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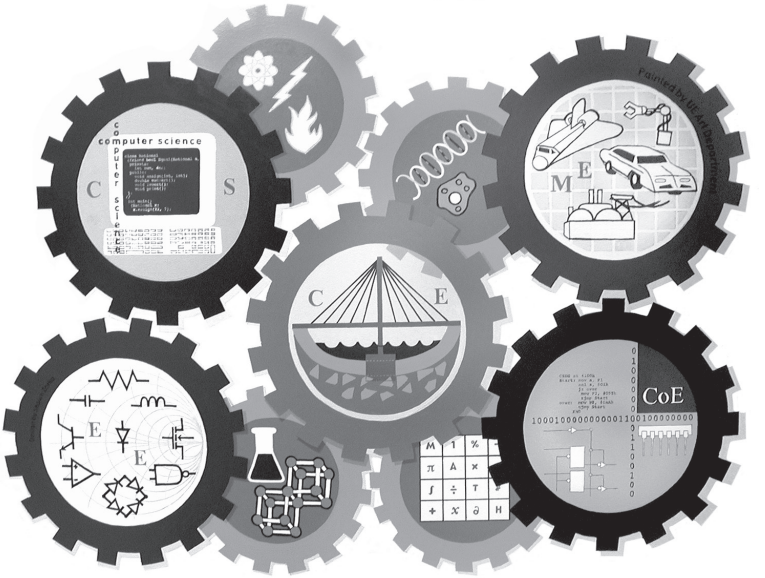

COMPUTER ENGINEERING
GUIDEBOOK

University of Evansville

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COMPUTER ENGINEERING PROGRAM GUIDEBOOK 2023-24

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Webpage

evansville.edu/computerengineering

ABET Computing & Engineering Accreditation Commissions

The Computer Engineering program at the University of Evansville is accredited by the Engineering Accreditation Commission of ABET; abet.org.

Revised 2023

PROGRAM OBJECTIVES

Computer engineers are always seeking new and innovative ways to make computers faster, more reliable, and smaller. They utilize design solutions to create and improve computer hardware and software. As technology becomes increasingly innovative and advanced, computer engineers will be in-demand across the globe. Practice areas include cybersecurity, manufacturing, artificial intelligence, embedded systems, consulting, and the biomedical field.

In accordance with ABET accreditation criteria, the faculty has established program educational objectives and outcomes for students majoring in Computer Engineering at the University of Evansville. The purpose of these is to ensure that graduates of the program are adequately prepared to enter the workforce fully prepared as computer engineers. Recognizing that performance of students and graduates is an important consideration in the evaluation of an institution, a system of ongoing assessment is conducted by faculty to continuously improve the effectiveness of the program.

Educational Objectives and Student Outcomes

"Graduates" are defined as Computer Engineering alumni within three to five years of graduation.

"Students" are defined as Computer Engineering students at the time of graduation from the University of Evansville.

Objective 1: *Graduates will be engaged in a professional career and continuing education, or advanced study in their chosen field. This implies that graduates will recognize the value and necessity of lifelong learning.*

- **Outcome 1a.** Students will have an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics. (ABET EAC outcome 1)
- **Outcome 1b.** Students will have an ability to acquire and apply new knowledge as needed, using appropriate learning strategies. (ABET EAC outcome 7)

Objective 2: *Graduates will be engaged in applications of problem-solving and communication skills for a wide variety of problems in engineering or computer science, either as individuals or in teams.*

- **Outcome 2a.** Students will have an ability to function effectively on a team whose members together provide leadership, create a collabo-rative and inclusive environment, establish goals, plan tasks, and meet objectives. (ABET EAC outcome 5)

- **Outcome 2b.** Students will have an ability to apply engineering design to produce solutions that meet specified needs with consid-eration of public health, safety, and welfare, as well as global, cul¬tural, social, environmental, and economic factors. (ABET EAC outcome 2)
- **Outcome 2c.** Students will have an ability to communicate effectively with a range of audiences. (ABET EAC outcome 3)
- **Outcome 2d.** Students will have an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions. (ABET EAC outcome 6)

Objective 3: *Graduates will be active participants in a local, national, or global engineering or computer science community.*

- **Outcome 3a.** Students will have an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineer¬ing solutions in global, economic, environmental, and societal con¬texts. (ABET EAC outcome 4).

In addition to strong technical skills, today's engineers in the global marketplace must be adept at working with other people who have very different professional backgrounds and who may be from other countries with different cultures. The University of Evansville is helping engineers meet that challenge by providing students with a strong liberal arts background and providing an opportunity for an international experience at Harlaxton, our study abroad center in England.

The Computer Engineering program at UE provides an in-depth understanding of electrical engineering and computer science topics. Students receive extensive training in software design and implementation. The curriculum provides a broad-based understanding of hardware and software. Students will have a heavy focus on C++ programming language, data structures, computer-aided design and simulation, and electric and digital circuit analysis. Laboratories are incorporated into the curriculum to provide hands-on training with computers and software design.

Students apply their knowledge to various projects during the second half of the program. This includes designing and inventing hardware and software to meet customized specifications. During this time, students will not only work with teams of students but also one-on-one with highly qualified professors.

The Computer Engineering curriculum is typical of most EAC-ABET accredited colleges and universities. What differentiates UE's program from larger university programs is the following:

- Students have the opportunity to study abroad at Harlaxton in England and still complete their Computer Engineering degree in eight semesters.
- Class sizes are small, allowing close personal contact between students and professors and for design project opportunities.
- The faculty is dedicated to teaching, which gives the program great flexibility. Course content is kept up-to-date, and innovative instruction techniques, such as interdisciplinary team projects, cooperative learning, and concurrent engineering are used in the classroom.
- Emphasis is placed on preparing students to enter the practice of Computer Engineering upon graduation.
- A personalized co-op program, featuring alternating terms of paid, full-time professional employment and University attendance, is available.
- The University's size and diversity facilitates the ability of Engineering students to interact with students and faculty in other programs, thus allowing intellectual and social interchange.
- Students are mentored to develop a love of learning and discovery that will motivate them to be lifelong learners.

UNDERGRADUATE RESEARCH

There are numerous opportunities to conduct undergraduate research. All students are encouraged to participate in at least one undergraduate research project at some point during their four years at UE. Students who have an interest in graduate school are strongly encouraged to participate in multiple programs. Some of the undergraduate research opportunities available to students studying Electrical or Computer Engineering or Computer Science are described below.

NSF Sponsored Research Experience for Undergraduates *(REU)*
This program is sponsored by the National Science Foundation. It allows undergraduates to participate in research projects at major research institutions across the country. Participating students typically have a B+ or better grade point average and have achieved junior status. Most REUs provide a stipend (about $2,000 to $3,000 for 10 weeks) and some provide a housing or moving allowance. All REUs take place during the summer. For more information visit the website at nsf.gov/crssprgm/reu/index.jsp.

UE Sponsored Undergraduate Research
The University of Evansville also sponsors summer research projects, which typically provide a housing allowance or a stipend. Almost all academic areas participate in these projects which are awarded to students on a competitive basis. All projects result in a student publication or presentation at a national or regional conference.

Special Topics and Independent Study
Many professors are willing to sponsor research projects during the school year. Students typically register for Electrical Engineering 498 or Computer Science 498 and receive 1-3 hours of credit for such study.

National Competition Projects
Computer Engineering students participate in several regional and national competitions, and all students (including freshmen) are eligible to participate in these projects. The southeast region of the Institute of Electrical and Electronics Engineers sponsors a robot competition each year. This is a team project and is usually completed as part of the senior design. Trinity University in Connecticut sponsors a national firefighting robot competition in which a robot must find its way through a maze, locate a candle, and extinguish it.

CO-OP PROGRAM

Computer Engineering majors are encouraged to participate in cooperative education (co-op program) or internships during their time at UE. These programs offer students the opportunity to gain industrial experience working as an computer engineer while completing their Bachelor of Science in Computer Engineering (BSCoE).

Internships are available to students who would like to gain engineering work experience without a long-term commitment. Internships are available as full-time jobs during the summer or as part-time jobs during the school year.

The typical Computer Engineering co-op student goes to school the first two years just as a non-co-op student does. At the end of their sophomore year the co-op student goes to work and works through the summer. The student is back in school in the fall and out to work in the spring. Thereafter, the student alternates between work and school.

CO-OP CALENDAR			
Year	**Fall**	**Spring**	**Summer**
1	School 1	School 2	Work option
2	School 3	School 4	Work 1
3	School 5	Work 2	School/Work option
4	Work 3	School 6	Work 4
5	School 7	School 8	

Some students who are exceptionally well-prepared to enter the work force may begin their co-op period in the summer after the freshman year. This is unusual and most students begin after the sophomore year. The summer after the junior year may be either school or work as needed. Many students work through this summer, thereby completing a full calendar year on the job.

To enter the co-op program, students should enroll in Experiential Education 90. This is a noncredit course which should be taken during the fall of the sophomore year. This course covers such topics as résumé writing, interviewing, and what is expected on the job. During the spring of the sophomore year the typical co-op student interviews with prospective employers. The career placement office takes care of contacting employers and arranging interviews for students. Placement in a co-op or intern position is dependent on the outcome of the interview process.

Co-op and internship students in Computer Engineering have a wide range of employers to choose from. Employers are located in the immediate Evansville area, in the surrounding region of Indiana, Kentucky, and Illinois, and at various places throughout the country.

The companies listed below are some of the companies that have had Computer Engineering students with co-op or intern opportunities in the past. If a student wants to work for a company with which we do not presently have a co-op program, the Center for Career Development will contact that company and attempt to establish a program. The requirement to qualify as a legitimate co-op employer is that the company has to provide a Computer Engineering opportunity for a prospective engineer that is relevant to the student's education and chosen profession.

Alcoa	Intel Corporation	Vectren Energy Delivery
Boeing	NWSC Crane	Whirlpool Corporation
General Electric	Toyota	Wright-Patterson AFB

The real value of the co-op program is in the experience that it provides the student. A co-op job can be a financial benefit, but one term at work does not typically cover the cost of one term of education. The co-op program gives employers a chance to look at a student as a prospective employee without making a commitment to long-term employment. Likewise, these programs give the student a chance to look at a company and gain some experience before entering the work force as a working professional.

Students who participate in the co-op and intern programs normally get a higher salary offer upon graduation than do non-co-op students. In many cases the co-op employer provides a long-term employment opportunity for the co-op student upon graduation. About 25 percent of Computer Engineering students participate in the co-op program.

HARLAXTON OPTION

Harlaxton is the study abroad center of UE and is located in the rolling countryside of Grantham, England. Harlaxton is about a one-hour ride by train from London. Engineering students who choose to spend a semester studying at Harlaxton have easy access to England's culture, history, and entertainment.

Harlaxton is housed in a large Victorian manor where about 300 students and faculty members live and hold classes. The Manor has a state dining room, library, soccer field, sports hall, student lounges, bistro, tennis courts, and a number of historic state rooms where classes are held.

Computer Engineering students who wish to study one semester in England are encouraged to do so during the first semester of their sophomore year. At Harlaxton, Computer Engineering students typically take Calculus, British studies, and general education classes. Harlaxton is on the semester system and all classes earn credit in the same way they would if they were taken in Evansville. Since the Computer Engineering program requires a number of general education classes, all classes taken at Harlaxton count as required courses toward the computer engineering degree. Tuition at Harlaxton is the same as tuition at UE and all scholarships and loans may be applied to Harlaxton costs.

Students at Harlaxton are encouraged to travel on weekends. The Manor arranges eight to 10 weekend field trips to locations such as Nottingham, London, Scotland, and Wales. During some semesters, less frequent but longer trips are arranged to Ireland and throughout the continent.

Harlaxton has its own resident British faculty as well as visiting faculty from UE and other universities in the US. Likewise, students at Harlaxton come from UE as well as other universities in England and the US.

Harlaxton Costs

While tuition at Harlaxton is the same as tuition at UE and all scholarships apply to Harlaxton, there are additional costs, namely those of travel. The typical airplane round-trip is about $1,500 and the typical student at Harlaxton will spend an additional $4,000 on weekend trips, souvenirs, and other miscellaneous expenses.

HONORS PROGRAM

The Honors Program is open to select students. Typically students apply when admitted to the University, but they also may apply during the first year of study. Admittance to the Honors Program is determined by the University Honors Committee on the basis of standardized test scores, high school grade point average, extracurricular activities, and an essay. The Honors Program provides participants with the opportunity to interact with other Honors Program students, both socially and academically. Special honors courses and other academic events are available for honors students. Honors students are able to register early, live in the honors residence hall, and receive a University Honors designation on official transcript.

To successfully complete the Honors Program, a student must fulfill the following requirements.

- Achieve a GPA of 3.5 or above by the time of graduation
- Complete 15 credit hours of honors courses
- Complete an honors project
- Earn four honors participation points per semester

Honors courses are designated as such by the Registrar. In addition, a limited number of courses may be contracted formally as honors courses, generally requiring additional or alternative coursework. A sufficiently complex Computer Engineering senior project can be approved as an honors project. Often these projects are more research-oriented than the typical senior project.

Honors participation points are earned by attending Honors Program activities. Each semester a major event is held that is worth three honors participation points. Currently the fall event is a formal banquet and the spring event is a Nerd Wars Trivia night. In addition, six to eight smaller events are organized that are worth one honors participation point each. These events include group attendance at athletic events, UE Theatre and Music Conservatory performances, other academic or social events, and Honors Project presentations. Students studying at Harlaxton or other study abroad programs are granted the four honors participation points for that semester automatically in recognition of the study abroad experience.

Honors Activities (points vary)
Students may receive Honors Program points for activities other than traditional coursework. These might include a summer research experience for undergraduates (REU) program, an internal research project, a paper or poster presentation, a summer internship, completion of the co-op program, participation in an IEEE or ACM-sponsored contest, participation in community projects, or a leadership role in a student professional organization.

Bachelor of Science in Computer Engineering

FALL			SPRING		
FRESHMAN					
ENGR 101	Introduction to Engineering	3	CS 210	Fundamentals of Programming I	3
FYS 112	First-Year Seminar	3	MATH 222	Calculus II	4
MATH 221	Calculus I	4	PHYS 210	Calculus Physics I	4
	Foreign Language 111*	3		Foreign Language 112*	3
	General Education	3		General Education	3
		16			17
SOPHOMORE					
CS 215	Fundamentals of Programming II	3	MATH 341	Linear Algebra	3
			EE 215	Circuits II	3
EE 210	Circuits	3	EE 254	Logic Design	3
MATH 324	Differential Equations	3	EE 342	Electronics I	3
MATH 323	Calculus III	4	ENGR 390	Applied Engineering Math	3
PHYS 211	Calculus Physics II	4			
		17			15
JUNIOR					
MATH 370	Discrete Mathematics	3	CS 315	Algorithms and Data Structures	3
EE 330	Introduction to Power Systems	3	CS 470	Operating Systems	3
EE 310	Signals and Systems	3	EE 380	Instrumentation	3
EE 343	Electronics II	3	EE 360	Control Systems	3
EE 354	Embedded Systems	3	EE 454	Microcontroller Applications	3
		15			15
SENIOR					
CS 475	Networks	3	EE/CS 497	Senior Project Phase 2	3
EE/CS 495	Senior Project Phase 1	3		Computer Engineering Elective	3
	Computer Engineering Elective	3	EE 320	Computer Architecture	3
	General Education	3		General Education	3
	General Education	3		General Education	3
	Health and Wellness	1			
		16			15

*Note: Only if necessary to meet the University foreign language requirement.

Harlaxton Option Plan of Study
Bachelor of Science in Computer Engineering

FALL			SPRING		
		FRESHMAN			
EE 101	Introduction to Electrical Engineering	3	CS 210	Fundamentals of Programming I	3
FYS 112	First-Year Seminar	3	EE 210	Circuits I	3
MATH 221	Calculus I	4	MATH 222	Calculus I	4
	General Education	3	PHYS 210	Calculus Physics I	4
	Foreign Language*	3		Foreign Language*	3
		16			17
		SOPHOMORE			
BRIT 2XX	British Studies	3	CS 215	Fundamentals of Programing II	3
BRIT 2XX	British Studies	3			
MATH 324	Differential Equations	3	EE 215	Circuits II	3
	Health and Wellness	1	EE 342	Electronics I	3
	General Education	3	EE 254	Logic Design	3
	General Education	3	MATH 323	Calculus III	4
		16			16
		JUNIOR			
EE 310	Signals and Systems	3	CS 315	Algorithms and Data Structures	3
EE 343	Electronics II	3			
EE 354	Embedded Systems	3	CS 470	Operating Systems (ODD)	3
ENGR 390	Applied Engineering Mathematics	3	EE 360	Linear Control Systems	3
			EE 380	Instrumentation	3
MATH 370	Discrete Mathematics	3	EE 454	Microcontroller Applications	3
		15			15
		SENIOR			
CS 475	Networks	3	CS 320	Comp. Architecture	3
EE495	Senior Project Phase 1	3	EE497	Senior Project Phase 2	3
PHYS 211	Calculus Physics II	4	MATH 341	Linear Algebra	3
EE 330	Introduction to Power Systems	3		Technical elective	3
	Technical Elective	3		General Education	3
		16			15

*Note: Only if necessary to meet the University foreign language requirement.

Engineering Management Minor

A minor in Engineering Management is offered by the School of Engineering and Computer Science in cooperation with the Schroeder Family School of Business Administration. For Electrical and Computer Engineering students, the Engineering Management minor can be earned by taking the following courses.

Engineering Management Minor *(18 hours)*

ECON 101	Principles of Macroeconomics (general education elective)
or	
ECON 102	Principles of Microeconomics
ENGR 390	Applied Engineering Mathematics (required)
ENGR 409	Engineering Economy and Decision Making
COMM 380*	Intercultural Communication (general education outcome 9 and overlay A)
or	
BUS 100	Introduction to Business
MGT 331	International Business Strategy
or	
MGT 377	Organizational Behavior
LSCM 315	Introduction to Logistics and Supply Chain Management

All Computer Engineering students pursuing this minor should see an advisor to carefully choose courses which also meet general education requirements.

Mathematics Minor

To obtain a minor in Mathematics from the College of Arts and Sciences, students must take MATH 221, MATH 222, and four Mathematics courses numbered 300 or above (including ENGR 390 and PHYS 305). Students who satisfy the Computer Engineering degree requirements automatically satisfy the requirements for the minor in Mathematics.

Computer Science Minor

A minor in Computer Science is offered by the School of Engineering and Computer Science. Electrical and Computer Engineering students can earn a Computer Science minor by taking the following courses.

ENGR 123	Programming for Engineers
or	
CS 210	Fundamentals of Programming I
CS 220	Logic Design and Machine Organization
or	
EE 254	Logic Design
CS 215	Fundamentals of Programming II
CS 290	Object Oriented Design

Plus 9 hours of 300 or 400 level CS courses

Computer Engineering students automatically satisfy the requirements for the minor in Computer Science.

COURSES

For course descriptions, visit evansville.edu/computerengineering and select Course Offerings under the About Our Program menu.

EE 210 Circuits

EE 215 Circuits and Systems

EE 224 Electrical Engineering Programming Laboratory

EE 254 Logic Design

EE 310 Signals and Systems

EE 311 Linear Systems and DSP II

EE 320 Engineering Electromagnetics

EE 330 Introduction to Power Systems

EE 342 Electronics I

EE 343 Electronics II

EE 354 Digital Systems

EE 356 Small Computer Software

EE 360 Linear Control Systems

EE 380 Intermediate Electrical Projects Lab

EE 410 Analog Circuit Synthesis

EE 415 Digital Image Processing

EE 421 Photonics I

EE 422 Photonics II

EE 425 Lines Waves and Antennas

EE 430 Energy Conversion Systems

EE 432 Analysis of Power Systems

EE 437 Power System Planning

EE 438 Electric Power Quality

EE 440 Communication Electronics

EE 445 Industrial Electronics and Controls

EE 454 Microcontroller Applications

EE 456 Small Computer System Design

EE 458 Embedded Systems and Real-Time Programming

EE 465 Digital Control Systems

EE 470 Analog and Digital Communications Theory

EE 471 Wireless Communication Theory

EE 494 Senior Project Seminar

EE 495 Senior Project Phase 1

EE 497 Senior Project Phase 2

EE 498 Independent Study in Electrical Engineering

EE 499 Special Topics in Electrical Engineering

CS 101 Introduction to Computer Science

CS 210 Fundamentals of Programming I

CS 215 Fundamentals of Programming II

CS 220 Logic Design and Machine Organization

CS 290 Object-Oriented Design

CS 310 Puzzle Programming

CS 315 Algorithms and Data Structures

CS 320 Computer Architecture

CS 350 Computer/Human Interaction

CS 355 Computer Graphics

CS 375 UNIX System Programming

CS 376 Small Computer Software

CS 380 Programming Languages

CS 381 Formal Languages

CS 390 Software Engineering

CS 391Software Engineering II

CS 415 Cryptography

CS 430 Artificial Intelligence

CS 440 Databases

CS 455 Advanced Graphics

CS 470 Operating Systems

CS 472 Concurrent and Parallel Programming

CS 473 Mobile Application Development

CS 475 Networks

CS 478 Embedded Systems and Real-Time Programming

CS 494 Senior Project Seminar

CS 495 Senior Project Phase I

CS 497 Senior Project Phase II

CS 498 Independent Study in Computer Science

CS 499 Special Topics in Computer Science

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