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 and MATH 249.

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 249.

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 261.

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, 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, T1 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, CS 239 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 interrelationship 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 CS 239 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 or CS 239. 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 350. Topics selected may dictate further prerequisites; students should consult the instructor prior to enrolling for the course.

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 350.

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."

Continuing Education

CE 490. Special Studies in Continuing Education. 1-3 credits.
This course is designed to allow exploration of current topics of interest including various trends and issues in a given field of study.