics in Biomedical, Computer, and Environmental Engineering, under the supervision of a faculty member. It may be repeated for credit. Restricted to Engineering Science majors. Permission of Director.
Outcomes:
Application of engineering science concepts, and analysis of Biomedical, Computer, or Environmental Engineering systems