**COMPUTER SCIENCE AND ENGINEERING (CSCE)**

**CSCE 810 Information Retrieval Systems**
Crosslisted with: CSCE 410
Prerequisites: CSCE 310, SOFT 260, or CSCE 311
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

**CSCE 811 Data Modeling for Systems Development**
Crosslisted with: CSCE 411
Prerequisites: CSCE 310, CSCE 310H, or CSCE 311
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
Format: LEC

**CSCE 812 Data Visualization**
Crosslisted with: CSCE 412
Prerequisites: CSCE 310, CSCE 310H or CSCE 311; 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
Format: LEC
Offered: FALL/SPR

**CSCE 813 Database Systems**
Crosslisted with: CSCE 413
Prerequisites: SOFT 260, CSCE 310, CSCE 310H, or CSCE 311
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
Format: LEC

**CSCE 821 Foundations of Constraint Processing**
Crosslisted with: CSCE 421
Prerequisites: CSCE 235; SOFT 260, CSCE 310, CSCE 310H, or CSCE 311.
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
Format: LEC

**CSCE 823 Design and Analysis of Algorithms**
Crosslisted with: CSCE 423
Prerequisites: CSCE 235; SOFT 260, CSCE 310, CSCE 310H, or CSCE 311.
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
Format: LEC

**CSCE 824 Computational Complexity Theory**
Crosslisted with: CSCE 424
Prerequisites: CSCE 235; SOFT 260, CSCE 310, CSCE 310H, or CSCE 311.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Computer Science and Engineering (CSCE)

CSCE 825 Compiler Construction
Crosslisted with: CSCE 425
Prerequisites: CSCE 235; SOFT 260, CSCE 310, CSCE 310H, or CSCE 311.
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 runtime 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
Format: LEC

CSCE 828 Automata, Computation, and Formal Languages
Crosslisted with: CSCE 428
Prerequisites: CSCE 235; SOFT 260, CSCE 310, CSCE 310H, or CSCE 311.
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
Format: LEC

CSCE 830 Computer Architecture
Crosslisted with: CSCE 430
Prerequisites: CSCE 230; SOFT 260, CSCE 310, CSCE 310H, or CSCE 311; Prereq or Coreq: MATH/STAT 380 or ELEC 305.
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
Format: LEC

CSCE 832 High-Performance Processor Architectures
Crosslisted with: CSCE 432
Prerequisites: CSCE 430; MATH 314; MATH/STAT 380 or ELEC 305.
Notes: CSCE 432 assumes knowledge of computer architecture, pipelining, memory hierarchy, instruction level parallelism, and compiler principles.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 834 VLSI Design
Crosslisted with: CSCE 434
Prerequisites: CSCE 335 or permission.
Description: Introduction to VLSI design using metal-oxide semiconductor (MOS) devices primarily aimed at computer science majors with little or no background in the physics or circuitry of such devices. Includes design of nMOS and CMOS logic, data-path, control unit, and highly concurrent systems as well as topics in design automation.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 835 Cluster and Grid Computing
Crosslisted with: CSCE 435
Prerequisites: SOFT 260, CSCE 310, CSCE 310H, or CSCE 311 or equivalent programming experience.
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
Format: LEC

CSCE 836 Advanced Embedded Systems
Crosslisted with: CSCE 436
Prerequisites: CSCE 236; SOFT 260, CSCE 310, CSCE 310H, CSCE 311, or equivalent; senior/graduate standing.
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
Format: LEC

CSCE 837 File and Storage Systems
Crosslisted with: CSCE 437
Prerequisites: CSCE 351 or 451/851; CSCE 430/830.
Description: System-level and device-level topics in the design, implementation, and use of file and storage systems. Components and organization of storage systems, disk drive hardware and firmware, multi-disk systems, RAID’s, local distributed and P2P file systems, and low-power design.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
CSCE 838 Sensor Networks
Crosslisted with: CSCE 438
Prerequisites: CSCE 230; SOFT 260, CSCE 310, CSCE 310H, CSCE 311 or equivalent; senior or graduate standing or instructor permission.
Description: Basics of sensor networks; theoretical and practical insight into wireless sensor networks, including low-power hardware and wireless communication principles; networking in wireless sensor networks; and applications of sensor networks, such as multimedia, underwater, and underground. A group project that provides hands-on interaction with a wireless sensor network testbed.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 839 Robotics: Algorithms and Applications
Crosslisted with: CSCE 439
Prerequisites: CSCE 236 or ELEC 222; SOFT 260, CSCE 310, CSCE 310H, CSCE 311 or equivalent programming experience; MATH 314; senior/graduate standing or instructor permission.
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
Format: LEC

CSCE 840 Numerical Analysis I
Crosslisted with: CSCE 440, MATH 440, MATH 840
Prerequisites: CSCE 155A, CSCE 155E, CSCE 155H, CSCE 155N, CSCE 155T, or SOFT 160; Math 107.
Notes: Credit toward the degree may be earned in only one of the following: CSCE/MATH 440/840 and MECH 480/880.
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
Format: LEC

CSCE 841 Approximation of Functions
Crosslisted with: CSCE 441, MATH 441, MATH 841
Prerequisites: A programming language, MATH 221 and 314.
Description: Polynomial interpolation, uniform approximation, orthogonal polynomials, least-first-power approximation, polynomial and spline interpolation, approximation and interpolation by rational functions.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Groups: Advanced Mathematics Courses

CSCE 847 Numerical Linear Algebra
Crosslisted with: CSCE 447, MATH 447, MATH 847
Prerequisites: MATH 314
Description: Mathematics and algorithms for numerically stable matrix and linear algebra computations, including solution of linear systems, computation of eigenvalues and eigenvectors, singular value decomposition, and QR decomposition.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Groups: Advanced Mathematics Courses

CSCE 850 Operating Systems Principles
Crosslisted with: CSCE 451
Prerequisites: CSCE 230; SOFT 260, CSCE 310, CSCE 310H, or CSCE 311.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 855 Distributed Operating Systems
Crosslisted with: CSCE 455
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
Format: LEC

CSCE 856 Parallel Programming
Crosslisted with: CSCE 456
Prerequisites: SOFT 260, CSCE 310, CSCE 310H, CSCE 311 or equivalent programming experience.
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
Format: LEC
CSCE 857 Systems Administration
Crosslisted with: CSCE 457
Prerequisites: SOFT 260, CSCE 310, CSCE 310H, CSCE 311 or equivalent programming experience.
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
Format: LEC

CSCE 861 Advanced Topics in Software Engineering
Crosslisted with: CSCE 461, SOFT 461
Prerequisites: CSCE 361, CSCE 361H or SOFT 261.
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
Format: LEC

CSCE 862 Communication Networks
Crosslisted with: CSCE 462
Prerequisites: CSCE 230; SOFT 260, CSCE 310, CSCE 310H, or CSCE 311; MATH/STAT 380 or ELEC 305.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 863 Data and Network Security
Crosslisted with: CSCE 463
Prerequisites: SOFT 260, CSCE 310, CSCE 310H, or CSCE 311.
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
Format: LEC

CSCE 864 Internet Systems and Programming
Crosslisted with: CSCE 464
Prerequisites: CSCE 156, CSCE 311, or CSCE 320 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
Format: LEC

CSCE 865 Wireless Communication Networks
Crosslisted with: CSCE 465
Prerequisites: CSCE 230; SOFT 260, CSCE 310, CSCE 310H, or CSCE 311; MATH/STAT 380 or ELEC 305; or instructor permission.
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
Format: LEC

CSCE 866 Software Design and Architecture
Crosslisted with: SOFT 466, CSCE 466
Prerequisites: SOFT 261 or CSCE 361 or equivalent.
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
Format: LEC

CSCE 867 Testing, Verification and Analysis
Crosslisted with: SOFT 467, CSCE 467
Prerequisites: SOFT 261 or CSCE 361 or equivalent.
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
Format: LEC
CSCE 868 Requirements Elicitation, Modeling and Analysis
Crosslisted with: SOFT 468, CSCE 468
Prerequisites: SOFT 261 or CSCE 361 or equivalent.
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
Format: LEC

CSCE 870 Computer Graphics
Crosslisted with: CSCE 470
Prerequisites: SOFT 260, CSCE 310, CSCE 310H, or CSCE 311; 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
Format: LEC

CSCE 871 Introduction to Bioinformatics
Crosslisted with: CSCE 471
Prerequisites: SOFT 260, CSCE 310, CSCE 310H, or CSCE 311; MATH/STAT 380.
Description: Fundamentals and trends in bioinformatics. Scoring matrices and pairwise sequence alignments via dynamic programming, BLAST, and other heuristics. Multiple sequence alignments. Applications of machine learning methods such as hidden Markov models and support vector machines to biological problems such as family modeling and phylogeny.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 872 Digital Image Processing
Crosslisted with: CSCE 472
Prerequisites: CSCE 156, SOFT 161, 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
Format: LEC

CSCE 873 Computer Vision
Crosslisted with: CSCE 473
Prerequisites: CSCE 156, SOFT 161, 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
Format: LEC

CSCE 874 Introduction to Data Mining
Crosslisted with: CSCE 474
Prerequisites: SOFT 260, CSCE 310, CSCE 310H, or CSCE 311; MATH/STAT 380.
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
Format: LEC

CSCE 875 Multiagent Systems
Crosslisted with: CSCE 475
Prerequisites: CSCE 156, SOFT 161, or CSCE 311.
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
Format: LEC

CSCE 876 Introduction to Artificial Intelligence
Crosslisted with: CSCE 476
Prerequisites: SOFT 260, CSCE 310, CSCE 310H, or CSCE 311.
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
Format: LEC
CSCE 890 Special Topics in Computer Science
Crosslisted with: CSCE 490
Prerequisites: Permission.
Notes: CSCE 490/890 will not count toward 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
Format: LEC

CSCE 891 Internship in Computer Practice
Description: Experiential learning in conjunction with an approved industrial or governmental agency under the joint supervision of an outside sponsor and a faculty member. A detailed project proposal must be prepared by the student and approved by the department prior to the start of the project. A final report must be submitted.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 6
Format: FLD

CSCE 896 Special Topics in Computer Science
Crosslisted with: CSCE 496
Prerequisites: Senior 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
Format: LEC

CSCE 897 Masters Project
Prerequisites: Permission of adviser
Notes: Designed for students pursuing a non-thesis option (Option III) to work on a project under the supervision of a member of the computer science and engineering faculty.
Credit Hours: 1-6
Min credits per semester: 1
Max credits per semester: 6
Max credits per degree: 6
Format: IND

CSCE 898 Computer Problems
Crosslisted with: CSCE 498
Prerequisites: Senior or graduate standing.
Description: Independent project executed under the guidance of a member of the faculty of the Department of Computer Science. 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
Format: IND

CSCE 899 Masters Thesis
Prerequisites: Admission to masters degree program and permission of major adviser
Credit Hours: 1-10
Min credits per semester: 1
Max credits per semester: 10
Max credits per degree: 99
Format: IND

CSCE 877 Cryptography and Computer Security
Crosslisted with: CSCE 477
Prerequisites: SOFT 260, CSCE 310, CSCE 310H, or CSCE 311; MATH 314.
Description: Introductory course on cryptography and computer security. Topics: classical cryptography (substitution, Vigenere, Hill and permutation ciphers, and the one-time pad); Block ciphers and stream ciphers; The Data Encryption Standard; Public-key cryptography, including RSA and El-Gamal systems; Signature schemes, including the Digital Signature Standard; Key exchange, key management and identification protocols.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 878 Introduction to Machine Learning
Crosslisted with: CSCE 478
Prerequisites: SOFT 260, CSCE 310, CSCE 310H, or CSCE 311.
Description: Introduction to the fundamentals and current trends in machine learning. Possible applications for game playing, text categorization, speech recognition, automatic system control, data 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
Format: LEC

CSCE 879 Introduction to Neural Networks
Crosslisted with: CSCE 479
Prerequisites: CSCE 310 or CSCE 311.
Description: Introduction to the concepts, design and application of connection-based computing begins by simulating neural networks, focusing on competing alternative network architectures, including sparse distributed memories, Hopfield networks, and the multilayered feed-forward systems. Construction and improvement of algorithms used for training of neural networks addressed to reduce training time and improve generalization. Algorithms for training and synthesizing effective networks implemented in high level language programs running on conventional computers. Emphasis on methods for synthesizing and simplifying network architectures for improved generalization. Application areas include: pattern recognition, computer vision, robotics medical diagnosis, weather and economic forecasting.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 890 Special Topics in Computer Science
Crosslisted with: CSCE 490
Prerequisites: Permission.
Notes: CSCE 490/890 will not count toward 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
Format: LEC

CSCE 891 Internship in Computer Practice
Description: Experiential learning in conjunction with an approved industrial or governmental agency under the joint supervision of an outside sponsor and a faculty member. A detailed project proposal must be prepared by the student and approved by the department prior to the start of the project. A final report must be submitted.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 6
Format: FLD

CSCE 896 Special Topics in Computer Science
Crosslisted with: CSCE 496
Prerequisites: Senior 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
Format: LEC

CSCE 897 Masters Project
Prerequisites: Permission of adviser
Notes: Designed for students pursuing a non-thesis option (Option III) to work on a project under the supervision of a member of the computer science and engineering faculty.
Credit Hours: 1-6
Min credits per semester: 1
Max credits per semester: 6
Max credits per degree: 6
Format: IND

CSCE 898 Computer Problems
Crosslisted with: CSCE 498
Prerequisites: Senior or graduate standing.
Description: Independent project executed under the guidance of a member of the faculty of the Department of Computer Science. 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
Format: IND

CSCE 899 Masters Thesis
Prerequisites: Admission to masters degree program and permission of major adviser
Credit Hours: 1-10
Min credits per semester: 1
Max credits per semester: 10
Max credits per degree: 99
Format: IND
CSCE 910 Information Organization and Retrieval
Prerequisites: CSCE 810
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 913 Advanced Topics in Database Systems
Prerequisites: CSCE 813
Description: Database system topics, coverage varying from year to year. Examples: Normalization theory; statistical databases; distributed databases; failure recovery; implementation issues. Readings in the current literature.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 914 Constraint Database Systems
Prerequisites: CSCE 813 or 913 and permission
Description: Introduction to constraint database systems. Constraint data model, constraint query languages, query optimization and evaluation, constraint data storage and applications. Assignments in both use and the implementation of systems.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 921 Advanced Constraint Processing
Prerequisites: CSCE421/821 or instructor permission
Description: A continuation of the course on Foundations of Constraint Processing (CSCE 421/821). Intended for students with some sophistication and considerable interest in exploring methods for designing and using algorithms useful for solving combinatorial problems. The goal of the course is to study, analyze and critique seminal and recent research papers. Projects are optional.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 923 Development and Analysis of Efficient Algorithms
Prerequisites: CSCE 423/823 or permission
Description: Analysis of performance of algorithms on random access machines and Turing machines, data structures for design of efficient algorithms, sorting algorithms, divide and conquer strategies, algorithms on graphs and their performance bounds, pattern matching algorithms, achievable lower bounds on complexity, NP-complete problems.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 924 Graph Algorithms
Prerequisites: CSCE 423/823 or permission
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 925 Scheduling Theory
Prerequisites: Permission
Description: Scheduling theory with particular emphasis to its application in computer science. Polynomial-time algorithms, NP-hardness proofs and analysis of heuristics. Minimization of makespan and mean flow time. Real-Time scheduling.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 930 Advanced Computer Architecture
Prerequisites: CSCE 830
Description: Recent advances in computer architecture including the effects of VLSI and methods of improving performance. Parallelism, pipelining, vector and array processors, multiprocessors and distributed processors, and data-flow architectures.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 932 Fault-Tolerance: Testing and Testable Design
Prerequisites: CSCE 834 or permission
Description: Increasing density of microelectronic circuits makes them harder to test during production and field operation. Theory and techniques developed to solve this problem. Faults and fault modeling; algorithms for test generation and fault simulation; built-in-self-test methods and standards; design for testability; and self-checking circuits.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 933 Fault-Tolerance: System Design and Analysis
Prerequisites: CSCE 830 or permission
Description: Theory and practice of creating extremely dependable digital systems through online fault-tolerance. Emphasizes modular redundancy in hardware and software to permit detection, masking, and removal of faulty components. Case studies from aerospace, banking, and other disciplines. Fault classification, error detection and diagnosis, dependability metrics, Byzantine Agreement, design trade-offs, and system simulation and modeling (esp. Markov).
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
CSCE 936 Cyber-Physical Systems  
**Prerequisites:** Permission.  
**Description:** Introduction to the research, design, and analysis of cyberphysical systems - the tight integration of computing, control, and communication. Applications for CPS research are far reaching and span medical devices, smart buildings, vehicle systems, and mobile computing.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Format:** LEC

CSCE 942 Numerical Analysis III  
**Crosslisted with:** MATH 942  
**Prerequisites:** CSCE/MATH 840 or 841 or 847 or permission  
**Description:** Advanced topics in numerical analysis.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Format:** LEC

CSCE 952 Advanced Computer Networks  
**Prerequisites:** CSCE 862  
**Description:** Advanced-level course on the recent development in computer networks. Integrated Services Digital Networks (ISDN), Broadband-ISDN and Asynchronous Transfer Mode (ATM), Multimedia Source and Traffic Characteristics, Source Policing, Scheduling and Quality of Service, Wireless Communication, Tracking of Mobile Users, Performance Computer networks.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Format:** LEC

CSCE 953 Optical Communication Networks  
**Prerequisites:** CSCE 462/862 or equivalent  
**Description:** State-of-the-art optical communication networks, encompassing traditional networks operating on optical fiber and next-generation networks such as wavelength division multiplexed (WDM) and optical time division multiplexed (OTDM) networks. Fundamentals of optical network design, control, and management. Optical network design and modeling, routing and wavelength assignment algorithms, optical network simulation tools and techniques.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Format:** LEC

CSCE 961 Coding Theory  
**Prerequisites:** MATH 817 desirable  
**Description:** Channels, introduction to information theory, Shannon's fundamental theorem, Linear codes, Hamming codes, Reed-Muller codes, cyclic codes, idempotents, BCH codes, Reed-Solomon codes, Quadratic residue codes, perfect single-error correcting codes, Sphere packings, the Golay codes, Lloyds theorem, nonexistence theorems, weight enumerators, the MacWilliams equation, association schemes, quasi-symmetric designs, polarities of designs, extension of graphs, self-orthogonal codes and designs.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Format:** LEC

CSCE 962 Advanced Software Engineering  
**Prerequisites:** CSCE 361 or CSCE 361H  
**Description:** Recent advances in the field of software engineering. Software reuse, artificial intelligence approaches to software design, usability and requirements engineering, and design environments. Computer tools for the design of software products. Analysis of software artifacts. Coordination in distributed software development. Readings from current software engineering literature discussed and evaluated. Students will participate in a group project which investigates specific software engineering research topics.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Format:** LEC

CSCE 970 Pattern Recognition  
**Prerequisites:** CSCE 310 or 311; MATH 314/814; MATH/STAT 380 or STAT 880 or ELEC 305  
**Description:** Introduction to statistical decision theory, adaptive classifiers, supervised and non-supervised training. Pattern recognition systems: Transducers, feature extractors, decision units. Applications to optical character recognition, speech processing, remote sensing.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Format:** LEC

CSCE 971 Advanced Bioinformatics  
**Prerequisites:** CSCE 471/871  
**Description:** Advanced algorithmic techniques for bioinformatics. Development and analysis of string matching, graph theoretic and dynamic programming techniques applied to systems and computational biology problems such as multiple sequence alignment, alignment of DNA and protein sequences, genome rearrangements, and phylogeny and haplotypes.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Format:** LEC

CSCE 973 Support Vector Machines  
**Prerequisites:** CSCE 310 or 311; MATH 314/814; MATH/STAT 380 or STAT 880; or ELEC 305  
**Description:** Core theory of the machine learning technique called support vector machines. Margin, kernels, and the formulation of a machine learning problem as an optimization problem that can be solved optimally. Implementation issues, kernel design, the appropriateness of various kernels for different applications, and regularization.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Format:** LEC

CSCE 974 Genetic Algorithms  
**Prerequisites:** CSCE 310 and 876  
**Description:** Introduction of the motivation and current implementations of advanced genetic algorithms. These algorithms are built on basic principles borrowed from biology. Illustrates how a novel, implicitly-parallel search is implemented to obtain solutions for combinatorially-difficult problems.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Format:** LEC
CSCE 976 Advanced Artificial Intelligence
Prerequisites: CSCE 876
Notes: For students with some sophistication and considerable interest in exploring methods of designing and using algorithms useful for finding adequate answers to combinatorically large problems that require largely symbolic rather than numeric computing.
Description: Study, analyze and critique basic and current research papers and to engage in artificial intelligence projects and experiments either alone or in small groups. Artificial intelligence environments, tools and expert system building. Class participation will be encouraged for the review of the more recent AI literature.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 977 Data Encryption
Prerequisites: STAT 880, CSCE 235 or MATH 817 or permission
Description: History of public cryptology; elements of statistics, combinatorics, number theory, group theory; symmetric and asymmetric cryptosystems, "trap door" functions; public key cryptosystems; RSA and knapsack; levels of cryptographic security; computational complexity of algorithms; National Bureau of Standards-DES (Standard); block and stream cyphers; cypher key management; protection of proprietary software and data.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 979 Advances in Neural Networks and Genetic Algorithms
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CSCE 990 Seminar
Prerequisites: Permission
Description: Frontiers of an area of computer science.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 24
Format: LEC

CSCE 996 Research Problems Other Than Thesis
Description: Investigation of minor research problems to introduce graduate students to the methods of research in computer science by assigning a problem which is of research interest but within the capacity of a graduate student to complete within a semester.
Credit Hours: 1-6
Min credits per semester: 1
Max credits per semester: 6
Max credits per degree: 6
Format: IND

CSCE 999 Doctoral Dissertation
Prerequisites: Admission to doctoral degree program and permission of supervisory committee chair
Credit Hours: 1-24
Min credits per semester: 1
Max credits per semester: 24
Max credits per degree: 99
Format: IND