## **Computer Science Course Descriptions**

CS 1136 (COSC 1136) Computer Science Laboratory (1 semester hour) Laboratory course to accompany CS 1336. This course teaches basic computer literacy/programming skills: disk operating system (DOS) commands (to format disks and to create, manipulate, and remove directories and files), the authoring of ASCII text files, compiler usage in converting source programs into executable form, printer commands. This class cannot be used to fulfill degree requirements for majors in the School of Engineering and Computer Science. Corequisite: CS 1336. (0-2) S

ECS 1200 Introduction to Engineering and Computer Science (2 semester hours) Introduction to the Engineering and Computing professions, professional ethics. Overview of ECS curricula, connections among ECS fields and to the basics of sciences, other fields. Basic study, problem solving and other skills needed to succeed as an ECS major. Engineering design and quantitative methods using MATLAB. Multi-disciplinary team projects designed to replicate decision processes in real-world situations. (1-2) Y

CS 1325 Introduction to Programming (3 semester hours) Computer programming in a high-level, block structured language. Basic data types and variables, memory usage, control structures, functions/procedures and parameter passing, recursion, input/output. Programming projects related to engineering applications, numerical methods. This class is designed for Electrical and Mechanical Engineering majors and cannot be used to fulfill Major Requirements for Computer Engineering, Computer Science, Software Engineering, Telecommunications Engineering majors. Prerequisite: Basic computer literacy/programming skills. (3-0) S

CS 1335 Computer Science I for Non-majors (3 semester hours) Introduction to object-oriented software analysis, design, and development. Classes and objects. Object composition and polymorphism. Sorting and searching. Strings using core classes. Inheritance and interfaces. Graphical User Interfaces. This class cannot be used to fulfill degree requirements for majors in the School of Engineering and Computer Science. Computer Science and Engineering majors may NOT take this course. Students who have taken CS 1337 cannot receive credit for this course. Prerequisite: CS 1336 with a grade of C or better or equivalent. (3-0) S

CS 1336 (COSC 1336) Programming Fundamentals (3 semester hours) Introduction to computers. Primitive data types, variable declarations, variable scope, and primitive operations. Control statements. Methods/functions. Arrays, and strings using primitive data arrays. Output formatting. Debugging techniques. Designed for students with no prior computer programming experience. This class cannot be used to fulfill degree requirements for majors in the School of Engineering and Computer Science. Corequisite: CS 1136. Note that a grade of 'C' or better is required in order to register for CS 1335 or CS 1337. (3-0) S

<u>CS 1337</u> (COSC 1337) Computer Science I (3 semester hours) Introduction to object-oriented software analysis, design, and development. Classes and objects. Object composition and polymorphism. Sorting, searching, recursion. Strings using core classes. Inheritance and

- interfaces. Graphical User Interfaces. Includes a comprehensive programming project. Prerequisite: CS 1336 with a grade of C or better or equivalent. (3-0) S
- <u>CS 2305</u> (MATH 2305) Discrete Mathematics for Computing I (*3 semester hours*) Principles of counting. Logic and proof methods, including induction. Basic recurrence relations. Basics of algorithm complexity. Sets, relations, functions. Elementary graph theory. Elementary number theory. Students cannot get credit for both CS2305 and <u>CE/TE 3307</u>. Prerequisite: <u>MATH 1326</u>, <u>MATH 2413</u> or <u>MATH 2417</u>. (3-0) S
- CS 2335 Computer Science II for Non-majors (3 semester hours) Exceptions and number formatting. File input/output using Stream classes. Implementation of primitive data structures, including linked lists, stacks, queues, and binary trees. Advanced data manipulation using core classes. This class cannot be used to fulfill degree requirements for majors in the School of Engineering and Computer Science. Students who have taken CS 2336 cannot receive credit for this course. Prerequisite: CS 1335 or CS 1337. (3-0) S
- CS 2336 (COSC 2336) Computer Science II (*3 semester hours*) Exceptions and number formatting. File input/output using Stream classes. Implementation of primitive data structures, including linked lists (all types), stacks, queues, and binary trees. Advanced data manipulation using core classes. Introduction to multithreading, multimedia, and networking. Includes a comprehensive programming project. Prerequisite: CS 1337. (Same as CE2336) Prerequisite or corequisite: CS 2305. (3-0) S
- <u>CS 2V95</u> Individual Instruction in Computer Science/Software Engineering (1-6 semester hours) Individual study under a faculty member's direction. May be repeated for credit as topics vary (6 hours maximum). Consent of instructor required. (Same as <u>SE 2V95</u>) ([1-6]-0) R
- CS 3149 Competitive Learning in Computer Science (*1 semester hour*) In this course, students will work together in small teams to solve graduated problems, similar to those used in programming contests around the world. Approaches to categorizing problems and selecting appropriate data structures and algorithms will be covered, along with types of algorithms for solving problems (brute force, greedy, divide and conquer, dynamic programming). Students will do problem solving in a competitive environment against the clock. May be repeated for credit (*3 hours maximum*). Prerequisites: CS 2336 and CS 3305. (1-0) Y
- <u>CS 3195</u> Special Topics in Computer Science/Software Engineering (*1 semester hour*) May be repeated for credit as topics vary (*4 hours maximum*). Must be taken credit/no credit. Consent of instructor required. (Same as <u>SE 3195</u>) (1-0) R
- CS 3305 Discrete Mathematics for Computing II (3 semester hours) Advanced counting methods; recurrence relations, divide and conquer algorithms, principle of inclusion and exclusion. Partial orders and lattices, Aalgorithmic complexity. Graph theory. Strings and languages. Number theory. Elements of modern algebra. Students cannot receive credit for both CS3305 and CE/TE3307. Prerequisite: CS 2305, MATH 2414 or MATH 2419. (3-0) S

CS 3333 Data Structures (3 semester hours) Programming with basic data structures (arrays, stacks, queues, lists, and trees) and their associated algorithms. Various sorting and searching techniques. Fundamental graph algorithms. This course covers much of the same material as CS 3345 without requiring the analysis of algorithms. Computer Science majors may NOT take this course. This course may not be taken for degree credit by students who have completed CS 2336 (C/C++). Prerequisite: CS 1335 or CS 1337 or CS 3335 or equivalent programming experience. (3-0) Y

CS 3335 C and C++ (3 semester hours) Numerous programming projects in both C and C++. All fundamentals of C, with special emphasis on use of pointers. Use of C++ extensions to create and extend (by inheritance) abstract data types. The use/advantages of virtual functions (dynamic polymorphism). Prerequisite: CS 2335 or CS 2336 or equivalent. (3-0) T

CS 3340 Computer Architecture (*3 semester hours*) This course introduces the concepts of computer architecture by going through multiple levels of abstraction, and the numbering systems and their basic computations. It focuses on the instruction-set architecture of the MIPS machine, including MIPS assembly programming, translation between MIPS and C, and between MIPS and machine code. General topics include performance calculation, processor datapath, pipelining, and memory hierarchy. Students who have already completed CS 2310 or CS/SE 4340 cannot receive credit for this course. Students cannot get credit for both CS/SE 3340 and CE/EE 4304. Prerequisite: CS 1337. (Same as SE 3340) (3-0) S

<u>CS 3341</u> Probability and Statistics in Computer Science and Software Engineering (*3 semester hours*) Axiomatic probability theory, independence, conditional probability. Discrete and continuous random variables, special distributions of importance to CS/SE and expectation. Simulation of random variables and Monte Carlo methods. Central limit theorem. Basic statistical inference, parameter estimation, hypothesis testing, and linear regression. Introduction to stochastic processes. Illustrative examples and simulation exercises from queuing, reliability, and other CS/SE applications. Students cannot get credit for both <u>CS/SE 3341</u> and <u>ENGR 3341</u>. Prerequisites: <u>MATH 1326</u>, <u>MATH 2414</u> or <u>MATH 2419</u>, and <u>CS 2305</u>. (Same as <u>SE 3341</u>) (3-0) S

CS 3345 Data Structures and Introduction to Algorithmic Analysis (3 semester hours) Analysis of algorithms including time complexity and Big-O notation. Analysis of stacks, queues, and trees, including B-trees. Heaps, hashing, and advanced sorting techniques. Disjoint sets and graphs. Course emphasizes design and implementation. Students cannot receive credit for both CS 3345 and CE/TE 3346. Prerequisites: CS 2305 and CS 2336. Prerequisite or corequisite: CS/SE 3341. (3-0) S

<u>CS 3354</u> **Software Engineering** (*3 semester hours*) Introduction to software life cycle models. Software requirements engineering, formal specification and validation. Techniques for software design and testing. Cost estimation models. Issues in software quality assurance and software maintenance. Prerequisites: <u>CS 2336</u> or <u>CS 3333</u>, and <u>CS 2305</u>. Pre- or corequisite: <u>ECS 3390</u>. (3-0) S

- CS 3361 Social Issues and Ethics in Computer Science and Engineering (3 semester hours) This course exposes students to major theoretical approaches and modes of thinking in the social sciences while exploring a range of important issues in computing and engineering, and the interrelationship between technology and important elements of social systems. Areas of exploration include the interface between technology, culture, economy, gender, politics, and religion. Issues of professional ethics, computer crime, privacy, intellectual property, the balance between scientific advances and acceptability of risk, globalization and the relevance of constitutional issues are all explored by drawing upon emperical research and important research methodologies in the social sciences. (Same as SOCS 3361) (3-0) Y
- CS 3375 Principles of UNIX (3 semester hours) Design and history of the UNIX operating system. Detailed study of process and file system data structures. Shell programming in UNIX. Use of process-forking functionality of UNIX to simplify complex problems. Interprocess communication and coordination. Device drivers and streams as interfaces to hardware features. TCP/IP and other UNIX inter-machine communication facilities. Prerequisite: CS 3335 or equivalent programming experience, including knowledge of C. (3-0) S
- <u>CS 3376</u> C/C++ Programming in a UNIX Environment (3 semester hours) Advanced programming techniques utilizing procedural and object oriented programming in a UNIX environment. Topics include file input and output, implementation of strings, stacks, queues, lists, and trees, and dynamic memory allocation/management. Design and implementation of a comprehensive programming project is required. Prerequisite: <u>CS 2336</u> or equivalent. (Same as <u>SE 3376</u>)(3-0) S
- CS 3385 Ethics, Law, Society, and Computing (3 semester hours) Issues of professional ethics; computer crime; wiretapping and encryption; protecting software and other intellectual property; privacy and information; careers and computers; reliability and safety; constitutional issues. Broader issues on the impact and control of computers. (3-0) S
- CS 3390 **Professional and Technical Communication** (3 semester hours) Course utilizes an integrated approach to writing and speaking for the technical profession. The writing component focuses on writing professional quality technical documents such as proposals, memos, abstracts, reports and letters. The oral communication part of the course focuses on planning, developing, and delivering dynamic, informative and persuasive presentations. Gives students a successful communication experience working in a functional team environment using a total on-line/real time learning environment. Prerequisite: <a href="RHET 1302">RHET 1302</a> and junior standing. (3-0) S
- <u>CS 3V95</u> Undergraduate Topics in Computer Science/Software Engineering (2-9 semester hours) Subject matter will vary from semester to semester. May be repeated for credit as topics vary (9 hours maximum). (Same as <u>SE 3V95</u>) ([2-9]-0) S
- <u>CS 4141</u> Digital Systems Laboratory (*1 semester hour*) Laboratory to accompany <u>CS 4341</u>. The purpose of this laboratory is to give students an intuitive understanding of digital circuits and systems. Laboratory exercises include construction of simple digital logic circuits using prototyping kits and board-level assembly of a personal computer. Students who have already completed <u>CS 2110</u> cannot receive credit for this course. Corequisite: <u>CS 4341</u>. (0-2) S

- <u>CS 4314</u> Intelligent Systems Analysis (*3 semester hours*) Mathematical tools for investigating the asymptomatic behavior of both deterministic and stochastic nonlinear dynamical systems. Topics include: artificial neural network architectures, Lyapunov stability theory, and stochastic approximation theory. Applications to artificial neural network models of brain and behavior. Prerequisite: <u>CGS 4313</u> or consent of instructor. (Same as <u>CGS 4314</u>) (3-0) T
- <u>CS 4315</u> Intelligent Systems Design (*3 semester hours*) Mathematical tools for the design and evaluation of artificially intelligent deterministic and stochastic nonlinear dynamical systems. Topics include: nonlinear optimization theory, Markov random fields, asymptotic statistical theory. Applications to theory and model construction in the behavioral and brain sciences as well as the field of artificial intelligence. Prerequisite: <u>CS/CGS 4314</u> or consent of instructor. (Same as <u>CGS 4315</u>) (3-0) T
- <u>CS 4334</u> Numerical Analysis (*3 semester hours*) Solution of linear equations, roots of polynomial equations, interpolation and approximation, numerical differentiation and integration, solution of ordinary differential equations, computer arithmetic, and error analysis. Students cannot get credit for both <u>CS/MATH 4334</u> and <u>ENGR 4334</u>. Prerequisites: <u>CS 1337</u>, MATH 2418, MATH 2451. (Same as MATH 4334) (3-0) Y
- CS 4336 Advanced Java (3 semester hours) Advanced Java programming techniques integrating the technologies of advanced swing GUI components, JavaBeans, Java Servlets and Server Pages, XML, Security, Java Database Connectivity, Remote Method Invocation, and Software applications for Wireless Devices. Students will have the opportunity to work on their own E-Business Solutions. Prerequisite: CS 2336 or equivalent. (3-0) T
- CS 4337 Organization of Programming Languages (3 semester hours) Principles of design and implementation of contemporary programming languages. Formal description including specification of syntax and semantics of programming languages. Language definition structures including binding, scoping, data types, control structures, parameter passing, abstraction mechanism, and run-time considerations. Design issues of imperative languages, object-oriented languages, functional languages and logic languages. Design, implement, and debug programs in various programming language paradigms. Prerequisites: CS 2336 or CS 3333, CS 2305, CS/SE 3340. (Same as CE 4337) (3-0) S
- CS 4341 Digital Logic and Computer Design (3 semester hours) Boolean algebra and logic circuits; synchronous sequential circuits; gate level design of ALSU, registers, and memory unit; register transfer operations; design of data path and control unit for a small computer; Input-Output interface. Students who have already completed CS/SE 4340 cannot receive credit for this course. Students cannot get credit for both CS 4341 and CE/EE 3320. Prerequisites: ENGR 2310 or CS 3340 and PHYS 2326. Corequisite: CS 4141. (3-0) S
- <u>CS 4347</u> **Database Systems** (*3 semester hours*) This course emphasizes the concepts and structures necessary for the design and implementation of database management systems. Topics include data models, data normalization, data description languages, query facilities, file organization, index organization, file security, data integrity, and reliability. Prerequisite: <u>CS 3345</u>. (Same as <u>SE 4347</u>) (3-0) Y

- CS 4348 Operating Systems Concepts (*3 semester hours*) An introduction to fundamental concepts in operating systems: their design, implementation, and usage. Topics include process management, main memory management, virtual memory, I/O and device drivers, file systems, secondary storage management, and an introduction to critical sections and deadlocks. Prerequisites: CS/SE 3340 or equivalent, CS 3345, and a working knowledge of C and UNIX. (3-0) S
- CS 4349 Advanced Algorithm Design and Analysis (3 semester hours) Asymptomatic analysis, recurrences, and graph algorithms. Algorithm design techniques such as greedy method, dynamic programming, and divide-and-conquer. Issues from computational complexity. Course emphasizes a theoretical approach. Prerequisite: CS 3305, CS 3345. (3-0) S
- <u>CS 4352</u> Human Computer Interactions I (*3 semester hours*) Methods and principles of human-computer interaction (HCI), user-centered design (UCD), and usability evaluation. Provides broad overview of HCI and how HCI informs UCD processes throughout product development lifecycle. (Same as <u>CGS 4352</u>) (3-0) T
- <u>CS 4353</u> Human Computer Interactions II (*3 semester hours*) Detailed exploration of human-computer interaction (HCI) through readings in journal articles and research reports. Practical experience in methodology typically used in the design of usable systems. Prerequisite: <u>CS/CGS</u> 4352 or consent of the instructor. (Same as CGS 4353) (3-0) T
- <u>CS 4361</u> Computer Graphics (*3 semester hours*) Review of graphic display architecture and graphic input devices. Two- and three-dimensional transformations, matrix formulations, and concatenation. Clipping and windowing. Data structures for graphics systems, segmented display files, rings, etc. Hidden line and surface elimination. Shading. Graphics packages and applications. Prerequisites: <u>MATH 2418</u>, <u>CS 2336</u>, and <u>CS 3345</u> or equivalent. (3-0) Y
- <u>CS 4365</u> Artificial Intelligence (*3 semester hours*) Basic concepts and techniques that enable computers to perform intelligent tasks. Examples are taken from areas such as natural language understanding, computer vision, machine learning, search strategies and control, logic, and theorem proving. Prerequisites: <u>CS 3345</u> or equivalent. (3-0) Y
- CS 4375 Introduction to Machine Learning (3 semester hours) Algorithms for creating computer programs that can improve their performance through learning. Topics include: cross-validation, decision trees, neural nets, statistical tests, Bayesian learning, computational learning theory, instance-based learning, reinforcement learning, bagging, boosting, support vector machines, Hidden Markov Models, clustering, and semi-supervised and unsupervised learning techniques. Prerequisites: CS/SE 3341 and CS 3345 or equivalent. (3-0) Y
- <u>CS 4376</u> Object-Oriented Programming Systems (*3 semester hours*) In-depth study of the features/advantages of object-oriented approach to problem solving. Special emphasis on issues of object-oriented analysis, design, implementation, and testing. Review of basic concepts of object-oriented technology (abstraction, inheritance, and polymorphism). Object-oriented programming languages, databases, and productivity tools. Prerequisite: <u>CS 2336</u> or equivalent. (Same as <u>SE 4376</u>) (3-0) S

- <u>CS 4384</u> Automata Theory (*3 semester hours*) A review of the abstract notions encountered in machine computation. Topics include finite automata, regular expressions, PDAs, and context-free languages. Prerequisite: <u>CS 3305</u>. (3-0) S
- <u>CS 4386</u> Compiler Design (*3 semester hours*) Basic phases of a compiler and their design principles. Topics include lexical analysis, basic parsing techniques such as LR(K) and LL(K) grammars. Prerequisites: <u>CS 3345</u> (or equivalent) and <u>CS 4384</u>. (3-0) R
- <u>CS 4389</u> Data and Applications Security (*3 semester hours*) Data as a critical resource. Threats to data and applications security including access control violations, integrity violations, unauthorized intrusions and sabotage; techniques to enforce security. Prerequisite: <u>CS/SE 4347</u>. (3-0) Y
- <u>CS 4390</u> Computer Networks (*3 semester hours*) The design and analysis of computer networks. Topics include: the ISO reference model, transmission media, medium-access protocols, LANs, data link protocols, routing, congestion control, internetworking, and connection management. Students cannot get credit for both <u>CS 4390</u> and <u>EE 4390</u>. Prerequisite: <u>CS 3345</u> or equivalent. . (3-0) S
- <u>CS 4391</u> Introduction to Computer Vision (*3 semester hours*) Techniques for manipulating and extracting information from digital images and video. Topics include color representations, analysis and processing based on image histograms, geometric transformations, convolutions, image blurring and sharpening, extraction of edges, matching, image and video motion. Prerequisites: <u>CS 3345</u> or equivalent. (3-0) Y
- CS 4392 Computer Animation (*3 semester hours*) Introduction to traditional animation. Kinematics of motion. Key framing. Coordinate systems and transformations (review), Euler angles and Quaternions, Catmull Rom and B-Splines, Advanced Key framing, articulated figures (forward kinematics), human and animal modeling (soft tissue, skin, etc.). Facial animation (parametric). Physically based modeling (rigid, collision detection). Physically based modeling (deformable). Behavioral and heuristic models. Algorithmic animation. Optimization techniques. Animation languages and systems. Motion capture and real time control. Virtual reality and animation. Rendering and temporal aliasing. 2D and 3D morphing. 3D modeling. Prerequisites: MATH 2418 and CS 3345 or equivalent. (3-0) Y
- CS 4393 Computer and Network Security (3 semester hours) The study of security and vulnerabilities in computer and network systems. Common attacking techniques such as buffer overflow, viruses, worms, etc. Security in existing systems such as UNIX, Windows, and JVM. Fundamental access control and information flow concepts. Symmetric Ciphers such as DES and AES. Public-key encryption techniques and related number theory. Message authentication, hash functions, and digital signatures. Authentication applications, IP security and Web security. Prerequisite: CS 4348 or equivalent. (3-0) Y
- CS 4394 Implementation of Modern Operating Systems (3 semester hours) This course focuses on developing systems implementation skills through a set of projects. Each project will explore one fundamental component of operating systems such as process scheduling, memory

management, device drivers, file systems, and network communication management. The projects are expected to involve kernel-level programming. Prerequisites: <u>CS 4348</u> and <u>CS 3335</u>, or equivalent programming experience. (3-0) R

CS 4395 Human Language Technologies (*3 semester hours*) Introduction to human language technologies (HLT), the study of natural languages from a computational perspective. Topics include computational models of syntax and semantics, natural language applications (such as machine translation, speech processing, information retrieval, and information extraction), and general machine-learning techniques commonly used in state-of-the-art HLT research. Prerequisite: CS/SE 3341, CS 3345 or equivalent. (3-0) Y

CS 4396 Networking Laboratory (3 semester hours) This course takes a lab-oriented approach to demonstrate how basic networking concepts are applied in a real network. The Hands-on projects include setting up simple network topologies, configuring devices to run basic network protocols, and using various debugging tools to identify, locate, and fix common problems in networking. Prerequisite: CS 4390 or equivalent. (3-0) Y

CS 4397 Embedded Computer Systems (3 semester hours) Introduction to embedded computer applications and concepts. Real-time operating systems and resource management. Real-time scheduling and communication. Senior data acquisition, processing and fusion. Error handling, fault tolerance, and graceful degradation. System performance analysis and optimization techniques. Includes a project to develop and analyze a small embedded computer application. Prerequisite: CS 4348 or equivalent. (3-0) Y

<u>CS 4398</u> **Digital Forensics** (*3 semester hours*) Creating and preserving digital evidence, data recovery and evidence collection algorithms, evidence construction and reconstruction, methods for certifying evidence, storing evidence, data acquisition, forensic analysis algorithms, image files, network forensics, logging methods to trace back attacks and digital trails, e-mail investigations. Prerequisites: <u>CS 4348</u> and <u>CS 4390</u> or equivalent. (3-0) Y

<u>CS 4399</u> Senior Honors in Computer Science/Software Engineering (*3 semester hours*) For students conducting independent research for honors theses or projects. Topics may vary. (Same as <u>SE 4399</u>) (3-0) R

CS 4485 Computer Science Project (4 semester hours) This course is intended to complement theory and to provide an in-depth, hands-on experience in all aspects of a software development project. Students will work in teams on projects of interest to industry and will be involved in specifying the problem and its solution, designing and analyzing the solution, developing the software architecture, along with implementation and testing plans. The deliverables will include reports that document these steps as well as a final project report and a user manual of the developed system. Teams will also make presentations during the class as well as demonstrate their software. Prerequisite: CS 3345, CS 3354 or equivalent, at least three CS 43XX classes. (4-0) S

<u>CS 4V95</u> Undergraduate Topics in Computer Science/Software Engineering (1-9 semester hours) Subject matter will vary from semester to semester. May be used as CS Guided Elective

on CS degree plans. May be repeated for credit as topics vary (9 hours maximum). (Same as  $\underline{SE}$  4V95) ([1-9]-0) R

<u>CS 4V98</u> Undergraduate Research in Computer Science/Software Engineering (1-9 semester hours) Topics will vary from semester to semester. May be repeated for credit as topics vary (9 hours maximum). Consent of instructor required. (Same as <u>SE 4V98</u>) ([1-9]-0) R