Courses

Contract All Courses |

Computer Engineering and Computer Science

CECS 80 - Foundations for Data Computing

(1 unit)

Corequisite(s): CECS 180.

This course is intended as a corequisite and must be taken concurrently with CECS 180. Students required to enroll in this corequisite course must maintain enrollment in both classes throughout the semester. Withdrawal from CECS 180 will not be permitted in this case.
Topics and skills that support student success in CECS 180. Topics include beginning algebra, probability, data acquisition, data preparation, graphical and tabular displays of data, and elementary data analysis.

Credit / No Credit only. (Activity 2 hours) Not repeatable for credit.

CECS 100 - Critical Thinking in the Digital Information Age

(3 units)

Prerequisite/Corequisite: ENGL 100B
or GE English Composition (Area 1A).

Help students develop critical thinking skills using technical software. Main topics include: identifying engineering issues for investigation, developing planning and problem solving strategies, locating pertinent information and examples, critically analyzing these sources, forming and testing hypotheses, synthesizing and organizing results for effective communication, and developing transferable problem solving skills.

Letter grade only (A-F). (Lecture 2 hours, laboratory 3 hours).

CECS 105 - Introduction to Computer Engineering and Computer Science

(1 unit)

Introduction to the fields of computer engineering and computer science. Current and future trends and challenges in various fields of computing. Social, ethical and economical issues related to

computing technology. Exploration of career and professional development opportunities.

Letter grade only (A-F). (Lecture 1 hour) Same Course as CECS 105H
. Not open for credit to students with credit in: CECS 105H
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CECS 105H - Introduction to Computer Engineering and Computer Science

(1 unit)

Prerequisite: Engr Honors Program track I or II.
Introduction to the fields of computer engineering and computer science. Current and future trends and challenges in various fields of computing. Social, ethical and economical issues related to computing technology. Exploration of career and professional development opportunities.

Letter grade only (A-F). Same course as CECS 105
. Open to students in the Engineering Honors Program. Additional assignments/projects adding depth to the course materials required for Engineering Honors students. Not open for credit to students with credit in CECS 105
. (Lecture 1 hour).

CECS 110 - Beginning Web Design

(3 units)

Introduction to HTML and CSS using modern tools, following the W3C guidelines for coding. Web sites designed with basic components and layouts. Overview of graphics, video, sound and commonly used tools.

Letter grade only (A-F). (Lecture 2 hours, laboratory 3 hours)

CECS 174 - Introduction to Programming and Problem Solving

(3 units)

Corequisite: CECS 180 or MATH 122.
Introduction to basic concepts of computer science and fundamental techniques for solving problems using the Python programming language. Variables, data types, conditional statements, loops and arrays. Programming style. Applications to numerical and non-numerical problems.

Letter grade only (A-F). (Lecture 2 hours, laboratory 3 hours)

CECS 180 - Data Computing for Everyone

(3 units)

Prerequisite(s)/Corequisite(s): Appropriate CSU Multiple Measures Placement, or concurrent

enrollment in the support class of CECS 80
.

Introduction to basic concepts of Data Science, helping students develop critical thinking skills and computer programming skills. Topics include identifying basic computing problems, critically analyzing quantitative data, formulating collections of data in different ways, and developing and presenting logically sound data computing problems.

Letter grade only (A-F). CECS 80 may be taken concurrently with CECS 180 for additional support. Students who enroll in CECS 80 must maintain enrollment in both classes throughout the semester. Withdrawal from CECS 80 will not be permitted in this case. Not repeatable for credit.

CECS 181 - Introduction to Data Science

(3 units)

Prerequisite/Corequisite: CECS 174.

Fundamental course for Data Science and its applications. The course includes principles in collecting, managing, and analyzing data. Main topics include data loading, cleaning, visualization, EDA, data distribution and practical statistics for data science.

Letter grade only (A-F). (Lecture 3 hours) Not repeatable for credit.

CECS 200 - Intermediate Web Design

(3 units)

Prerequisite: CECS 110
with a grade of "C" or better.
Intermediate HTML and CSS using modern tools, following the W3C guidelines for coding. Web sites designed with popular frameworks and content management systems such as Bootstrap and WordPress.

Letter grade only (A-F). (Lecture 2 hours, laboratory 3 hours)

CECS 201 - Computer Logic Design I

(3 units)

Prerequisite: Computer Science and Computer Engineering majors, pre-majors, and minors only.
Corequisite: MATH 122.
Basic topics in combinational and sequential switching circuits with applications to the design of digital devices. Introduction to Electronic Design Automation (EDA) tools. Laboratory projects with Field Programmable Gate Arrays (FPGA).

Letter grade only (A-F). (Lecture 2 hours, lab 3 hours)

CECS 211 - Principles of Computer Engineering I

(3 units)

Prerequisite: MATH 122
with a grade of "C" or better. Computer Science and Computer Engineering majors, pre-majors, and minors only.
Basic principles of analysis and design of computer-based circuits. Application of transistors, logic families, digital, devices in computer and embedded processor interfacing, importance of phasors and the complex plane. Basic DC/AC circuit fundamentals. Laboratory safety.

Letter grade only (A-F). (Lecture 2 hours, laboratory 3 hours)

CECS 225 - Digital Logic and Assembly Programming

(3 units)

Prerequisite: Computer Science and Computer Engineering majors, pre-majors, and minors only.
Corequisite: CECS 174

An introductory course in digital logic and assembly programming covering number representation, digital logic, Boolean algebra and logic gates, combinatorial building blocks, latches and flip-flops, arithmetic circuits, memory system organization, machine and assembly language programming, and MIPS architecture.

Letter grade only (A-F). (Lecture-problems 3 hours)

CECS 228 - Discrete Structures with Computing Applications

(3 units)

Prerequisites: CECS 174 and (MATH 170 or MATH 122) all with a grade of "C" or better. Computer Science, Applied Data Science, and Computer Engineering majors, pre-majors, and minors only
An introduction to discrete mathematics with applications towards computing. Topics include sets, functions, logic, relations, graphs, trees, recursion, combinatorics, and mathematical reasoning.

Letter grade only (A-F). (Lecture-problems 3 hours) Same course as CECS 228H
. Not open for credit to students with credit in CECS 228H.

CECS 228H - Discrete Structures with Computing Applications

(3 units)

Prerequisites: CECS 174 and MATH 122 all with a grade of "C" or better. Engr Honors Program track I or II.
An introduction to discrete mathematics with applications towards computing. Topics include sets, functions, logic, relations, graphs, trees, recursion, combinatorics, and mathematical reasoning.

Letter grade only (A-F). (Lecture-problems 3 hours) Same course as CECS 228. CECS 228H is open only to students in the Engineering Honors Program. Additional assignments/projects adding depth to the course materials required for Engineering Honors students. Not open for credit to students with credit in CECS 228.

CECS 229 - Discrete Structures with Computing Applications II

(3 units)

Prerequisites: CECS 228
with a grade of "C" or better
This is the second course in a two-course sequence in computing applications of discrete structures. Topics include applications of computer arithmetic and matrices in computer systems. Programming assignments in Python will be provided.

Letter grade only (A-F). (Lecture-problems 3 hours). Same course as CECS 229H
. Not open for credit to students with credit in CECS 229H.

CECS 229H - Discrete Structures with Computing Applications II

(3 units)

Prerequisites: CECS 228
or CECS 228H
with a grade of "C" or better. Engr Honors Program track I or II.
This is the second course in a two-course sequence in computing applications of discrete structures. Topics include applications of computer arithmetic and matrices in computer systems. Programming assignments in Python will be provided.

Letter grade only (A-F). (Lecture-problems 3 hours) CECS 229H is open only to students in the Engineering Honors Program. Additional assignments/projects adding depth to the course materials required for Engineering Honors students. Not open for credit to students with credit in CECS 229.

CECS 262 - Introduction to Embedded System Programming

(3 units)

Prerequisites: CECS 174
and CECS 201
all with a grade of "C" or better.
Introduction to embedded system architecture, memory organization and programming using C. Interfacing with external I/O devices, Use of internal special function registers. Development tools and extended C instructions unique to embedded systems. Course will be taught using an embedded processor development board.

Letter grade only (A-F). (Lecture 2 hours, laboratory 3 hours.)

CECS 271 - Introduction to Numerical Methods

(3 units)

Prerequisites: CECS 229
or MATH 247
with a grade of "C" or better.
Numerical methods for algebraic equations, computer arithmetic, error propagation, fixed and arbitrary precision, numerical integration and differentiation, ordinary differential equations, Fourier Transform, discrete Fourier Transform. Programming assignments for implementation.

Letter grade only (A-F). (Lecture-problems 3 hours)

CECS 274 - Data Structures

(3 units)

Prerequisite: CECS 174 with a grade of "C" or better. Computer Science, Applied Data Science, and Computer Engineering majors, pre-majors, and minors only.
Data Structures. Topics include lists, hash tables, binary trees, balanced trees, heaps, sorting-algorithms, graphs, external memory searching.

Letter grade only (A-F). (Lecture 2 hours, laboratory 3 hours). Same course as CECS 274H. Not open for credit to students with credit in CECS 274H.

CECS 275 - Programming and Data Structures in C++

(3 units)

Prerequisite: CECS 262
or equivalent with a grade of "C" or better
Disciplined methods of design, coding and testing using the C++ programming language. Data abstraction and class design. Introduction to data structures (linked lists, stacks, queues and trees.) Recursion. Sorting and searching.

Letter grade only (A-F). (Lecture 2 hours, laboratory 3 hours)

CECS 277 - Object Oriented Application Development

(3 units)

Prerequisite: CECS 174
with a grade of "C" or better. Computer Science and Computer Engineering majors, pre-majors, and minors only.
Object oriented programming and design for large scale software. Class design, interfaces, inheritance, and polymorphism. Robust programming with exceptions, streams, iterators, and testing.

Letter grade only (A-F). (Lecture 2 hours, laboratory 3 hours)

CECS 278 - Cyber Security Principles

(3 units)

Prerequisite: CECS 100

Principles, mechanisms, implementation, and sound practices of computer security and data protection. Cryptography. Authentication and access control. Internet security. Malicious software. Common vulnerabilities. Practical security in everyday life.

Letter grade only (A-F). (Lecture 2 hours, laboratory 3 hours)

CECS 280 - Introduction to Data Mining

(3 units)

Prerequisites: CECS 181 or STAT 181.
Introductory data mining course with fundamental theory and application. The course focuses on the fundamental concepts of data mining including statistics and information theory, data preparation, classification and clustering, outlier detection, and pattern mining with various applications. Hands-on practice and/or assignment for programming in Python or R or equivalent language.

Letter grade only (A-F). (Lecture 3 hours) Same course as STAT 280. Not repeatable for credit.

CECS 281 - Introduction to Data Visualization for Data Science

(3 units)

Prerequisites: STAT 181 or CECS 181 with a grade of "C" or better.
A comprehensive introduction to the principles and techniques of data visualization. Topics covered include visualizations of qualitative, quantitative, time-dependent, geospatial, and network-structured data. Other topics include misleading visualizations, supplemental visualization techniques for communicating information, and building dashboards. Programming assignments.

Letter grade only (A-F). (Lecture 3 hours) Same course as STAT 281. Not repeatable for credit.

CECS 300 - Design of Dynamic Web Sites

(3 units)

Prerequisite: CECS 200
with a grade of "C" or better.
Design of dynamic web sites using modern tools. Interdisciplinary group project with a focus on creating an accessible Web site for a client. Software used will give students experience in local web hosting and understanding of portability.

Letter grade only (A-F). (Lecture 2 hours, laboratory 3 hours)

CECS 301 - Computer Logic Design II

(3 units)

Prerequisites: CECS 174
, CECS 201
all with a grade of "C" or better.
Sequential logic emphasizing Finite State Machine design & analysis, timing analysis of sequential logic, Introduction to Data Path, Control and Memory. Use of Electronic Design Automation (EDA) tools for design, simulation, verification. Laboratory projects with Field Programmable Gate Arrays (FPGA's).

Letter grade only (A-F). (Lecture 2 hours, laboratory 3 hours) Same course as CECS 301H
. Not open for credit to students with credit in CECS 301H
.

CECS 301H - Computer Logic Design II

(3 units)

Prerequisites: CECS 174
, CECS 201
all with a grade of "C" or better. Engr Honors Program track I or II.
Sequential logic emphasizing Finite State Machine design & analysis, timing analysis of sequential logic, Introduction to Data Path, Control and Memory. Use of Electronic Design Automation (EDA) tools for design, simulation, verification. Laboratory projects with Field Programmable Gate Arrays (FPGA's).

Letter grade only (A-F). (Lecture 2 hours, laboratory 3 hours) CECS 301H is open only to students in the Engineering Honors Program. Additional assignments/projects adding depth to the course materials required for Engineering Honors students. Not open for credit to students with credit in CECS 301
.

CECS 302 - Introduction to Computer Forensics

(3 units)

Prerequisite: CECS 100

Introduction to principles of digital forensics, evidence collection, preservation and analysis. Topics include investigation principles, data acquisition, OS and memory recovery/analysis, computer network forensics, mobile forensics, legal consideration, ethics, digital evidence control and documentation.

Letter grade only (A-F). (Lecture 2 hours, Laboratory 3 hours).

CECS 303 - Networks and Network Security

(3 units)

Prerequisite: either CECS 278
or CECS 378
, with a grade of "C" or better
An examination of common computer security threats; fundamental techniques for implementing secure software systems and networks; practical experience in attacking and defending networked systems.

Letter grade only (A-F). (Lecture 2 hours, Laboratory 3 hours).

CECS 311 - Principles of Computer Engineering II

(3 units)

Prerequisites: CECS 201
and CECS 211
all with a grade of "C" or better.
Embedded system components. Bipolar and MOS devices and switching circuits. Embedded systems signal processing with operational amplifiers. Digital/analog interfacing including A/D and D/A converters. Schematic capture, analysis and implementation of embedded signal processing algorithms. Fundamentals of digital communication.

Letter grade only (A-F). (Lecture 2 hours, laboratory 3 hours)

CECS 323 - Database Fundamentals

(3 units)

Prerequisites: CECS 228
and CECS 277
all with a grade of C or better.
Techniques for representing data using modern database systems. Designing schemas in relational, document, and other models of data storage. Data manipulation languages. Database application programming.

Letter grade only (A-F). (Lecture-problems 3 hours)

CECS 325 - System Programming

(3 units)

Prerequisites: CECS 274

and CECS 277
.
Development, debugging, and deployment of systems-level software for experienced programmers. Operating system abstractions for processes, memory management, file systems, and parallel programming. Modern C++ programming in a Unix-based environment.

Letter grade only (A-F). (Lecture-problems 3 hours) Not repeatable for credit.

CECS 326 - Operating Systems

(3 units)

Prerequisites: (CECS 275
or CECS 282 or CECS 325
) and (CECS 341
or CECS 346)
all with a grade of "C" or better.
The structure and functions of operating systems. Interrupt handling, processes and interprocess communication, memory management, resource scheduling, information sharing and protection. Project implementation in C/C++.

Letter grade only (A-F). (Lecture-problems 3 hours)

CECS 327 - Introduction to Networks and Distributed Computing

(3 units)

Prerequisite: CECS 326
with a grade of "C" or better.
Introduction to Distributed Computing and Interprocess Communication. Networking Protocols. Client Server Paradigm. Peer to Peer Networking. Sockets and the Socket API. Distributed Objects. Coordination, Agreements and Distributed Transactions.

Letter grade only (A-F). (Lecture-problems 3 hours) Same course as CECS 327H
. Not open for credit to students with credit in CECS 327H.

CECS 327H - Introduction to Networks and Distributed Computing

(3 units)

Prerequisite: CECS 326
with a grade of "C" or better. Engr Honors Program track I or II. Freshmen Excluded.
Introduction to Distributed Computing and Interprocess Communication. Networking Protocols. Client Server Paradigm. Peer to Peer Networking. Sockets and the Socket API. Distributed Objects. Coordination, Agreements and Distributed Transactions.

Letter grade only (A-F). (Lecture-problems 3 hours) CECS 327H is open only to students in the Engineering Honors Program. Additional assignments/projects adding depth to the course materials

required for Engineering Honors students. Not open for credit to students with credit in CECS 327.

CECS 328 - Algorithms

(3 units)

Prerequisite: CECS 228
and (CECS 274
or CECS 275
), all with a grade of "C" or better.
Greedy algorithms, dynamic programming, divide and conquer, network flow, approximation algorithms, NP-complete problems. Programming projects to exemplify these concepts.

Letter grade only (A-F). (Lecture-problems 3 hours) Same course as CECS 328H
. Not open for credit to students with credit in CECS 328H.

CECS 328H - Algorithms

(3 units)

Prerequisite: CECS 228
and (CECS 274
or CECS 275
), all with a grade of "C" or better. Engr Honors Program track I or II. Freshmen Excluded.
Greedy algorithms, dynamic programming, divide and conquer, network flow, approximation algorithms, NP-complete problems. Programming projects to exemplify these concepts.

Letter grade only (A-F). (Lecture-problems 3 hours) CECS 328H is open only to students in the Engineering Honors Program. Additional assignments/projects adding depth to the course materials required for Engineering Honors students. Not open for credit to students with credit in CECS 328.

CECS 329 - Concepts of Computer Science Theory

(3 units)

Prerequisite: CECS 328
with a grade of "C" or better.
Fundamental topics in theoretical computer science. Topics include regular languages, finite automata, context-free languages. Turing machine, computability theory, computational complexity, NP-completeness.

Letter grade only (A-F). (Lecture-problems 3 hours)

CECS 341 - Computer Architecture and Organization

(3 units)

Prerequisites: CECS 225
with a grade of "C" or better.
Basic computer architecture and organization, instruction set architecture, central processing unit, processor's datapath, arithmetic and logic unit, processor performance, pipelined processors, memory systems, cache memory organization, virtual memory, I/O systems, processor parallelism, and multicore processor architectures.

Letter grade only (A-F). (Lecture 3 hours)

CECS 342 - Principles of Programming Languages

(3 units)

Prerequisite: CECS 328
with a grade of "C" or better.
Fundamental topics in the design and implementation of programming languages. Programing language paradigms. Comparison of languages in type systems, data types, control flow, subroutines, concurrency, and exception handling.

Letter grade only (A-F). (Lecture-problems 3 hours)

CECS 343 - Introduction to Software Engineering

(3 units)

Prerequisites: CECS 277
or CECS 275
all with a grade of "C" or better.
Principles of software engineering, UML, modeling large software systems, requirements elicitation, object oriented analysis and design using UML, introduction to design patterns, implementation of large systems, software testing, project management, the software lifecycle. Semester long programming project.

Letter grade only (A-F). (Lecture-problems 3 hours)

CECS 346 - Embedded Systems I

(3 units)

Prerequisites: CECS 211
and CECS 262
all with a grade of "C" or better.
Intro microprocessor/controller, embedded programming and design. Basic computer organization, representation of information and instruction, addressing techniques, input/output, assembly language programming. Introduction to assemblers, linkage editors and loaders. Study of the 8051. Design of microprocessor-based systems.

Letter grade only (A-F). (Lecture 2 hours, laboratory 3 hours) Same course as CECS 346H
. Not open for credit to students with credit in CECS 346H

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CECS 346H - Embedded Systems I

(3 units)

Prerequisites: CECS 211
and CECS 262
all with a grade of "C" or better. Engr Honors Program track I or II. Freshmen Excluded.
Intro microprocessor/controller, embedded programming and design. Basic computer organization, representation of information and instruction, addressing techniques, input/output, assembly language programming. Introduction to assemblers, linkage editors and loaders. Study of the 8051. Design of microprocessor-based systems.

Letter grade only (A-F). (Lecture 2 hours, laboratory 3 hours) CECS 346H is open only to students in the Engineering Honors Program. Additional assignments/projects adding depth to the course materials required for Engineering Honors students. Not open for credit to students with credit in CECS 346
.

CECS 347 - Embedded Systems II

(3 units)

Prerequisites: CECS 311
, and CECS 346
all with a grade of "C" or better.
Study of embedded processor applications and interfacing. Embedded systems design, control of external devices, embedded programming in C and assembly. A/D and D/A converters, digital signal processing, motor and LCD controllers. Laboratory implementation of embedded designs and hardware-assisted debugging.

Letter grade only (A-F). (Lecture 2 hours, laboratory 3 hours)

CECS 351 - Social Data Analytics

(3 units)

Prerequisites: CECS 280 with a grade of "C" or better.
Introduction to social data analysis. Topics include graph theory, graph centrality, network structures, social media data collection, text processing, sentiment analysis, anomaly detection, and visualization techniques. Key issues of security, privacy, ethics, and bias in social data are also addressed.

Letter grade only (A-F). (Lecture 3 hours) Not repeatable for credit.

CECS 361 - Digital Design Techniques and Verification

(3 units)

Prerequisites: CECS 301
with a grade of "C" or better.
Discussion of advanced techniques for synchronous digital design, verification of digital designs utilizing test fixtures, and the confirmation of meeting the physical constraints of timing, area and power, with an emphasis on timing.

Letter grading only (A-F). (Lecture 2 hours, laboratory 3 hours).

CECS 378 - Introduction to Computer Security Principles

(3 units)

Prerequisites: CECS 229
and CECS 274
or CECS 275
all with a grade of "C" or better.
An introduction to the fundamentals of cryptography and information and computer security. Basic concepts, theories and protocols in computer security. Basic cryptography, software security, operating system security, database security, network security, human factors, social engineering, digital forensics, privacy and anonymity.

Letter grade only (A-F). (Lecture-problems 3 hours)

CECS 381 - Stochastic Computing

(3 units)

Prerequisite: CECS 229 with a grade of C or better.
Applications of probability and statistics to computing. Topics include axioms of probability, random variables and their statistics, discrete and continuous probability distributions, Chernoff bounds, randomized algorithms, Markov chains, Monte Carlo simulation, regression techniques. Programming assignments provided.

Letter grade only (A-F). (Lecture-Problems 3 hours) Not repeatable for credit.

CECS 401 - Fundamentals of Computer Programming for Educators

(3 units)

Prerequisites: Consent of Single Subject Credential Program (SSCP) is required.
Computer programming in a high-level language and visual block language. Variables, data types, conditions, loops, functions, and lists.

Letter grade only (A-F). (Lecture 2 hours, Activities 2 hours) Not repeatable for credit.

CECS 402 - Computer Science Fundamentals

(3 units)

Prerequisite: CECS 401
.
Fundamental computing concepts and techniques for teaching them. Problem solving with decomposition, abstraction, and algorithms. Data abstraction and logic. Computational complexity.

Letter grade only (A-F). (Lecture-problems 3 hours) Not repeatable for credit.

CECS 403 - Digital Devices and Computing Systems

(3 units)

Prerequisite: CECS 401
An overview of digital devices and the computing systems they constitute. Basic electronic hardware and computer components. The roles of software and hardware in digital communications, networks, robotics, physical computing, and the Internet of Things.

Letter grade only (A-F). (Lecture-problems, 3 hours) Not repeatable for credit.

CECS 406 - Selected Topics in Computer Science

(3 units)

Prerequisite: Senior Standing. Computer Science majors only.
Each offering is based upon an area of computer science and technology in which recent advances have been made.

Letter grade only (A-F). (Lecture-problems 3 hours) May be repeated to a maximum of 6 units with different topics in different semesters. Topics announced in the Schedule of Classes.

CECS 410 - Computers and Networks

(3 units)

Prerequisite: Course design assumes familiarity with computers.
Gain practical, hands-on experience in installing hardware and software on a PC. Learn what a computer network is and how it is similar to the telephone network. Learn the parts that make up a computer and a network.

Letter grade only (A-F). (Lecture 2 hours, laboratory 3 hours)

CECS 419 - Theory of Computation

(3 units)

Prerequisite: CECS 329 with a grade of “C” or better.
Advanced topics in computability theory and computational complexity theory. Topics include Turing Machines, coverage of the standard complexity classes P, NP, IP, and PSPACE, hierarchy, decidability, and recognizability theorems. Additional projects required for CECS 519.

Letter grade only (A-F). (Lecture-problems 3 hours) Additional projects required for CECS 519.
Double Numbered with: CECS 519

CECS 427 - Dynamic Networks

(3 units)

Prerequisite: Completion of at least 60 units, CECS 328
.
Fundamental concepts in dynamic networks. Topics include graphs, random graphs, social and large-scale networks, network information, network theory, metrics, network
algorithms and network models. Programming assignments will be provided.

Letter grade only (A-F). (Lecture-problems, 3 hours) Not repeatable for credit.

CECS 428 - Analysis of Algorithms

(3 units)

Prerequisite: CECS 328
with a grade of “C” or better.
Applications of standard combinatorial techniques to applied programming problems. Rigorous analysis of correctness/complexity of algorithms. Advanced graph algorithms are emphasized. Topics include shortest paths on graphs, sorting, string matching, union find problem, divide-and-conquer technique, and weighted-edge problem.

Letter grade only (A-F). (Lecture-problems 3 hours)

CECS 429 - Search Engine Technology

(3 units)

Prerequisites: CECS 328 and (CECS 381 or MATH 380 or E E 381) all with a grade of “C” or better.
Models, algorithms, and evaluation of the retrieval of information from a collection of documents. Document preprocessing. Indexing and searching. Retrieval evaluation. Search engines.

Letter grade only (A-F). (Lecture-problems 3 hours) Double Numbered with: CECS 529

CECS 440 - Computer Architecture

(3 units)

Prerequisites: CECS 346
and CECS 361
, all with a grade of "C" or better.
Review of logic design. Register transfer and micro-operations. Basic computer organization. Central processor organization. Microprogram control organization. Arithmetic processor design. Arithmetic algorithms. Input-output organization. Memory organization.

Letter grade only (A-F). (Lecture 2 hours, laboratory 3 hours) Same course as CECS 440H
. Not open for credit to students with credit in CECS 440H
.

CECS 440H - Computer Architecture

(3 units)

Prerequisites: (CECS 346
or CECS 346H
) and CECS 361
all with a "C" or better. Engr Honors Program track I or II. Exclude freshmen.
Review of logic design. Register transfer and micro-operations. Basic computer organization. Central processor organization. Microprogram control organization. Arithmetic processor design. Arithmetic algorithms. Input-output organization. Memory organization.

Letter grade only (A-F). (Lecture 2 hours, laboratory 3 hours) CECS 440H is open only to students in the Engineering Honors Program. Additional assignments/projects adding depth to the course materials required for Engineering Honors students. Not open for credit to students with credit in CECS 440
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CECS 443 - Software Project Management and Testing

(3 units)

Prerequisites: CECS 343
with a grade of "C" or better.
The concepts of software project management. Metrics, teams, estimation and scheduling for software projects, risks. Software testing. Review techniques, quality assurance, testing strategies for various application types. Unit level testing: black-box, glass-box, code coverage, testing platforms. Integration testing. Regression testing.

Letter grade only (A-F). (Lecture-problems, 3 hours) Not repeatable for credit.

CECS 444 - Compiler Construction

(3 units)

Prerequisites: CECS 328
and CECS 341
, all with a grade of "C" or better.
Syntax directed compiler study. Organization of a compiler and overall design: parsing, semantic analysis, optimization and code generation.

Letter grade only (A-F). (Lecture-problems 3 hours)

CECS 447 - Embedded Systems III

(3 units)

Prerequisite: CECS 347
with a grade of "C" or better.
Embedded system applications and techniques. Real-time multitasking systems, schedulers, kernels, and operating systems for embedded processors. Advanced I/O technologies - CAN, I2C, Ethernet. Embedded Internet applications. Polling vs. interrupt handling. Lab implementation of embedded designs and hardware-assisted debugging.

Letter grade only (A-F). (Lecture 2 hours, laboratory 3 hours)

CECS 448 - User Interface Design

(3 units)

Prerequisite: CECS 343
with a grade of "C" or better or consent of instructor.
Evaluation, design and programming of user interface systems. Fundamentals of human cognition, system characteristics, and the interaction between humans and systems. Usability methods and user/task-centered design. Tools for designing and building user interfaces, with emphasis on rapid applications development.

Letter grade only (A-F). (Lecture-problems 3 hours)

CECS 449 - Computer Graphics

(3 units)

Prerequisites: CECS 328
and CECS 229
or MATH 247
all with a grade of "C" or better.
Introduction to the theory and practice of computer graphics, Graphics systems, 2-D and 3-D modeling, transformations, viewing transformations, projections, rendering techniques.

Letter grade only (A-F). (Lecture-problems 3 hours)

CECS 450 - Data Visualization

(3 units)

Prerequisite: CECS 343
with a grade of "C" or better
Introduction to various techniques in data visualization supporting the analytical process of turning data into wisdom. Introduction to general concepts, principles, and practices with specific visualization designs. Overview of analytical techniques, analytical interaction, and navigation design. Programming assignments.

Letter grading only (A-F). (Lecture-problems 3 hours)

CECS 451 - Artificial Intelligence

(3 units)

Prerequisites: CECS 328
with a grade of "C" or better.
Introduction to the history and implementation of artificial intelligence agents. Topics include search, constraint satisfaction, game-playing, logical agents, belief networks, optimal sequential decision systems. Project implementation.

Letter grade only (A-F). (Lecture-problems 3 hours)

CECS 453 - Mobile Application Development

(3 units)

Prerequisite: CECS 328
with a grade of "C" or better or consent of the instructor.
Languages and application programming interfaces for mobile device platforms. Development of thick and thin client applications for mobile devices.

Letter grade only (A-F). (Lecture-problems 3 hours)

CECS 455 - Introduction to Game Programming

(3 units)

Prerequisite: CECS 328
with a grade of "C" or better or consent of instructor.
Introduction to game programming and graphics. "Slow" games. Realtime games with no adversary. Adversarial real-time games in 2-D.

Letter grade only (A-F). (Lecture-problems 3 hours)

CECS 456 - Machine Learning

(3 units)

Prerequisites: CECS 381
or E E 381
or STAT 381
with a grade of "C" or better.
An introduction to machine learning and its applications, including supervised, unsupervised learning and deep learning. Main topics include regression, classification and neural networks. Programming assignments.

Letter grade only (A-F). (Lecture-problems 3 hours)

CECS 457 - Applied Machine Learning

(3 units)

Prerequisite: CECS 456
.
Fundamentals of machine learning with an emphasis on the process of applying machine learning techniques to various real-world computing applications, including natural language processing, text mining, cybersecurity, and computer vision.

Letter grade only (A-F). (Lecture-problems 3 hours) Not repeatable for credit.

CECS 458 - Deep Learning

(3 units)

Prerequisite(s): CECS 381 or EE 381 or MATH 380 with a grade of "C" or better.
Foundational and advanced deep learning concepts. Introduction to neural networks, backpropagation, specialized neural network architectures, deep reinforcement learning, and large language models. Programming assignments to reinforce understanding.

Letter grade only (A-F). (Lecture-Problems 3 hours) Not repeatable for credit.

CECS 460 - System on Chip Design

(3 units)

Prerequisite: CECS 361
with a grade of "C" or better.
Complete System on Chip (SOC) design flow from design specification to working SOC. Creation of RTL level modules designed for reuse, integration of Intellectual Property (IP) for RTL and physical level IP, IC verification, creation of self-checking test benches for designs.

Letter grade only (A-F). (Lecture 2 hours, laboratory 3 hours) Same course as CECS 460H
. Not open for credit to students with credit in CECS 460H
.

CECS 460H - System on Chip Design

(3 units)

Prerequisite: CECS 361
with a "C" or better. Engr Honors Program track I or II. Exclude freshmen.
Complete System on Chip (SOC) design flow from design specification to working SOC. Creation of RTL level modules designed for reuse, integration of Intellectual Property (IP) for RTL and physical level IP, IC verification, creation of self-checking test benches for designs.

Letter grade only (A-F). (Lecture 2 hours, laboratory 3 hours) CECS 460H is open only to students in the Engineering Honors Program. Additional assignments/projects adding depth to the course materials required for Engineering Honors students. Not open for credit to students with credit in CECS 460
.

CECS 461 - Hardware/Software Co-design

(3 units)

Prerequisite: CECS 341
or CECS 440
all with a grade of "C" or better.
Introduction to top-down methods for hardware/software system-on-chip co-design. Design flow - system specification, software implementation, hardware synthesis, system design, and verification. Process optimization with various design decisions emphasized. Projects/case studies using system-level design methods and tools.

Letter grade only (A-F). Additional projects required for CECS 561. (Lecture-problems 3 hours) CECS 561

CECS 463 - Digital Signal Processing Design and Simulation

(3 units)

Prerequisite: CECS 271
and CECS 361
, all with a grade of "C" or better.
System on Chip (SOC) design applications. Study of a variety of signal processing SOC designs and ASIC algorithms. Class projects emphasizing hardware/software integration with use of FPGA/CPLD devices. Design reviews, specification, team design implementation with project planning and tracking for system level design applications.

Letter grade only (A-F). (Lecture 2 hours, laboratory 3 hours)

CECS 470 - Web Programming and Accessibility

(3 units)

Prerequisites: CECS 323
and CECS 343
all with a grade of "C" or better.
Introduction to World-Wide Web development. Accessibility issues. Web architecture, standards, and programming, emphasizing XML technologies and cascading style sheets. Visual design principles and information architecture. Client-side and server-side programming and protocols. Development for adaptive technologies and mobile devices.

Letter grade only (A-F). (Lecture-problems 3 hours)

CECS 474 - Computer Network Interoperability

(3 units)

Prerequisite: CECS 326
with a grade of "C" or better.
Overview of computer network theory and practice from a systems perspective. Topics include network infrastructure, local area network (LAN) protocols, wide area network (WAN) protocols, switching technologies, Internet Protocol (IP), Transmission Control Protocol (TCP), network security, and network configuration, design, and performance.

Letter grade only (A-F). (Lecture 2 hours, laboratory 3 hours)

CECS 475 - Software Development with Frameworks

(3 units)

Prerequisite: CECS 343
with a grade of "C" or better.
Introduction to enterprise application development utilizing a modern software framework. Topics include large-scale software design, framework components, data management, events, extensibility, user interfaces, web services, and web applications. Includes programming projects.

Letter grade only (A-F). (Lecture-problems 3 hours)

CECS 478 - Introduction to Data Security and Privacy

(3 units)

Prerequisite: CECS 328
or CECS 346
with a grade of "C" or better.
Fundamental concepts of data security, privacy, and cybersecurity with a focus on data science applications. Techniques such as encryption, access control, and network security to protect data in large-scale systems. Emphasis on regulatory compliance, privacy-preserving data analysis, and ethical considerations.

Letter grade only (A-F). (Lecture-problems 3 hours) Not open for credit to students with credit in CECS 478H.

CECS 479 - Introduction to Hardware Security

(3 units)

Prerequisite(s): CECS 201 or CECS 225 with a grade of 'C' or better
Principles of systems security from a hardware perspective. Key topics include vulnerabilities in digital systems, physical attacks, reverse engineering, counterfeit detection, hardware security primitives, secure integrated circuit (IC) design, hardware trojan detection, and side-channel attacks.

Letter grade only (A-F). (Lecture-Problems 3 hours) Not repeatable for credit.

CECS 480 - Quantum Computation

(3 units)

Prerequisite: CECS 328.
Fundamental topics in quantum computation. Topics include the matrix formulation of quantum computation and information, Simon's Algorithm, Deutsch's algorithm, quantum circuits, Shor's factoring algorithm.

Letter grade only (A-F). (Lecture-problems 3 hours) Not repeatable for credit.

CECS 490A - Computer Engineering Senior Project I

(3 units)

Prerequisites: CECS 347
with a grade of "C" or better, senior standing.
The first in a two-course capstone senior project in computer engineering that fulfills GE integrative learning. Students work in teams to define a problem, complete a design and provide both a written report and a multimedia presentation at the end of the semester.

Letter grade only (A-F). (Lecture-problems 3 hours)

CECS 490B - Computer Engineering Senior Project II

(3 units)

Prerequisites: CECS 490A
with a grade of "C" or better.
Second of a two-semester capstone senior project in computer engineering that fulfills GE integrative learning. Student teams will build, program and verify operation of project started in prior design course. Student teams must submit a written report, give an oral multimedia presentation and provide a working demonstration.

Letter grade only (A-F). (Lecture-problems 3 hours)

CECS 491A - Computer Science Senior Project I

(3 units)

Prerequisites: CECS 343
and ENGR 350
, all with a grade of "C" or better.
Corequisite: CECS 328

First course in a two-course capstone design sequence that fulfills integrative learning. Design of a commercial grade software application including requirements analysis, functional, architectural and detailed design, emphasizing written communication, teamwork and the Object-Oriented

Methodology.

Letter grade only (A-F). (Lecture-problems 3 hours)

CECS 491B - Computer Science Senior Project II

(3 units)

Prerequisite: CECS 491A
with a grade of "C" or better and consent of instructor.
Second course in a two-course capstone design sequence that fulfills integrative learning.
Implementation, testing, packaging and deployment of the system designed in CECS 491A
emphasizing written communication, teamwork and the Object- Oriented Methodology.

Letter grade only (A-F). (Lecture-problems 3 hours)

CECS 492A - Data Science Senior Project I

(3 units)

Prerequisite(s): CECS 456 and ENGR 350 with a grade of "C" or better.

Effective Spring 2026 prerequisites will be: Completion of at least 60 units, CECS 456 and ENGR 350 with a grade of "C" or better.
First course in a two-course capstone design sequence that fulfills integrative learning. Design of a commercial grade data science application including requirements analysis, functional, architectural and detailed design, emphasizing written communication, teamwork and the data science methodology.

Letter grade only (A-F). Not repeatable for credit.

CECS 492B - Data Science Senior Project II

(3 units)

Prerequisite(s): CECS 492A with a grade of "C" or better.
Second course in a two-course capstone design sequence that fulfills integrative learning.
Implementation, testing, packaging and deployment of the system designed in CECS 492A.
Emphasis on written and oral communication, teamwork, and data science methodology.

Letter grade only (A-F). (Lecture-Problem 3 hours) Not repeatable for credit.

CECS 495 - Computational Physiology

(3 units)

Prerequisite: E E 381

with a grade of “C” or better.
This course will introduce students to cardiovascular (heart) and cerebrovascular (brain) systems and signals, and the computational methods to analyze related signals, and detect/predict a physiological event of interest.

Letter Grade only (A-F). (Lecture 2 hours, Laboratory 3 hours). Same course as: E E 495. Not open for credit to students with credit in E E 495.

CECS 496 - Computer Science Problem Solving

(1 unit)

Prerequisites: CECS 274
with a grade of “C” or better and consent of instructor.
Problem solving in Computer Science. Theory necessary to solve computer science problems and the solutions to the problems. Problems studied will involve applications of graph theory, data structures, recursion, and algorithms.

Letter grade only (A-F). (Lecture 1 hour) May be repeated to a maximum of 6 units in different semesters.

CECS 497 - Directed Studies

(1-3 units)

Prerequisite: Consent of instructor.
Assigned study in topics in current computer literature or computer-related projects with a final report.

Both grading options. May be repeated to a maximum of 6 units with written consent of the Department Chair.

CECS 519 - Theory of Computation

(3 units)

Prerequisite: CECS 528
.
Advanced topics in computability theory and computational complexity theory. Topics include Turing Machines, coverage of the standard complexity classes P, NP, IP, and PSPACE, hierarchy, decidability, and recognizability theorems. Additional projects required for CECS 519.

Letter grade only (A-F). (Lecture-problems 3 hours). Double Numbered with: CECS 419

CECS 521 - Database Architecture

(3 units)

Prerequisites: Open to Computer Science MS, Computer Engineering MS, or Engineering MS students only.
Relational database design theory-a rigorous approach. Security, recovery, transaction management, distributed databases and query optimization. Master's students register in CECS 521 or CECS 621 ; Ph.D. students register in CECS 621 . Additional projects required for CECS 621 .

Letter grade only (A-F). (Lecture-problems 3 hours). Double Numbered with: CECS 621

CECS 524 - Advanced Topics in Programming Languages

(3 units)

Prerequisite: Open to Computer Science MS, Computer Engineering MS, or Engineering MS students only.
Intensive study of languages of current interest which support object-oriented, client-server, and multimedia applications (e.g. JAVA). Master's students register in CECS 524 or CECS 624 ; Ph.D. students register in CECS 624 .

Letter grade only (A-F). Additional projects required for CECS 624. (Lecture-problems 3 hours) Double Numbered with: CECS 624

CECS 526 - Advanced Operating Systems

(3 units)

Prerequisites: Open to Computer Science MS, Computer Engineering MS, or Engineering MS students only.
Theoretical foundations of concepts applied in the design of operating systems. Control of concurrent processes, deadlocks, mutual exclusion, virtual memory, resource management and scheduling. Master's students register in CECS 526 or CECS 626 ; Ph.D. students register in CECS 626 .

Letter grade only (A-F). Additional projects required forCECS 626. (Lecture-problems 3 hours) Double Numbered with: CECS 626

CECS 528 - Advanced Analysis of Algorithms

(3 units)

Prerequisites: Open to Computer Science MS, Computer Engineering MS, or Engineering MS students only.
Theoretical analysis of algorithms. Divide and conquer, dynamic programming and greedy

algorithms; basic search and traversal techniques including search trees; sorting; matrix manipulations; NP-completeness. Master's students register in CECS 528 or CECS 628
; Ph.D. students register in CECS 628
. Additional projects required for CECS 628
.

Letter grade only (A-F). (Lecture-problems 3 hours) Double Numbered with: CECS 628

CECS 529 - Search Engine Technology

(3 units)

Prerequisites: Open to Computer Science MS, Computer Engineering MS, or Engineering MS students only.
Models, algorithms, and evaluation of the retrieval of information from a collection of documents. Document preprocessing. Indexing and searching. Retrieval evaluation. Search engines. Additional projects required for CECS 529.

Letter grade only (A-F). (Lecture-problems 3 hours) Double Numbered with: CECS 429

CECS 530 - Advanced Computer Architecture I

(3 units)

Prerequisite: Open to Computer Science MS, Computer Engineering MS, or Engineering MS students only.
Fundamentals of computer architecture. Parallelism, Instruction Level Parallelism, Pipelining. Hazards and their management, Branch Prediction, Dynamic Scheduling, Multiple Instructions, Multithreading, Data Level Parallelism, SIMD, Graphic Processing Units, Memory Hierarchy, Cache, Virtual Memory, Protection. Master's students register in CECS 530 or CECS 630
; Ph.D. students register in CECS 630
. Additional projects required for CECS 630
.

Letter grade only (A-F). (Lecture-problems 3 hours). Double Numbered with: CECS 630

CECS 532 - Memory Design and Implementation

(3 units)

Prerequisite: Open to Computer Science MS, Computer Engineering MS, or Engineering MS students only.
Logic design and operation, physical design and operation, performance characteristics, design trade-offs, energy consumption of modern memory hierarchies, memory errors and error correction.

Letter grade only (A-F). (Lecture-problems 3 hours).

CECS 543 - Advanced Software Engineering

(3 units)

Prerequisite: Open to Computer Science MS, Computer Engineering MS, or Engineering MS students only.
Study of software engineering as a broad, problem-solving discipline. Includes structured programming and software project management. Master's students register in CECS 543 or CECS 643 ; Ph.D. students register in CECS 643 . Additional projects required for CECS 643 .

Letter grade only (A-F). (Lecture-problems 3 hours). Double Numbered with: CECS 643

CECS 544 - Software Testing and Verification

(3 units)

Prerequisite: Open to Computer Engineering MS, Computer Science MS and Engineering MS students only; CECS 543 with a grade of "C" or better.
Testing/verification techniques for software development including black box, white box, incremental, top-down and bottom-up, static and dynamic, performance, regression, thread, and stress testing. Object-oriented software testing with a hierarchical approach. Metrics for test, and verification will be introduced. Master's students register in CECS 544 or CECS 644 ; Ph.D. students register in CECS 644 .

Letter grade only (A-F). Additional projects required for CECS 644. (Lecture-problems 3 hours) CECS 644