

Each student selects elective courses to fulfill their credit hour requirements. One elective must be selected from courses that require significant programming and another must be a fundamental course in computer science. A list of courses fulfilling these requirements is below; note that some course are listed in both categories. Courses other than those listed may fulfill these requirements by prior explicit permission of the Director of Software Engineering.

CSE 5400 Special Topics offerings must be approved in either instance by the Director of Software Engineering.

### **Programming Courses:**

CSE 5231 COMPUTER NETWORKS (3 credits). Introduces network design, protocol, function layering, networking architectures (TCP/IP, frame relay, ATM) and components (hubs, routers, switches), analytical issues (throughput, delay, bandwidth management, congestion and error control, sliding windows, retransmission strategies, contention resolution) and network traffic analysis methodologies. Prerequisites: CSE 2400, MTH 1002.

CSE 5232 NETWORK PROGRAMMING (3 credits). Covers design and implementation of programs that communicate with other programs across a computer network. Includes streams, server-side networking, client-side networking, multithreading, exceptions and remote method invocation. Prerequisites: CSE 2010.

CSE 5250 PROGRAMMING LANGUAGES (3 credits). Surveys programming language concepts including language features, implementation issues and language groups. Prerequisites: CIS 5200 or CSE 2010.

CSE 5240 PARALLEL PROCESSING (3 credits). Investigates architectures for parallel computers and parallel algorithms for computational problems. Discusses performance evaluation metrics for the performance of parallel processing.

CSE 5241 DISTRIBUTED COMPUTING (3 credits). Studies the fundamental concepts in software systems that support and work in a distributed computing environment. Includes discussion of network communication mechanisms, distributed operating systems, services

supporting distributed systems, distributed database system

CSE 5251 COMPILER THEORY AND DESIGN (3 credits). Covers extensively the major topics of compiler design. Includes lexical analysis, scanner-generator tools, parsing, syntax-directed translation, static semantic checking, storage organizations, code generation and code optimization. Prerequisites: CSE 2010, CSE 3120.

CSE 5280 COMPUTER GRAPHICS (3 credits). Presents the graphics pipeline for polygonal-based models. Includes mathematical concepts and data structures for graphics, coordinate systems, clipping, scan conversion, hidden-object detection, rendering, color models and graphics programming standards. Prerequisites: CSE 2050 or CIS 5200, MTH 1002.

CSE 5290 ARTIFICIAL INTELLIGENCE (3 credits). Introduces the theoretical foundations of artificial intelligence, focusing on the areas of automated reasoning, search and heuristics. Introduces an AI language to implement concepts. Prerequisites: CIS 5200 or CSE 2010.

### **Fundamental Courses:**

CSE 5210 FORMAL LANGUAGES AND AUTOMATA THEORY (3 credits). Presents abstract models of computers (finite automata, pushdown automata and Turing machines) and the language classes they recognize or generate (regular, context-free and recursively enumerable). Also presents applications in compiler design, algorithms and complexity theory. Prerequisites: CSE 2010.

CSE 5211 ANALYSIS OF ALGORITHMS (3 credits). Presents time and space complexity of computer algorithms. Includes algorithm classes, such as divide-and-conquer, greedy, dynamic programming and backtracking; techniques for solving recurrence equations; graph algorithms; searching and sorting; and deterministic and nondeterministic polynomial time problem classes. Prerequisites: CSE 2010 or CIS 5200, MTH 1002.

CSE 5231 COMPUTER NETWORKS (3 credits). Introduces network design, protocol, function layering, networking architectures (TCP/IP, frame relay, ATM) and components

(hubs, routers, switches), analytical issues (throughput, delay, bandwidth management, congestion and error control, sliding windows, retransmission strategies, contention resolution) and network traffic analysis methodologies. Prerequisites: CSE 2400, MTH 1002.

**CSE 5232 NETWORK PROGRAMMING (3 credits).** Covers design and implementation of programs that communicate with other programs across a computer network. Includes streams, server-side networking, client-side networking, multithreading, exceptions and remote method invocation. Prerequisites: CSE 2010.

**CSE 5240 PARALLEL PROCESSING (3 credits).** Investigates architectures for parallel computers and parallel algorithms for computational problems. Discusses performance evaluation metrics for the performance of parallel processing.

**CSE 5241 DISTRIBUTED COMPUTING (3 credits).** Studies the fundamental concepts in software systems that support and work in a distributed computing environment. Includes discussion of network communication mechanisms, distributed operating systems, services supporting distributed systems, distributed database systems.

**CSE 5250 PROGRAMMING LANGUAGES (3 credits).** Surveys programming language concepts including language features, implementation issues and language groups. Prerequisites: CIS 5200 or CSE 2010.

**CSE 5260 DATABASE SYSTEMS (3 credits).** Introduces the analysis and design of typical database systems. Includes theoretical and practical aspects of designing database systems and a substantial project. Prerequisites: CIS 5200 or CSE 2010.

**CSE 5280 COMPUTER GRAPHICS (3 credits).** Presents the graphics pipeline for polygonal-based models. Includes mathematical concepts and data structures for graphics, coordinate systems, clipping, scan conversion, hidden-object detection, rendering, color models and graphics programming standards. Prerequisites: CSE 2050 or CIS 5200, MTH 1002.

**CSE 5290 ARTIFICIAL INTELLIGENCE (3 credits).** Introduces the theoretical foundations of artificial intelligence, focusing on the areas of automated reasoning, search and heuristics. Introduces an AI language to implement concepts. Prerequisites: CIS 5200 or CSE 2010.

CSE 5610 COMPUTATIONAL COMPLEXITY (3 credits). Reviews problems, algorithms, Turing machines and computability. Studies Boolean and first-order logic, leading to undecidability results; and relations among complexity classes using reductions and completeness. Presents approximate and randomized algorithms. Prerequisites: CSE 5210, CSE 5211.

CSE 5630 ADVANCED OPERATING SYSTEMS (3 credits). Studies in detail the design and implementation of an operating system. Discusses various data structures and algorithms for process, memory and input/output device management. Investigates issues in distributed operating systems. Prerequisites: CSE 4001.

CSE 5636 NETWORK SECURITY (3 credits). Covers network intrusion detection, statistical anomaly detection and network perimeter security, and traffic monitoring including tools (Ethereal, TCPDUMP) used to analyze captured traffic streams. Overviews methods and tools used by hackers. Includes statistical anomaly detection and its role in detecting previously unseen attacks. Prerequisites: CSE 5231 or ECE 5535.

CSE 5650 ADVANCED PROGRAMMING LANGUAGES (3 credits). Presents theoretical topics in programming languages. Includes the lambda-calculus, functional programming, type interface and different approaches to the semantics of programming languages. Prerequisites: CSE 5250.

CSE 5660 DATABASE MANAGEMENT SYSTEMS (3 credits). Studies the internal components of a database management system (DBMS). Includes data organization, query optimization, transaction processing, concurrency control, logging and recovery, security and distributed DBMS. Prerequisites: CSE 5260.

CSE 5693 MACHINE LEARNING (3 credits). Covers computational paradigms and techniques in learning and adaptation. Includes tree learning, rule learning, genetic algorithms, neural networks, case-based learning, Bayesian learning, analytical learning and reinforcement learning. Prerequisites: CSE 5290.