Computer Science and Computer Engineering (CSCE)

Faculty
David Andrews, Professor, Thomas Mullins Chair of Computer Science and Computer Engineering
M. Gordon Beavers, Associate Professor
Christophe Bobda, Professor
Jia Di, Professor, 21st Century Research Leadership Chair
Michael S. Gashler, Assistant Professor
John Michael Gauch, Professor
Susan E. Gauch, Professor
Miaoqing Huang, Associate Professor
Qinghua Li, Assistant Professor
Wing Ning Li, Professor
Xiaojing "Frank" Liu, Professor, Rodger S. Kline Leadership Chair
Rida Moustafa, Visiting Lecturer
Brajendra Nath Panda, Professor
Pat Parkerson, Associate Professor
Matthew J. Patitz, Assistant Professor
Yarui Peng, Assistant Professor
Dale R. Thompson, Associate Professor
Xintao Wu, Professor, Charles D. Morgan/Acxiom Graduate Research Chair

Xiaojing "Frank" Liu
Head of the Department
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479-575-6197
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The faculty of the Computer Science and Computer Engineering Department is engaged in multidisciplinary academic research, course offerings, and student projects in areas such as: networking, data security, low power chip design, Web search, embedded systems, and graphics.

The educational objectives of the department are to produce graduates who are recruited in a competitive market and make valuable contributions to a wide variety of industries, particularly in computer and information technology; succeed in graduate or professional studies; pursue life-long learning and continued professional development; and undertake leadership roles in their profession, in their communities, and in the global society.

Accreditations
The B.S. in Computer Engineering is accredited by the Engineering Accreditation Commission of ABET (www.ABET.org). The B.S. in Computer Science is accredited by the Computing Accreditation Commission of ABET (www.ABET.org)

Requirements for B.S. in Computer Engineering
The computer engineering degree has required sequences of courses in both hardware and software aspects of computer applications and design. Since almost all of today's complex systems encompass hardware and software elements, computer engineering graduates must acquire the skills required to design, build, and test complex digital systems. At the advanced level, students are exposed to hands-on experience with open-ended problems with opportunities for research and design.

Humansities and social science electives are selected from the University Core Requirements listed in the Catalog of Studies. To satisfy the University Core, all CSCE students are required to take the following 18 hours of humanities/social science courses:

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
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<tbody>
<tr>
<td>PHIL 3103 Ethics and the Professions (Sp, Su, Fa)</td>
<td>3</td>
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<tr>
<td>Fine Arts from Category &quot;A&quot;</td>
<td>3</td>
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<tr>
<td>U.S. History or Government</td>
<td>3</td>
</tr>
<tr>
<td>Social Science</td>
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</tbody>
</table>

The Undergraduate Handbook has a list of approved basic science, mathematics, and technical electives. Any course not included in these lists requires faculty approval.

The Bachelor of Arts in Computer Science degree has the same educational objectives as the Bachelor of Science degree. However, the course requirements differ greatly to allow students to double major or pursue other interests.

Degree Program Changes
Students must meet all requirements of their degree programs and are expected to keep informed concerning current regulations, policies, and program requirements in their fields of study. Changes made in the curriculum at a level beyond that at which a student is enrolled might become graduation requirements for that student. Changes made in the curriculum at a level lower than the one at which a student is enrolled are not required of that student. Students should consult their departmental adviser for additional information.

Computer Engineering B.S.Cmp.E. Eight-Semester Degree Program
The following sections contain the list of courses required for the Bachelor of Science in Computer Engineering (B.S.Cmp.E.) with a suggested sequence below.

Not all courses are offered every semester, so students who deviate from the suggested sequence must pay careful attention to course scheduling and course prerequisites. Students wishing to follow the eight-semester degree plan should see the Eight-Semester Degree Policy (http://catalog.uark.edu/undergraduatereg/catalog/academicregulations/eightsemesterdegreecompletionpolicy) in the Academic Regulations chapter for university requirements of the program.

<table>
<thead>
<tr>
<th>First Year</th>
<th>Fall</th>
<th>Spring</th>
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<tbody>
<tr>
<td>GNEG 1111 Introduction to Engineering I (Sp, Fa)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>MATH 2554 Calculus I (ACTS Equivalency = MATH 2405) (Sp, Su, Fa)</td>
<td>4</td>
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<tr>
<td>PHYS 2054 University Physics I (ACTS Equivalency = PHYS 2034) (Sp, Su, Fa)</td>
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<tr>
<td>CHEM 1103 University Chemistry I (ACTS Equivalency = CHEM 1414 Lecture) (Su, Fa)</td>
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<td>ENGL 1013 Composition I (ACTS Equivalency = ENGL 1013) (Sp, Su, Fa)</td>
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<tr>
<td>GNEG 1121 Introduction to Engineering II (Sp, Fa)</td>
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</table>
MATH 2564 Calculus II (ACTS Equivalency = MATH 2505) (Sp, Su, Fa) 4
History/Government Elective 3
PHYS 2074 University Physics II (ACTS Equivalency = PHYS 2044 Lecture) (Sp, Su, Fa) 4
ENGL 1023 Composition II (ACTS Equivalency = ENGL 1023) (Sp, Su, Fa) 3
Year Total: 15 15

Second Year

<table>
<thead>
<tr>
<th>Units</th>
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<th>Spring</th>
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<tr>
<td>CSCE 2004 Programming Foundations I (Sp, Fa)</td>
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<td>CSCE 2114 Digital Design (Sp, Fa)</td>
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<td>MATH 2574 Calculus III (ACTS Equivalency = MATH 2603) (Sp, Su, Fa)</td>
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<td>MATH 2603 Discrete Mathematics (Sp, Su, Fa)</td>
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<td>CSCE 2214 Computer Organization (Sp, Fa)</td>
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<td>MATH 2584 Elementary Differential Equations (Sp, Su, Fa)</td>
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Third Year

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<tr>
<th>Units</th>
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<th>Spring</th>
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</thead>
<tbody>
<tr>
<td>CSCE 3193 Programming Paradigms (Sp, Fa)</td>
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<tr>
<td>CSCE 3613 Operating Systems (Sp, Fa)</td>
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<td>CSCE 3953 System Synthesis and Modeling (Fa)</td>
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<td>INEG 2313 Applied Probability and Statistics for Engineers I (Sp, Fa)</td>
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<tr>
<td>Basic Science Elective With Lab*</td>
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<td>CSCE 3513 Software Engineering (Sp, Fa)</td>
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<tr>
<td>CSCE Elective</td>
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</tr>
<tr>
<td>ELEG 3933 Circuits &amp; Electronics (Sp)</td>
<td>3</td>
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<tr>
<td>PHIL 3103 Ethics and the Professions (Sp, Su, Fa)</td>
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<tr>
<td>Free Elective</td>
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<td>Year Total:</td>
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Fourth Year

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<th>Units</th>
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<tbody>
<tr>
<td>CSCE 4561 Capstone I (Fa)</td>
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<tr>
<td>CSCE 4114 Embedded Systems (Fa)</td>
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<td>Two CSCE Electives</td>
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<td>Fine Arts Elective</td>
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<td>COMM 1313 Public Speaking (ACTS Equivalency = SPCH 1003) (Sp, Su, Fa)</td>
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<td>CSCE 4213 Computer Architecture (Sp)</td>
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<td>CSCE 4963 Capstone II (Sp)</td>
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<td>Free elective</td>
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<td>Year Total:</td>
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Total Units in Sequence: 126

Requirements for B.S. in Computer Science

A degree in computer science provides a wide variety of career choices. Computer science graduates can design, implement, or manage computer systems, as well as adapt computers to new applications. Computer science core courses include the fundamentals of programming concepts, data structures, operating systems, algorithms, formal languages, and database management systems.

The Bachelor of Science programs in Computer Engineering and Computer Science culminate in a capstone project completed in two consecutive semesters. In the first semester, students form teams and develop a project proposal. In the second semester, students develop, implement, and present the final project.

Humanities and social science electives are selected from the University Core Requirements listed in the Catalog of Studies. To satisfy the University Core, all CSCE students are required to take the following 18 hours of humanities/social science courses:

- PHIL 3103 Ethics and the Professions (Sp, Su, Fa) 3
- Fine Arts From Category “A” 3
- U.S. History or Government 3
- Social Science 9

The Undergraduate Handbook has a list of approved basic science, mathematics, and technical electives. Any course not included in these lists requires faculty approval.

Degree Program Changes

Students must meet all requirements of their degree programs and are expected to keep informed concerning current regulations, policies, and program requirements in their fields of study. Changes made in the curriculum at a level beyond that at which a student is enrolled might become graduation requirements for that student. Changes made in the curriculum at a level lower than the one at which a student is enrolled are not required of that student. Students should consult their departmental adviser for additional information.

Computer Science B.S. Eight-Semester Degree Program

The following sections contain the list of courses required for the Bachelor of Science in Computer Science (B.S.) degrees with a suggested sequence below.

Not all courses are offered every semester, so students who deviate from the suggested sequence must pay careful attention to course scheduling and course prerequisites. Students wishing to follow the eight-semester degree plan should see the Eight-Semester Degree Policy (http://catalog.uark.edu/undergraduatecatalog/academicregulations/eightsemesterdegreecompletionpolicy) in the Academic Regulations chapter for university requirements of the program.

First Year

<table>
<thead>
<tr>
<th>Units</th>
<th>Fall</th>
<th>Spring</th>
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<tbody>
<tr>
<td>GNEG 1111 Introduction to Engineering I (Sp, Fa)</td>
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</tbody>
</table>
ENGL 1013 Composition I (ACTS Equivalency = ENGL 1013) (Sp, Su, Fa) 3
CHEM 1103 University Chemistry I (ACTS Equivalency = CHEM 1414 Lecture) (Su, Fa) 3
MATH 2554 Calculus I (ACTS Equivalency = MATH 2405) (Sp, Su, Fa) 4
PHYS 2054 University Physics I (ACTS Equivalency = PHYS 2034) (Sp, Su, Fa) 4
GNEG 1121 Introduction to Engineering II (Sp, Fa) 1
MATH 2564 Calculus II (ACTS Equivalency = MATH 2505) (Sp, Su, Fa) 4
ENGL 1023 Composition II (ACTS Equivalency = ENGL 1023) (Sp, Su, Fa) 3

Year Total: 15 15

Second Year

Factors Sp Spring
CSCE 2004 Programming Foundations I (Sp, Fa) 4
CSCE 2114 Digital Design (Sp, Fa) 4
MATH 2603 Discrete Mathematics (Sp, Su, Fa) 3
Basic Science Elective With Lab 4
Social Science Elective 3
CSCE 2014 Programming Foundations II (Sp, Fa) 4
CSCE 2214 Computer Organization (Sp, Fa) 4
MATH 3103 Combinatorial and Discrete Mathematics (Sp, Fa) 3
Fine Arts Elective 3
Social Science Elective 3
Year Total: 18 17

Third Year

Factors Sp Spring
CSCE 3193 Programming Paradigms (Sp, Fa) 3
CSCE 3613 Operating Systems (Sp, Fa) 3
COMM 1313 Public Speaking (ACTS Equivalency = SPCH 1003) (Sp, Su, Fa) 3
MATH 3083 Linear Algebra (Sp, Su, Fa) 3
INEG 2313 Applied Probability and Statistics for Engineers I (Sp, Fa) 3
CSCE 3513 Software Engineering (Sp, Fa) 3
CSCE 4523 Database Management Systems (Sp) 3
CSCE Elective 3
PHIL 3103 Ethics and the Professions (Sp, Su, Fa) 3
Free Elective 3
Year Total: 15 15

Fourth Year

Factors Sp Spring
CSCE 4133 Algorithms (Fa) 3
CSCE 4561 Capstone II (Sp) 3
Two CSCE Electives 6
Two Free Electives 6

CSCE 4323 Formal Languages and Computability (Sp) 3
CSCE 4963 Capstone I (Sp) 3
Free Elective 3
Social Science Elective 3
Year Total: 16 15

Total Units in Sequence: 126

* Choose between PHYS 2074 University Physics II or CHEM 1123/CHEM 1121L University Chemistry II and lab

Requirements for B.A. in Computer Science

The Bachelor of Arts in Computer Science degree has the same educational objectives as the Bachelor of Science degree. However, the course requirements differ greatly to allow students to double major or pursue other interests.

 Humanities and social science electives are selected from the University Core Requirements listed in the Catalog of Studies. To satisfy the University Core, all CSCE students are required to take the following 18 hours of humanities/social science courses:

PHIL 3103 Ethics and the Professions (Sp, Su, Fa) 3
Fine Arts from Category “A” 3
U.S. History or Government 3
Social Science 9

The Undergraduate Handbook has a list of approved basic science, mathematics, and technical electives. Any course not included in these lists requires faculty approval.

The Bachelor of Arts in Computer Science degree has the same educational objectives as the Bachelor of Science degree. However, the course requirements differ greatly to allow students to double major or pursue other interests.

Degree Program Changes

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Computer Science B.A. Eight-Semester Degree Program

The following sections contain the list of courses required for the Bachelor of Arts in Computer Science (B.A.) degrees with a suggested sequence below.

Not all courses are offered every semester, so students who deviate from the suggested sequence must pay careful attention to course scheduling and course prerequisites. Students wishing to follow the eight-semester degree plan should see the Eight-Semester Degree Policy (http://catalog.uark.edu/undergraduatecatalog/academicregulations/)
eight semester degree completion policy) in the Academic Regulations chapter for university requirements of the program.

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<th>First Year</th>
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<td>ENGL 1013 Composition I (ACTS Equivalency = ENGL 1013) (Sp, Su, Fa)</td>
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<td>HIST 2013 History of the American People, 1877 to Present (ACTS Equivalency = HIST 2123) (Sp, Su, Fa)</td>
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<td>CSCE 2004 Programming Foundations I (Sp, Fa)</td>
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<td>CSCE 2114 Digital Design (Sp, Fa)</td>
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<td>CSCE 2014 Programming Foundations II (Sp, Fa)</td>
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<td>CSCE 2214 Computer Organization (Sp, Fa)</td>
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<td>Social Science Elective (from University Core)</td>
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<tr>
<td>Fine Arts</td>
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<td>Free Elective</td>
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<td>CSCE 3193 Programming Paradigms (Sp, Fa)</td>
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<td>COMM 1313 Public Speaking (ACTS Equivalency = SPCH 1003) (Sp, Su, Fa)</td>
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<td>STAT 2303 Principles of Statistics (ACTS Equivalency = MATH 2103) (Sp, Su, Fa)</td>
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<tr>
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<td>CSCE elective (3000-level or higher)</td>
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<tr>
<td>ENGL 3053 Technical and Report Writing (ACTS Equivalency = ENGL 2023) (Sp, Fa)</td>
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<td>Science Elective (from University Core)</td>
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<td>Two Free Elective</td>
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<tr>
<td>CSCE elective (3000-level or higher)</td>
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<tr>
<td>PHIL 3103 Ethics and the Professions (Sp, Su, Fa)</td>
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<td>Two Free electives</td>
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<td>Fall</td>
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<tr>
<td>Two CSCE electives (3000 level or higher)</td>
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<td>Science Elective (from University Core)</td>
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<td>Two Free electives (3000 level or higher)</td>
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<td>Two CSCE electives (3000-level or higher)</td>
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<td>Three Free electives (3000-level or Higher)</td>
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<td>Year Total:</td>
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Total Units in Sequence: 120

Requirements for a Minor in Computer Science:

- CSCE 2004 Programming Foundations I (Sp, Fa) 4
- CSCE 2014 Programming Foundations II (Sp, Fa) 4
- CSCE 3193 Programming Paradigms (Sp, Fa) 3
- Three additional CSCE courses numbered above 2000. 9

Total Hours 20

Requirements for Departmental Honors in Computer Science and Computer Engineering

The Honors Program in Computer Science and Computer Engineering is designed for the superior student and is intended to help the student develop a more comprehensive view of Computer Science and Computer Engineering. The program provides a vehicle for the recognition of achievements beyond the usual course of study. Higher degree distinctions are recommended only in truly exceptional cases and are based upon the candidate’s whole program of honors studies. A minimum of 12 hours of honors coursework is required.

The following requirements are necessary for graduation with honors in either the Computer Engineering or Computer Science Bachelor of Science program:

1. The candidate must satisfy the requirements set forth by the College of Engineering.
2. The student must obtain at least a 3.50 grade-point average in required Computer Engineering and/or Computer Science courses.
3. The student must complete 6 hours of Honors credit in the major, which includes 3 hours of Honors Thesis taken as successive semesters of CSCE 491VH and 3 hours of CSCE coursework.

Courses


  Introductory programming course for students majoring in computer science or computer engineering. Software development process: problem specification, program design, implementation, testing and documentation. Programming topics: data representation, conditional and iterative statements, functions, arrays, strings, file I/O and classes. Using C++ in a UNIX environment. Corequisite: Lab component. Prerequisite: MATH 2554 or MATH 2554C with a grade of C or better.
This course continues developing problem solving techniques by focusing on fundamental data structures and associated algorithms. Topics include: abstract data types, introduction to object-oriented programming, linked lists, stacks, queues, hash tables, binary trees, graphs, recursion, and searching and sorting algorithms. Using C++ in UNIX environment. Corequisite: Lab component. Prerequisite: CSCE 2004 with a grade of C or better.

CSCE 2114. Digital Design (Sp, Fa). 4 Hours.
Introduction to the hardware aspects of digital computers, logic gates, flip-flops, reduction, finite state machines, sequential logic design, digital systems, software design tools, hardware description language (VHDL), and implementation technologies. Corequisite: Lab component. Prerequisite: MAT 2554 or MAT 2554C with a grade of C or better. This course is cross-listed with ELEG 2904.

CSCE 2214. Computer Organization (Sp, Fa). 4 Hours.
 Presents the relationship between computing hardware and software with a focus on the concepts for current computers. CPU design topics are covered including various techniques for microprocessor design and performance evaluation. Corequisite: Lab component. Prerequisite: CSCE 2114 with a grade of C or better.

CSCE 3193. Programming Paradigms (Sp, Fa). 3 Hours.
Programming in different paradigms with emphasis on object oriented programming and networking programming. Survey of programming languages, event driven programming, and concurrency. Prerequisite: CSCE 2014 with a grade of C or better.

CSCE 3193H. Honors Programming Paradigms (Fa). 3 Hours.
Programming in different paradigms with emphasis on object oriented programming and network programming. Survey of programming languages, event driven programming, and concurrency. Prerequisite: CSCE 2014 with a grade of C or better.

This course is equivalent to CSCE 3193.

CSCE 3213. Cluster Computing (Irregular). 3 Hours.
Cluster computing solves problems too large in terms of memory or run time for a single workstation. Common approaches to these problems combine the resources of multiple computers to collectively find the solution. High performance computing is quickly expanding to areas including: chemistry, physics, mathematics, engineering, bio-informatics, finance, logistics, etc.

CSCE 3513. Software Engineering (Sp, Fa). 3 Hours.
A modern approach to the current techniques used in software design and development. This course emphasizes the use of modern software development tools, multi-module programming, and team design and engineering. Prerequisite: CSCE 3193 or CSCE 3193H with a grade of C or better.

An introduction to operating systems including topics in system structures, process management, storage management, files, distributed systems, and case studies. Prerequisite: CSCE 2014 and CSCE 2214, each with a grade of C or better.

CSCE 3613H. Honors Operating Systems (Sp). 3 Hours.
An introduction to operating systems including topics in system structures, process management, storage management, files, distributed systems, and case studies. Prerequisite: CSCE 2014 and CSCE 2214, each with a grade of C or better. This course is equivalent to CSCE 3613.

CSCE 3953. System Synthesis and Modeling (Fa). 3 Hours.
This course instructs the students in the use of modern synthesis and modeling languages and approaches for design automation. This course will teach students the use of HDLs and modeling languages for representing and implementing digital computer systems. Prerequisite: CSCE 2214 with a grade of C or better.

CSCE 4013. Special Topics (Irregular). 3 Hours.
Consideration of computer science topics not covered in other courses. Prerequisite: CSCE 3193 and CSCE 2214. May be repeated for up to 12 hours of degree credit.

CSCE 4023H. Honors Special Topics (Irregular). 3 Hours.
Consideration of current computer engineering topics not covered in other courses. Prerequisite: Honors standing.

CSCE 4043. RFID Information Systems Security (Irregular). 3 Hours.
Radio frequency identification (RFID) information systems provide information to users about objects with RFID tags. They require the application of information systems security (INFOSEC) to protect the information from tampering, unauthorized information disclosure, and denial of service to authorized users. This course addresses security and privacy in an RFID system. Prerequisite: INEG 2313.

CSCE 4114. Embedded Systems (Fa). 4 Hours.
The architecture, software, and hardware of embedded systems. Involves a mixture of hardware and software for the control of a system (including electrical, electro-mechanical, and electro-chemical systems). They are found in a variety of products including cars, VCRs, HDTVs, cell phones, pacemakers, spacecraft, missile systems, and robots for factory automation. Corequisite: Lab component. Prerequisite: CSCE 2214 with a grade of C or better.

CSCE 4123. Programming Challenges (Irregular). 3 Hours.
This course studies the principle methods used in the solution of programming contest problems, e.g., data structures strings, sorting, machine arithmetic and algebra, combinatorics, number theory, backtracking, graph traversal, graph algorithms, dynamic programming, grids, and computational geometry. Prerequisite: CSCE 2014.

CSCE 4133. Algorithms (Fa). 3 Hours.
Provides an introduction to formal techniques for analyzing the complexity of algorithms. The course surveys important classes of algorithms used in computer science and engineering. Prerequisite: CSCE 3193 and (MATH 2603 or MATH 2803) or MATH 3423.

CSCE 4213. Computer Architecture (Sp). 3 Hours.
The architecture of modern scalar and parallel computing systems. Techniques for dynamic instruction scheduling, branch prediction, instruction level parallelism, shared and distributed memory multiprocessor systems, array processors, and memory hierarchies. Prerequisite: CSCE 2214 with a grade of C or better. This course is cross-listed with ELEG 4983.

The reduction of power consumption is rapidly becoming one of the key issues in digital system design. Traditionally, digital system design has mainly focused on performance and area trade-offs. This course will provide a thorough introduction to digital design for lower consumption at the circuit, logic, and architectural level. Prerequisite: CSCE 2214 with a grade of C or better.

CSCE 4253. Concurrent Computing (Irregular). 3 Hours.
Programming concurrent processes; computer interconnection network topologies; loosely coupled and tightly coupled paralleled computer architectures; designing algorithms for concurrency; distributed computer architectures. Prerequisite: CSCE 3193.

CSCE 4263. Advanced Data Structures (Irregular). 3 Hours.
This course continues the study of data structures, algorithmic analysis for these data structures, and their efficient implementation to support standard library in programming languages. Topics include: AVL trees, Red-Black trees, Splay trees, Optimal Binary Search trees, 2-3 tree, 2-3-4 tree, B-trees, Segment trees, Leftist Heaps, Binomial Heaps, Fibonacci Heap, Disjoint Set, Hashing, and big integer with hundreds to thousands of digits. Prerequisite: CSCE 3193.
CSCE 4323. Formal Languages and Computability (Sp). 3 Hours.
Finite Automata and regular languages, regular expressions, context-free languages
and pushdown automata, nondeterminism, grammars, and Turing machines.
Church’s thesis, halting problem, and undecidability. Prerequisite: CSCE 4133.

CSCE 4333. Introduction to Integrated Circuit Design (Fa). 3 Hours.
Design and layout of large scale digital integrated circuits using CMOS technology.
Topics include MOS devices and basic circuits, integrated circuit layout and
fabrication, dynamic logic, circuit design and layout strategies for large scale CMOS
circuits. Students may not receive credit for both CSCE 4333 and CSCE 5223.
Prerequisite: ELEG 3214 or ELEG 3933 and MATH 2584.

CSCE 4353. CPLD/FPGA-Based System Design (Irregular). 3 Hours.
Field Programmable Logic devices (FPGAs/CPLDs) have become extremely popular
as basic building blocks for digital systems. They offer a general architecture that
users can customize by inducing permanent or reversible physical changes. This
course will deal with the implementation of logic options using these devices.
Prerequisite: CSCE 2214 with a grade of C or better.
This course is cross-listed with ELEG 4963.

Basic concepts of problem analysis, model design, and simulation experiments. A
simulation will be introduced and used in this course. Prerequisite: CSCE 2014 with
a grade of C or better and INEG 2313.

CSCE 4433. Cryptography (Irregular). 3 Hours.
This course provides a general introduction to modern cryptography. Topics include:
stream ciphers, block ciphers, message authentication codes, public key encryption,
key exchange, and signature schemes. Prerequisite: CSCE 2214 with a grade of C
or better and (MATH 2603 or MATH 2803).

CSCE 4523. Database Management Systems (Sp). 3 Hours.
Introduction to database management systems, architecture, storage structures,
indexing, relational data model, E-R diagrams, query languages, SQL, ODBC,
transaction management, integrity, and security. Prerequisite: CSCE 3193 or
CSCE 3193H.

CSCE 4543. Software Architecture (Irregular). 3 Hours.
A study of software architecture through the use of case studies drawn from real
systems designed to solve real problems from technical as well as managerial
perspectives. Techniques for designing, building, and evaluating software
architectures. Prerequisite: CSCE 4133 and CSCE 3513.

CSCE 4561. Capstone I (Fa). 1 Hour.
CSCE students complete a comprehensive software capstone project during their
final year of undergraduate studies. The project is done over 2 semesters in phases:
concept, formal proposal, implementation, and presentation. The projects include
and may require the integration of software and hardware elements and are developed to software engineering methodologies. Prerequisite:
CSCE 3513 and (CSCE 3613 or CSCE 3613H) and completion of 96 credit hours.

CSCE 4613. Artificial Intelligence (Irregular). 3 Hours.
Introduction to intelligent agents, AI languages, search, first order logic, knowledge
representation, ontologies, problem solving, natural language processing, machine
vision, machine learning, and robotics. Prerequisite: CSCE 214 with a grade of C
or better.

CSCE 4623. Mobile Programming (Irregular). 3 Hours.
An introduction to software development on mobile devices. The major topics
covered in this course include underlying concepts and principles in mobile
programming, as well as hands-on programming experience on mobile devices with
an emphasis on smartphones. Prerequisite: CSCE 3193 or CSCE 3193H.

This course provides an introduction to massively parallel programming
using Graphics Processing Units (GPUs). Topics include basic programming
model, GPU thread hierarchy, GPU memory architecture, and performance
optimization techniques and parallel patterns needed to develop real-life
applications. Prerequisite: CSCE 2014 with a grade of C or better.

CSCE 4753. Computer Networks (Irregular). 3 Hours.
This course is an introductory course on computer networks. Using the Internet
as a vehicle, this course introduces underlying concepts and principles of modern
computer networks, with emphasis on protocols, architectures, and implementation
issues. Prerequisite: INEG 2313.

Introduction to the theory and algorithms used in computer graphics systems and
applications. Topics include: 2D and 3D geometric models (points, lines, polygons,
surfaces), affine transformations (rotation, translation, scaling), viewpoint calculation
(clipping, projection), lighting models (light-material interactions, illumination
and shadow calculation). Students will implement their own graphics pipeline to
demonstrate many of these techniques. Higher level computer graphics applications
will be created using OpenGL. Prerequisite: CSCE 2014 with a grade of C or better.

CSCE 4853. Information Security (Irregular). 3 Hours.
This course covers principles, mechanisms, and policies governing confidentiality,
integrity, and availability of digital information. Topics to be covered include security
concepts and mechanisms, security policies, multilevel security models, system
vulnerability, threat and risk assessment, basic cryptography and its applications,
intrusion detection systems. Prerequisite: CSCE 3193 or CSCE 3193H.

CSCE 490V. Individual Study (Irregular). 1-3 Hour.
Individual study directed by faculty in current research topics, state of the art,
or advanced methodology in one of the major computer science or computer
engineering areas. May be repeated for up to 3 hours of degree credit.

To master advanced logic design concepts, including the design and testing of
synchronous and asynchronous combinational and sequential circuits using state
of the art CAD tools. Corequisite: Lab component. Prerequisite: CSCE 2114 or
ELEG 2904.
This course is cross-listed with ELEG 4914.

CSCE 491VH. Honors Thesis (Sp, Fa). 1-3 Hour.
To provide honors students with experience in presenting their research
accomplishments to their peers and faculty. Prerequisite: Honors standing. May be
repeated for up to 3 hours of degree credit.

CSCE 4963. Capstone II (Sp). 3 Hours.
CSCE students complete a comprehensive capstone project during their final year
of undergraduate studies. The project is done over two consecutive semesters
in phases: concepts, formal proposal, implementation, and presentation. The
projects include and may require the integration of software, hardware factors,
and hardware elements and are developed using software engineering methodologies.
Prerequisite: CSCE 4561.