

two-dimension computer simulation of surface water quality. Prerequisite: ENVE 270 or equivalent. SPRING. [3]

ENVE 276. Groundwater Hydrology. The occurrence and flow of ground water. Basic concepts of the effects of varying permeability and capillarity on seepage flow. Flow toward wells, through dikes, and beneath dams. Students cannot receive credit for both ENVE 276 and Earth and Environmental Sciences 257. Prerequisite: Math 198; CE 203. SPRING. [3]

ENVE 277. Physical/Chemical Unit Processes. Principles of mass transfer, chemistry, and chemical reactor technology applied to the design and operation of water and wastewater treatment processes. Unit processes such as coagulation/flocculation, sedimentation, filtration, carbon adsorption, ion exchange, air stripping, precipitation, chemical oxidation and chemical reduction will be evaluated as alternatives for the treatment of drinking water and industrial wastewaters. Prerequisite: CE 226 or equivalent and senior standing or above. SPRING. [3]

ENVE 280. Atmospheric Pollution. (Also listed as ChE 280) Fundamentals of atmospheric pollution and control. The sources and nature of gaseous and particulate air pollutants, the relation of meteorological conditions to their dispersal, and their effects on health and materials are discussed along with administration, standards, and control of air pollution. Prerequisite: junior standing. SPRING. [3]

ENVE 296. Safety, Security, and Environmental Risk Management. Development of safety and security programs for protecting human health, the environment and business continuity. Focus on defining an all-hazards risk management process and program implementation, performing risk assessments, determining and selecting appropriate risk reduction strategies, and influencing risk management decisions internally and externally. Applications drawn from natural disasters, man-made accidents and intentional acts. Prerequisite: senior standing or consent of instructor. SPRING [3]

ENVE 312. Pollutant Transport in the Environment. An introduction to the mathematical foundations of fluid mechanics and transport of pollutants in the environment. Fundamental conservation of mass, momentum, and energy equations will be developed. Appropriate initial and boundary conditions and solution techniques will be discussed for a number of applications. Prerequisite: CE 203, Math 198. FALL. [3]

ENVE 325a–325b–325c. Individual Study. Literature review and analysis, or laboratory investigation of special problems under faculty supervision. FALL, SPRING, SUMMER. [Variable credit: 1–4 each semester]

ENVE 369. Master's Thesis Research.

ENVE 389. Master of Engineering Project.

ENVE 399. Ph.D. Dissertation Research.

Computer Engineering

DIRECTOR A. B. Bonds

PROFESSORS EMERITI Arthur J. Brodersen, James A. Cadzow

PROFESSORS Gautam Biswas, A. B. Bonds, Benoit M. Dawant, Lawrence W. Dowdy, J. Michael Fitzpatrick, Weng Poo Kang, Gábor Karsai, Kazuhiko Kawamura, Douglas C.

Schmidt, Lloyd W. Massengill, Ronald D. Schrimpf, Janos Sztipanovits

ASSOCIATE PROFESSORS Bharat L. Bhuva, Robert E. Bodenheimer, Jr., Douglas H. Fisher, Nilanjan Sarkar, Stephen R. Schach, D. Mitchell Wilkes

ASSISTANT PROFESSORS Julie A. Adams, Yi Cui, Aniruddha S. Gokhale, Xenofon D. Koutsoukos, William H. Robinson, Yuan (Emily) Xue

✿ THE program in Computer Engineering deals with the organization, design, and application of digital processing systems as general-purpose computers or as embedded systems, i.e., components of information processing, control, and communication systems. The program provides a strong engineering background centered on digital technology combined with an understanding of the principles and techniques of computer science. Computer engineering is design-oriented. The basic principles of engineering and computer science are applied to the task at hand, which may be the design of a digital processor, processor peripheral, or a complete digital processor-based system. Whatever the undertaking, the comprehensive academic training in this program enables engineers to evaluate the impact of their decisions, whether working with hardware, software, or the interface between the two.

The Computer Engineering program combines fundamental core requirements with flexibility to allow students to specialize in a variety of emphasis areas within the program. The curriculum includes requirements in the basic sciences, mathematics, and humanities; a primary core of hardware and software courses; and a set of electives that combine breadth and depth requirements as described below. Students who major in Computer Engineering who wish to apply for graduate study in Electrical Engineering or Computer Science are encouraged strongly to select their elective courses to demonstrate depth in that particular area; the structure of the program enables that option. The course of study leads to a Bachelor of Engineering degree.

Undergraduate Honors Program. With faculty approval, junior and senior students may be accepted into the Honors Program. To achieve honors status, the student must:

1. achieve and maintain a minimum GPA of 3.5.
2. choose 6 hours of EE/CmpE program elective credit from among the following list:
 - a. research-based independent study credit, or
 - b. design domain expertise (DE) courses beyond the one course required by the program, or
 - c. 300-level courses.
3. complete 3 hours of research-based independent study credit (with final written report) in addition to all other requirements.

The diploma designation is Honors in Computer Engineering.

Curriculum Requirements

The B.E. degree in Computer Engineering requires a minimum of 127 hours distributed as follows:

1. Mathematics (18 hours). Required courses: 155a, 155b, 175, 196, 216 (qualified students may substitute an honors mathematics sequence).

2. Basic Science (16 hours). Required courses: Chemistry 102a, Chemistry 104a, Physics 116a-b and 118a-b, MSE 150 (or Chemistry 102b).

3. Engineering Fundamentals (6 hours). Required courses: ES 140, ES 210W.

4. Culminating Design Experience (7 hours). Required courses: EECE 295, EECE 296, EECE 297.

5. Computer Engineering Core (at least 26 hours). Required courses: EECE 112, 116/116L, 218/218L and either 213/213L or 214; CS 101, 201, 231, and 251.

6. Computer Engineering Electives (18 hours). Defined by a structure that includes the three Computer Engineering Areas of Concentration listed below. Students must complete at least two courses in each of two areas of concentration. Embedded Systems (Area 1) must include EECE 276, Computing Systems and Networks (Area 2) must include CS 281 and Intelligent Systems and Robotics (Area 3) must include EECE 257. Students must complete at least one approved design domain expertise (DE) course as designated below. Other electives from any of the Areas of Concentration or approved independent study to total 18 hours.

Computer Engineering Areas of Concentration

Embedded Systems (area 1)	Computing Systems and Networks (area 2)	Intelligent Systems and Robotics (area 3)
EECE 276 (DE)	CS 281	EECE 257
EECE 256 (DE)	CS 265	EECE 253 (DE)
EECE 257	CS 274 (DE)	EECE 254
EECE 258 (DE)	CS 278 (DE)	EECE 258 (DE)
EECE 277 (DE)	CS 279 (DE)	EECE 271
EECE 285 (DE)	CS 282 (DE)	CS 260
CS 274 (DE)	CS 283 (DE)	CS 269 (DE)
	CS 284 (DE)	
	CS 285	
	EECE 261	
	EECE 262	

(DE) designates a Design Domain Expertise course

7. Liberal Arts Core (18 hours). To be selected from the approved lists (see Distribution Requirements, p. 504).

8. Technical electives (15 hours).

a. (6-15 hours). At least 6 hours must be taken from this list of approved engineering technical electives.

BME (except 201, 240a-240b, 241a-241b)

ChE (except 216)

CE (except 216)

CS (except 103, 150, 151, 255, 257)

EECE (hours above basic requirement in sections 5 and 6 above)

ENGM 273

ME

MSE (except 150)

b. (0-9 hours). Up to 9 hours may be taken from this list of optional technical electives.

CS 255, 257

ChE 216 or CE 216 or ENGM 216

MSE 150 (if Chemistry 102b is used as a basic science)

ENGM 221, 244

Astronomy (except 102, 115F, 130, 203)

Biological Sciences (except 115F)

Chemistry (except 101a-b, 102a-b, 115F)

Earth and Environmental Sciences (except 100, 102, 115F)

Mathematics above 194 (except 198, 252)

Physics (except courses numbered 122 or below)

Neuroscience 201, 255

Psychology 208, 209, 234, 236, 269

9. Open Elective (3 hours).

Specimen Curriculum for Computer Engineering

		Semester hours	
		FALL	SPRING
FRESHMAN YEAR			
EECE 116/116L†	Digital Logic		4
CS101	Programming and Problem Solving		3
	Other freshman courses (see the engineering freshman-year specimen curriculum)	14	8
		14	15
SOPHOMORE YEAR			
Math 175	Multivariable Calculus	3	–
Math 196	Differential Equations and Linear Algebra	–	4
Physics 116b	General Physics	3	–
Physics 118b	General Physics Laboratory	1	–
MSE 150 †	Materials Science I	–	4
EECE 112	Circuits I	3	–
EECE 218/218L	Microcontrollers	–	4
CS 201	Program Design and Data Structures	3	–
CS 231	Computer Organization	–	3
	Liberal Arts Core	3	3
		16	18
JUNIOR YEAR			
Math 216	Probability and Statistics for Engineers	–	3
ES 210W	Technical Communications	3	–
EECE 276/276L	Embedded Systems		–
or CS 281	Principles of Operating Systems I	4/3	–
EECE 213/213L	Circuits II		–
or EECE 214	Signals and Systems	4/3	–
CS 251	Intermediate Software Design	3	–
	CmpE Program Elective ‡	3	6
	Liberal Arts Core	–	3
	Technical Electives	–	6
		15–17	18

SENIOR YEAR		FALL	SPRING
EECE 295	Project Management for EECE	3	–
EECE 296	EECE Design	–	3
EECE 297	Senior Engineering Design Seminar	1	–
	Cmp E Program Electives †	3	3
	Liberal Arts Core	3	3
	Technical Electives	6	3
	Open Electives	–	3
		16	15

† Computer engineering majors are encouraged to take EECE 116 in the spring of their freshman year in lieu of MSE 150. MSE 150 may be taken in the sophomore year.

‡ As described in "Computer Engineering Degree Requirements" subsection 6. At least one design domain expertise (DE) course required prior to EECE 296.

CmpE 203–204. Independent Study. Readings or projects on basic topics in computer engineering or related fields under the supervision of staff. Consent of instructor required. No more than 6 hours may be applied towards graduation. [Variable credit: 1–3 each semester]

CmpE 291–292. Special Topics. [Variable credit: 1–3 each semester]

Computer Science

E

DEPARTMENT CHAIR Daniel M. Fleetwood

ASSOCIATE CHAIR Douglas C. Schmidt

DIRECTOR OF UNDERGRADUATE STUDIES Robert E. Bodenheimer, Jr.

DIRECTOR OF GRADUATE STUDIES Jeremy P. Spinrad

PROFESSORS EMERITI Patrick C. Fischer, William H. Rowan Jr.

PROFESSOR EMERITA Charlotte F. Fischer

PROFESSORS Gautam Biswas, Benoit M. Dawant, Lawrence W. Dowdy, J. Michael Fitzpatrick, Gábor Karsai, Douglas C. Schmidt, Janos Sztipanovits


ASSOCIATE PROFESSORS Robert E. Bodenheimer, Jr., Douglas H. Fisher, Stephen R. Schach, Jeremy P. Spinrad

ASSOCIATE PROFESSOR OF THE PRACTICE Gerald H. Roth

ASSISTANT PROFESSORS Julie A. Adams, Yi Cui, Aniruddha S. Gokhale, Xenofon D. Koutsoukos, Yuan Xue

RESEARCH ASSISTANT PROFESSOR Bradley A. Malin

LECTURER Julie L. Johnson

 THE program in Computer Science blends scientific and engineering principles, theoretical analysis, and actual computing experience to provide undergraduate students with a solid foundation in the discipline. Emphasis is on computing activities of both practical and intellectual interest, and on theoretical studies of efficient algorithms and the limits of computation. Computer facilities are available for class assignments, team projects, and individual studies. Students are challenged to seek original insights throughout their study. Working in teams, participating in summer internships, supporting student professional organizations, and developing interdisciplinary projects are strongly encouraged.