Computer Science

CS 101. Introduction to Computer Science. 3 credits.
How to think like a computer scientist. Topics include an overview of the context of computing, computational operations, computational devices, algorithms and data structures, the storage and transmission of data, the presentation of information, and the limits of computing. Students learn about the design and implementation of computational systems, the value of abstraction, problem solving and the ways in which computation impacts society.

CS 139. Programming Fundamentals (3, 2). 4 credits.
Students learn fundamental problem-solving techniques using a modern programming language. This course covers the same material as CS 149, but at a slower pace for students with little or no programming experience. Students may not receive credit for both CS 139 and CS 149.

Students learn fundamental problem-solving techniques using a modern programming language. This course covers same material as CS 139, but at an accelerated pace for students with programming experience. Students may not receive credit for both CS 139 and CS 149. Prerequisite: A prior programming course or equivalent experience.

CS 159. Advanced Programming. 3 credits.
Students use advanced problem-solving strategies to develop algorithms using classes and objects and techniques such as recursion, exceptions and file I/O. This course also focuses on designing small applications and effective testing strategies. Students may not receive credit for both CS 159 and CS 239. Prerequisite: A grade of “B-” or better in CS 139 or CS 149 or equivalent.

CS/MATH 227. Discrete Structures I. 3 credits.
An introduction to discrete mathematical structures including functions, relations, sets, logic, matrices, elementary number theory, proof techniques, basics of counting, graphic theory, discrete probability, digital logic, finite state machines, integer and floating point representations. Prerequisites: MATH 155, MATH 156 or sufficient score on the Mathematics Placement Exam.

CS 240. Algorithms and Data Structures. 3 credits.
Students learn to implement and analyze elementary data structures and the basic complexity classes of algorithms that use strategies such as greedy algorithms, divide-and-conquer algorithms and backtracking algorithms. This analysis is especially applied to problems in searching, sorting and parsing. Prerequisites: Grades of “C-” or better in CS/MATH 227 or MATH 245, MATH 231 or equivalent, and CS 159.

CS 260. Technical Communication for Computer Science. 3 credits.
An introduction to the process of planning, researching, producing, and revising technical documents attuned to specific audiences in the computing industry. Document
forms studied include definitions, correspondence, descriptions, specifications, instructions, proposals, reports, resumes and plans. **Prerequisite: Full admission to the CS major.**

**CS 261. Computer Systems I. 3 credits.**
Introduction to the operation of modern interrupt-driven computer systems. Explores the representation of software and information in binary memory, the primary components of a CPU, multithreaded programming and basic interactions with an Operating System. **Prerequisite: Grade of “C-” or better in CS 159.**

**CS 280. Projects in Computer Science. 1-3 credits.**
Projects or topics in computer science which are of interest to the lower division student. May be repeated for credit when course content changes. Topics may vary. **Prerequisite: Students should consult the instructor prior to enrolling for the course.**

**CS 327. Discrete Structures II. 3 credits each semester.**
This course builds on the theoretical foundation developed in Discrete Structures I. Students study a range of topics from discrete mathematics and theoretical computer science including elementary number theory, matrices, graph theory, automata, computability and complexity theory. **Prerequisites: Grade of “C-” or better in CS/MATH 227 or MATH 245, and CS 240.**

**CS 330. Societal and Ethical Issues in Computing. 3 credits.**
Overview of philosophical and professional ethics, and a survey of societal and ethical issues in computing such as privacy, intellectual property, computer security, computer crime, product liability, and the societal, environmental, and economic impact of computers. Students develop skills in assuming and defending positions on societal and ethical issues through oral presentations and written reports.

**CS/ISAT 344. Intelligent Systems. 3 credits.**
In-depth introduction to current and future intelligent systems, including expert systems, neural networks, hybrid intelligent systems, and other intelligent system technologies and their development, uses and limitations. **Prerequisite: CS 159 or ISAT 340.**

**CS 345. Software Engineering. 3 credits.**
Study of modern methods and tools for the development of software products. Topics include software development process models, software development tools, design and construction principles and practice, software quality assurance and program management. **Prerequisites: A grade of “C-” or better in CS 159.**

**CS 347. Web-Based Information Systems. 3 credits.**
This course covers the design and development of applications intended for deployment over the World Wide Web. Students will examine Web protocols, the architecture of Web-based applications, the languages and facilities with which they are developed, and related issues such as security and reliability. Students will also work in teams using a representative suite of development tools and languages to design and construct a simple client/server application that includes a GUI and a database interface. **Prerequisites: Grades of “C-” or better in CS 345 and CS 159.**

**CS 349. Developing Interactive Multimedia. 3 credits.**
Students learn the concepts of multimedia, the issues in designing multimedia to interact effectively with users, the performance and speed issues in designing multimedia and how to implement interactive multimedia applications. **Prerequisite: A grade of “C-” or better in CS 240.**
CS 354. Introduction to Autonomous Robotics. 3 credits.
A hands-on introduction to programming autonomous mobile robots. The focus of this course is on designing robotic systems that navigate independently in complex environments. Specific topics include localization, mapping, kinematics, path planning and computer vision. Prerequisite: A grade of “C-” or better in CS 240.

CS 361. Computer Systems II. 3 credits.
Intermediate exploration of modern interrupt-driven computer systems. Explores models of computation and complex systems, techniques for communication and synchronization of parallel and concurrent software, and the protocols that make up the Internet. Prerequisites: Grades of “C-” or better in CS 240 and CS 261.

CS 432. Compilers. 3 credits.
Introduction to the theory and implementation of compilers. Explores the lexical, syntactic, and semantic analysis of high-level language code as well as code generation, optimization techniques, and architectural or operating system considerations. Course work includes a significant programming component. Prerequisites: Grades of “C-” or better in CS 327 and CS 361.

CS 430. Programming Languages. 3 credits.
Several actual programming languages are studied in terms of the fundamental principles of computer programming language design, including object-oriented programming, functional programming, concurrent programming and logic programming. Prerequisites: Grades of “C-” or better in CS 240 and CS 261.

CS 442. Logic in Computer Science. 3 credits.
An exploration of some of the many connections between logic and computing, such as the application of classical and temporal logic in program verification, logic and logic programming, decidability, computability, automatic theorem proving, the computational complexity of logic algorithms, and applications of logic in artificial intelligence. A course in discrete mathematics or logic is recommended as preparation for this course. Prerequisite: Junior or senior standing.

CS 444. Artificial Intelligence. 3 credits.
Students will study the history, premises, goals, social impact and philosophical implications of artificial intelligence. Students will study heuristic algorithms for large state spaces and learn to develop recursive and non-deterministic algorithms. Prerequisite: A grade of “C-” or better in CS 240.

CS 446. Software Analysis and Design. 3 credits.
Contemporary software analysis and design methods, tools, notations, techniques, processes, principles and practices. Students solve analysis and design problems alone or in teams and present their work to their peers and the instructor. Prerequisites: Grades of “C-” or better in CS 240 and CS 345.

CS/ISAT 447. Interaction Design. 3 credits.
Study of and practice with processes, principles, tools, models and techniques for designing interactions between humans and digital products and systems. Topics include physiological and psychological factors affecting interaction design, interaction design processes, interaction models, styles and paradigms, design notations and representations, prototyping, and interaction design evaluation. Prerequisite: Junior standing.

CS/MATH 448. Numerical Analysis. 3 credits. Offered every third semester as of fall 2014.
Study and analysis of algorithms used to solve nonlinear equations and systems of linear and nonlinear equations. Iterative methods for matrices and Newton-type methods. Numerical differential and integral calculus. Programming using a high-level language and/or software packages. **Prerequisites:** MATH 237, MATH 238 or MATH 300; and MATH 248.

**CS/MATH 449. Numerical Analysis for Differential Equations.**
3 credits. Offered every third semester as of spring 2015.
Study and analysis of numerical techniques to solve ordinary and partial differential equations, including Euler, Runge-Kutta, Picard, finite-difference and finite-element methods. Programming using a high-level language and/or software packages. **Prerequisites:** MATH 237, MATH 238 or MATH 336, and MATH 248.

**CS 450. Operating Systems.** 3 credits.
Introduction to the design and implementation of modern operating systems. Explores fundamental concepts of operating systems, memory management, virtualization, resource allocation, file systems and system protection mechanisms. Course work includes a significant programming component. **Prerequisite:** Grade of “C-” or better in CS 361.

**CS/MATH 452. Design and Analysis of Algorithms.** 3 credits.
An introduction to the analysis, design and theory of algorithms. Algorithms studied will be selected from searching, sorting and graph theory. Included are elements of counting, recurrence relations, direct and indirect proofs, recursion, complexity classes, language theory, decidability and undecidability. **Prerequisites:** CS 327 and CS 240.

**CS 456. Computer Architecture.** 3 credits.
Introduction to the design and implementation of modern CPU architectures. Explores hardware-based parallel execution, quantitative performance evaluation, I/O interfacing techniques and hardware descriptor languages. Course work includes a significant programming component. **Prerequisite:** Grade of “C-” or better in CS 361.

**CS 457. Information Security.** 3 credits.
This course covers the basic issues of information system security. The roles of planning, management, policies, procedures and personnel in protecting the confidentiality, integrity and availability of information are described. Specific threats (malicious code, network attacks and hostile content) and widely used countermeasures (access control, mechanisms, firewalls and intrusion detection systems) are also discussed. **Corequisite:** CS 361.

**CS 458. Cyber Defense.** 3 credits.
A hands-on, lab-based learning experience in which the students engage in a series of mini projects to perform security assessment, penetration testing and hardening of networked systems. Students also participate in a cyber defense exercise. **Prerequisites:** Grades of “C-” or better in CS 457 and CS 361.

**CS/ISAT 461. Internetworking.** 3 credits.
Wide Area Network (WAN) and Metropolitan Area Network (MAN) design. Audio, voice, data and TV transmission over ATM/B-ISDN networks. The SONET signal hierarchy and Q3 standard interface model. Network security. Performance analysis of a given network. **Prerequisite:** CS 361 or ISAT 460.

**CS/ISAT 462. Network Applications Development.** 3 credits.
Design and implementation of network-based applications using languages and architectures such as sockets, JAVA, TL1 and CORBA. Concepts in distributed
processing, including synchronization of interprocess communication and management of replicated data. Analysis of performance issues related to distributed applications. **Prerequisites:** CS 361 or ISAT 460 and either CS 159 or CIS 344.

**CS/ISAT 463. Network Analysis and Design. 3 credits.**
In-depth introduction to the techniques and tools used to design and analyze computer and telecommunications networks. Overview of issues related to network performance, including the impact on cost, reliability and security. **Prerequisites:** CS 361 or ISAT 460 and either CS 159 or ISAT 340.

**CS/ISAT 464. Issues in the Telecommunications Business. 3 credits.**
Addresses complex business concepts and issues in the telecommunications industry. Explores the interrelation of the economics of the telecommunications industry with ensuing social, ethical and security issues. Discusses topics in product and service creation, marketing, customer service and billing and electronic commerce. **Prerequisites:** CIS 320, SMAD 356, and ISAT 340 or equivalent.

**CS 470. Parallel and Distributed Systems. 3 credits.**
Introduction to parallel and distributed systems. Explores shared memory, cluster, grid, peer-to-peer, and cloud computing models along with parallel software patterns, distributed file systems and performance considerations. Course work includes a significant programming component. **Prerequisite:** Grade of “C-” or better in CS 361.

**CS 474. Database Design and Application. 3 credits.**
Students study database design and management with emphasis placed on data definition languages, data manipulation languages, query languages and management of the database environment. **Prerequisites:** Grades of “C-” or better in CS 345 and either CS 159 or equivalent.

**CS 475. Distributed Database Management. 3 credits.**
Students learn the concepts of client-server architectures and other aspects that arise in the design of distributed database systems. **Prerequisite:** A grade of “C-” or better in CS 474.

**CS 476. Database Administration. 3 credits.**
Students learn to administer a database by manipulating physical and logical components of a database management system. Topics include creation of an instance, managing of tables, indexes, privileges, profiles and roles. **Prerequisite:** A grade of “C-” or better in CS 474.

**CS 480. Selected Topics in Computer Science. 1-3 credits.**
Topics in computer science which are of interest but not otherwise covered in the regular computer science offerings of the department. Offered only with the approval of the department head; may be repeated for credit when course content changes. **Prerequisite:** A grade of “C-” or better in CS 159. Topics selected may dictate further prerequisites; students should consult the instructor prior to enrolling for course.

**CS 482. Selected Topics in Information Security. 1-3 credits.**
Topics in information security. Offered only with the approval of the department head; may be repeated for credit when course content changes. **Prerequisites:** Grades of “C-” or better in CS 240 and CS 261. Topics selected may dictate further prerequisites; students should consult the instructor prior to enrolling for the course.

**CS 488. Computer Graphics Applications. 3 credits.**
This course develops a computer graphics application package based on standard graphics functions as well as attributes of a graphical user interface. It includes
experience in applying interactive computer graphics techniques to industrial problems. 
Prerequisites: Grades of “C-” or better in CS 240 and CS 261.

CS 497. Independent Study. 1-3 credits.
An advanced course to give independent study experience under faculty supervision. 
May be taken multiple times for credit, but no more than three credits may be used in 
the computer science program graduation requirements. Prerequisites: Junior standing, 
major in computer science and permission of the program coordinator.

CS 499. Honors. 6 credits.
Year course. See catalog section “Graduation with Honors.”