COMPUTER ENGINEERING

Description

Websites: https://computing.unl.edu and https://engineering.unl.edu/ece/

Email: computing@unl.edu

The College of Engineering offers a comprehensive computer engineering undergraduate program to students on the City (Lincoln) and Scott (Omaha) campuses of the University of Nebraska-Lincoln. Curriculum requirements are nearly identical on both campuses and students can complete all degree requirements on either campus.

In the college, the School of Computing and the Department of Electrical and Computer Engineering offer this baccalaureate degree program in computer engineering that prepares graduates for professional practice in commerce, industry, and government and for post-graduate education to enter careers in research, development, and academia.

The focus of the program is hands-on integrated hardware/software system design. Increasingly, diverse systems, products, and processes depend on computers for design, control, data acquisition, and other functions. The computer engineer possesses the range of expertise to have an integrated view of computer-based systems and to make global design decisions.

Consistent with this focus, the computer engineering baccalaureate program develops:

- The ability to view computer systems as an integrated continuum of technologies and to engage in integrated system-level design. Studies include mathematical foundations, digital logic and technologies, programming and software design, system components and design, application of theory, experimentation, design tools and techniques, and documentation and maintenance.
- The ability to work with professionals in related fields over the spectrum of system design. Studies include natural sciences, electricity/electronics, and programming and software design.
- Skills to quickly adapt to new work environments, assimilate new information, and solve new problems. Studies develop skills in the application of theory, experimentation, design tools and techniques, documentation and maintenance, and technical communications.
- The background and perspective for post-graduate education. Studies develop skills in the application of theory, experimentation, and lifelong learning/professional development.
- Ability to work in conformance with societal needs and expectations. Studies include liberal arts and ethical/social issues.
- Insight into the world of practicing professionals for collaborations, mutual support, and representing the profession to government and society. Studies include teamwork and lifelong learning/professional development, plus students are provided multiple opportunities for involvement in organizations such as ACM, UPE, and IEEE.

The School of Computing also offers a degree of bachelor of science in computer science, a bachelor of science in software engineering, and a bachelor of science in data science through the College of Engineering.

The Electrical and Computer Engineering department also offers a degree of bachelor of science in electrical engineering. All students should see their advisor during their first semester to ensure they understand the requirements for each undergraduate degree program. Students should consult with their advisors each semester for registration advising.

Introductory Courses

CSCE 155E Computer Science I: Systems Engineering Focus emphasizes computing for systems engineering, such as control systems, mobile computing, and embedded devices and is designed for students majoring in computer engineering. CSCE 164 Introduction to Computer Engineering provides an introduction to basic concepts and skills needed in computer engineering.

Entering students who do not have adequate programming background should talk to their advisors about taking additional beginner courses.

Program Professional Admission

Students are expected to meet minimum college entrance requirements. After being admitted to the college, students wishing to pursue a degree in computer engineering must go through the Professional Admission process, which is automatically performed for qualifying students at the end of the sophomore year. In order to be considered for Professional Admission to the computer engineering program, students must receive at least a C+ in CSCE 230 and CSCE 310 (RAIK 283H), at least a C in ECEN 215, with a GPA of at least 2.5 (semester and cumulative). If a student's cumulative GPA drops below 2.4, the student may be placed on restricted status, may be removed from the College, and may not be able to graduate.

Accreditation

The Computer Engineering (BS) program is accredited by the Engineering Accreditation Commission of ABET, https://www.abet.org, under the commission's General Criteria and Program Criteria for Electrical, Computer, Communications, Telecommunication(s) and Similarly Named Engineering Programs.

Program Educational Objectives

The Program Educational Objectives (PEOs) are a statement of what graduates are doing, or are capable of doing, three to five years after graduation. The students in the Computer Engineering program receive a strong foundation in engineering science and design that not only enables them to pursue productive careers in the computer engineering fields but also play an integral role in advancing other areas including business, management, medicine and manufacturing through computer engineering technologies. The Program Educational Objectives for the Computer Engineering program are that graduates will be:

- Employed in business, non-profit, academia, government, or industry.
- Successful engineers who view computer systems as an integrated contiunuum of technologies, which engaging and collaborating with professionals in related fields to provide innovative, effective, responsible, and sustainable computer engineering solutions.
- Capable of quickly adapting to new work environments, assimilating new information, solving new problems, and creating new devices.
- Engaging in lifelong learning, which may include postgraduate education and being part of professional organizations, to successfully adapt to technological, industry specific, and cultural changes and to foster adept functioning in society.

- Performing engineering practice in a context that reflects awareness of the ethics of their profession and of the impacts of their work on the profession and society at large.

These Program Educational Objectives were developed with input from the program's constituency, consisting of employers (including the Industry Advisory Board), graduates of the program, and faculty.

College Requirements

College Admission

College Entrance Requirements

Students must meet both the University and College of Engineering entrance requirements. The following includes both the University and College of Engineering entrance requirements.

Students must have high school credit for (one unit is equal to one high school year):

1. Mathematics – 4 units: 2 of algebra, 1 of geometry, and 1 of precalculus and trigonometry
2. English – 4 units
3. Natural sciences – 3 units that must include 1 unit of physics and 1 unit of chemistry (chemistry requirement waived for students in construction management or computer science)
4. Foreign language – 2 units of a single foreign language
5. Social studies – 3 units
6. Students having a composite ACT score of 28 or greater (or equivalent SAT score) will be admitted to the College of Engineering even if they lack any one of the following: trigonometry, chemistry, or physics. Students without test scores who are missing a full unit of trigonometry/pre-calculus/calculus or chemistry or physics will be evaluated through College Review.
7. Students having an ACT score of 19 or less in English (or equivalent SAT score) or a grade lower than B in high school English, must take ENGL 150 Writing and Inquiry or ENGL 151 Writing for Change.

A total of 16 units is required for admission.

Engineering requires that student performance meet one of the following standards: composite ACT of 24, SAT of 1180, ACT Math subscore of 24, SAT Math subscore of 580, or a 3.5 cumulative GPA.

Any domestic first-year student who does not gain admission to Engineering but does gain admission to the University of Nebraska-Lincoln (UNL) will be reviewed through College Review. College Review is conducted through the College Review Committee which considers factors beyond standardized testing. Any first-year student who is not admitted through college review is placed in Pre-Engineering (PENG) with the Exploratory and Pre-Professional Advising Center (Explore Center). Students in the Explore Center can transfer to the College of Engineering once college admission requirements are met.

Students for whom English is not their language of nurture must meet the minimum English proficiency requirements of the University.

Students who lack entrance units may complete precollege training by Independent Study through the University of Nebraska–Lincoln Office of On-line and Distance Education, in summer courses, or as a part of their first or second semester course loads while in the Explore Center or other colleges at UNL.

Students should consult their advisor, their department chair, or Engineering Student Services (ESS) if they have questions on current policies.

Other Admission Requirements

Students who transfer to the University of Nebraska–Lincoln from other accredited colleges or universities and wish to be admitted to the College of Engineering (COE) must meet COE first-year student entrance requirements, have a minimum cumulative GPA of 2.5, and be calculus-ready. Students not meeting either of these requirements must enroll in the Explore Center or another University college until they meet COE admission requirements. Students transferring from UNO, UNL, or UNK to the College of Engineering must be in good academic standing with their institution.

The COE accepts courses for transfer for which a C or better grade was received from colleges outside of the NU system. Although the University of Nebraska–Lincoln and the College of Engineering in general accepts C- and D grades from the University of Nebraska Kearney and the University of Nebraska Omaha, not all majors in the COE accept such low grades. Students must conform to the requirements of their intended major and, in any case, are strongly encouraged to repeat courses with a grade of C- or less.

Students who were previously admitted to COE and are returning to the College of Engineering must demonstrate a cumulative GPA of 2.5 to be readmitted to COE.

College Degree Requirements

Grade Rules

Grade Appeals

In the event of a dispute involving any college policies or grades, the student should appeal to their instructor, and appropriate department chair or school director (in that order). If a satisfactory solution is not achieved, the student may appeal their case through the College Academic Appeals Subcommittee.

Catalog Rule

Students must fulfill the requirements stated in the catalog for the academic year in which they are first admitted at the University of Nebraska–Lincoln. In consultation with advisors, a student may choose to follow a subsequent catalog for any academic year in which they are admitted to and enrolled as a degree-seeking student at Nebraska in the College of Engineering. Students must complete all degree requirements from a single catalog year. The catalog which a student follows for degree requirements may not be more than 10 years old at the time of graduation.

Students who have transferred from a community college may be eligible to fulfill the requirements as stated in the catalog for an academic year in which they were enrolled at the community college prior to attending the University of Nebraska-Lincoln.#This decision should be made in consultation with the student's College of Engineering academic advising team (e.g., ESS professional advisor and the chief faculty advisor for the student's declared degree program).#The chief faculty advisor has the final authority for this decision. Eligibility is based on a) enrollment in a community college during the catalog year the student wishes to utilize, b) maintaining continuous enrollment of at least 12 credit hours per semester at the previous institution for at least 2 semesters, and c) continuous enrollment at the University of Nebraska-Lincoln within 1 calendar year from the student's last term at the previous institution.

#Students must complete all degree requirements from a single catalog year and within the timeframe allowable for that catalog year.

Student Outcomes

Graduates of computer engineering must have:

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
3. An ability to communicate effectively with a range of audiences.
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Major Requirements

Computer Engineering Core (58 hours)

CSCE 155E / ECEN 155E	Computer Science I: Systems Engineering Focus	3
or CSCE 155H	Honors: Computer Science I	
CSCE 156	Computer Science II	4
or CSCE 156H	Honors: Computer Science II	
CSCE 164	Introduction to Computer Engineering	2
CSCE 230	Computer Organization	4
CSCE 235	Introduction to Discrete Structures	3
or CSCE 235H	Honors: Introduction to Discrete Structures	
CSCE 251	Unix Programming Environment	1
CSCE 310	Data Structures and Algorithms	3
or CSCE 310H	Honors: Data Structures and Algorithms	
CSCE 335 / ECEN 370	Digital Logic Design	3
CSCE 336	Embedded Systems	4
or ECEN 220	Introduction to Embedded Systems	
CSCE 351	System Resource Management	3
CSCE 361	Software Engineering	3
or CSCE 361H	Software Engineering	
CSCE 463	Data and Network Security	3
or ECEN 484	Network Security	
CSCE 478	Introduction to Machine Learning	3
or ECEN 478	Practical Machine Learning	
ECEN 215	Electronics and Circuits I	3
ECEN 222	Electronic Circuits I	4
ECEN 235	Introductory Electrical Laboratory I	1
ECEN 304	Signals and Systems I	3
ECEN 305	Probability Theory and Statistics for Electrical and Computer Engineers	3
ECEN 325	Communication and Networking	4
ECEN 327	Discrete Systems Laboratory	1
or ECEN 313	Switching Circuits Theory	
Total Credit Hours		**58**

Senior Design Experience (6 hrs)

Select one of the following:		3
CSCE 488	Computer Engineering Professional Development	
or CSCE 488H	Honors Computer Engineering Professional Development	
or ECEN 481	Electrical Engineering Capstone I	
or ECEN 483	Computer Engineering Capstone I	
or RAIK 401H	Honors: RAIK Design Studio I	
or RAIK 403H	Honors: RAIK Design Studio III	
Select one of the following:		3
CSCE 489	Computer Engineering Senior Design Project	
or CSCE 489H	Honors Computer Engineering Senior Design Project	
or ECEN 495	Electrical Engineering Capstone II	
or ECEN 499	Computer Engineering Capstone II	
or RAIK 402H	Honors: RAIK Design Studio II	
or RAIK 404H	Honors: RAIK Design Studio IV	
Total Credit Hours		**6**

Note: CSCE 488 or CSCE 488H and CSCE 489 or CSCE 489H are to be taken in consecutive semesters. CSCE 488, CSCE 488H, or RAIK 401H will satisfy the ACE 8 requirements. ECEN 481, ECEN 483, and RAIK 403H do **not** satisfy the ACE 8 requirement. CSCE 489, CSCE 489H, or RAIK 402H will satisfy the ACE 10 requirement. RAIK 404H does **not** satisfy the ACE 10 requirement.

Double majors in electrical engineering may elect to take either of the senior design course sequences (CSCE 488 / CSCE 488H) then CSCE 489 / CSCE 489H) or ECEN 483 then ECEN 499); or ECEN 481 then ECEN 495. Students not taking CSCE 488 / CSCE 488H) must satisfy ACE outcome 8 with another course(s).

Technical Electives (18 hours)

Complete a total of 18 hours of technical electives.

- Complete 12 hours of courses at the 300/400 level from CSCE or SOFT or ECEN.
- Complete an additional 6 hours from any 300 or 400 level course from the following subject codes: AGEN, BSEN, CHME, CIVE, CSCE, CONE, ECEN, MECH, MATL, SOFT, BIOS, CHEM, MATH, STAT, PHYS, ASTR as well as selected 100 and 200 classes listed below. BIOS 310 and MATH 493 will not count towards technical electives.

Additional 100/200 Level Courses

AGEN 225 / BSEN 225	Engineering Properties of Biological Materials	3
ASTR 204	Introduction to Astronomy and Astrophysics	3

ASTR 224	Astronomy and Astrophysics Laboratory	1
BIOS 201	General Genetics	4
BIOS 213	Human Physiology	3
CHEM 109A	General Chemistry I	3
CHEM 110A	General Chemistry II	3
CHEM 113A	Fundamental Chemistry I	3
CHEM 114	Fundamental Chemistry II	3
CHME 202	Mass and Energy Balances	3
MATH 208	Calculus III	4
MATL 260	Elements of Materials Science	3
MATL 262	Materials Laboratory I	1
MECH 200	Engineering Thermodynamics	3
MECH 223	Engineering Statics	3
MECH 250	Mechanics I	2
PHYS 213	General Physics III	4
PHYS 223	General Physics Laboratory III	1

Mathematics (15 hours)

MATH 106	Calculus I (ACE 3)	5
MATH 107	Calculus II	4
MATH 221	Differential Equations	3
MATH 314	Linear Algebra	3
Total Credit Hours		**15**

Science (9 hours)

PHYS 211	General Physics I (ACE 4)	4
PHYS 212	General Physics II	4
PHYS 221	General Physics Laboratory I	1
Total Credit Hours		**9**

Other Supporting Courses (18 hours)

ENGR 10	Freshman Engineering Seminar [1]	0
or ENGR 30	Transfer Student Engineering Seminar	
or CSCE 10	Introduction to the School of Computing	
or RAIK 10	Raikes School Freshman Seminar	
ENGR 20	Sophomore Engineering Seminar [2]	0
Select one of the following (ACE 2):		3
COMM 286	Business and Professional Communication	
ENGR 100	Interpersonal Skills for Engineering Leaders	
JGEN 300	Technical Communication II	
Select one course each from ACE 1, 5, 6, 7, and 9		15
Total Credit Hours		**18**

1 ENGR 193 *may apply for* ENGR 10 *(students must be in the Kiewit Scholars Program to take the course).*

2 ENGR 493 *may apply for* ENGR 20 *(students must be in the Kiewit Scholars Program to take the course).*

Program Assessment. In order to assist the school in evaluating the effectiveness of its programs, majors will be required to complete a written exit survey in their senior year. The results of the survey will in no way affect a student's GPA or graduation.

Additional Major Requirements

Grade Rules

C- and D Grades

Applicants for professional admission to computer engineering must meet the usual college and department requirements. The school requires the minimum grade listed below in the following core courses (or their equivalents):

- Grade of C+ or higher in CSCE 230/ECEN 230 and CSCE 310 (or RAIK 283H)
- Grade of C or higher in ECEN 215

Description

The Jeffrey S. Raikes School of Computer Science and Management is a unique program developing world-class innovators and leaders through an interdisciplinary computer science and business management education. Raikes School students are selected from the nation's top high school graduates. The typical Raikes School student scores a 31 or higher on their ACT (or 1400 on the SAT), ranks in the top 10% of their high school class and has challenged themselves both inside and outside the classroom.

Students who wish to be considered for admission to the Raikes School must complete the application to the University of Nebraska as well as the application for the University Honors Program and the Raikes School. Submitted applications are then reviewed by the Director of Recruitment and Student Success based on the following areas: academics, oral and written communication, business and/or computer programming experience, leadership and service experience, involvement and related work experience. Interviews are conducted with selected candidates in January. At the beginning of February, selected students receive offers from the Raikes School along with notification of any Raikes School scholarship awards. Raikes School scholarship awards are typically 4-year renewable awards covering a portion of room and board which can be stacked on top of most other awards received from Nebraska.

Students in the Raikes School live in the Kauffman Academic Residential Center, which consists of suite-style rooms, technology enabled classrooms, and faculty/staff offices on the first floor. This living arrangement offers the advantage of a community atmosphere within a large university setting.

Students take classes with their cohort each semester in the Raikes School. The Raikes School's curriculum includes core business and computing concepts as well as data science, leadership and communication coursework. Approximately 60-65 credit hours are completed in the Raikes School, leaving an additional 60-65 credit hours for students to complete in their respective areas of interest. Students in the Raikes School pursue a variety of majors including: computer science, computer engineering, software engineering, electrical engineering, actuarial science, business management, economics, finance and mathematics.

Students interested in learning more about the Jeffrey S. Raikes School of Computer Science and Management are encouraged to contact Theresa Luensmann, Assistant Director of Recruitment and Outreach, at tluensmann2@unl.edu or 402-472-9097, or visit http://raikes.unl.edu (http://raikes.unl.edu/).

Plan for Required Courses

Course	Title	Credit Hours
Year 1		
Fall		
RAIK 10	Raikes School Freshman Seminar	0
RAIK 183H	Honors: Computer Problem Solving Essentials	4
RAIK 163H	Honors: Innovation Processes and Software Engineering Fundamentals	3
UHON 101H	Honors Community (University Honors Program Requirement)	1
UHON 189H	University Honors Seminar (University Honors Program Requirement)	3
MATH 106	Calculus I (ACE 3)	5
	Credit Hours	**16**
Spring		
RAIK 184H	Honors: Software Development Essentials	4
RAIK 181H	Honors: Foundations of Accounting	4
RAIK 182H	Honors: Foundations of Economics (ACE 6)	4
RAIK 185H	Honors: Foundations of Leadership I	1
MATH 107	Calculus II	4
	Credit Hours	**17**
Year 2		
Fall		
RAIK 283H	Honors: Software Engineering III	4
RAIK 341H	Honors: Marketing	3
RAIK 270H	Statistics and Applications	3
CSCE 230	Computer Organization	4
CSCE 251	Unix Programming Environment	1
PHYS 211 & PHYS 221	General Physics I and General Physics Laboratory I (ACE 4)	5
	Credit Hours	**20**
Spring		
RAIK 186H	Honors: Foundations of Leadership II	1
RAIK 284H	Software Engineering IV (ACE 2)	3
RAIK 381H	Honors: Fundamentals of Finance	3
RAIK 370H	Honors: Data and Models II: Data Science Fundamentals (Technical Elective)	3
ECEN 220 or CSCE 336	Introduction to Embedded Systems or Embedded Systems	4
ECEN 215	Electronics and Circuits I	3
ECEN 235	Introductory Electrical Laboratory I	1
	Credit Hours	**18**
Year 3		
Fall		
UHON 99H	Honors Experience (University Honors Program Requirement)	0
RAIK 401H	Honors: RAIK Design Studio I	3
ECEN 304	Signals and Systems I	3
ECEN 236	Introductory Electrical Laboratory II	1
ECEN 327	Discrete Systems Laboratory	1
PHYS 212	General Physics II	4
MATH 221	Differential Equations	3
ACE Elective (1, 5, 7, or 9) [3]		3
	Credit Hours	**18**
Spring		
RAIK 402H	Honors: RAIK Design Studio II (ACE 10)	3
RAIK 371H	Honors: Data & Models III: Fundamentals of Management Science	3
RAIK 372H	Honors: Business Law (ACE 8)	3
CSCE 335 or ECEN 370	Digital Logic Design or Digital Logic Design	3
MATH 314	Linear Algebra	3
Technical Elective [1]		3
	Credit Hours	**18**
Year 4		
Fall		
RAIK 403H or RAIK 405H	Honors: RAIK Design Studio III (Technical Elective) or Honors: RAIK Research Studio I	3
CSCE 351	System Resource Management	3
ECEN 325	Communication and Networking	4
Math/Statistics Elective (Technical Elective) [2]		4-5
ACE Elective (1, 5, 7, or 9) [3]		3
RAIK 40	Professional and Life Skills	0
	Credit Hours	**17-18**
Spring		
RAIK 404H or RAIK 406H	Honors: RAIK Design Studio IV (Technical Elective) or Honors: RAIK Research Studio II	3
RAIK 476H	Honors: Business Strategies	3
CSCE 463	Data and Network Security	3
Technical Elective [1]		3
ACE Elective (1, 5, 7, or 9) [3]		3
ACE Elective (1, 5, 7, or 9) [3]		3
	Credit Hours	**18**
	Total Credit Hours	**142-143**

1 *See "Technical Electives" requirement list on the* non-Raikes School Major tab *(p. 3).*

2 *Select from* MATH 208, MATH 208H, MATH 428, MATH 439, STAT 412, STAT 414, *or* STAT 450. *See advisor for other possible advanced math/stat classes.*

3 *One course each from ACE 1, 5, 7, and 9 must be completed for a total of 12 hours.*

Note: A minimum of 123 credit hours is required for the degree but Raikes School students will complete more than the 123 credit hours required.

Bachelor of Science in Computer Engineering with the Master of Science in Computer Science

In an accelerated program, a student may count up to 12 credit hours of approved graduate courses toward both the current undergraduate degree and the later graduate degree. Students must apply for graduate admission and be accepted prior to enrollment. For more information, visit https://graduate.unl.edu/academics/programs/accelerated-

masters/accelerated-masters-faq (https://graduate.unl.edu/academics/programs/accelerated-masters/accelerated-masters-faq/).

The following courses are approved for this program. Requirements are the same for students completing or not completing the Raikes version of the major.

No Specialization

CSCE 823	Design and Analysis of Algorithms (replaces CSCE 423)	3
CSCE 828	Automata, Computation, and Formal Languages (replaces CSCE 428)	3
CSCE 851	Operating Systems Principles (replaces CSCE 451)	3
CSCE 862	Communication Networks (replaces CSCE 462)	3

Specialization in Computer Engineering

CSCE 823	Design and Analysis of Algorithms (replaces CSCE 423)	3
CSCE 830	Computer Architecture (replaces CSCE 430)	3
CSCE 851	Operating Systems Principles (replaces CSCE 451)	3
CSCE 862	Communication Networks (replaces CSCE 462)	3

Grading Requirements

Grading rules as defined by the undergraduate degree/major apply. Please consult your academic advisor and/or the department graduate chair for grading policy as it relates to credit applying toward a graduate degree.

CSCE 100 Introduction to Informatics
Prerequisites: Placement in to MATH 101 or higher
Notes: This course does not count towards a major or minor in Computer Science or a major in Computer Engineering or a major in Software Engineering.
Description: Introduction to the use of data-centric and information technologies-and issues and challenges-in today's applications in sciences, engineering, the humanities, and the arts. Exposure to computational thinking and programming, statistical thinking and research design, data analysis and database techniques, and visualization and creative thinking.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

CSCE 101 Fundamentals of Computer Science
Notes: A course in the science of computation suitable for prospective CSCE majors and for non-CSCE majors who desire a deeper understanding of computers and the work of computer scientists. This course may be used to satisfy a technical elective for Computer Science and Computer Engineering majors if taken at UNL prior to CSCE 155, CSCE 156, CSCE 310 and CSCE 361, or for Software Engineering majors, if taken at UNL prior to SOFT 160, SOFT 161, SOFT 260 and SOFT 261.
Description: Introduction to problem solving with computers. Problem analysis and specification, algorithm development, program design, and implementation in a high-level programming environment. Hardware, software, software engineering, networks, and impacts of computing on society.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Prerequisite for: CIVE 201; CIVE 202; CSCE 101L
ACE: ACE 3 Math/Stat/Reasoning
Course and Laboratory Fee: $35

CSCE 101L Fundamentals of Computing Laboratory
Prerequisites: CSCE 101 or parallel.
Notes: This course does not count towards a major or minor in Computer Science or a major in Computer Engineering or a major in Software Engineering.
Description: A variety of computer oriented exercises using many software tools is presented which supplement and are coordinated with the topics taught in CSCE 101. Students are exposed to programming, operating systems, simulation software, spreadsheets, database software, the Internet, etc. Applications software introduced in the context of tools to explore the computer science topics and as alternatives to traditional programming languages. Emphasis on learning by experiment, with a goal of developing problem solving skills. A major component is the study of a programming language-the choice of which may vary by course section.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Grading Option: Graded with Option
Course and Laboratory Fee: $10

CSCE 120 Learning to Code
Prerequisites: Placement in to MATH 101 or higher
Notes: This course does not count towards a major or minor in Computer Science or a major in Computer Engineering or a major in Software Engineering. First course in a sequence for the minor in Software Development.
Description: Introduction to coding in the context of current web development technologies (JavaScript, HTML, CSS). Basic coding skills and an introduction to computing with an emphasis on processing data: data formatting and structure, data manipulation, data presentation and the basics of an interactive program.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Prerequisite for: CSCE 220

CSCE 155A Computer Science I
Prerequisites: MATH 102 or a Math Placement Test score for MATH 103 or higher. Credit toward the degree may be earned in only one of: CSCE 155, CSCE 155A, CSCE 155E/ECEN 155E, CSCE 155H, CSCE 155N, or CSCE 155T.
Notes: Recommended for students majoring in computer science or computer engineering.
Description: Introduction to problem solving with computers. Topics include problem solving methods, software development principles, computer programming, and computing in society.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Prerequisite for: CIVE 201; CSCE 156, ECEN 156; CSCE 156H; CSCE 235; CSCE 235H; CSCE 311; CSCE 320; CSCE 352; CSCE 802; ECEN 106; ECEN 123; ECEN 224; MECH 300
Course and Laboratory Fee: $35

CSCE 155E Computer Science I: Systems Engineering Focus
Crosslisted with: ECEN 155E
Prerequisites: MATH 102 or a Math Placement Test score for MATH 103 or higher. Credit toward the degree may be earned in only one of:CSCE 155, CSCE 155A, CSCE 155E/ECEN 155E, CSCE 155H, CSCE 155N, or CSCE 155T.
Notes: Recommended for students interested in systems engineering, such as operating systems, mobile computing, and embedded devices.
Description: Introduction to problem solving with computers. Topics include problem solving methods, software development principles, computer programming, and computing in society
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Prerequisite for: CIVE 201; CSCE 156, ECEN 156; CSCE 156H; CSCE 235; CSCE 235H; CSCE 311; CSCE 320; CSCE 336; CSCE 352; CSCE 802; ECEN 106; ECEN 123; ECEN 220; ECEN 224; MECH 300
Course and Laboratory Fee: $10

CSCE 155H Honors: Computer Science I
Prerequisites: Good standing in UNL Honors Program; MATH 102 or a Math Placement Test score for MATH 103 or higher. Credit toward the degree may be earned in only one of:CSCE 155, CSCE 155A, CSCE 155E/ECEN 155E, CSCE 155H, CSCE 155N, or CSCE 155T.
Notes: Covers the same topics as CSCE 155A, but in greater depth.
Description: Introduction to problem solving with computers. Topics include problem solving methods, software development principles, computer programming, and computing in society.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Prerequisite for: CIVE 201; CSCE 156, ECEN 156; CSCE 156H; CSCE 235; CSCE 235H; CSCE 311; CSCE 320; CSCE 352; CSCE 802; ECEN 106; ECEN 224; MECH 300
Course and Laboratory Fee: $35

CSCE 155N Computer Science I: Engineering and Science Focus
Prerequisites: MATH 102 or a Math Placement Test score for MATH 103 or higher. Credit toward the degree may be earned in only one of:CSCE 155, CSCE 155A, CSCE 155E/ECEN 155E, CSCE 155H, CSCE 155N, or CSCE 155T.
Notes: Recommended for students interested in numerical and graphical applications in engineering and science, such as applied physics, working with time-sequence data, and matrix applications.
Description: Introduction to problem solving with computers. Topics include problem solving methods, software development principles, computer programming, and computing in society.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Prerequisite for: BSEN 311; CHME 312; CIVE 201; CSCE 156, ECEN 156; CSCE 156H; CSCE 235; CSCE 235H; CSCE 311; CSCE 320; CSCE 802; ECEN 106; ECEN 224; MECH 300; MECH 318; MECH 330; MECH 350; MECH 381
Course and Laboratory Fee: $35

CSCE 155T Computer Science I: Informatics Focus
Prerequisites: MATH 102 or a Math Placement Test score for MATH 103 or higher. Credit toward the degree may be earned in only one of:CSCE 155, CSCE 155A, CSCE 155E/ECEN 155E, CSCE 155H, CSCE 155N, or CSCE 155T.
Notes: Recommended for students interested in data and information processing, such as library and database applications, online commerce, and bioinformatics.
Description: Introduction to computers and problem-solving with computers. Topics include problem solving methods, software development principles, computer programming, and computing in society.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Prerequisite for: CSCE 156, ECEN 156; CSCE 156H; CSCE 235; CSCE 235H; CSCE 311; CSCE 320; CSCE 352; CSCE 802; ECEN 106; ECEN 224; MECH 300

CSCE 156 Computer Science II
Crosslisted with: ECEN 156
Prerequisites: A grade of "P" or "C" or better in CSCE 155A, CSCE 155E, CSCE 155H, CSCE 155N, or CSCE 155T; coreq: MATH 106.
Notes: Laboratories supplement the lecture material and give an opportunity to practice concepts.
Description: Data structures, including linked lists, stacks, queues, and trees; algorithms, including searching, sorting, and recursion; programming language topics, including object-oriented programming; pointers, references, and memory management; design and implementation of a multilayer application with SQL database.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Grading Option: Graded with Option
Offered: FALL/SPR
Prerequisite for: CSCE 235; CSCE 310; CSCE 310H; CSCE 322; CSCE 322H; CSCE 378; CSCE 378H; CSCE 453H, RAIK 453H; SOFT 162
Course and Laboratory Fee: $35

CSCE 156H Honors: Computer Science II
Prerequisites: Good standing UNL Honors Program. A grade of "P" or "C" or better in CSCE 155A, CSCE 155E, CSCE 155H, CSCE 155N, or CSCE 155T; Coreq: MATH 106. Credit toward the degree cannot be earned in both CSCE 156 and CSCE 156H.
Notes: Covers the same topics as CSCE 156, but in greater depth. Laboratories supplement the lecture material and give an opportunity to practice concepts.
Description: Data structures, including linked lists, stacks, queues, and trees; algorithms, including searching, sorting, and recursion; programming language topics, including object-oriented programming; pointers, references, and memory management; design and implementation of a multilayer application with SQL database.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Grading Option: Graded
Prerequisite for: CSCE 310; CSCE 310H; CSCE 322; CSCE 322H; CSCE 378; CSCE 378H; CSCE 453H, RAIK 453H; SOFT 162
Course and Laboratory Fee: $35

CSCE 163H Honors: Innovation Processes and Software Engineering Fundamentals
Crosslisted with: RAIK 163H
Prerequisites: Good standing in the University Honors Program; admission to the Jeffrey S. Raikes School of Computer Science and Management.
Description: Introduction to innovation processes for interdisciplinary and team-oriented problem solving of software engineering, business development, and industrial design problems.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Offered: FALL

CSCE 164 Introduction to Computer Engineering
Crosslisted with: ECEN 164
Notes: Project-based introduction to the computer engineering field.
Description: Introduction to basic concepts and skills needed in computer engineering. Practical application of basic computing concepts through an introduction to programming an embedded system.
Credit Hours: 2
Max credits per semester: 2
Max credits per degree: 2
Grading Option: Graded with Option
Offered: SPRING
Prerequisite for: ECEN 220; ECEN 370, CSCE 335

CSCE 183H Honors: Computer Problem Solving Essentials
Crosslisted with: RAIK 183H
Prerequisites: Good standing in the University Honors Program; admission to the Jeffrey S. Raikes School of Computer Science and Management.
Description: Introduction to problem solving with computers. Problem analysis and specification, algorithm development, program design, and implementation. JAVA in a Windows platform.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Grading Option: Graded
Prerequisite for: CSCE 235; CSCE 235H; CSCE 352; RAIK 184H, CSCE 184H; SCMA 335

CSCE 184H Honors: Software Development Essentials
Crosslisted with: RAIK 184H
Prerequisites: Good standing in the University Honors Program; admission to the Jeffrey S. Raikes School of Computer Science and Management; and CSCE/RAIK 183H.
Description: Problem solving with computers. Problem analysis and specification, data structures, relational databases, algorithm development, and program design and implementation. Discrete mathematics topics, propositional and predicate logic, sets, relations, functions, and proof techniques. Software Development Principles.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Grading Option: Graded
Prerequisite for: BSAD 372H, RAIK 372H; CSCE 230, ECEN 230; CSCE 231; CSCE 322; CSCE 322H; CSCE 378; CSCE 378H; CSCE 453H, RAIK 453H; SOFT 260H, RAIK 283H

CSCE 191 Special Topics in Computer Science
Prerequisites: Permission.
Notes: Will not count towards a major or minor in computer science and computer engineering. Topics will vary.
Description: Aspects of computers and computing at the freshman level for non-computer science and computer engineering majors and/or minors.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 6
Grading Option: Graded with Option
Course and Laboratory Fee: $10

CSCE 192 Special Topics in Computer Science
Prerequisites: Permission.
Description: Aspects of computers and computing for computer science and computer engineering majors and minors. Topics vary.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 6
Grading Option: Graded with Option

CSCE 194 Independent Study in Computing
Prerequisites: Freshmen standing; permission of the instructor.
Description: Independent study of computer science topics performed under the guidance of a member of the faculty in the Department of Computer Science and Engineering.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

CSCE 220 Software Development for Smart-Mobile Systems
Prerequisites: CSCE 120
Notes: This course does not count towards a major or minor in Computer Science or a major in Computer Engineering or a major in Software Engineering. Second course in a sequence for the minor in Software Development.
Description: Practical experience on building larger scale applications and familiarity with the tools, environments (e.g., Android or IoS), and requirements to develop software for current smart-mobile devices such as phones and tablets.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Prerequisite for: CSCE 453H, RAIK 453H

CSCE 230 Computer Organization
Crosslisted with: ECEN 230
Prerequisites: A grade of 'P' or 'C' or better in CSCE 235, CSCE 235H, or RAIK 184H.
Notes: Laboratories supplement the lecture material and give an opportunity to practice concepts.
Description: Introduction to organization and structure of computer systems. Boolean logic, digital arithmetic, processor organization, machine language programming, input/output, memory organization, system support software, communication, and ethics.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Grading Option: Graded with Option
Offered: FALL
Prerequisite for: CSCE 336; CSCE 351, ECEN 351; CSCE 362; ECEN 370, CSCE 335
Course and Laboratory Fee: $20

CSCE 231 Computer Systems Engineering
Prerequisites: Grade of "P" or "C" or better in CSCE 235, CSCE 235H or RAIK 184H.
Description: Introduction to organization, structure, and applications of computer systems. Boolean Logic, Digital Arithmetic, Processor Organization, C Programming, Machine Language Programming, Input/Output, Memory Organization and Management, Building Embedded System Application.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Grading Option: Graded with Option
Prerequisite for: CSCE 336; CSCE 351, ECEN 351; CSCE 362
Course and Laboratory Fee: $20

CSCE 235 Introduction to Discrete Structures
Prerequisites: A grade of 'P' or 'C' or better in CSCE 155A, CSCE 155E, CSCE 155H, CSCE 155N, CSCE 155T, SOFT 160, SOFT 160H or RAIK 183H; and MATH 106.
Notes: Theoretical concepts with programming assignments.
Description: Survey of elementary discrete mathematics. Elementary graph and tree theories, set theory, relations and functions, propositional and predicate logic, methods of proof, induction, recurrence relations, principles of counting, elementary combinatorics, and asymptotic notations.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Prerequisite for: CSCE 230, ECEN 230; CSCE 231; CSCE 310; CSCE 310H; CSCE 362; CSCE 377; SOFT 260
Course and Laboratory Fee: $20

CSCE 235H Honors: Introduction to Discrete Structures
Prerequisites: A grade of 'P' or 'C' or better in CSCE 155A, CSCE 155E, CSCE 155H, CSCE 155N, CSCE 155T, SOFT 160, SOFT 160H or RAIK 183H; and MATH 106. Credit toward the degree cannot be earned in both CSCE 235 and CSCE 235H.
Notes: Theoretical concepts with programming assignments. Covers the same topics as CSCE 235, but in greater depth.
Description: Survey of elementary discrete mathematics. Elementary graph and tree theories, set theory, relations and functions, propositional and predicate logic, methods of proof, induction, recurrence relations, principles of counting, elementary combinatorics, and asymptotic notations.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Prerequisite for: CSCE 230, ECEN 230; CSCE 231; CSCE 310; CSCE 310H; CSCE 362; CSCE 377; SOFT 260
Course and Laboratory Fee: $20

CSCE 251 Unix Programming Environment
Crosslisted with: ECEN 251
Notes: Familiarity with at least one high-level programming language.
Description: Introduction to the Unix operating system. Unix file system. Unix tools and utilities. Shell programming.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Grading Option: Graded with Option
Offered: FALL
Course and Laboratory Fee: $25

CSCE 291 Special Topics in Computer Science
Prerequisites: Permission.
Notes: Will not count towards a major or minor in computer science and computer engineering. Topics vary.
Description: Aspects of computers and computing for non-computer science and computer engineering majors and/or minors.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 6
Grading Option: Graded with Option

CSCE 292 Special Topics in Computer Science
Prerequisites: Permission.
Description: Aspects of computers and computing for computer science and computer engineering majors and minors. Topics vary.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 6
Grading Option: Graded with Option

CSCE 294 Independent Study in Computing
Prerequisites: Sophomore standing; permission of the instructor.
Description: Independent study of computer science topics performed under the guidance of a member of the faculty in the Department of Computer Science and Engineering.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

CSCE 310 Data Structures and Algorithms
Prerequisites: Grades of "Pass" or "C" or better in CSCE 156/156H or SOFT 161 and CSCE 235/235H. Credit toward the degree may be earned in only one of CSCE 310 or CSCE 311
Notes: Theoretical concepts with programming assignments.
Description: A review of algorithm analysis, asymptotic notation, and solving recurrence relations. Advanced data structures and their associated algorithms, heaps, priority queues, hash tables, trees, binary search trees, and graphs. Algorithmic techniques, divide and conquer, transform and conquer, space-time trade-offs, greedy algorithms, dynamic programming, randomization, and distributed algorithms. Introduction to computability and NP-completeness.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Prerequisite for: CSCE 351, ECEN 351; CSCE 360; CSCE 361, CSCE 361H; CSCE 493
Course and Laboratory Fee: $20

CSCE 310H Honors: Data Structures and Algorithms
Prerequisites: Good Standing in UNL Honors Program or by invitation; grades of 'P' or 'C' or better in CSCE 156/156H or SOFT 161 and CSCE 235/235H. Credit toward the degree cannot be earned in CSCE 310 and CSCE 310H.
Description: CSCE 310H covers the same topics as CSCE 310, but in greater depth. For course description, see CSCE 310.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: CSCE 351, ECEN 351; CSCE 360; CSCE 493
Course and Laboratory Fee: $20

CSCE 311 Data Structures and Algorithms for Informatics
Prerequisites: Grade of "Pass" or "C" or better in CSCE 155A, CSCE 155E, CSCE 155H, CSCE 155N, CSCE 155T, CSCE 320, or SOFT 160. Credit toward the degree may be earned in only one of CSCE 310 or CSCE 311
Notes: CSE majors must take CSCE 310.
Description: An introduction to algorithms and data structures for informatics. Foundational coverage of algorithms includes both problems (such as indexing, searching, sorting, and pattern matching) and methods (such as greedy, divide-and-conquer, and dynamic programming). Foundational coverage of data structures includes lists, tables, relational databases, regular expressions, trees, graphs, and multidimensional arrays. The topics will be studied in the context of informatics applications.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Prerequisite for: CSCE 322; CSCE 322H; CSCE 351, ECEN 351; CSCE 360; CSCE 361, CSCE 361H; CSCE 378; CSCE 378H; CSCE 386; CSCE 453H, RAIK 453H; CSCE 484; CSCE 493; CSCE 493A

CSCE 320 Data Analysis
Prerequisites: A grade of "P" or "C" or better in CSCE 155A, CSCE 155E, CSCE 155H, CSCE 155N, or CSCE 155T.
Description: Practical experience in modeling and analysis of large datasets through data mining and machine learning techniques. Use of models to promote efficient and effective data processing and analysis, including artificial intelligence-based applications.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Offered: FALL
Prerequisite for: CSCE 311; CSCE 493

CSCE 322 Programming Language Concepts
Prerequisites: A grade of "P" or "C" or better in CSCE 156, CSCE 156H, CSCE 311, SOFT 161, SOFT 161H, or RAIK 184H.
Description: List-processing, string-processing, and other types of high-level programming languages. Fundamental concepts of data types, control structures, operations, and programming environments of various programming languages. Analysis, formal specification, and comparison of language features.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Course and Laboratory Fee: $40

CSCE 322H Honors: Programming Language Concepts
Prerequisites: Good Standing in UNL Honors Program or by invitation; A grade of "P" or "C" or better in CSCE 156, CSCE 156H, CSCE 311, SOFT 161, SOFT 161H, or RAIK 184H. Credit toward the degree cannot be earned in CSCE 322 and CSCE 322H.
Description: List-processing, string-processing, and other types of high-level programming languages. Fundamental concepts of data types, control structures, operations, and programming environments of various programming languages. Analysis, formal specification, and comparison of language features.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Offered: FALL/SPR

CSCE 335 Digital Logic Design
Crosslisted with: ECEN 370
Prerequisites: ECEN 103 or CSCE 230
Description: Combinational and sequential logic circuits. MSI chips, programmable logic devices (PAL, ROM, PLA) used to design combinational and sequential circuits. CAD tools. LSI and PLD components and their use. Hardware design experience.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: ECEN 307; ECEN 327; ECEN 333; ECEN 481

CSCE 336 Embedded Systems
Prerequisites: A grade of "P" or "C" or better in CSCE 155E or CSCE 230 or CSCE 231.
Description: Introduction to designing, interfacing, configuring, and programming embedded systems. Configure simple embedded microprocessor systems, control peripherals, write device drivers in a high-level language, set up embedded and real-time operating systems, and develop applications for embedded systems.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Grading Option: Graded with Option
Offered: SPRING
Prerequisite for: CSCE 488; CSCE 488H
Course and Laboratory Fee: $40

CSCE 351 System Resource Management
Crosslisted with: ECEN 351
Prerequisites: A grade of "P" or "C" or better in CSCE 230 or CSCE 231 and CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H.
Description: An introduction to management of computing resources, including CPUs, shared memory, I/O devices, address spaces, and threads of execution, with a focus on implementation.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Offered: FALL
Course and Laboratory Fee: $40

CSCE 352 Exploring Virtual Reality
Prerequisites: CSCE 155A/155E/155T/155H, SOFT 160, RAIK 183H, or equivalent.
Notes: Requires familiarity with a high-level programming language .
Description: Introduction to designing, developing and producing virtual reality and immersive experiences. Work in interdisciplinary teams to produce a virtual reality/immersive project, game or storytelling experience.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

CSCE 360 Software Security in Practice
Prerequisites: A grade of "P" or "C" or higher in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H, or RAIK 283H
Description: Introduction to web application security risks and associated mitigation strategies, along with cloud-based resource management, and security basics on cloud application hosting.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

CSCE 361 Software Engineering
Crosslisted with: CSCE 361H
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H.
Notes: Requires participation in a group design and implementation of a software project.
Description: Techniques used in the disciplined development of large software projects. Software requirements analysis and specifications, program design, coding and integration testing, and software maintenance. Software estimation techniques, design tools, and complexity metrics.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Prerequisite for: CSCE 461, CSCE 861, SOFT 461; CSCE 486; CSCE 486H; CSCE 488; CSCE 488H
Course and Laboratory Fee: $20

CSCE 361H Software Engineering
Crosslisted with: CSCE 361
Prerequisites: Good Standing in UNL Honors Program or by invitation; A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H.
Notes: Requires participation in a group design and implementation of a software project.
Description: Techniques used in the disciplined development of large software projects. Software requirements analysis and specifications, program design, coding and integration testing, and software maintenance. Software estimation techniques, design tools, and complexity metrics.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Prerequisite for: CSCE 461, CSCE 861, SOFT 461; CSCE 486; CSCE 486H; CSCE 488; CSCE 488H
Course and Laboratory Fee: $20

CSCE 362 Fundamentals of Communication Systems
Prerequisites: A grade of "P" or "C" or better in CSCE 230, CSCE 231 or CSCE 235.
Description: Covers fundamentals of digital communication systems, in particular, various source and channel coding techniques and channel properties, and touches upon concepts from information theory that are used to determine and quantify transmission of information through a channel. Includes a comparison between analog and digital modulation techniques, with a special focus on the latter (e.g., PSK (BPSK, QPSK), PAM, QAM, FSK, etc.). Covers constellation mapping and detection techniques.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Offered: FALL/SPR

CSCE 370H Honors: Data and Models II: Data Science Fundamentals
Crosslisted with: RAIK 370H
Prerequisites: Good standing in the University Honors Program or by invitation; admission to the Jeffrey S.Raikes School of Computer Science and Management; and RAIK 270H
Description: Introduction to approaches using data for prediction and learning. Exploration of data for linear and nonlinear data modeling, machine learning, and supportive methods from statistics and numerical methods.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Offered: FALL/SPR
Prerequisite for: BSAD 371H, RAIK 371H

CSCE 377 Fundamentals of Cybersecurity
Prerequisites: A grade of "P" or "C" or better in CSCE 235.
Description: Introduction to security concepts, fundamental security properties, basic cryptographic building blocks, and their application to build secure protocols and systems.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Course and Laboratory Fee: $35

CSCE 378 Human-Computer Interaction
Prerequisites: A grade of "P" or "C" or better in CSCE 156, CSCE 156H, SOFT 161, SOFT 161H, RAIK 184H or CSCE 311.
Notes: STAT 380 or ECEN 305 recommended. Meeting ACE 1 and ACE 2 requirements prior to taking this course recommended.
Description: Knowledge and techniques useful in the design of computing systems for human use. Includes models of HCI, human information processing characteristics important in HCI, computer system features, such as input and output devices, dialogue techniques, and information presentation, task analysis, prototyping and the iterative design cycle, user interface implementation, interface evaluation.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Course and Laboratory Fee: $20

CSCE 378H Honors: Human-Computer Interaction
Prerequisites: Good standing in the University Honors Program; A grade of "P" or "C" or better in CSCE 156, CSCE 156H, SOFT 161, SOFT 161H, RAIK 184H or CSCE 311. Credit toward the degree cannot be earned in CSCE 378 and CSCE 378H.
Notes: STAT 380/RAIK 270H or ECEN 305 recommended. Meeting ACE 1 and ACE 2 requirements prior to taking this course recommended.
Description: Knowledge and techniques useful in the design of computing systems for human use. Includes models of HCI, human information processing characteristics important in HCI, computer system features, such as input and output devices, dialogue techniques, and information presentation, task analysis, prototyping and the iterative design cycle, user interface implementation, interface evaluation.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

CSCE 386 Practice and Professional Development: Design and Implementation
Prerequisites: Grade of "Pass" or "C" in CSCE 311.
Description: Studies in data science practice and professional development. Data science topics include data-centric and model-driven approaches; information and knowledge structures, organization, and access; searching and mining; and visualization. Professional development involves instruction in career development, entrepreneurship, professional ethics, and professional communications.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Offered: FALL

CSCE 391 Special Topics in Computer Science
Prerequisites: Permission.
Description: Aspects of computers and computing for non-computer science and computer engineering majors and/or minors. Topics vary.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 6
Grading Option: Graded with Option

CSCE 392 Special Topics in Computer Science
Prerequisites: Permission.
Description: Aspects of computers and computing for computer science and computer engineering majors and minors. Topics vary.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 6
Grading Option: Graded with Option

CSCE 394 Independent Study in Computing
Prerequisites: Junior standing; permission of the instructor.
Description: Independent study of computer science topics performed under the guidance of a member of the faculty in the Department of Computer Science and Engineering.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

CSCE 399 Undergraduate Thesis
Prerequisites: Permission.
Description: Independent practice and research leading to a thesis.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 6
Grading Option: Graded

CSCE 399H Honors Undergraduate Thesis
Prerequisites: Permission. Credit toward the degree cannot be earned in both CSCE 399 and CSCE 399H.
Description: Independent practice and research leading to a thesis.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 6
Grading Option: Graded

CSCE 401H Honors: RAIK Design Studio I
Crosslisted with: RAIK 401H, BSAD 401H, SOFT 401H
Prerequisites: Good standing in the University Honors Program or by invitation; admission to the Jeffrey S. Raikes School of Computer Science and Management; RAIK 284H/SOFT 261H or equivalent.
Notes: First semester in the Jeffrey S. Raikes School of Computer Science and Management design studio
Description: Application of Raikes School core content in a team oriented, project management setting. Complete projects in consultation with private and public sector clients.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Offered: FALL
Prerequisite for: RAIK 402H, BSAD 402H, CSCE 402H, SOFT 402H
ACE: ACE 8 Civic/Ethics/Stewardship
Experiential Learning: Case/Project-Based Learning

CSCE 402H Honors: RAIK Design Studio II
Crosslisted with: RAIK 402H, BSAD 402H, SOFT 402H
Prerequisites: Good standing in the University Honors Program or by invitation; admission to the Jeffrey S. Raikes School of Computer Science and Management; BSAD/CSCE/SOFT/RAIK 401H.
Notes: Second semester in the Jeffrey S. Raikes School of Computer Science and Management design studio
Description: Application of Raikes School core content in a team oriented, project management setting. Complete projects in consultation with private and public sector clients.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Offered: SPRING
Prerequisite for: RAIK 403H, BSAD 403H, CSCE 403H
ACE: ACE 10 Integrated Product
Experiential Learning: Case/Project-Based Learning

CSCE 403H Honors: RAIK Design Studio III
Crosslisted with: RAIK 403H, BSAD 403H
Prerequisites: Good standing in the University Honors Program or by invitation; admission to the Jeffrey S. Raikes School of Computer Science and Management; BSAD/CSCE/SOFT/RAIK 402H.
Notes: Third semester of Jeffrey S. Raikes School of Computer Science and Management design studio sequence.
Description: Application of Jeffrey S. Raikes School of Computer Science and Management core content in a team oriented, project management setting. Complete projects in consultation with private and public sector clients.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: RAIK 404H, BSAD 404H, CSCE 404H
Experiential Learning: Case/Project-Based Learning

CSCE 404H Honors: RAIK Design Studio IV
Crosslisted with: RAIK 404H, BSAD 404H
Prerequisites: Good standing in the University Honors Program or by invitation; admission to the Jeffrey S. Raikes School of Computer Science and Management; and BSAD/CSCE/SOFT/RAIK 403H.
Notes: Fourth semester in the Jeffrey S. Raikes School of Computer Science and Management design studio sequence.
Description: Application of Raikes School core content in a team oriented, project management setting. Complete projects in consultation with private and public sector clients.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Experiential Learning: Case/Project-Based Learning

CSCE 405H Honors: RAIK Research Studio I
Crosslisted with: RAIK 405H
Prerequisites: Good standing in the University Honors Program or by invitation; admission to the Jeffrey S. Raikes School of Computer Science and Management; RAIK 284H/SOFT 261H or equivalent.
Notes: First semester of Jeffrey S. Raikes School of Computer Science and Management research studio experience. Students work individually with a sponsoring faculty member from the area of their research and Raikes School faculty.
Description: Application of research principles to solve complex problems through the delivery of innovative, cutting-edge solutions and to gain an understanding of the roles involved.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Offered: FALL
Prerequisite for: CSCE 406H, RAIK 406H

CSCE 406H Honors: RAIK Research Studio II
Crosslisted with: RAIK 406H
Prerequisites: RAIK 405H
Notes: Second semester of Jeffrey S. Raikes School of Computer Science and Management research studio experience. Students work individually with a sponsoring faculty member from the area of their research and Raikes School faculty.
Description: Application of research principles to solve complex problems through the delivery of innovative, cutting-edge solutions and to gain an understanding of the roles involved.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Offered: SPRING

CSCE 410 Information Retrieval Systems
Crosslisted with: CSCE 810
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H.
Description: Outline of the general information retrieval problem, functional overview of information retrieval. Deterministic models of information retrieval systems; conventional Boolean, fuzzy set theory, p-norm, and vector space models. Probabilistic models. Text analysis and automatic indexing. Automatic query formulation. System-user adaptation and learning mechanisms. Intelligent information retrieval. Retrieval evaluation. Review of new theories and future directions. Practical experience with a working experimental information retrieval system.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Offered: SPRING

CSCE 411 Data Modeling for Systems Development
Crosslisted with: CSCE 811
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H.
Description: Concepts of relational and object-oriented data modeling through the process of data model development including conceptual, logical and physical modeling. Techniques for identifying and creating relationships between discrete data members, reasoning about how data modeling and analysis are incorporated in system design and development, and specification paradigms for data models. Common tools and technologies for engineering systems and frameworks for integrating data. Design and analysis of algorithms and techniques for identification and exploration of data relationships, such as Bayesian probability and statistics, clustering, map-reduce, and web-based visualization.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

CSCE 412 Data Visualization
Crosslisted with: CSCE 812
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H; MATH 314.
Description: Fundamentals and implementations of data visualization techniques. Programming skills and practices in interactive visualization applications. Visualization foundations, human perception for information processing, and visualization techniques for different data types, such as scalar-field data, vector-field data, geospatial data, multivariate data, graph/network data, and text/document data. Advanced visualization algorithms and topics as time permits.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Offered: FALL/SPR

CSCE 413 Database Systems
Crosslisted with: CSCE 813
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H.
Notes: Involves practical experience with a working database system.
Description: Data and storage models for database systems; entity/relationship, relational, and constraint models; relational databases; relational algebra and calculus; structured query language; Logical database design: normalization; integrity; distributed data storage; concurrency; security issues. Spatial databases and geographic information systems.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Prerequisite for: CSCE 913; CSCE 914
Course and Laboratory Fee: $40

CSCE 415 Computational Linguistics
Crosslisted with: CSCE 815
Prerequisites: Standing of junior class or above; one of CSCE 310, CSCE 311 or SOFT 260.
Description: Covers the fundamentals of language modeling, parsing, machine translation, computational and statistical methods in comparative linguistics, laws of phonological change and language evolution, language families and script families, ancient scripts, computational methods for script comparison and the analysis of script evolution.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Offered: FALL/SPR
Prerequisite for: CSCE 915

CSCE 417 Artificial Intelligence For Social Good
Crosslisted with: CSCE 817
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H. Graduate prerequisite CSCE 802.
Description: Analyzes studies that address societal challenges through machine learning (ML) and, more broadly, artificial intelligence (AI). Focuses on selected research categorized under AI for Social Good (AI4SG), spanning areas such as agriculture, education, environmental sustainability, healthcare, social care, public safety, and transportation.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Offered: FALL/SPR

CSCE 420 Introduction to Natural Language Processing
Crosslisted with: CSCE 820
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H. Graduate prerequisite: CSCE 802.
Description: Introduction to fundamental concepts and techniques in Natural Language Processing.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Offered: FALL/SPR

CSCE 421 Foundations of Constraint Processing
Crosslisted with: CSCE 821
Prerequisites: A grade of "P" or "C" or better in CSCE 235 and CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H.
Description: Constraint processing for articulating and solving industrial problems such as design, scheduling, and resource allocation. The foundations of constraint satisfaction, its basic mechanisms (e.g., search, backtracking, and consistency-checking algorithms), and constraint programming languages. New directions in the field, such as strategies for decomposition and for symmetry identification.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Prerequisite for: CSCE 921
Course and Laboratory Fee: $10

CSCE 422 Introduction to Computational Game Theory
Crosslisted with: CSCE 822
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H. Graduate prerequisite CSCE 802.
Description: Introduction to essential tools for modeling and analyzing strategic interactions between self-interested agents. Covers key solution concepts used to predict decision-making behavior and examines the computational aspects of these solutions. Explores applications of game theory in areas such as security and social sciences.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Offered: SPRING

CSCE 423 Design and Analysis of Algorithms
Crosslisted with: CSCE 823
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H.
Description: Mathematical preliminaries. Strategies for algorithm design, including divide-and-conquer, greedy, dynamic programming and backtracking. Mathematical analysis of algorithms. Introduction to NP-Completeness theory, including the classes P and NP, polynomial transformations and NP-complete problems.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Prerequisite for: CSCE 923; CSCE 924
Course and Laboratory Fee: $20

CSCE 424 Computational Complexity Theory
Crosslisted with: CSCE 824
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H.
Description: Turing machine model of computation: deterministic, nondeterministic, alternating, probabilistic. Complexity classes: Time and space bounded, deterministic, nondeterministic, probabilistic. Reductions and completeness. Complexity of counting problems. Non-uniformity. Lower bounds. Interactive proofs.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

CSCE 425 Compiler Construction
Crosslisted with: CSCE 825
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H.
Description: Review of program language structures, translation, loading, execution, and storage allocation. Compilation of simple expressions and statements. Organization of a compiler including compile-time and run-time symbol tables, lexical scan, syntax scan, object code generation, error diagnostics, object code optimization techniques, and overall design.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Course and Laboratory Fee: $20

CSCE 428 Automata, Computation, and Formal Languages
Crosslisted with: CSCE 828
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H.
Description: Introduction to the classical theory of computer science. Finite state automata and regular languages, minimization of automata. Context free languages and pushdown automata, Turing machines and other models of computation, undecidable problems, introduction to computational complexity.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Course and Laboratory Fee: $20

CSCE 429 Information Theory
Crosslisted with: CSCE 829
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H; STAT 380, ECEN 305 or RAIK 270H.
Description: Deals with the foundations of information theory, as well as the more practical aspects of information coding. Information measures are first introduced, and then applied to the analysis of the theoretical performance achievable in data compression and propagation over noisy channels.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Offered: SPRING

CSCE 430 Computer Architecture
Crosslisted with: CSCE 830
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H; Coreq: STAT 380, ECEN 305 or RAIK 270H.
Description: Architecture of single-processor (Von Neumann or SISD) computer systems. Evolution, design, implementation, and evaluation of state-of-the-art systems. Memory Systems, including interleaving, hierarchies, virtual memory and cache implementations; Communications and I/O, including bus architectures, arbitration, I/O processors and DMA channels; and Central Processor Architectures, including RISC and Stack machines, high-speed arithmetic, fetch/execute overlap, and parallelism in a single-processor system.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Course and Laboratory Fee: $20

CSCE 431 Hardware and Software Acceleration for Machine Learning
Crosslisted with: CSCE 831
Prerequisites: A grade of "P" or "C" or better in CSCE 230 or CSCE 231 and CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H.
Description: Overview of the hardware and software acceleration techniques, including basics of deep learning, deep learning frameworks, hardware accelerators, co-optimization of algorithms and hardware, training and inference, support for state-of-the-art deep learning networks.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Offered: FALL

CSCE 435 Cluster and Grid Computing
Crosslisted with: CSCE 835
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H, or RAIK 283H.
Notes: Designed for CSCE and non-CSCE students who have an interest in building or programming clusters to enhance their computationally-intense research.
Description: Build and program clusters. Cluster construction, cluster administration, cluster programming, and grid computing.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

CSCE 436 Advanced Embedded Systems
Crosslisted with: CSCE 836
Prerequisites: A grade of "P" or "C" or better in CSCE 231, CSCE 336 or ECEN 220.
Description: Embedded hardware design techniques; transceiver design and low-power communication techniques; sensors and distributed sampling techniques; embedded software design and embedded operating systems; driver development; embedded debugging techniques;hardware and software architectures of embedded systems; and design, development, and implementation of embedded applications.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Course and Laboratory Fee: $40

CSCE 438 Internet of Things
Crosslisted with: CSCE 838
Prerequisites: CSCE 230 or CSCE 231; SOFT 260, CSCE 310, CSCE 310H, CSCE 311 or equivalent; senior or graduate standing or instructor permission.
Description: Theoretical and practical insight into the Internet of Things (IoT). Basics of IoT, including devices and sensors, connectivity, cloud processing and storage, analytics and machine learning, security, business models as well as advanced topics such as localization, synchronization, connected vehicles, and applications of IoT. Includes a group project that provides hands-on interaction with IoT.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Course and Laboratory Fee: $20

CSCE 439 Robotics: Algorithms and Applications
Crosslisted with: CSCE 839
Prerequisites: A grade of "P" or "C" or better in CSCE 231, CSCE 336 or ECEN 220 and CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H
Description: Fundamental theory and algorithms for real world robot systems. Design and build a robot platform and implement algorithms in C++ or other high level languages. Topics include: open and closed loop control, reactive control, localization, navigation, path planning, obstacle avoidance, dynamics, kinematics, manipulation and grasping, sensing, robot vision processing, and data fusion.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Offered: FALL/SPR
Course and Laboratory Fee: $50

CSCE 440 Numerical Analysis I
Crosslisted with: CSCE 840, MATH 440, MATH 840
Prerequisites: CSCE 155A, CSCE 155E, CSCE 155H, CSCE 155N, CSCE 155T, or SOFT 160; MATH 107. Credit toward the degree may be earned in only one of the following: CSCE440/MATH 440 and MECH 480
Description: Principles of numerical computing and error analysis covering numerical error, root finding, systems of equations, interpolation, numerical differentiation and integration, and differential equations. Modeling real-world engineering problems on digital computers. Effects of floating point arithmetic.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Prerequisite for: CSCE 942
Course and Laboratory Fee: $20

CSCE 443 Cybersecurity for Big Data, Cloud and Cryptocurrencies
Crosslisted with: CSCE 843
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H.
Notes: Labs will be conducted on academic cloud and compute environments as well as public clouds.
Description: Covers the cybersecurity threat landscape and the mitigation strategies for Big Data, Cloud environments and Cryptocurrencies. Discusses emerging technologies and frameworks such as End-to-end encryption, Blockchains, Smart Contracts, OpenID Connect and OAuth2.0 as promising solutions to ensure data confidentiality and privacy.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Offered: FALL

CSCE 445 Eye Tracking in Usability and Software Engineering
Crosslisted with: CSCE 845
Prerequisites: SOFT 261 or CSCE 361.
Description: Create and evaluate new and existing human computer interfaces in the context of software engineering. Interdisciplinary applications of eye tracking in various areas of software engineering, biometrics, and psychology among others will be presented. Learn how to design, conduct, and analyze a technically sound eye tracking empirical study for software engineering problems in a group setting.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Offered: SPRING

CSCE 451 Operating Systems Principles
Crosslisted with: CSCE 851
Prerequisites: A grade of "P" or "C" or better in CSCE 230 or CSCE 231 and CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H.
Description: Organization and structure of operating systems. Control, communication, and synchronization of concurrent processes. Processor and job scheduling. Memory organization and management including paging, segmentation, and virtual memory. Resource management. Deadlock avoidance, detection, recovery. File system concepts and structure. Protection and security. Substantial programming.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Prerequisite for: CSCE 455, CSCE 855
Course and Laboratory Fee: $20

CSCE 453H Honors: User Interfaces
Crosslisted with: RAIK 453H
Prerequisites: A grade of "P" or "C+" or higher in CSCE 156, CSCE 156H, CSCE 220, CSCE 311, RAIK 184H, SOFT 161, or SOFT 161H. Good standing in the University Honors Program.
Notes: Enrolled students are expected to have advanced communication skills and a high commitment to conscientiousness. Students who are not in the University Honors Program but nonetheless meet these requirements may request permission of the instructor to enroll. Meeting ACE1 and ACE2 requirements prior to taking this course is recommended.
Description: Introduction to the areas of user interfaces and user experience through reading and hands-on experiences. Areas covered include the psychology and physiology of design, the process of interface design, cultural values and accessibility, designing for beauty and delight, and dynamic evaluation strategies.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

CSCE 454 Human-Robot Interaction
Crosslisted with: CSCE 854
Prerequisites: A grade of "P" or "C" or better in CSCE 156, CSCE 156H, SOFT 161, SOFT 161H, RAIK 184H or CSCE 311.
Notes: Meeting ACE1 and ACE2 requirements prior to taking this course is recommended. Non-CSCE majors may discuss qualifications with the instructor.
Description: Introduction to the area of human-robot interaction through the reading and discussion of current peer-reviewed articles on topic to include teleoperation, social robotics, and open questions with field-based or aerial robotic systems. Areas covered include: research methods, experimental design, and identification of problems/open questions.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Offered: FALL/SPR

CSCE 455 Distributed Operating Systems
Crosslisted with: CSCE 855
Prerequisites: CSCE 451/851.
Description: Organization and structure of distributed operating systems. Control, communication and synchronization of concurrent processes in the context of distributed systems. Processor allocation and scheduling. Deadlock avoidance, detection, recovery in distributed systems. Fault tolerance. Distributed file system concepts and structure.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Prerequisite for: CHME 496, CHME 896
Course and Laboratory Fee: $20

CSCE 456 Parallel Programming
Crosslisted with: CSCE 856
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H, or RAIK 283H.
Description: Introduction to the fundamentals of parallel computation and applied algorithm design. Methods and models of modern parallel computation; general techniques for designing efficient parallel algorithms for distributed and shared memory multiprocessor machines; principles and practice in programming an existing parallel machine.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Course and Laboratory Fee: $10

CSCE 457 Systems Administration
Crosslisted with: CSCE 857
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H.
Description: Introduction to basic concepts of system administration. Operating systems and networking overview. User and resource management. Networking, systems and internet related security. System services and common applications, web services, database services, and mail servers. Basic scripting in shell, Perl, and Expect. Systems administration on UNIX® platform.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

CSCE 458 Molecular and Nanoscale Communication
Crosslisted with: CSCE 858
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H; STAT 380, ECEN 305 or RAIK 270H.
Notes: Completing CSCE 462/862 and CSCE 465/865 prior to taking this course is recommended. Exceptions can be granted on a per-student basis by the instructor.
Description: Overview of nanoscale communication options. Focus on bio-inspired communication through molecule exchange and biochemical reactions. Different techniques to realize nanomachines will be surveyed in the course, with particular attention to the tools provided by synthetic biology for the programming of biological cooperative systems.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Offered: FALL/SPR

CSCE 459 Genetically Engineered Systems
Crosslisted with: CSCE 859
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H; STAT 380, ECEN 305 or RAIK 270H.
Notes: Completing CSCE/MATH 440/840, MATH 439/839, and CSCE 471/871 prior to taking this course is recommended. Exceptions can be granted on a per-student basis by the instructor. Meeting ACE 1 and ACE 2 requirements prior to taking this course is recommended. Non-CSCE majors may discuss qualifications with the instructor.
Description: Introduction to the field of synthetic biology, and its interdisciplinary foundational concepts. Presents the technologies at the basis of synthetic biology, together with the engineering concepts that underlie the design, modeling, and realization of genetically engineered systems. Surveys examples of cutting edge applications.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Offered: FALL/SPR

CSCE 460 Software Engineering for Robotics
Crosslisted with: SOFT 460, CSCE 860
Prerequisites: SOFT 261 or RAIK 284H or CSCE 361
Description: Application of software engineering practices and principles to autonomous robotic systems.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Offered: FALL

CSCE 461 Advanced Topics in Software Engineering
Crosslisted with: CSCE 861, SOFT 461
Prerequisites: A grade of "P" or "C" or better in CSCE 361, CSCE 361H, SOFT 261, SOFT 261H or RAIK 284H.
Description: Advanced or emerging techniques in software engineering. Topics include but not limited to design methodology, software dependability, and advanced software development environments.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

CSCE 462 Communication Networks
Crosslisted with: CSCE 862
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H; STAT 380, ECEN 305 or RAIK 270H.
Description: Introduction to the architecture of communication networks and the rudiments of performance modeling. Circuit switching, packet switching, hybrid switching, protocols, local and metro area networks, wide area networks and the Internet, elements of performance modeling, and network programming. Network security, asynchronous transfer mode (ATM), optical, wireless, cellular, and satellite networks, and their performance studies.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Prerequisite for: CSCE 952; CSCE 953
Course and Laboratory Fee: $20

CSCE 463 Data and Network Security
Crosslisted with: CSCE 863, ECEN 487, ECEN 887
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H.
Description: Concepts and principles of data and network security. Focuses on practical aspects and application of crypto systems in security protocols for networks such as the Internet. Topics include: applications of cryptography and cryptosystems for digital signatures, authentication, network security protocols for wired and wireless networks, cyberattacks and countermeasures, and security in modern computing platforms.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Offered: SPRING

CSCE 464 Internet Systems and Programming
Crosslisted with: CSCE 864
Prerequisites: A grade of "Pass" or C or better in CSCE 156, SOFT 161, RAIK 184H or CSCE 311 or equivalent programming experience.
Notes: A grade of "Pass" or C or better in CSCE 156, SOFT 161, RAIK 184H or CSCE 311 or equivalent programming experience.
Description: Paradigms, systems, and languages for Internet applications. Client-side and server-side programming, object-based and event-based distributed programming, and multi-tier applications. Coverage of specific technologies varies.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

CSCE 465 Wireless Communication Networks
Crosslisted with: CSCE 865
Prerequisites: A grade of "P" or "C" or better in STAT 380, ECEN 305 or RAIK 270H
Description: Discussion of theoretical and practical insight to wireless communications and wireless networking, current practices, and future trends. Wireless network architectures, mobility management, radio propagation, modulation, power control, antennas, channel access, pricing, and standards.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Prerequisite for: CSCE 954

CSCE 466 Software Design and Architecture
Crosslisted with: SOFT 466, CSCE 866
Prerequisites: A grade of "P" or "C" or better in CSCE 361, CSCE 361H, SOFT 261, SOFT 261H or RAIK 284H.
Notes: Letter grade only.
Description: Introduction to the concepts, principles, and state-of-the-art methods in software design and architecture. Topics include application of software engineering process models and management approaches for the design and architecture of large-scale software systems, trade-offs of designing for qualities such as performance, security, and dependability, and techniques and tools for analyzing and evaluating software architectures.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

CSCE 467 Testing, Verification and Analysis
Crosslisted with: SOFT 467, CSCE 867
Prerequisites: A grade of "P" or "C" or better in CSCE 361, CSCE 361H, SOFT 261, SOFT 261H or RAIK 284H.
Notes: Letter grade only.
Description: In-depth coverage of problems related to software quality, and approaches for addressing them. Topics include testing techniques, dynamic and static program analysis techniques, and other approaches for verifying software qualities. Tool support for performing testing, verification, and analysis will also be studied.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Course and Laboratory Fee: $20

CSCE 468 Requirements Elicitation, Modeling and Analysis
Crosslisted with: SOFT 468, CSCE 868
Prerequisites: A grade of "P" or "C" or better in CSCE 361, CSCE 361H, SOFT 261, SOFT 261H or RAIK 284.
Notes: Letter grade only.
Description: In-depth coverage of processes, methods and techniques for determining, or deciding, what a proposed software system should do. Topics include the requirements engineering process, identification of stakeholders, requirements elicitation techniques, methods for informal and formal requirements documentation, techniques for analyzing requirements models for consistency and completeness, and traceability of requirements across system development and evolution. Tool support for modeling functional and non-functional requirements to support elicitation and analysis will be studied.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

CSCE 469 Secure Software Engineering
Crosslisted with: SOFT 469, CSCE 869
Prerequisites: SOFT 261, CSCE 361, RAIK 284H, or graduate standing.
Description: Introduction to concepts, principles and state-of-the-art methods in creating and maintaining secure software systems.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

CSCE 470 Computer Graphics
Crosslisted with: CSCE 870
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H; MATH 314
Description: Display and recording devices; incremental plotters; point, vector, and character generation; grey scale displays, digitizers and scanners, digital image storage; interactive and passive graphics; pattern recognition; data structures and graphics software; the mathematics of three dimensions; homogeneous coordinates; projections and the hidden-line problem.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Course and Laboratory Fee: $20

CSCE 471 Computational Methods in Bioinformatics
Crosslisted with: CSCE 871
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H.
Description: Introduction to computational methods for tackling challenges in biological data analysis and modeling and understanding complex systems at the molecular and cellular level. The main topics include bio-sequence analysis, motif finding, structure prediction, phylogenic inference, regulation network modeling, and high-throughput omics data analysis.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Offered: SPRING
Prerequisite for: CSCE 971

CSCE 472 Digital Image Processing
Crosslisted with: CSCE 872
Prerequisites: A grade of "Pass" or C or better in CSCE 156, SOFT 161, RAIK 184H or CSCE 311 or equivalent programming experience.
Notes: A grade of "Pass" or C or better in CSCE 156, SOFT 161, RAIK 184H or CSCE 311 or equivalent programming experience.
Description: Digital imaging systems, digital image processing, and low-level computer vision. Data structures, algorithms, and system analysis and modeling. Digital image formation and presentation, image statistics and descriptions, operations and transforms, and system simulation. Applications include system design, restoration and enhancement, reconstruction and geometric manipulation, compression, and low-level analysis for computer vision.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Course and Laboratory Fee: $10

CSCE 473 Computer Vision
Crosslisted with: CSCE 873
Prerequisites: CSCE 156, SOFT 161, or CSCE 311 or equivalent programming experience.
Notes: A grade of "Pass" or C or better in CSCE 156, SOFT 161, RAIK 184H or CSCE 311 or equivalent programming experience.
Description: High-level processing for image understanding and high-level vision. Data structures, algorithms, and modeling. Low-level representation, basic pattern-recognition and image-analysis techniques, segmentation, color, texture and motion analysis, and representation of 2-D and 3-D shape. Applications for content-based image retrieval, digital libraries, and interpretation of satellite imagery.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Course and Laboratory Fee: $40

CSCE 474 Introduction to Data Mining
Crosslisted with: CSCE 874
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H; STAT 380, ECEN 305 or RAIK 270H.
Notes: Requires the completion of a project involving the application of data mining techniques to real-world problems.
Description: Data mining and knowledge discovery methods and their application to real-world problems. Algorithmic and systems issues. Statistical foundations, association discovery, classification, prediction, clustering, spatial data mining and advanced techniques.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

CSCE 475 Multiagent Systems
Crosslisted with: CSCE 875
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H.
Description: Distributed problem solving and planning, search algorithms for agents, distributed rational decision making, learning multiagent systems, computational organization theory, formal methods in Distributed Artificial Intelligence, multiagent negotiations, emergent behaviors (such as ants and swarms), and Robocup technologies and real-time coalition formation.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

CSCE 476 Introduction to Artificial Intelligence
Crosslisted with: CSCE 876
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H.
Description: Introduction to basic principles, techniques, and tools now being used in the area of machine intelligence. Languages for AI programming introduced with emphasis on LISP. Lecture topics include problem solving, search, game playing, knowledge representation, expert systems, and applications.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Prerequisite for: CSCE 976
Course and Laboratory Fee: $40

CSCE 478 Introduction to Machine Learning
Crosslisted with: CSCE 878
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H.
Notes: STAT 380, ECEN 305, or RAIK 270H recommended.
Description: Introduction to the fundamentals and current trends in machine learning. Possible applications for game playing, text categorization, speech recognition, automatic system control, date mining, computational biology, and robotics. Theoretical and empirical analyses of decision trees, artificial neural networks, Bayesian classifiers, genetic algorithms, instance-based classifiers and reinforcement learning.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Course and Laboratory Fee: $50

CSCE 479 Introduction to Deep Learning
Crosslisted with: CSCE 879
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H.
Notes: Completing STAT 380/RAIK 270H or ECEN 305 prior to taking this course is recommended.
Description: Fundamentals and current trends in deep learning. Backpropagation, activation functions, loss functions, choosing an optimizer, and regularization. Common architectures such as convolutional, autoencoders, and recurrent. Applications such as image analysis, text analysis, sequence analysis, and reinforcement learning.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Offered: SPRING
Course and Laboratory Fee: $50

CSCE 480H Honors: Generative AI - Applications, Ethics, and Research
Crosslisted with: RAIK 480H, CSCE 880
Prerequisites: Good standing in the University Honors Program; CSCE 320 or RAIK 370. Familiarity with machine learning is recommended.
Description: Focuses on research and discussion to examine recent developments in and the implementations of Generative Artificial Intelligence (AI) systems. Covers ethical implications and potential broader impacts, while applying them to various domains, culminating in a class project. Specific concepts covered include core generative technologies ranging from variational autoencoders (VAEs), generative adversarial networks (GANs), and transformer-based models like large language models (LLMs) and diffusion image generation; key related concepts in terms of data considerations, model parameters and hyperparameters, finetuning and prompt engineering techniques; and practical use cases in terms of technology and industry through research paper reviews and case study discussions.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Offered: FALL

CSCE 484 Data Science Professional Development
Prerequisites: CSCE 311
Description: Preparation for the senior design project. Professional practice through familiarity with current tools, resources, and technologies. Professional standards, practices and ethics, and the oral and written report styles used specifically in the field of data science.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Offered: FALL

CSCE 486 Computer Science Professional Development
Prerequisites: A grade of "Pass" or "C" or better in SOFT 261, SOFT 261H, CSCE 361, or CSCE 361H. JGEN 200.
Notes: Must be taken exactly one semester before CSCE 487 or CSCE 487H.
Description: Preparation for the senior design project. Professional practice through familiarity with current tools, resources, and technologies. Professional standards, practices and ethics, and the oral and written report styles used specifically in the field of computer science.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Prerequisite for: CSCE 487; CSCE 487H
ACE: ACE 8 Civic/Ethics/Stewardship
Course and Laboratory Fee: $10
Experiential Learning: Case/Project-Based Learning

CSCE 486H Honors Computer Science Professional Development
Prerequisites: A grade of "Pass" or "C" or better in SOFT 261, SOFT 261H, CSCE 361, or CSCE 361H. JGEN 200. Credit toward the degree cannot be earned in CSCE 486 and CSCE 486H.
Notes: Must be taken exactly one semester before CSCE 487 or CSCE 487H.
Description: Preparation for the senior design project. Professional practice through familiarity with current tools, resources, and technologies. Professional standards, practices and ethics, and the oral and written report styles used specifically in the field of computer science.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Offered: FALL
Prerequisite for: CSCE 487H
ACE: ACE 8 Civic/Ethics/Stewardship
Experiential Learning: Case/Project-Based Learning

CSCE 487 Computer Science Senior Design Project
Prerequisites: CSCE 486
Notes: Should be taken in the immediate next term after CSCE 486.
Description: A substantial computer science project requiring design, planning and scheduling, teamwork, written and oral communications, and the integration and application of technical and analytical aspects of computer science and software engineering.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Prerequisite for: SOFT 403; SOFT 403H
ACE: ACE 10 Integrated Product
Course and Laboratory Fee: $40
Experiential Learning: Case/Project-Based Learning

CSCE 487H Honors Computer Science Senior Design Project
Prerequisites: CSCE 486 or CSCE 486H. Credit toward the degree cannot be earned in both CSCE 487 and CSCE 487H.
Notes: Should be taken in the immediate next term after CSCE 486 or CSCE 486H.
Description: A substantial computer science project requiring design, planning and scheduling, teamwork, written and oral communications, and the integration and application of technical and analytical aspects of computer science and software engineering.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Offered: SPRING
Prerequisite for: SOFT 403H
ACE: ACE 10 Integrated Product
Experiential Learning: Case/Project-Based Learning

CSCE 488 Computer Engineering Professional Development
Prerequisites: CSCE 336; A grade of "Pass" or "C" or better in CSCE 361 or CSCE 361H; formal admission to the College of Engineering; prereq or coreq: JGEN 300.
Notes: Must be taken exactly one semester before CSCE 489 or CSCE 489H.
Description: Preparation for the senior design project. Professional practice through familiarity and practice with current tools, resources, and technologies; professional standards, practices, and ethics; and oral and written report styles used in the computer engineering field.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Prerequisite for: CSCE 489; CSCE 489H
ACE: ACE 8 Civic/Ethics/Stewardship
Course and Laboratory Fee: $10
Experiential Learning: Case/Project-Based Learning

CSCE 488H Honors Computer Engineering Professional Development
Prerequisites: CSCE 336; A grade of "Pass" or "C" or better in CSCE 361 or CSCE 361H; formal admission to the College of Engineering; prereq or coreq: JGEN 300. Credit toward the degree cannot be earned in CSCE 488 and CSCE 488H.
Notes: Must be taken exactly one semester before CSCE 489 or CSCE 489H.
Description: Preparation for the senior design project. Professional practice through familiarity and practice with current tools, resources, and technologies; professional standards, practices, and ethics; and oral and written report styles used in the computer engineering field.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Offered: FALL
Prerequisite for: CSCE 489H
ACE: ACE 8 Civic/Ethics/Stewardship
Experiential Learning: Case/Project-Based Learning

CSCE 489 Computer Engineering Senior Design Project
Prerequisites: CSCE 488 (taken exactly one semester previous).
Description: A substantial computer engineering project requiring hardware-software co-design, planning and scheduling, teamwork, written and oral communications, and the integration and application of technical and analytical aspects of computer science and computer engineering.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
ACE: ACE 10 Integrated Product
Course and Laboratory Fee: $40
Experiential Learning: Case/Project-Based Learning

CSCE 489H Honors Computer Engineering Senior Design Project
Prerequisites: CSCE 488 or CSCE 488H (taken exactly one semester previous). Credit toward the degree cannot be earned in both CSCE 489 and CSCE 489H.
Description: A substantial computer engineering project requiring hardware-software co-design, planning and scheduling, teamwork, written and oral communications, and the integration and application of technical and analytical aspects of computer science and computer engineering.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Offered: SPRING
ACE: ACE 10 Integrated Product
Experiential Learning: Case/Project-Based Learning

CSCE 492 Special Topics in Computer Science
Crosslisted with: CSCE 892
Prerequisites: CSCE 310/310H, CSCE 311, SOFT 260/260H/RAIK 283H, or graduate standing.
Description: Aspects of computers and computing not covered elsewhere in the curriculum presented as the need arises.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 6
Grading Option: Graded with Option
Course and Laboratory Fee: $40

CSCE 492H Honors Special Topics in Computer Science
Prerequisites: Permission. Credit toward the degree cannot be earned in both CSCE 492 and CSCE 492H.
Description: Topics vary
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 6
Grading Option: Graded with Option

CSCE 493 Innovation Lab Project
Prerequisites: CSCE 310, CSCE 310H, CSCE 311, or CSCE 320
Description: Innovative team projects executed under the guidance of members of the faculty of the Department of Computer Science and Managing Director of the CSCE Innovation Lab. Students will work in teams and collaborate with CSE research faculty, supervising MS students, and sponsors that include private sectors and UNL faculty to design and develop real-world systems.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 6
Grading Option: Graded with Option
Experiential Learning: Case/Project-Based Learning

CSCE 493A Interdisciplinary Capstone
Prerequisites: CSCE 311
Notes: Does not apply toward any requirements for the Computer Science or Computer Engineering degree. Required for the Informatics minor.
Description: Innovative team projects executed under the guidance of members of the faculty of the Department of Computer Science and Managing Director of the CSCE Innovation Lab. Work in teams and collaboration with CSE research faculty and sponsors that include private sectors and UNL faculty to design and develop real-world systems to solve interdisciplinary problems.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 6
Grading Option: Graded
Experiential Learning: Case/Project-Based Learning

CSCE 495 Internship in Computing Practice
Prerequisites: Permission.
Notes: Requires a detailed project proposal and final report.
Description: Experiential learning in conjunction with an approved industrial or government agency under the joint supervision of an outside sponsor and a faculty advisor.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 6
Grading Option: Graded with Option
Experiential Learning: Internship/Co-op

CSCE 498 Computer Problems
Crosslisted with: CSCE 898
Prerequisites: Senior or graduate standing.
Description: Independent project executed under the guidance of a member of the faculty of the School of Computing. Solution and documentation of a computer problem demanding a thorough knowledge of either the numerical or nonnumerical aspects of computer science.
Credit Hours: 1-6
Min credits per semester: 1
Max credits per semester: 6
Max credits per degree: 6
Grading Option: Graded with Option

ECEN 102 Introduction to Electrical Engineering
Prerequisites: Open to first year students only or by permission.
Description: An overview of the electrical engineering field. Introduction to some basic concepts and skills needed in electrical engineering. Professionalism and ethics are addressed as well as the need for lifelong learning experiences. Information on professional careers available upon graduation.
Credit Hours: 2
Max credits per semester: 2
Max credits per degree: 2
Grading Option: Graded
Course and Laboratory Fee: $25

ECEN 103 Electrical and Computer Engineering Fundamentals
Prerequisites: MATH 106 or (UNO) MATH 1950, or parallel.
Description: Introduction to DC circuit analysis and digital logic. Ohm's and Kirchoff's laws, mesh and nodal analysis, Boolean algebra, logic gates, minimization, counters, and flip-flops. Uses of computer based resources for data analysis and report generation. Use of internet to locate and retrieve engineering resources.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Grading Option: Graded with Option
Offered: FALL/SPR
Prerequisite for: ECEN 106; ECEN 123; ECEN 213; ECEN 220; ECEN 225; ECEN 370, CSCE 335
Course and Laboratory Fee: $20

ECEN 106 Microprocessor Applications
Prerequisites: ECEN 103; CSCE 155A, 155E, 155H, 155N, 155T or (UNO) CIST 1400.
Description: Introduction to assembly language programming of microprocessors / microcontrollers, assemblers, and debugging tool utilization. Microprocessor system hardware components, control signals, and 'C' language micro-controller programming.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Prerequisite for: ECEN 224; ECEN 332; ECEN 345

ECEN 123 Introduction to Electrical and Computer Engineering
Prerequisites: ECEN 103 or parallel; CSCE155A/CSCE 155E/(UNO) CIST 1400 or parallel. Open to first year students only.
Description: Laboratory design projects introducing some basic concepts and skills needed in electrical and computer engineering.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Grading Option: Graded
Offered: FALL/SPR
Course and Laboratory Fee: $30

ECEN 155E Computer Science I: Systems Engineering Focus
Crosslisted with: CSCE 155E
Prerequisites: MATH 102 or a Math Placement Test score for MATH 103 or higher. Credit toward the degree may be earned in only one of:CSCE 155, CSCE 155A, CSCE 155E/ECEN 155E, CSCE 155H, CSCE 155N, or CSCE 155T.
Notes: Recommended for students interested in systems engineering, such as operating systems, mobile computing, and embedded devices.
Description: Introduction to problem solving with computers. Topics include problem solving methods, software development principles, computer programming, and computing in society
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Prerequisite for: CIVE 201; CSCE 156, ECEN 156; CSCE 156H; CSCE 235; CSCE 235H; CSCE 311; CSCE 320; CSCE 336; CSCE 352; CSCE 802; ECEN 106; ECEN 123; ECEN 220; ECEN 224; MECH 300
Course and Laboratory Fee: $10

ECEN 156 Computer Science II
Crosslisted with: CSCE 156
Prerequisites: A grade of "P" or "C" or better in CSCE 155A, CSCE 155E, CSCE 155H, CSCE 155N, or CSCE 155T; coreq: MATH 106.
Notes: Laboratories supplement the lecture material and give an opportunity to practice concepts.
Description: Data structures, including linked lists, stacks, queues, and trees; algorithms, including searching, sorting, and recursion; programming language topics, including object-oriented programming; pointers, references, and memory management; design and implementation of a multilayer application with SQL database.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Grading Option: Graded with Option
Offered: FALL/SPR
Prerequisite for: CSCE 235; CSCE 310; CSCE 310H; CSCE 322; CSCE 322H; CSCE 378; CSCE 378H; CSCE 453H, RAIK 453H; SOFT 162
Course and Laboratory Fee: $35

ECEN 164 Introduction to Computer Engineering
Crosslisted with: CSCE 164
Notes: Project-based introduction to the computer engineering field.
Description: Introduction to basic concepts and skills needed in computer engineering. Practical application of basic computing concepts through an introduction to programming an embedded system.
Credit Hours: 2
Max credits per semester: 2
Max credits per degree: 2
Grading Option: Graded with Option
Offered: SPRING
Prerequisite for: ECEN 220; ECEN 370, CSCE 335

ECEN 192 Special Topics in Electrical and Computer Engineering I
Notes: Requires an ECE departmentally approved proposal.
Description: Special topics in emerging areas of electrical and computer engineering which may not covered in other courses in the electrical and computer engineering curriculum.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

ECEN 194 Independent Study in Electrical and Computer Engineering I
Prerequisites: Freshman standing.
Description: Individual study in a selected area of Electrical and Computer Engineering under the supervision and guidance of an Electrical and Computer Engineering faculty member.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

ECEN 198 Undergraduate Research in Electrical and Computer Engineering I
Prerequisites: Permission.
Description: Supervised undergraduate research
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

ECEN 211 Elements of Electrical Engineering I
Prerequisites: Prerequisite or parallel: MATH 107/(UNO) MATH 1960 and PHYS 211/(UNO) PHYS 2110.
Notes: Not for electrical engineering majors.
Description: Basic circuit analysis including direct and alternating currents and operational amplifiers. Digital signals and circuits.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Prerequisite for: AGEN 325, BSEN 325; AREN 320; AREN 322; ECEN 231; MECH 350

ECEN 213 Electrical Circuits I
Prerequisites: ECEN 103; ECEN 225; MATH 221/221H/821 or (UNO) MATH 2350, or parallel.
Description: Electrical circuit theory, Kirchoff's and Ohm's laws, circuit analysis theorems, Norton and Thevenin equivalence. The analysis of resistor circuits, with capacitors and inductors, in DC and AC steady state. Transients and variable frequency responses are studied, including computer solutions to circuit problems.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Offered: FALL/SPR
Prerequisite for: ECEN 217; ECEN 218; ECEN 222; ECEN 345

ECEN 214 Electrical Circuits II
Prerequisites: ECEN 213; ECEN 218; (UNO) MATH 2050 or parallel.
Description: Introduction to the analysis of electrical circuits in sinusoidal steady states. The concepts of impedance, phasors, power, frequency response, resonance, magnetic circuits, and two-port networks. Transform techniques for circuit analysis.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Prerequisite for: ECEN 304; ECEN 338

ECEN 215 Electronics and Circuits I
Prerequisites: MATH 314/(UNO) MATH 2050 or MATH 221/(UNO)2350
Description: Introduction to electrical engineering circuit theory. Kirchhoff's laws and circuit analysis theorems applied to steady state DC resistive circuits. Analysis of transient RLC and sinusoidal steady-state circuits. Modern computer methods employed.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Prerequisite for: ECEN 216; ECEN 235; ECEN 345

ECEN 216 Electronics and Circuits II
Prerequisites: ECEN 215 with a grade of "C" or better. Prerequisite or parallel: MATH 221/(UNO) MATH 2350 or MATH 221H.
Description: Steady state power calculations for sinusoidal single-phase and balanced three-phase circuits. Mutual inductance. Frequency response. Introduction to fundamentals of semiconductor theory and their application to p-n junction devices. Kirchhoff's laws and circuit analysis theorems applied to steady state diode circuits. Modern computer methods employed.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Prerequisite for: ECEN 304; ECEN 306; ECEN 316; ECEN 338

ECEN 217 Electrical Circuits III
Prerequisites: ECEN 213
Notes: This course is for computer engineering majors only.
Description: Analysis of first and second order RLC circuits using differential equations and Laplace transforms. Variable frequency network performance analysis.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Grading Option: Graded with Option

ECEN 218 Electrical Circuits Laboratory
Prerequisites: ECEN 213 or parallel.
Notes: Lab to accompany ECEN 213
Description: The use of laboratory tools for measurement and verification of electrical concepts. Experiments using both passive and semiconductor devices at audio frequencies. Analysis verification with computer simulation.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Grading Option: Graded with Option
Prerequisite for: ECEN 214; ECEN 222
Course and Laboratory Fee: $15

ECEN 220 Introduction to Embedded Systems
Prerequisites: ECEN 155E; ECEN 103 or ECEN 164
Description: Basic hardware and software concepts of embedded microprocessor systems and interfacing with other hardware components. Simple circuits are designed and drivers to run them are written. Design and build hardware and write drivers in assembly or C programming languages.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Grading Option: Graded
Offered: FALL/SPR
Prerequisite for: CSCE 488; ECEN 307; ECEN 313; ECEN 345
Course and Laboratory Fee: $25

ECEN 222 Electronic Circuits I
Prerequisites: ECEN 213 with a grade of "C" or better; ECEN 218
Description: Analysis and design of modern electronic circuits. Diode circuits, bipolar and field effect transistor switching and amplifier circuits, and operational amplifier circuits.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Grading Option: Graded with Option
Offered: FALL/SPR
Prerequisite for: ECEN 310; ECEN 325; ECEN 347; ECEN 352; ECEN 481
Course and Laboratory Fee: $30

ECEN 224 Introduction to Signal Processing
Prerequisites: ECEN 106; CSCE 155A, 155E, 155H, 155N, 155T or (UNO) CIST 1400; MATH 107/107H or (UNO) MATH 1960.
Description: The use of mathematical and digital computation tools key to engineering applications. Auditory and visual senses are used in the presentation and study of sinusoidal signals, sampling, frequency response and filtering theory.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Grading Option: Graded with Option

ECEN 225 Electrical and Computer Engineering Seminar
Prerequisites: ECEN 103 or parallel
Description: An overview of electrical, computer, electronics and telecommunication fields. There will be information on professional careers available upon graduation. Professionalism and ethics are addressed as well as the need for lifelong learning experiences.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Grading Option: Graded with Option
Prerequisite for: ECEN 213

ECEN 230 Computer Organization
Crosslisted with: CSCE 230
Prerequisites: A grade of 'P' or 'C' or better in CSCE 235, CSCE 235H, or RAIK 184H.
Notes: Laboratories supplement the lecture material and give an opportunity to practice concepts.
Description: Introduction to organization and structure of computer systems. Boolean logic, digital arithmetic, processor organization, machine language programming, input/output, memory organization, system support software, communication, and ethics.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Grading Option: Graded with Option
Offered: FALL
Prerequisite for: CSCE 336; CSCE 351, ECEN 351; CSCE 362; ECEN 370, CSCE 335
Course and Laboratory Fee: $20

ECEN 231 Electrical Engineering Laboratory
Prerequisites: Prerequisite or parallel: ECEN 211
Description: Laboratory accompanying ECEN 211
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Grading Option: Graded with Option
Prerequisite for: MECH 380
Course and Laboratory Fee: $15

ECEN 235 Introductory Electrical Laboratory I
Prerequisites: Prerequisite or parallel: ECEN 215
Description: Laboratory accompanying ECEN 215
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Grading Option: Graded with Option
Prerequisite for: ECEN 236
Course and Laboratory Fee: $15

ECEN 236 Introductory Electrical Laboratory II
Prerequisites: ECEN 235; Prerequisite or parallel: ECEN 216
Description: Laboratory accompanying ECEN 216
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Grading Option: Graded with Option
Prerequisite for: ECEN 307
Course and Laboratory Fee: $15

ECEN 251 Unix Programming Environment
Crosslisted with: CSCE 251
Notes: Familiarity with at least one high-level programming language.
Description: Introduction to the Unix operating system. Unix file system. Unix tools and utilities. Shell programming.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Grading Option: Graded with Option
Offered: FALL
Course and Laboratory Fee: $25

ECEN 292 Special Topics in Electrical and Computer Engineering II
Prerequisites: Sophomore standing.
Notes: Requires a ECE departmentally approved proposal.
Description: Special topics in emerging areas of Electrical and Computer Engineering which may not be covered in other courses in the Electrical and Computer Engineering curriculum.
Credit Hours: 1-6
Min credits per semester: 1
Max credits per semester: 6
Max credits per degree: 6
Grading Option: Graded with Option

ECEN 294 Independent Study in Electrical and Computer Engineering II
Prerequisites: Sophomore standing.
Description: Individual study in a selected area of Electrical and Computer Engineering under the supervision and guidance of an Electrical and Computer Engineering faculty member.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

ECEN 298 Undergraduate Research in Electrical and Computer Engineering II
Prerequisites: Permission.
Description: Supervised undergraduate research.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

ECEN 304 Signals and Systems I
Prerequisites: ECEN 214 or ECEN 216 with a grade of "C" or better; MATH 221 or 221H or (UNO) MATH 2350.
Description: Mathematical modeling of physical systems and signals. Representation of signals in terms of basis functions. Fourier series expansions, Fourier Transforms, Laplace and z-Transforms. Input-output relations, convolution. Transfer functions. System Stability. Poles/zeros and s- and z-plane methods. Applications.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Prerequisite for: ECEN 481

ECEN 305 Probability Theory and Statistics for Electrical and Computer Engineers
Prerequisites: MATH 208/(UNO) MATH 1970.
Description: Random experiment model, random variables, functions of random variables, and introduction to random processes; statistics and practical data analysis.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Prerequisite for: ECEN 325; ECEN 435, ECEN 835; ECEN 850, ECEN 450

ECEN 306 Electromagnetic Field Theory
Prerequisites: ECEN 216; PHYS 212 or (UNO) PHYS 2120; MATH 208 or (UNO) MATH 1970; MATH 221 or (UNO) 2350.
Description: Complex vectors. Maxwell's equations. Uniform plane waves. Wave reflection and transmission at interfaces. Waveguides and resonators. Transmission line principles. Antennas. Topics in waves.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: ECEN 481

ECEN 307 Electrical Engineering Laboratory I
Prerequisites: ECEN 220 or (UNO) ECEN 1060 and ECEN 236 or (UNO) ECEN 2220; prereq or parallel ECEN 370 or (UNO) ECEN 3700 or (UNO) ECEN 3130; admission to the College of Engineering.
Description: Laboratory work on circuits and systems, digital and analog electronic circuits.
Credit Hours: 2
Max credits per semester: 2
Max credits per degree: 2
Grading Option: Graded with Option
Offered: FALL/SPR
Course and Laboratory Fee: $10

ECEN 310 Digital Design and Interfacing
Prerequisites: ECEN 222; ECEN 313 or parallel.
Notes: Lab exercises provide practical experience with design tools and the design process.
Description: Digital design from both the circuit and system perspectives. The structure and analysis of digital integrated circuits, interface signal integrity, Field Programmable Gate Array (FPGA) design and synthesis, and software simulation.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Grading Option: Graded with Option
Course and Laboratory Fee: $10

ECEN 313 Switching Circuits Theory
Prerequisites: ECEN 220
Description: Combinational circuit analysis and design. State machine analysis and design. Synchronous/clock mode circuits and asynchronous sequential circuits. Minimization, race, and hazard elimination are covered. Circuits are implemented in discrete logic and in CPLD and FPGA devices. VHDL hardware description language is used to describe circuits.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Grading Option: Graded with Option
Prerequisite for: ECEN 310; ECEN 333; ECEN 481
Course and Laboratory Fee: $10

ECEN 316 Electronics and Circuits III
Prerequisites: ECEN 216 with a grade of 'C' or better.
Description: Kirchhoff's laws and circuit analysis theorems applied to steady state transistor circuits. Frequency response of filters and amplifiers. Basic power amplifier types. Advanced operational amplifier circuits. Introduction to the fundamentals of semiconductor theory and their application to p-n junction and field devices.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Prerequisite for: ECEN 347; ECEN 361; ECEN 481

ECEN 325 Communication and Networking
Prerequisites: ECEN 222; Pre or Co ECEN 305
Description: Communication: amplitude-, frequency/phase-modulation, sampling theorem, pulse-code modulation, OFDM, channel coding, and communication system/analysis. Networking: multiplexing, WANs, ATM, LANs, Internet/transport protocols, and data/computer communications.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Grading Option: Graded with Option
Offered: SPRING
Course and Laboratory Fee: $30

ECEN 327 Discrete Systems Laboratory
Prerequisites: ECEN 106 or ECEN 220
Description: Laboratory work on discrete systems.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Grading Option: Graded
Prerequisite for: ECEN 333
Course and Laboratory Fee: $15

ECEN 332 Assembly Language Programming
Prerequisites: ECEN 106
Description: Architecture and assembly language programming of 8-bit and 32-bit microcontrollers. Assemblers and debugging tool utilization.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Grading Option: Graded with Option

ECEN 333 Computer Design
Prerequisites: ECEN 313 or ECEN 370 and ECEN 327
Description: Designed to present and discuss the design techniques for microprocessor-based systems. Discussion includes the design and implementation of hardware and software for a microprocessor system with memory, input/output, and support subsystems.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Grading Option: Graded with Option
Offered: FALL/SPR

ECEN 338 Introduction to Power and Energy Systems
Prerequisites: ECEN 216 or ECEN 214 with a grade of "C" or better.
Description: Energy sources, environmental impacts, power systems principles, three-phase circuits, transmission lines, transformers, per unit analysis, generators, loads, and power system modeling.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Offered: FALL/SPR

ECEN 345 Mobile Robotics I
Prerequisites: ECEN 106 or ECEN 220; ECEN 213 or ECEN 215
Description: Introduction to the primary issues spanning the field of mobile robotics, including robotics history, robot components (sensors, actuators), robot system design considerations, low-level control (feedback control) and robotics control architectures. The lab focuses on the practical implementation of autonomous robot control on a real mobile robot using behavior-based methods in the C language.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Grading Option: Graded with Option
Course and Laboratory Fee: $5

ECEN 347 Electrical Engineering Laboratory II
Prerequisites: ECEN 307/(UNO) ECEN2350; pre- or parallel ECEN 222/(UNO) ECEN 2220 or ECEN 316/(UNO) ECEN 3160
Description: Lab work on electromagnetics, fields and waves, solid state devices and control systems.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Grading Option: Graded
Prerequisite for: ECEN 481
Course and Laboratory Fee: $10

ECEN 350 Electrical and Computer Engineering Cooperative Educational Experience
Prerequisites: Co-requisite UGEP 350/(UNO) ENGR 3500. Open to Electrical and Computer Engineering majors only. Approval of faculty sponsor prior to the Co-op is required.
Notes: International students have to complete a curricular practical training (CPT) application for the campus which issued their I-20. Students should start with ISSO at UNL if they are City Campus, or ISA at UNO if they are Scott Campus. They need to then meet with Engineering Career Services.
Description: For Cooperatives primarily technical in nature lasting 4.5 months or greater. Weekly communication and/or final report required. Must be taken during or after the semester in which the Co-op occurs.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

ECEN 351 System Resource Management
Crosslisted with: CSCE 351
Prerequisites: A grade of "P" or "C" or better in CSCE 230 or CSCE 231 and CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H.
Description: An introduction to management of computing resources, including CPUs, shared memory, I/O devices, address spaces, and threads of execution, with a focus on implementation.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Offered: FALL
Course and Laboratory Fee: $40

ECEN 352 Electronics Circuits II
Prerequisites: ECEN 222/(UNO) CEEN 2220.
Description: Operational amplifier circuit design and analysis feedback and stability. Design and analysis of large signal power amplifiers. Other integrated devices such as: regulators, comparators, Schmitt triggers, oscillators, and active filters.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Grading Option: Graded with Option
Prerequisite for: ECEN 362
Course and Laboratory Fee: $20

ECEN 361 Advanced Electronics and Circuits
Prerequisites: ECEN 316
Description: Analog and digital electronics for discrete and integrated circuits. Multistage amplifiers, frequency response, feedback amplifiers, simple filters and amplifiers, MOS and bipolar logic gates and families, A/D and D/A converters.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

ECEN 362 Data and Telecommunications Transceivers
Prerequisites: ECEN 352; ECEN 325 or parallel; and ECEN 328 or parallel.
Description: Noise and signal distortions in communication systems, impedance matching techniques, high frequency measurement techniques, design of high frequency amplifiers and oscillators, PLL and frequency synthesizers, data synchronization and multiplexing techniques, Antennas and their arrays.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Grading Option: Graded with Option
Course and Laboratory Fee: $10

ECEN 370 Digital Logic Design
Crosslisted with: CSCE 335
Prerequisites: ECEN 103 or CSCE 230
Description: Combinational and sequential logic circuits. MSI chips, programmable logic devices (PAL, ROM, PLA) used to design combinational and sequential circuits. CAD tools. LSI and PLD components and their use. Hardware design experience.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: ECEN 307; ECEN 327; ECEN 333; ECEN 481

ECEN 392 Special Topics in Electrical and Computer Engineering III
Prerequisites: Permission
Notes: Requires a ECE departmentally approved proposal.
Description: Special topics in emerging areas of Electrical and Computer Engineering which may not be covered in other courses in the Electrical and Computer Engineering curriculum.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

ECEN 394 Independent Study in Electrical and Computer Engineering III
Prerequisites: Permission
Description: Individual study in a selected area of Electrical and Computer Engineering under the supervision and guidance of Electrical and Computer Engineering faculty member.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

ECEN 395 Electrical and Computer Engineering Internship Educational Experience
Prerequisites: Open to Electrical and Computer Engineering majors only. Approval of faculty sponsor prior to the internship is required.
Notes: Weekly communication and/or final report is required. Must be taken during or after the semester in which internship occurs.
Description: Provides the experience of Internship Education
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Experiential Learning: Internship/Co-op

ECEN 398 Undergraduate Research in Electrical and Computer Engineering III
Prerequisites: Permission.
Description: Supervised undergraduate research.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

ECEN 399 Undergraduate Research
Prerequisites: Electrical engineering seniors.
Description: Research accompanied by a written report of the results.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Experiential Learning: Research

ECEN 399R Undergraduate Research
Notes: ECEN 399 and ECEN 399R should be taken in consecutive semesters.
Description: Independent research project executed under the guidance of a member of the faculty of the Department of Electrical Engineering which contributes to the advancement of knowledge in the field. Culminates in a written thesis or report and an oral presentation. For electrical engineering majors selecting the research option.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

ECEN 406 Power Systems Analysis
Crosslisted with: ECEN 806
Prerequisites: ECEN 338 or ECEN 838
Description: Symmetrical components and fault calculations, power system stability, generator modeling (circuit view point), voltage control system, high voltage DC transmission, and system protection.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: ECEN 957

ECEN 407 Power Systems Planning
Crosslisted with: ECEN 807
Prerequisites: ECEN 305
Description: Economic evaluation, load forecasting, generation planning, transmission planning, production simulation, power plant reliability characteristics, and generation system reliability.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

ECEN 408 Engineering Electromagnetics
Crosslisted with: ECEN 808
Prerequisites: ECEN 306
Notes: Laboratory experiments.
Description: Applied electromagnetics: Transmission lines in digital electronics and communication. The quasistatic electric and magnetic fields: electric and magnetic circuits and electromechanical energy conversion. Guided waves: rectangular and cylindrical metallic waveguides and optical fibers. Radiation and antennas: line and aperture antennas and arrays.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

ECEN 410 Multivariate Random Processes
Crosslisted with: ECEN 810
Prerequisites: ECEN 305
Description: Probability space, random vectors, multivariate distributions, moment generating functions, conditional expectations, discrete and continuous-time random processes, random process characterization and representation, linear systems with random inputs.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: ECEN 911; ECEN 912; ECEN 915; ECEN 946

ECEN 420 Plasma Processing of Semiconductors
Crosslisted with: ECEN 820
Prerequisites: Senior or graduate standing.
Description: Physics of plasmas and gas discharges developed. Includes basic collisional theory, the Boltzman equation and the concept of electron energy distributions. Results are related to specific gas discharge systems used in semiconductor processing, such as sputtering, etching, and deposition systems.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

ECEN 421 Principles of Semiconductor Materials and Devices I
Crosslisted with: ECEN 821
Prerequisites: PHYS 213/(UNO) PHYS 2130
Description: Introduction to semiconductor fundamentals, charge carrier concentration and carrier transport, energy bands, and recombination. PN junctions, static and dynamic, and special PN junction diode devices.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

ECEN 422 Introduction to Physics and Chemistry of Solids
Crosslisted with: PHYS 422, PHYS 822, ECEN 822
Prerequisites: PHYS 213 or CHEM 481/881, MATH 221/821.
Description: Introduction to structural, thermal, electrical, and magnetic properties of solids, based on concepts of atomic structure, chemical bonding in molecules, and electron states in solids. Principles underlying molecular design of materials and solid-state devices.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

ECEN 428 Power Electronics
Crosslisted with: ECEN 828
Prerequisites: ECEN 304 and ECEN 316
Description: Basic analysis and design of solid-state power electronic devices and converter circuitry.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Grading Option: Graded
Prerequisite for: ECEN 932
Course and Laboratory Fee: $30

ECEN 430 Wind Energy
Crosslisted with: ECEN 830
Prerequisites: Senior standing
Description: Engineering principles of both the mechanical/aero dynamical and electrical components and systems, along with economic and environmental considerations for citing and public policy, to appropriately cover the relevant topics associated with all scales of wind energy implementations.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

ECEN 433 Microprocessor System Design
Crosslisted with: ECEN 833
Prerequisites: ECEN 310 with a grade of "C" or better; ECEN 332 with a grade of "C" or better.
Description: Discussion of different microprocessor hardware and software systems designs including; microprocessor bus interfacing, memory systems, peripheral design and interfacing, interrupts, Direct Memory Access, and other hardware related topics. Software includes system code, firmware generation, and designing device drivers. Design, build, program, and show successful operation of a microprocessor board with memory, I/O and other related peripheral systems.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Grading Option: Graded with Option
Offered: FALL/SPR
Prerequisite for: ECEN 435, ECEN 835; ECEN 483
Course and Laboratory Fee: $25

ECEN 435 Embedded Microcontroller Design
Crosslisted with: ECEN 835
Prerequisites: ECEN 433/833 with a grade of "C" or better; ECEN 305
Notes: The prerequisite is different from the syllabus.
Description: Microcontroller architecture: design, programming, and interfacing for embedded systems. Including advanced RISC based microcontroller architecture and design, standard asynchronous and synchronous serial communications, I2C, SPI, USB, and related board design, development, and fabrication with surface mount technology. Design, build, program and show successful operation of a single microcontroller board with a specific application.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Grading Option: Graded with Option
Offered: FALL/SPR
Prerequisite for: ECEN 437, ECEN 837
Course and Laboratory Fee: $25

ECEN 436 Electric Machines
Crosslisted with: ECEN 836
Prerequisites: PHYS 212/(UNO) PHYS 2120 and ECEN 216
Description: Provides a solid background in electric machine analysis, covering fundamental concepts, techniques, and methods for analysis and design. Discussion of transformers and presentation of some new systems and applications.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Prerequisite for: ECEN 932

ECEN 437 Parallel and Distributed Processing
Crosslisted with: ECEN 837
Prerequisites: ECEN 435/835
Description: Parallel and distributed processing concepts, principles, techniques, and machines.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

ECEN 438 Integrated Systems Programming
Crosslisted with: ECEN 838
Prerequisites: ECEN 310 and ECEN 332
Description: Introduction to the basics of computer architectural details under the context of computer system programming. Topics include representing and manipulating information, machine level representation of programs, processor architecture and pipelining, compiling and linking, optimizing program performance from the system level, memory hierarchy, dynamic memory allocation and exceptional control flow. Linux system programming tool chain will also be introduced.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Offered: FALL/SPR
Prerequisite for: ECEN 406, ECEN 806

ECEN 442 Basic Analytical Techniques in Electrical Engineering
Crosslisted with: ECEN 842
Prerequisites: MATH 221/(UNO) MATH 2350
Description: Applications of partial differential equations, matrices, vector analysis, complex variables, and infinite series to problems in electrical engineering.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

ECEN 444 Linear Control Systems
Crosslisted with: ECEN 844
Prerequisites: ECEN 304
Description: Classical (transfer function) and modern (state variable) control techniques. Both time domain and frequency domain techniques are studied. Traditional proportional, lead, lag, and PID compensators are examined, as well as state variable feedback.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

ECEN 448 Decision Analysis
Crosslisted with: ECEN 848
Prerequisites: ECEN 305 or STAT 380/(UNO) STAT 3800
Description: Principles of engineering economy including time value of money, net present value and internal rate of return. Use of influence diagram and ecision tree to structure and analyze decision situations under uncertainty including use of stochastic dominance, value of information, and utility theory. Fundamentals of two-person matrix games including Nash equilibrium.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

ECEN 450 Bioinformatics
Crosslisted with: ECEN 850
Prerequisites: Computer programming language and ECEN 305 or MECH 321 or STAT 380/(UNO) STAT 3800 or equivalent
Description: Examination of how information is organized in biological sequences such as DNA and proteins and computational techniques which make use of this structure. Various biochemical processes that involve these sequences are studied to understand how these processes affect the structure of these sequences. In the process bioinformatics algorithms, tools, and techniques which are used to explore genomic and amino acid sequences are also introduced.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

ECEN 451 Introduction to VLSI System Design
Crosslisted with: ECEN 851
Prerequisites: ECEN 310
Description: The concepts, principles, and methodology at all levels of digital VLSI system design and focused on gate-level VLSI implementation.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

ECEN 452 Introduction to Computer-Aided Digital Design
Crosslisted with: ECEN 852
Prerequisites: ECEN 310
Description: The concepts, simulation techniques and methodology in computer-aided digital design at system and logic levels.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

ECEN 453 Computational and Systems Biology
Crosslisted with: ECEN 853
Prerequisites: By permission.
Notes: Basic knowledge of probability and statistics (e.g. ECEN 305 or STAT 380) and basic programming skills are recommended. May also be taught as a distance course for the Omaha campus.
Description: Provides the required biology primer and covers functional genomics, transcriptomics, differential expression, clustering, classification, prediction, biomarker discovery, pathway analysis and network based approaches to high throughput biological data analysis. Includes the development of databases, algorithms, web-based and other tools regarding management and analysis of life science data. Areas of study include DNA, RNA, and protein sequence analysis, functional genomics and proteomics, 3D macromolecule structure prediction, and systems/network approach.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Offered: SPRING

ECEN 454 Power Systems Operation and Control
Crosslisted with: ECEN 854
Prerequisites: ECEN 338
Description: Characteristics and generating units. Control of generation, economic dispatch, transmission losses, unit commitment, generation with limited supply, hydrothermal coordination, and interchange evaluation and power pool.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

ECEN 456 Real Time DSP Applications
Crosslisted with: ECEN 856
Prerequisites: ECEN 220; ECEN 463
Description: Introduction to concepts, principles, and state-of-the-art methods in creating embedded real-time digital signal processing systems.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

ECEN 460 Labview Programming
Crosslisted with: ECEN 860
Prerequisites: Prior programming experience
Description: Labview as a programming language and for applications to acquire and analyze data, to access the network, control lab instruments, and for video and sound applications.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

ECEN 462 Communication Systems
Crosslisted with: ECEN 862
Prerequisites: ECEN 304 and ECEN 305
Description: Mathematical descriptions of signals in communication systems. Principles of analog modulation and demodulation. Performance analysis of analog communication systems in the presence of noise.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: CSCE 954; ECEN 911

ECEN 463 Digital Signal Processing
Crosslisted with: ECEN 863
Prerequisites: ECEN 304
Description: Discrete system analysis using Z-transforms. Analysis and design of digital filters. Discrete Fourier transforms.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: ECEN 915

ECEN 464 Digital Communication Systems
Crosslisted with: ECEN 864
Prerequisites: ECEN 462
Description: Principals of digital transmission of information in the presence of noise. Design and analysis of baseband PAM transmission systems and various carrier systems including ASK, FSK, PSK.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: ECEN 911; ECEN 912; ECEN 959

ECEN 465 Introduction to Data Compression
Crosslisted with: ECEN 865
Prerequisites: ECEN 305
Description: Introduction to the concepts of Information Theory and Redundancy removal. Simulation of various data compression schemes such as Delta Modulation, Differential Pulse Code Modulation, Transform Coding and Runlength Coding.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

ECEN 466 Telecommunications Engineering I
Crosslisted with: ECEN 866
Prerequisites: ECEN 362; ECEN 461/861 or parallel.
Description: Standard telecommunications protocols, architecture of long distance integrated data networks, local area networks, wide area networks, radio and satellite networks. Network management, internetworking, system modeling and performance analysis.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Grading Option: Graded with Option

ECEN 468 Microwave Engineering
Crosslisted with: ECEN 868
Prerequisites: ECEN 306
Description: Applications of active and passive devices to microwave systems. Includes impedance matching, resonators, and microwave antennas.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: ECEN 965

ECEN 469 Analog Integrated Circuits
Crosslisted with: ECEN 869
Prerequisites: ECEN 361
Description: Analysis and design of analog integrated circuits both bipolar and MOS. Basic circuit elements such as differential pairs, current sources, active loads, output drivers used in the design of more complex analog integrated circuits.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: ECEN 913

ECEN 470 Digital and Analog VLSI Design
Crosslisted with: ECEN 870
Prerequisites: ECEN 316; ECEN 370 or ECEN 313
Description: Introduction to VLSI design techniques for analog and digital circuits. Fabrication technology and device modelling. Design rules for integrated circuit layout. LSI design options with emphasis on the standard cell approach of digital and analog circuits. Lab experiments, computer simulation and layout exercises.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

ECEN 471 Computer Communication Networks
Crosslisted with: ECEN 871
Prerequisites: ECEN 325
Description: High-speed access control protocols, routing protocols, traffic management, and network topologies. Giga-bit Ethernet, ATM, and TCP/IP. Performance modeling and simulation techniques.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Grading Option: Graded with Option

ECEN 472 Image Understanding, Perception, and Signal Processing
Crosslisted with: ECEN 872
Prerequisites: ECEN 304 or graduate standing
Description: Introduces fundamental principles and theory for computer vision, image understanding, and pattern recognition, perception, and signal processing. Specific attention given to analysis of the geometric properties and appearance of objects in images, such as region size, connectedness, topology, color, and texture.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

ECEN 473 Mobile and Personal Communications
Crosslisted with: ECEN 873
Prerequisites: ECEN 325
Description: Concepts on mobile and personal communications. Modulation techniques for mobile radio, equalization, diversity, channel coding, and speech coding.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Grading Option: Graded with Option

ECEN 474 Digital Systems
Crosslisted with: ECEN 874
Prerequisites: ECEN 370
Description: Synthesis using state machines; design of digital systems; micro programming in small controller design; hardware description language for design and timing analysis.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

ECEN 475 Satellite Communications
Crosslisted with: ECEN 875
Prerequisites: ECEN 325
Description: The fundamental concepts of satellite communications. Orbits, launching satellites, modulation and multiplexing, multiple access, earth stations, coding, interference and special problems in satellite communications.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Grading Option: Graded with Option

ECEN 476 Wireless Communications
Crosslisted with: ECEN 876
Prerequisites: ECEN 325 or ECEN 462 or parallel
Description: The fundamental concepts of wireless communications. Basic communications concepts such as multiple access and spectrum. Propagation, radio standards and internet working. Current issues in wireless communications.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Prerequisite for: ECEN 926; ECEN 977

ECEN 478 Practical Machine Learning
Crosslisted with: ECEN 878
Prerequisites: CSCE/ECEN 155E, CSCE 155A, or CSCE 155N
Description: Designed to provide a solid grasp of the methods of machine learning (ML) and how to build powerful ML models for discovering statistical regularities from both structured and unstructured data. Offers an introduction to Deep Learning for Computer Vision and Natural Language Processing.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

ECEN 479 Optical Fiber Communications
Crosslisted with: ECEN 879
Prerequisites: ECEN 461/861
Description: Fundamentals of lightwave communication in optical fiber waveguides, physical description of fiber optic systems. Properties of the optical fiber and fiber components. Electro-optic devices: light sources and modulators, detectors and amplifiers; optical transmitter and receiver systems. Fiber optic link design and specification; fiber optic networks.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Grading Option: Graded with Option
Prerequisite for: ECEN 979

ECEN 480 Introduction to Lasers and Laser Applications
Crosslisted with: ECEN 880, PHYS 480, PHYS 880
Prerequisites: PHYS 213/(UNO) PHYS 2130
Description: Physics of electronic transition production stimulated emission of radiation. Threshold conditions for laser oscillation. Types of lasers and their applications in engineering.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

ECEN 481 Electrical Engineering Capstone I
Prerequisites: ECEN 222 or ECEN 316; ECEN 313 or ECEN 370; ECEN 304; ECEN 306; ECEN 347; ENGL 151 (or JGEN 200)/(UNO) ENGL 1160
Notes: The first in a two semester electrical engineering capstone senior design course sequence.
Description: A substantial design project that allows application of electrical engineering skills to a multidisciplinary project. Requires project definition, planning and scheduling, effective written and oral communication of technical ideas, incorporation of realistic constraints and engineering standards, functioning effectively on a multidisciplinary team, and applying new ideas as needed to meet project goals.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Offered: FALL/SPR
Prerequisite for: ECEN 495
Course and Laboratory Fee: $10

ECEN 482 Antennas and Radio Propagation for Wireless Communications
Crosslisted with: ECEN 882
Prerequisites: ECEN 328
Description: Fundamental theory of antennas and radio propagation for wireless communications. Basic antenna characteristics and various antennas and antenna arrays. Basic propagation mechanisms and various channel models, such as Friis free space model, Hata model, lognormal distribution, and multipath model. Includes practical antenna design for high radio frequency (RF) with modeling software tools such as Numerical Electromagnetic Code (NEC) and Advanced Design System (ADS). Design projects will be assigned as the main part of course.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Grading Option: Graded with Option

ECEN 483 Computer Engineering Capstone I
Prerequisites: ECEN 433; ENGL 151 or JGEN 200 or (UNO) ENGL 1160.
Notes: The first in a two semester computer engineering capstone senior design course sequence.
Description: A substantial design project that allows application of computer engineering skills to a multidisciplinary project. Requires project definition, planning and scheduling, effective written and oral communication of technical ideas, incorporation of realistic constraints and engineering standards, functioning effectively on a multidisciplinary team, and applying new ideas as needed to meet project goals.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Offered: FALL/SPR
Prerequisite for: ECEN 499

ECEN 484 Network Security
Crosslisted with: ECEN 884
Prerequisites: ECEN 325
Description: Network security and cryptographic protocols. Classical encryption techniques, block ciphers and stream cyphers, public-key cryptography, authentications digital signatures, key management and distributions, network vulnerabilities, transport-level security, IP security.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Grading Option: Graded with Option

ECEN 486 Fundamentals of Photonics
Crosslisted with: ECEN 886
Prerequisites: ECEN 306
Description: Introduction to the use of electromagnetic radiation for performing optical measurements in engineering applications. Basic electromagnetic theory and light interaction with matter are covered with corresponding laboratory experiments conducted.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: ECEN 986

ECEN 487 Data and Network Security
Crosslisted with: CSCE 463, CSCE 863, ECEN 887
Prerequisites: A grade of "P" or "C" or better in CSCE 310, CSCE 310H, CSCE 311, SOFT 260, SOFT 260H or RAIK 283H.
Description: Concepts and principles of data and network security. Focuses on practical aspects and application of crypto systems in security protocols for networks such as the Internet. Topics include: applications of cryptography and cryptosystems for digital signatures, authentication, network security protocols for wired and wireless networks, cyberattacks and countermeasures, and security in modern computing platforms.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Offered: SPRING

ECEN 488 Wireless Security
Crosslisted with: ECEN 888
Prerequisites: ECEN 325
Description: A comprehensive overview on the recent advances in wireless network and system security. Covers security issues and solutions in emerging wireless access networks and systems as well as multihop wireless networks.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Grading Option: Graded with Option

ECEN 491 Special Topics in Electrical and Computer Engineering IV
Crosslisted with: ECEN 891
Prerequisites: Senior standing
Description: Special topics in the emerging areas of electrical, computer, and electronics engineering which may not be covered in other courses in the electrical and computer engineering curriculum.
Credit Hours: 1-4
Min credits per semester: 1
Max credits per semester: 4
Max credits per degree: 4
Grading Option: Graded with Option

ECEN 492 Special Topics in Electrical and Computer Engineering IV
Crosslisted with: ECEN 892
Prerequisites: Senior standing
Notes: Requires an ECE departmentally approved proposal.
Description: Special topic in emerging areas of electrical and computer engineering which may not be covered in other courses in the electrical and computer engineering curriculum.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

ECEN 495 Electrical Engineering Capstone II
Prerequisites: ECEN 494 or permission; admission to the College of Engineering.
Notes: The second in a two semester capstone senior design course sequence.
Description: A substantial design project that allows application of electrical engineering skills to a multidisciplinary project. Requires project definition, planning and scheduling, effective written and oral communication of technical ideas, incorporation of realistic constraints and engineering standards, functioning effectively on a multidisciplinary team, and applying new ideas as needed to meet project goals.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
ACE: ACE 10 Integrated Product
Course and Laboratory Fee: $10
Experiential Learning: Case/Project-Based Learning

ECEN 498 Research in Electrical Engineering IV
Crosslisted with: ECEN 898
Prerequisites: Permission
Description: Research in a selected area of electrical engineering under the supervision and guidance of an Electrical and Computer Engineering faculty member.
Credit Hours: 1-6
Min credits per semester: 1
Max credits per semester: 6
Max credits per degree: 18
Grading Option: Graded with Option

ECEN 499 Computer Engineering Capstone II
Prerequisites: ECEN 496 or permission; admission to the College of Engineering.
Notes: The second in a two semester capstone senior design course sequence.
Description: A substantial design project that allows application of computer engineering skills to a multidisciplinary project. Requires project definition, planning and scheduling, effective written and oral communication of technical ideas, incorporation of realistic constraints and engineering standards, functioning effectively on a multidisciplinary team, and applying new ideas as needed to meet project goals.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
ACE: ACE 10 Integrated Product
Course and Laboratory Fee: $10

ECEN 499H Honors Thesis
Prerequisites: Senior standing in electrical engineering; admission to the University Honors Program. Credit toward the degree cannot be earned in ECEN 499 and ECEN 499H.
Description: Honors thesis research project meeting the requirements of the University Honors Program. Independent research project executed under the guidance of a member of the faculty of the Department of Electrical Engineering which contributes to the advancement of knowledge in the field. Culminates in the presentation of an honors thesis to the department and college.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

Career Information

The following represents a sample of the internships, jobs and graduate school programs that current students and recent graduates have reported.

Jobs of Recent Graduates

- Electronics Engineer, National Air and Space Intelligence Center - Dayton, OH
- Design Engineer, Garmin - Olathe, KS
- Jr. Project Engineer, Union Pacific - Omaha, NE
- Product Manager, Hudl - Lincoln, NE
- Embedded Systems Engineer, Lockheed Martin - Denver, CO
- Software Developer, IBM - Rochester, MN
- Computer Engineer, United States Department of Defense - San Antonio, TX
- Software Developer in Test, Amazon - Seattle, WA

- Software Developer Engineer, Microsoft - Seattle, WA
- System Integration Specialist, Sandhills Publishing - Lincoln, NE
- Software Engineer, Target Headquarters - Minneapolis, MN
- Software Design Engineer, Communication System Solutions - Lincoln, NE
- Embedded Software Engineer I, Northrop Grumman - San Diego, CA
- Junior Applications Developer, BuilderTrend - Omaha, NE
- Senior Managing Consultant, IBM - Austin, TX
- Controls Engineer, Anderson Industrial Engines - Omaha, NE
- Frontend Engineer, Hayneedle, Inc. - Omaha, NE
- Software Engineer, Cerner Corporation - Kansas City, MO
- Senior IT Infrastructure Support Analyst, State of Nebraska - Lincoln, NE
- Design Engineer & Project Manager, LI-COR Biosciences - Lincoln, NE
- Software Developer, Epic Systems - Verona, WI
- Application Developer II, Buildertrend, Inc. - Omaha, NE
- Electronic Engineer, United States Department of Defense - Bedford, MA
- Software Developer, Spreetail - Lincoln, NE
- Firmware Design Engineer, Fisher Controls - Marshalltown, IA

Internships

- System Intern, Sandhills Publishing - Lincoln, NE
- Aviation Software Engineer, Garmin - Olathe, KS
- Software Engineer Intern, Microsoft - Redmond, WA
- Simulation Lab Intern, University of Nebraska Medical Center - Omaha, NE
- Hardware Engineer, Springbok Inc. - Omaha, NE
- Software Development Intern, Epic Systems - Madison, WI
- Software Engineering Intern, Firespring - Lincoln, NE
- Applications Developer Intern, Gallup - Omaha, NE
- Design Engineering Intern, Communication Systems Solutions - Lincoln, NE
- Network Design Intern, Union Pacific - Omaha, NE
- TTS Intern, Target - Minneapolis, MN
- Cyber Security Notification System (CYNOT), Nebraska Public Power District-Cooper Nuclear - Brownville ,NE
- Quality Engineer Intern, Bosch Security Systems - Lincoln, NE
- Creative Consultant, UNL Information and Technology Services - Lincoln, NE
- Software Development Intern, Cerner - Kansas City, MO
- Software Quality Analyst Intern, Hudl - Lincoln, NE
- Research Student, Illinois Institute of Technology - Chicago, IL
- Software Development, National Strategic Research Institute - Omaha, NE
- Research Assistant, University of Alabama - Tuscaloosa, AL
- App Development Intern, Farm Credit Services of America - Omaha, NE
- System Application Developer Intern, Gallup - Lincoln, NE
- Quality Engineer Intern, Bosch Security Systems - Lincoln, NE
- Intern, Machine Solutions, Inc. - Flagstaff, AZ
- Software Developer Intern, Molex - Lincoln, NE
- Intern, Tesla Motors - Fremont, CA

Graduate & Professional Schools

- Master's in Electrical Engineering, University of Nebraska-Lincoln - Lincoln, NE
- Ph.D., Electrical Engineering, University of California - Los Angeles, CA
- Master's in Software Engineering, University of Sheffield - Sheffield, Great Britain
- Master's in Visualization, Texas A&M University - College Station, TX
- Ph.D., Computer Science, University of Colorado - Boulder, CO
- Master's in Information Technology, University of Texas - Austin,TX
- Medical Sciences Interdepartmental Areas, University of Nebraska Medical Center - Omaha, NE
- Master's in Computer Science, University of Nebraska-Lincoln - Lincoln, NE
- Master's in Mathematics, University of Nebraska Omaha - Omaha, NE