COMPUTER ENGINEERING

Department Website: Computer Engineering (https://www.gonzaga.edu/school-of-engineering-applied-science/degrees-and-programs/computer-engineering/)

The purpose of the electrical engineering (EE) and computer engineering (CpE) programs is to develop knowledgeable and competent engineering professionals who exemplify the humanistic, Catholic, and Jesuit tradition of education, and who are committed to social justice, service to others, life-long learning, ethical and moral responsibility, and concern for the environment. The integration of the Gonzaga University core curriculum as an essential part of the EE and CpE curricula gives the programs their distinct and desirable characteristics.

Roughly half of the credits in either the EE or the CpE program are devoted to engineering topics and design. While the EE program offers five technical electives, the CpE program provides four technical electives, allowing students to pursue specialization in one or more areas of electrical engineering and/or computer engineering. During their final year, students complete a design project, which involves both technical and non-technical aspects of an engineering problem, under faculty supervision. The senior design project culminates in a comprehensive written report and an oral presentation.

Career Opportunities

Graduates of our EE and CpE programs are well prepared to embark on careers in electrical engineering or computer engineering, or to further their education at graduate schools of their choice. Our graduates find employment with a broad segment of industry, as well as with governmental agencies. Employment opportunities include the design of electronic products, design of electrical systems, development of computer, hardware, software/firmware, robots, artificial intelligence (AI), computer applications, research and development, engineering consulting, electrical utilities, manufacturing, marketing, operations and maintenance, administration, and teaching. Moreover, electrical and computer engineers traditionally engage in interdisciplinary fields, such as aerospace engineering, national defense systems, global communication systems, biomedical engineering, instrumentation, transportation systems, energy conversion, robotics, and industrial automation. Many of our graduates have distinguished themselves at some of the best graduate schools in the USA. Moreover, a substantial number of our graduates have achieved high positions in academia, business, and government.

Computer Engineering (BS) Program Requirements

Course	Title	Hours
First Year		
Fall		
CHEM 101	General Chemistry I	3
CHEM 101L	General Chemistry I Lab	1
DEPT 193	FYS:	3
MATH 157	Calculus and Analytic Geometry I	4
PHIL 101	Reasoning	3
COMM 100	Communication and Speech	3
	Hours	**17**
Spring		
CPSC 121	Computer Science I	3
ENGL 101	Writing	3
MATH 258	Calculus and Analytic Geometry II	4
CPEN 230	Introduction Digital Logic	3
CPEN 230L	Introduction Digital Logic Lab	1
PHIL 201	Philosophy of Human Nature	3
	Hours	**17**
Second Year		
Fall		
CPEN 231	Embedded Computer Systems	3
CPEN 231L	Embedded Computer Systems Lab	1
PHYS 121	Physics I	4
PHYS 121L	Physics I Lab	1
EENG 201	Circuit Analysis I	3
EENG 201L	Circuit Analysis I Lab	1
MATH 231	Discrete Structures	3
	Hours	**16**
Spring		
CPSC 122	Computer Science II	3
CPEN 247	Network Interfacing and Sockets	3
EENG 202	Circuit Analysis II	3
MATH 259	Calculus and Analytic Geometry III	4
Religion Requirement: Christianity and Catholic Traditions		3
	Hours	**16**
Third Year		
Fall		
CPSC 223	Algorithm and Abstract Data Structures	3
EENG 303	Electronics Design I	3
EENG 303L	Electronics Design I Lab	1
EENG 311	Signals and Systems I	4
MATH 260	Ordinary Differential Equation	3
Ethics core requirement		3
	Hours	**17**
Spring		
CPEN 342	Cyber-Physical Systems	3
CPEN 342L	Cyber-Physical Systems Lab	1
EENG 304	Electronics Design II	3
EENG 304L	Electronics Design II Lab	1
EENG 322	Signals and Systems II	3
Religion Requirement: World or Comparative Religion		3
Core Broadening Requirement		3
	Hours	**17**
Fourth Year		
Fall		
CPEN 430	Digital System Design	3
CPEN 430L	Digital System Design Lab	1
CPEN 442	Introduction to Robotics	3
Technical elective [1]		3
ENSC 491	Senior Design Project I	2
Technical elective [1]		3
	Hours	**15**
Spring		
ENSC 492	Senior Design Project II	3
ENSC 400	Foundations of Engineering Exam	0
Technical elective [1]		3
Technical elective [1]		3
Technical elective [1]		3
ENSC 432	CIS:	3
	Hours	**15**
	Total Hours	**130**

[1] Approved EENG, CPEN or CPSC elective courses

Technical Electives in Computer Engineering

Only 300 and 400 level courses that are not required in the degree plan can be used to satisfy the technical elective requirements. Approved electrical and computer engineering and computer science courses with an EENG, CPEN or CPSC designation may be used as electives. The student's advisor must approve the selection. However, a maximum number of two approved computer science courses with a CPSC course designation may be used to satisfy computer engineering technical elective degree requirements. Please see your advisor for current course offerings.

Computer Engineering and Computer Science

Code	Title	Hours
CPEN 431	Computer Hardware Design and Architecture	3
CPEN 435	Parallel & Cloud Computing	3
CPEN 436	Machine Learning in Biomed	3
CPEN 443	Autonomous Mobile Robots	3
CPSC 321	Database Management Systems	3
CPSC 322	Data Science Algorithms	3
CPSC 346	Operating Systems	3
CPSC 435	Parallel and Cloud Computing	3
CPSC 436	Biomedical Informatics and Computing	3
CPSC 450	Design and Analysis of Computer Algorithms	3

Electrical Engineering

Code	Title	Hours
EENG 340 & 340L	Introduction Electric Power Engineering and Introduction Electric Power Engineering Lab	4
EENG 401	Lower Power Bioelectronics	3
EENG 403	Passive and Active Filter Design	3
EENG 406	VLSI Circuits and Systems	3
EENG 410	Information Theory and Coding	3
EENG 411	Introduction to Control Systems	3
EENG 412	Digital Control Systems	3
EENG 413	Artificial Intelligence Powered Automation	3
EENG 421	Introduction Communication Systems	3
EENG 424	Digital Signal Processing	3

ECE: Concentration in Robotics

The Department of Electrical and Computer Engineering offers a Concentration in Robotics.

This concentration is for students majoring in either the BSEE or the BSCpE degrees. A student majoring in one of these programs may pursue the concentration as they are not eligible for a minor in this area. The concentration course requirements are identical regardless of the degree a student is seeking.

Code	Title	Hours
CPEN 442	Introduction to Robotics	3
CPEN 443	Autonomous Mobile Robots	3
Select two of the following:		6
CPEN 436	Machine Learning in Biomed	
EENG 411	Introduction to Control Systems	
EENG 412	Digital Control Systems	
EENG 424	Digital Signal Processing	

Courses

CPEN 193. FYS:. (3 Credits)
The First-Year Seminar (FYS) introduces new Gonzaga students to the University, the Core Curriculum, and Gonzaga's Jesuit mission and heritage. While the seminars will be taught by faculty with expertise in particular disciplines, topics will be addressed in a way that illustrates approaches and methods of different academic disciplines. The seminar format of the course highlights the participatory character of university life, emphasizing that learning is an active, collegial process.

CPEN 230. Introduction Digital Logic. (3 Credits)
Number systems and codes, Boolean Algebra, Logic gates and flip-flops. Verilog HDL. Combinational and sequential Logic Design using CPLDs. Three lecture hours per week.
Corequisites: CPEN 230L

CPEN 230L. Introduction Digital Logic Lab. (1 Credit)
Three laboratory hours per week. Taken concurrently with CPEN 230.
Corequisites: CPEN 230

CPEN 231. Embedded Computer Systems. (3 Credits)
Study of components of simple computer systems: CPU's memory, registers, busses, computer control, microprogramming, assembly language programming. Three lecture hours per week.
Prerequisites: CPSC 121 with a minimum grade of D or ENSC 201 with a minimum grade of D
Corequisites: CPEN 231L

CPEN 231L. Embedded Computer Systems Lab. (1 Credit)
Three laboratory hours per week.
Corequisites: CPEN 231

CPEN 247. Network Interfacing and Sockets. (3 Credits)
Reviewing main programming concepts. Introducing network models, services and applications. Processes Communications. UDP and TCP Client/Server Sockets. Offered during Spring semesters.
Prerequisites: CPSC 121 with a minimum grade of D

CPEN 342. Cyber-Physical Systems. (3 Credits)
The microcontroller as an engineering component. Hardware expansion with analog and digital devices. Board-level design of real-time systems. Design of user-friendly interactive displays. Design project. Troubleshooting with logic analyzers and in-circuit emulation. Three lecture hours per week.
Prerequisites: (CPEN 231 with a minimum grade of D or CPSC 260 with a minimum grade of D) and EENG 201 with a minimum grade of D and EENG 201L with a minimum grade of D

CPEN 342L. Cyber-Physical Systems Lab. (1 Credit)
Three laboratory hours per week. Taken concurrently with CPEN 342.
Corequisites: CPEN 342

CPEN 430. Digital System Design. (3 Credits)
Modern methods of digital design realization. Technology independence. Designs utilizing gate arrays and custom integrated circuits. Use of high-level design software. Extensive use of Verilog hardware design language for system description, simulation, and implementation. Three lecture hours per week.
Prerequisites: CPEN 231 with a minimum grade of D or CPSC 260 with a minimum grade of D
Corequisites: CPEN 430L

CPEN 430L. Digital System Design Lab. (1 Credit)
Three laboratory hours per week. Taken concurrently with CPEN 430.
Corequisites: CPEN 430

CPEN 431. Computer Hardware Design and Architecture. (3 Credits)
Understanding the design techniques, machine structures, technology factors, evaluation methods that will determine the form of computers in 21st century. Three lecture hours per week.
Prerequisites: CPEN 231 with a minimum grade of D or CPSC 260 with a minimum grade of D
Equivalent: CPSC 431

CPEN 435. Parallel & Cloud Computing. (3 Credits)
Parallel Programming platforms; principles of parallel algorithm design; basic communication operations; programming using the message-passing paradigm (MPI); programming on shared address space platforms (POSIX Thread and OpenMP); cloud computing; big data analysis; and other advanced topics. On sufficient demand.
Prerequisites: CPEN 231 with a minimum grade of D or CPSC 260 with a minimum grade of D
Equivalent: CPSC 435

CPEN 436. Machine Learning in Biomed. (3 Credits)
Investigation of the role of computers in the provision of medical services; machine learning algorithms for regression, classification, clustering, and anomaly detection; medical decision-making support; genomic medicine and its techniques. On sufficient demand.
Prerequisites: CPSC 121 with a minimum grade of D or ENSC 201 with a minimum grade of D
Equivalent: CPSC 436

CPEN 442. Introduction to Robotics. (3 Credits)
Principles of real-time systems and robotics. Thread management and inter-thread communications. Semaphores and thread synchronization. Design and simulation of simple robotic systems. Cooperation, blocking semaphores, FIFO queues, and deadlocks. Thread sleeping and scheduling. File system management, solid-state drives (SSDs), Controller Area Network (CAN). Robotic control systems and fuzzy logic.
Prerequisites: CPEN 231 with a minimum grade of D or CPSC 260 with a minimum grade of D

CPEN 443. Autonomous Mobile Robots. (3 Credits)
Introducing the principles of robotic sensor integration, mobility, real-time systems, line tracking, data acquisition systems, cognition: object detection and tracking, robotic wireless control, tachometers, and odometry. This course will be offered every spring semester
Prerequisites: CPEN 231 with a minimum grade of D or CPSC 260 with a minimum grade of D

CPEN 481. Special Topics. (1-3 Credits)
May be repeated for credit.
Courses of special interest may be offered from time to time. Prerequisites will depend on the nature of the material offered and will be announced.