Computing and Design Department

Computing and Design Degrees, Minors and Certificates

**Associate Degree**
- Associate of Applied Science in General Technology - Design Emphasis (catalog.dixie.edu/programs/computing-and-design/general-technology-design-aas/)
- Associate of Applied Science in General Technology - Information Technology Emphasis (catalog.dixie.edu/programs/computing-and-design/general-technology-information-technology-aas/)

**Bachelor Degrees**
- Bachelor of Science in Computer Science (catalog.dixie.edu/programs/computing-and-design/computer-science-bs/)
- Bachelor of Science in Computer & Information Technology (catalog.dixie.edu/programs/computing-and-design/computer-information-technology-bs/)
- Bachelor of Science in Computer & Information Technology – Software Development Emphasis (catalog.dixie.edu/programs/computing-and-design/computer-information-technology-software-development-bs/)
- Bachelor of Science in Computer & Information Technology – Web Design & Development Emphasis (catalog.dixie.edu/programs/computing-and-design/web-design-development-bs/)
- Bachelor of Arts/Science in Design - Digital Design Emphasis (catalog.dixie.edu/programs/computing-and-design/design-digital-design-bs/)
- Bachelor of Arts/Science in Design - Graphic Design Emphasis (catalog.dixie.edu/programs/computing-and-design/design-graphic-design-bs/)
- Bachelor of Arts/Science in Design - Interaction Design Emphasis (catalog.dixie.edu/programs/computing-and-design/design-interaction-design-bs/)
- Bachelor of Science in Information Technology (catalog.dixie.edu/programs/computing-and-design/information-technology-bs/)
- Bachelor of Arts/Science in Integrated Studies - Digital Design Emphasis (catalog.dixie.edu/programs/interdisciplinary-arts-and-sciences/integrated-studies-digital-design-bs/)
- Bachelor of Arts/Science in Integrated Studies - Information Technology Emphasis (catalog.dixie.edu/programs/interdisciplinary-arts-and-sciences/integrated-studies-information-technology-bs/)
- Bachelor of Arts/Science in Integrated Studies - Software Development Emphasis (catalog.dixie.edu/programs/computing-and-design/computer-information-technology-software-development-bs/)
- Bachelor of Arts/Science in Integrated Studies - Web Design & Development Emphasis (catalog.dixie.edu/programs/interdisciplinary-arts-and-sciences/integrated-studies-web-design-development-bs/)

**Minors**
- Minor in Computer Science (catalog.dixie.edu/programs/computing-and-design/computer-science-minor/)
- Minor in Digital Design (catalog.dixie.edu/programs/computing-and-design/digital-design-minor/)
- Minor in Information Technology (catalog.dixie.edu/programs/computing-and-design/information-technology-minor/)
- Minor in Web Design & Development (catalog.dixie.edu/programs/computing-and-design/web-design-development-minor/)

**Certificates**
- Computing Fundamentals (catalog.dixie.edu/programs/computing-and-design/computing-fundamentals-certificate/)
- Design (catalog.dixie.edu/programs/computing-and-design/design-certificate/)
- Information Technology (catalog.dixie.edu/programs/computing-and-design/information-technology-certificate/)

Click here for Computing and Design Website (http://cit.dixie.edu/) (following this link will take you out of the University Catalog)

**CIT 1001. FYE: Computer & Information Technology. 1 Hour.**
First Year Experience seminar course designed to help freshman students interested in computing adapt to college life and become integrated into Dixie State University and the Computer and Information Technology department. Students will refine academic skills, create and foster social networks, learn about college resources, explore the different options available within the CIT department, and learn about career opportunities in Computing. Multiple listed with all other sections of First Year Experience (all 1001 courses, ENGR 1000). Students may only take one FYE course for credit. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to:** 1. Understand the university support system by identifying and using campus resources. 2. Explore different majors. 3. Develop college survival skills. 4. Learn how to construct a graduation plan. FA, SP.
CS 1030. Problem Solving with Computers. 3 Hours.
For any student interested in how computers are used to solve problems. This course will introduce the use of computers in problem solving including problem decomposition and algorithm construction. Students will be required to complete simple programming projects. Offered based upon sufficient student need. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Read and write small computer programs and a simple web page. 2. Communicate through discussion and writing about data and its effect on daily life. 3. Work with peers in creating, writing, and evaluating computer programs. Course fee required.

CS 1400. Fundamentals of Programming. 3 Hours.
Required of all students pursuing Computer and Information Technology degrees. Open to all students with a general interest in computer programming. Covers structured programming techniques and the syntax of a high level programming language through completion of programming projects of increasing difficulty. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Read and write simple computer programs. 2. Use language components such as variables, conditionals, and lists. 3. Decompose small problems. Course fee required. Prerequisites: CS 1030 (Grade C- or higher); OR MATH 1010 or higher MATH course (Grade C- or higher); OR ACT math score of 23 or higher or equivalent placement score within two years of enrollment in this course. FA, SP, SU.

CS 1410. Object Oriented Programming. 3 Hours.
Required of all students pursuing Computer and Information Technology degrees, open to all students with a general interest in computer programming. Introduces object oriented programming techniques through completion of programming projects of increasing difficulty. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Construct computer programs in a modern development environment using standard tools. 2. Develop solutions using a range of programming constructs, including control structures, functions, input/output, classes and objects, and data collections. 3. Design and implement programs from English descriptions. 4. Demonstrate the use of correct syntax and semantics in a high-level programming language. Course fee required. Prerequisites: CS 1400 (Grade C- or higher). FA, SP.

CS 2420. Introduction to Algorithms and Data Structures. 3 Hours.
Required of students pursuing a Computer Science or Information Technology degree or emphasis, open to any student with a strong interest in computer programming. Covers the design and use of common data structures, lists, stacks, queues, trees, hash tables, and graphs through completion of several challenging programming projects. Introduces computational complexity and algorithm analysis. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Discuss the basic principles of many software data structures, including efficiencies and tradeoffs. 2. Implement and use several data structures, including Binary Search Trees, Hash Tables, and Graphs. 3. Demonstrate a working knowledge of Big-O complexity. 4. Demonstrate a working knowledge of Algorithm Analysis. 5. Parse mathematical expressions into a functioning graphics calculator. 6. Implement several recursive algorithms. 7. Implement and analyze several sorting algorithms. Course fee required. Prerequisite: CS 1410 (Grade C- or higher). FA, SP.

CS 2450. Software Engineering. 3 Hours.
Required of students pursuing a Computer Science degree or emphasis, open to any student with a strong interest in computer programming. Covers current software engineering theory and practice through completion of a challenging team project. Dual listed with WEB 3450 (students may take only one course for credit). **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Demonstrate understanding of software engineering knowledge and skills and of the professional standards necessary to begin practice as a software engineer. 2. Apply appropriate theories, models, and techniques that provide a basis for problem identification and analysis, software design, development, implementation, verification, and documentation. 3. Collaborate as part of a team or individually to develop and deliver quality software artifacts. 4. Reconcile conflicting project objectives, finding acceptable compromises within the limitations of cost, time, knowledge, existing systems, and organizations. 5. Evaluate new development models, techniques, and technologies as they emerge and appreciate the necessity of such continuing professional development. Course fee required. Prerequisites: CS 2420 (Grade C- or higher). FA, SP.

CS 2810. Computer Organization and Architecture. 3 Hours.
Required of students pursuing a Computer Science degree or emphasis, open to any student with a strong interest in computer programming. Covers digital hardware design and systems programming, including numeric representations, digital logic, processor architecture, instruction sets, assembly language, and other low-level programming topics. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Convert between number systems including binary, hexadecimal, octal, and decimal. 2. Debate and compare the design of computer instruction sets and assembly languages. 3. Compose low-level solutions to programming problems that interact directly with the operating system. 4. Generate structured assembly language solutions to algorithmic problems. Course fee required. Prerequisite: CS 1410 (Grade C- or higher). FA, SP.

CS 3005. Programming in C++. 3 Hours.
For student pursuing degrees in Computer Science and Computer and Information Technologies, or any student with a strong interest in computer programming. Covers syntax and semantics of C++ programming language through completion of hands-on projects. The student must already be fluent in some other programming language. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Construct computer programs in C++, using functions, classes and STL elements. 2. Construct computer programs using stack, heap and static memory. 3. Construct computer programs in a statically typed language. 4. Construct and use unit tests. 5. Use version control to manage code. 6. Use memory checking and debugging tools. 7. Create larger programs than in previous course work. Course fee required. Prerequisite: CS 1410 (Grade C- or higher). FA, SP.
CS 3010. Mobile Application Development for Android. 3 Hours.
For students pursuing degrees in Computer Science, or other students interested in writing applications for modern mobile devices using Apple's iOS operating system. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Develop modern applications for phones and tablets using the iOS SDK and related tools. 2. Design and implement a functional graphical user interface suitable for a mobile application. 3. Structure sophisticated mobile applications using the software architecture and design patterns of contemporary practice. Course fee required. Prerequisites: CS 2420 (Grade C- or higher) AND CS 3005 (Grade C- or higher). SP.

CS 3020. Mobile Application Development: iOS. 3 Hours.
For students pursuing degrees in Computer Science, or other students interested in writing applications for modern mobile devices using Apple's iOS operating system. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Develop modern applications for phones and tablets using the iOS SDK and related tools. 2. Design and implement a functional graphical user interface suitable for a mobile application. 3. Understand the software architectural and design patterns necessary to develop sophisticated mobile applications. Course fee required. Prerequisites: CS 2420 (Grade C- or higher); AND CS 3005 (Grade C- or higher). FA.

CS 3150. Computer Networks. 3 Hours.
A comprehensive introduction to the principles of computer networks from a developer's perspective, with emphasis on the design and implementation of the Internet, its protocols, and applications. Topics include network applications, network programming interfaces, layered network architectures, transport and congestion control protocols, routing and data link protocols, local area networks, and a selection of special topics. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Identify, interpret, and analyze the basic principles of computer networks, including switching, layering and abstraction, routing, and the various protocols that drive network behavior. 2. Explain and implement how applications use networks and the Internet to communicate using network programming interfaces. 3. Assemble limited components of common Internet applications such as email, video streaming, and peer-to-peer applications. 4. Construct portions of the Internet, including transport protocols and routing algorithms, and justify their design. Prerequisite: CS 2810 (Grade C- or higher). SP.

CS 3200. Web Application Development I. 3 Hours.
For students pursuing a degree in Computer Science or an emphasis in Software Development, or other students interested in writing applications for the modern web. Covers the fundamentals of three-tier web applications, including client-side code for modern browsers, server code using representative languages, and integration with database systems; also covers the protocols that connect these components and the environments in which they run. Daul listed with WEB 3200. Students may only take one course for credit. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Develop modern web applications using both client-side and server-side languages and technologies. 2. Integrate database technologies into the ecosystem of a web application at a fundamental level. 3. Deploy the environments and infrastructure required by web application servers and related systems. 4. Implement the architectures, protocols and standards necessary to interconnect the client-side and server-side components. Course fee required. Prerequisites: CS 1410 (Grade C- or higher) AND WEB 1400 (Grade C- or higher); OR CS 2810 (Grade C- or higher). FA, SP.

CS 3310. Discrete Mathematics. 3 Hours.
For students pursuing degrees in Computer Science, or other students interested in counting theory and applications. Covers mathematical reasoning, combinatorial analysis, sets, permutations, relations, computational complexity, and Boolean logic through homework and programming assignments. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Apply the principles of logic and set theory to solve computational and combinatorial problems. 2. Enumerate discrete structures of a given kind and size via the use of combinations, permutations, and other combinatorial constructs. 3. Reduce complex problems into simpler sub-problems. 4. Implement software related to discrete math topics. Course fee required. Prerequisites: MATH 1100 (Grade C- or higher) OR MATH 1210 (Grade C- or higher); AND CS 1410 (Grade C- or higher). FA.

CS 3400. Operating Systems. 3 Hours.
Can be used to fulfill a requirement for students pursuing a degree or emphasis in Computer Science, and open to other students. Covers operating systems design and implementation, including processes and threads, synchronization, virtual memory, and file systems. Course taught by arrangement. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Design the major components of an operating system. 2. Analyze the trade-offs between competing goals in system software projects, including safety, performance, convenience, and ease of future maintenance. 3. Build and modify complex software projects in teams. 4. Assess and criticize the design of modern and historical operating systems. Course fee required. Prerequisites: CS 2420 (Grade C- or higher); AND CS 2810 (Grade C- or higher); AND CS 3005 (Grade C- or higher). SP.

CS 3410. Distributed Systems. 3 Hours.
Can be used to fulfill a requirement for students pursuing a degree or emphasis in Computer Science, and open to other students. Covers design and implementation of network applications, including message passing, concurrency, synchronization, scalability, and partial failure. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Design and implement software solutions that span multiple computers across a network. 2. Analyze the tradeoffs between competing goals in system software projects, including safety, performance, convenience, and ease of future maintenance. 3. Build and modify complex software projects in teams. 4. Debate and differentiate the approaches and solutions to distributed systems problems taken by modern internet organizations. Course fee required. Prerequisites: CS 2420 (Grade C- or higher); AND CS 2810 (Grade C- or higher). SP.
CS 3440. Software Practices. 3 Hours.
For students pursuing degrees in Computer Science, or other students interested in gaining experience in software development practices. Covers practical usage of software development tools, source code control, software debugging, third party libraries and frameworks, and effective team work. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Design software development workflows that use modern tools. 2. Analyze the tradeoffs between different development practices for individual and team projects. 3. Build and deploy systems using professional best practices and methodologies. Course fee required. Prerequisites: CS 3005 (Grade C- or higher).

CS 3500. Application Development. 3 Hours.
For students pursuing degrees in Computer Science or Computer Information Technology, or others with an interest in graphical interface design and implementation. Covers the theory and practice of constructing easy to use interfaces through programming graphical environment projects in a variety of languages and platforms. Course taught by arrangement. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Develop GUI software in a variety of environments. 2. Be proficient in a variety of software development environments that are relevant to our local economy. Course fee required. Prerequisite: CS 3005 (Grade C- or higher).

CS 3510. Advanced Algorithms/Data Structures. 3 Hours.
Required of students pursuing a Computer Science degree or emphasis. Covers the analysis and design of algorithms and data structures, including graphs, greedy algorithms, divide and conquer algorithms, and dynamic programming. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Analyze and classify algorithms of various types, including divide-and-conquer algorithms, graph algorithms, dynamic programming, and linear programming. 2. Assess the run-time complexity of algorithms through analysis and measurement. 3. Evaluate and select suitable algorithms for programming problems. 4. Construct algorithmic solutions to complex problems using the full range of algorithmic approaches. Course fee required. Prerequisites: CS 2420 (Grade C- or higher); AND CS 2810 (Grade C- or higher); AND CS 3310 (Grade C- or higher). SP.

CS 3520. Programming Languages. 3 Hours.
Required of students pursuing a Computer Science degree or emphasis. Covers the principles and concepts that characterize high-level computer programming languages, including function and data abstraction, and imperative, functional, logic and object-oriented programming techniques. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Learn the syntax and use of an appropriate graphics API such as OpenGL. 2. Learn raster display concepts, input and output device management, human and camera visual systems, and a computer visual system. 3. Learn about frame buffers, pixel manipulation, lines, circles, text, and other basic primitives. 4. Learn how an RGB color display physically works, and how to program it as desired. 5. Learn viewing transformation, modeling transformation, and the Graphics Pipeline. 6. Learn to program the mouse and keyboard to respond appropriately to user input. 7. Learn modeling, rendering and animation techniques. 8. Learn the 3D Phong shading model. 9. Learn other graphics techniques such as hidden surface removal, texture mapping, and antialiasing. 10. Be briefly introduced to Curve and Surface modeling. 11. Be briefly introduced to Ray Tracing. 12. Be briefly introduced to Physically Based Modeling. 13. Be briefly introduced to Fractals. 14. Create several 2D and 3D graphics applications. Course fee required. Prerequisites: CS 2420 (Grade C- or higher); AND CS 2810 (Grade C- or higher); and CS 3310 (can be concurrently enrolled). FA.

CS 3530. Computational Theory. 3 Hours.
Required of students pursuing a Computer Science degree or emphasis. Covers the theory of computation, including finite-state automata, pushdown automata, Turing machines, and equivalent formalisms. Also introduces complexity theory. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Compare the capabilities of various computational models and formulating new models as needed to research new classes of problems. 2. Analyze formal systems with mathematical rigor and the appropriate formal notation. 3. Investigate computational problems and categorizing their algorithmic complexity. 4. Appraise and justify the limits of computational models and the real-world systems that rely on them. Course fee required. Prerequisites: CS 2420 (Grade C- or higher); AND CS 2810 (Grade C- or higher); and CS 3310 (Grade C- or higher). FA.

CS 3600. Graphics Programming. 3 Hours.
Required of students pursuing a Computer Science degree or emphasis, and open to other interested students. Covers 2-D and 3-D model creation, transformation, and various rendering techniques through completion of programming assignments. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Learn the syntax and use of an appropriate graphics API such as Open GL. 2. Learn raster display concepts, input and output device management, human and camera visual systems, and a computer visual system. 3. Learn about frame buffers, pixel manipulation, lines, circles, text, and other basic primitives. 4. Learn how an RGB color display physically works, and how to program it as desired. 5. Learn viewing transformation, modeling transformation, and the Graphics Pipeline. 6. Learn to program the mouse and keyboard to respond appropriately to user input. 7. Learn modeling, rendering and animation techniques. 8. Learn the 3D Phong shading model. 9. Learn other graphics techniques such as hidden surface removal, texture mapping, and antialiasing. 10. Be briefly introduced to Curve and Surface modeling. 11. Be briefly introduced to Ray Tracing. 12. Be briefly introduced to Physically Based Modeling. 13. Be briefly introduced to Fractals. 14. Create several 2D and 3D graphics applications. Course fee required. Prerequisites: CS 2420 (Grade C- or higher); AND CS 3005 (Grade C- or higher). SP.

CS 3620. Advanced Algorithms/Data Structures. 3 Hours.
Required of students pursuing a Computer Science degree or emphasis. Covers the analysis and design of algorithms and data structures, including graphs, greedy algorithms, divide and conquer algorithms, and dynamic programming. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Compare the capabilities of various computational models and formulating new models as needed to research new classes of problems. 2. Analyze formal systems with mathematical rigor and the appropriate formal notation. 3. Investigate computational problems and categorizing their algorithmic complexity. 4. Appraise and justify the limits of computational models and the real-world systems that rely on them. Course fee required. Prerequisites: CS 2420 (Grade C- or higher); AND CS 2810 (Grade C- or higher); and CS 3310 (Grade C- or higher). FA.

CS 3640. Software Practices. 3 Hours.
For students interested in writing applications for the modern web. Covers advanced concepts and topics in client-side and server-side web application development. Students will be introduced to a variety of modern software frameworks, languages, architectural patterns, and techniques in order to create interactive, data-centric web applications. Course is dual listed with WEB 4200. Students may only take one course for credit. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Develop modern web applications using both client-side and server-side languages and technologies. 2. Assess the makeup of various client-side and server-side web application frameworks and their constituent components. 3. Create an interactive user experience using a client-side framework and interaction with a web service. 4. Implement the architectural and design patterns used by web application frameworks, and justify how they are used to produce maintainable and scalable web applications. Course fee required. Prerequisites: CS 3200 (Grade C- or higher). SP.
CS 4300. Artificial Intelligence. 3 Hours.
Required of students pursuing a Computer Science degree or emphasis. Introduces the broad field of artificial intelligence in computer software followed by specific applications in computer gaming strategies. Students will complete programming assignments. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Construct solutions for a range of problems using search algorithms. 2. Discern problems that can be solved using propositional logic and build appropriate solutions. 3. Design and implement Bayesian networks. 4. Integrate third-party libraries into solutions for large software projects. 5. Collaborate to solve large and complex problems. Course fee required. Prerequisites: CS 2420 (Grade C- or higher); AND CS 2810 (Grade C- or higher); AND CS 3005 (Grade C- or higher). SP.

CS 4307. Database Design & Management. 3 Hours.
Required of students pursuing a Computer Science degree or emphasis. Covers administration of database management systems, logical database design, implementation of database designs, and application development using a DBMS. Students will design, manage, and implement databases and applications that use databases. Dual listed with IT 4300 (students may take only one course for credit). **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Design and implement the major components of a database management system. 2. Analyze the storage needs of a software project and create a data schema and query strategy to address those needs. 3. Construct substantial software that balances requirements of data safety, performance, and complexity. 4. Debate and criticize modern approaches to data management. Course fee required. Prerequisites: CS 2420 (Grade C- or higher) AND CS 2810 (Grade C- or higher) AND CS 3005 (Grade C- or higher). FA, SP.

CS 4310. Database Administration. 3 Hours.
This course covers the database architecture and environment. Students will be able to manage user access control. Students will be able to perform backup, restore, and recovery operations. Students will be able control performance and optimization issues. It covers updating and upgrading of a database system. Students will be able to perform the importing and exporting of data to/from a database. Dual listed with IT 4310 (only one course may be taken for credit). **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Manage and organize data into a database. 2. Backup and restore a database. 3. Tune a database for better performance performance. 4. Import/export data to and from a database. Course fee required. Prerequisite: CS 4307 (Grade C- or higher). FA.

CS 4320. Machine Learning. 3 Hours.
For students pursuing degrees in Computer Science or related fields, with an interest in the theory and practice of machine learning. Covers an introduction to supervised and unsupervised learning, including decision trees, neural networks, naive Bayes classifiers and support vector machines. Students will be required to implement machine learning systems. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Use supervised and unsupervised learning techniques. 2. Implement software learning systems. 3. Evaluate quality of learned systems. 4. Implement software utilizing the results of learning systems. Course fee required. Prerequisites: CS 2420 (Grade C- or higher); AND CS 2810 (Grade C- or higher); AND CS 3005 (Grade C- or higher). SP.

CS 4550. Compilers. 3 Hours.
Required of students pursuing a Computer Science degree or emphasis. Covers compiler design and implementation, including lexical analysis, parsing, symbol table management, and generating code through challenging programming assignments. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Be further exposed to computer science theory, including Languages, Grammars, and Machines. 2. Study and implement Scanning and Lexical analysis. 3. Study and implement Parsing. 4. Study and implement an Interpreter. 5. Study and implement Machine Code Generation on a modern CPU. 6. Study and implement a Storage and Symbol Management system. 7. Review the intricacies of C++. 8. Implement a very large project using correct Software Engineering principles. Course fee required. Prerequisites: CS 2420 (Grade C- or higher); AND CS 2810 (Grade C- or higher); AND CS 3005 (Grade C- or higher). SP.

CS 4600. Senior Project. 3 Hours.
Required of students pursuing a Computer Science degree or emphasis. Students will complete an aggressive programming project of software engineering. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Have practical experience in project specification. 2. Have practical experience in project design. 3. Have practical experience in project implementation. 4. Have practical experience in project testing. Course fee required. Prerequisite: Senior status. SP.

CS 4920R. Internship. 1-3 Hours.
Internship course in Computer Science and Software Development. Variable credit 1.0 - 3.0. Repeatable up to 3 credits subject to graduation restrictions. Offered by arrangement. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Design and implement programming solutions to meet user needs. 2. Use current software development tools and techniques. 3. Develop software in a team environment. 4. Work with an employer. Prerequisites: CS 2420 (Grade C- or higher); AND CS 2810 (Grade C- or higher); AND CS 3005 (Grade C- or higher); AND instructor permission.

CS 4990. Special Topics in Computer Science. 3 Hours.
For students wishing instruction that is not available through other regularly scheduled courses in this discipline. Occasionally, either students need some type of non-traditional instruction, or an unanticipated opportunity for instruction presents itself. This course may include standard lectures, travel and field trips, guest speakers, laboratory exercises, or other nontraditional instruction methods. Repeatable for credit as topics vary, up to 6 credits. Offered by arrangement. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Develop and build systems using a specific software framework or methodology. 2. Extrapolate the specialized insights and practices of a specific computational system to a wider field of practice. 3. Apply general purpose algorithmic and problem solving skills to a specific problem domain. Course fee required. Prerequisites: Instructor permission.
OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to:

- Describe and demonstrate the screen printing production process.
- Explain the basics of the graphics and screen printing using photographically/mechanically generated stencils, reproducing images with computers for positive reproduction, and multi-color screen printing.
- For students interested in the screen printing industry on the commercial level. Includes hands-on experiences for printing on various substrates.

**COURSE LEARNING OUTCOMES (CLOs)** At the successful conclusion of this course, students will be able to:

1. Explain the basics of the graphics and screen printing using photographically/mechanically generated stencils, reproducing images with computers for positive reproduction, and multi-color screen printing.
2. For students interested in the screen printing industry on the commercial level. Includes hands-on experiences for printing on various substrates.
DES 2100. Design Thinking. 3 Hours.
An introduction to design thinking, an empathy-based, human-centered, and rapid prototype-driven methodology for innovation. Students will explore challenges such as the creation of new products, technological innovation, services, business models, experiences, processes and/or systems through the design thinking process. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Understand what is design thinking. 2. Understand the differences between design thinking and conventional problem solving. 3. Learn the design thinking process and the various tools, techniques and templates used in design thinking. 4. Apply the tools taught onto real life environment and situations. 5. Uncover unmet needs, unarticulated needs and undreamt needs. 6. Students will be able to examine critical theories of design, systems thinking, and design methodologies. 7. Students will be able to demonstrate sound thinking, creative inquiry, and diverse modes of reasoning-visual, perceptual, conceptual, inductive, deductive, analytical, logical, critical, organizational, and creative-through discussion and writing. 8. Students will be able to solve problems and address social concerns with innovative approaches to design and exploratory methodologies. Course fee required. FA, SP.

DES 2300. Design II. 3 Hours.
An intermediate level course that expands the skills and knowledge acquired in Design I. The course emphasizes practical assignments that examine applied problem solving and professional solutions for graphic designers. Specific themes/topics for the course include visual grouping and hierarchy, visual identity development and application of Gestalt theory. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Think creatively from the expression of an idea to the completion of a design. 2. Apply design fundamentals successfully. 3. Demonstrate an awareness of the history and context of design in relation to contemporary topics and social, political and cultural issues. 4. Communicate an understanding for the use of an design for expression. 5. Communicate and apply technical proficiency in areas appropriate as a designer to produce a cohesive body of work. Course fee required. Prerequisites: DES 1100 (Grade C or higher) OR WEB 1400 (Grade C or higher); AND DES 1300 (Grade C or higher) OR ART 1120 (Grade C or higher) OR ART 1120 (Grade C or higher). FA, SP.

DES 2710. Typography I. 3 Hours.
Study of basic layout, lettering, type design, identification of styles, and typographic history. Students learn how to use type as a basic element of graphic communication, how the use of different typefaces visually communicate a desired effect, and fundamental terminology of type specification. Consists of lectures, quizzes, and ongoing typographically-related projects intended to be of portfolio-quality. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Follow direction and meet deadlines. 2. Follow the design process from thumbnails through the finished project. 3. Present work in a professional manner and to give and receive feedback during critiques. 4. Have competency in craftsmanship, creativity, in while using the appropriate design principles. 5. Have an understanding of the basic history and evolution of type. 6. Name the basic anatomy of type: x-height, baseline, descender, apex, etc. 7. Identify the difference between basic typefaces. 8. Know the how typefaces are classified based on their visual properties. 9. Choose appropriate typefaces for projects i.e., web vs print. 10. Demonstrate an understanding of visual hierarchy in relation to type. 11. Understand the importance of function vs form in relation to readability and use of typefaces. 12. Demonstrate an understanding and ability to put into practice the use of the typographic grid. 13. Adjust the leading and kerning or letter-spacing. 14. Set tabs, margins, style sheets and other type functions in InDesign and Illustrator. Course fee required. Prerequisite: ART 1120 OR DES 1300 (Grade C or higher). FA, SP.

DES 3000. Design III. 3 Hours.
Advanced application of design theory and processes, conceptual thinking and expansive form-making. Students will continue to develop their unique design voice and process, through further exploration of typography, imagery, and visual continuity to create complex portfolio-ready work. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Acquire and demonstrate fluency in the visual vocabulary and technical skills relevant to design. 2. Demonstrate the ability to analyze, synthesize, and develop probable solutions. 3. Successfully present project processes and outcomes through both written and oral communication. 4. Combine excellent craft skills with strong conceptual abilities. 5. Produce a portfolio of work that meets employer and marketplace expectations. Course fee required. Prerequisites: ART 1110 (Grade C or higher); AND DES 1300 (Grade C or higher) OR ART 1120 (Grade C or higher). SP.

DES 3300. Motion Graphics I. 3 Hours.
An exploration of motion graphics fundamentals including visual rhythm, kinetic typography and motion and time as it applies to visual communication in linear narratives. Includes the basic principles of video capture, editing and covers the integration of motion graphics and sound. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Demonstrate a basic working familiarity with appropriate software applications. 2. Describe the basic principles of Motion Graphics and Animation. 3. Apply the design process from storyboard through the finished project. 4. Determine the appropriate techniques and processes to produce portfolio quality Motion Graphics work. 5. Develop competency in ideation, craftsmanship and ability to meet deadlines. Course fee required. Prerequisites: DES 1300 (Grade C or higher) OR ART 1120 (Grade C or higher). SP.

DES 3400. Information Design. 3 Hours.
Introduction to the field of information design, data visualization, infographics and instructional materials. Students will explore information design problems in both stand-alone and system applications; digital (interaction) media, print, and environmental communication. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Develop a deep understanding of visual organization and information design. 2. Develop skills to analyze and design effective data visualizations and communication. 3. Learn to develop a visual narrative through the design process. 4. Understand the implications that information design skills hold for design management in the distillation of multivariate data. Demonstrate ability to create impactful and relevant data visualizations and information graphics. Course fee required. Prerequisites: DES 2710 (Grade C or higher). SP.
DES 3500. Interface Design. 3 Hours.
Students will learn a user-centered approach and process to design interfaces for web, mobile and software applications successfully. Exploration of grid structures, layouts, signs and symbols, branding, and typography as they relate to interface design. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Demonstrate an understanding of the design process as it relates to User Interface design through iterative, user-centered design practices and implementations. 2. Demonstrate proficiency in the evaluation, presentation, design, and delivery of a successful User Interface. 3. Demonstrate use of appropriate layout, typography, color and visual hierarchy for User Interface design. 4. Demonstrate the ability to analyze, synthesize, and develop probable solutions. 5. Combine excellent craft skills with strong conceptual abilities. 6. Effectively collaborate on projects while working in teams. Course fee required. Prerequisites: WEB 1400 (Grade C or higher); AND DES 2300 (Grade C or higher); AND DES 2710 (Grade C or higher). SP.

DES 3600. 3-D Visualization. 3 Hours.
Introduces three-dimensional modeling and rendering techniques on the computer, including various modeling processes, defining and applying textures, assembling scenes, and rendering images, which are applicable to realistic package and product designs, motion picture effects, video game assets, as well as graphics for desktop or Internet publishing projects. Course fee required. Prerequisites: ART 1130 (Grade C or higher). FA.

DES 3710. Typography II. 3 Hours.
Covers typography as a functional and experimental medium and typeface design. Students develop typographic solutions that explore verbal/visual messages in designs for publication through design problem-solving for a diverse range of specifications, including audience, client needs, and budget constraints, using traditional and digital tools. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Explain the various systems used to classify typefaces and file formats. 2. Relate the principles and practice of typeface design & nomenclature. 3. Design an original typeface family including all glyphs, punctuation and diacritical marks. 4. Analyze, synthesize, and develop probable typeface design solutions. 5. Demonstrate excellent craft skills with strong conceptual abilities. 6. Collaborate on projects while working in teams. Course fee required. Prerequisite: DES 2300 (Grade C or higher); AND DES 2710 (Grade C or higher). FA.

DES 3780. Production Design. 3 Hours.
Overview of desktop publishing and digital imaging in the prepress industry. Topics include input and output, correct creation of digital files, data storage, proofing methods, and relevant terminology/communication with prepress and printing professionals. Also acquaints students with the variety of jobs offered in the field, file evaluation, and much more. Field trips to printers and other prepress service providers reinforce lectures/projects. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Demonstrate the ability to create print ready digital files for output. 2. Distinguish the difference between process and spot color systems. 3. Identify and decide between various printing and production techniques. 4. Analyze, synthesize, and develop probable design solutions. 5. Combine excellent craft skills with strong conceptual abilities. Course fee required. Prerequisite: DES 2300 (Grade C or higher) and DES 2710 (Grade C or higher). SP.

DES 3800. Branding. 3 Hours.
Explores the history, psychology and purpose of corporate identity programs and the role of communication design in the current corporate environment by analyzing, investigating, and reporting on current company corporate objectives and target markets and then designing a sound multifaceted identity program. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Demonstrate and understanding of thought process, practical consideration, and application of creating a brand. 2. Analyze and compare the difference between a logo and a brand. 3. Create an effective brand usage guide. 4. Evaluate and critique brand as a system. 5. Summarize design decisions both orally and in writing. 6. Collaborate on projects while working in teams. Course fee required. Prerequisite: DES 2300 (Grade C or higher) and DES 2710 (Grade C or higher). FA.

DES 3850. Graphic Design Problems. 3 Hours.
For students pursuing a Graphic Design degree or an emphasis in Digital Design; also open to other interested students. Students will develop critical thinking, research, and practical skills related the graphic design industry. Students solve design problems by designing for commercial media, self-promotion. Includes practical exercises in project management and other real-world applications. Course content changes by semester to reflect current trends and issues in the design industry. Course fee required. Prerequisites: DES 2100 (Grade C or higher); AND DES 2300 (Grade C or higher); AND DES 2710 (Grade C or higher). FA.

DES 4100. Interaction Design. 3 Hours.
Exploration of advanced User Interface and User Experience design. Students will learn how to use words, visual representations, objects or space, time and behavior to create successful interaction between a user and a product which enables the user to achieve their objective(s) in the best way possible. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Demonstrate the ability to analyze, synthesize, and develop probable solutions. 2. Learn the process of interaction design, including crafting user flows, site mapping, sketching, wireframing, prototyping, and creating mock-ups. 3. Perform user research, develop user stories, and implement user testing. 4. Create and evaluate interactive prototypes and/or high-fidelity prototypes. 5. Combine excellent craft skills with strong conceptual abilities. Course fee required. Prerequisites: DES 2100 (Grade C or higher); AND DES 2300 (Grade C or higher). SP.

DES 4200. Tangible Interaction. 3 Hours.
This course explores the use of tangible interaction in relationship to emerging technologies. Students will explore the how humans interact with technology while creating tangible objects that affect how we work, play, communicate and learn. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Demonstrate the ability to analyze, synthesize, and develop probable solutions. 2. Understand the process of planning and executing tangible interactive work. 3. Combine excellent craft skills with strong conceptual abilities. 4. Effectively collaborate on projects while working in teams. 5. Criticize and discuss tangible artifacts through low and high resolution prototypes. 6. Design, implement and communicate tangible interaction concepts. 7. Demonstrate practical and conceptual ways of utilizing tangible interaction. Course fee required. Prerequisites: CS 1400 (Grade C or higher); AND DES 2100 (Grade C or higher). FA.
DES 4300. Motion Graphics II. 3 Hours.
A continuation of the course DES 3300 Motion Graphics I. Students will learn intermediate and advanced techniques and principles of motion graphics design, video editing, animation, sound integration, pre-production, and post-production. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Demonstrate an understanding of the design process as it relates to Motion Graphics through iterative, user-centered design practices and implementations. 2. Demonstrate proficiency in all steps of the Motion Graphics creation process from planning, pre-visualization, creation, revision, and finalization. 3. Demonstrate an understanding of the principles of non-linear motion graphics systems and proficiency in at least one industry-standard system. 4. Demonstrate the ability to analyze, synthesize, and develop probable solutions. 5. Combine excellent craft skills with strong conceptual abilities. 6. Effectively collaborate on projects while working in teams. 7. Demonstrate an understanding of the persuasive and informative advantages and responsibilities inherent in motion graphics, and synthesize solutions to ethical considerations. 8. Demonstrate persistence in the process of revision while iterating motion graphics projects from start to finish. Course fee required. Prerequisites: DES 3300 (Grade C or higher). FA (odd).

DES 4600. Senior Project. 3 Hours.
For students pursuing a degree in Design. Emphasizes application of skills to commercial projects through design of or contribution to various private sector or university internet projects, print, and multimedia projects. Includes portfolio development. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Identify, devise and produce a meaningful design project with approval from the instructor. 2. Construct prototypes, user experiences, and final projects using the design thinking process. 3. Identify and assemble necessary resources for the completion of projects. 4. Demonstrate ability to collaborate on projects while working in teams. 5. Articulate project goals both orally and in writing. Course fee required. Prerequisite: Senior standing. SP.

DES 4650. Publication Design. 3 Hours.
Explores creative, functional, and aesthetic aspects of editorial design with emphasis on page layout. Students will focus on the significance of consistency and thematic continuity, developing aesthetic awareness, and integrating design principles. Students will refine and further develop visual judgment in the arrangement of type and images to effectively convey visual messages. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Analyze and identify the elements of successful branding and package design. 2. Describe current production methods and terminology. 3. Relate various legal, regulatory, pricing, materials and construction issues. 4. Construct professional mockups and prototypes. 5. Evaluate and critique packaging design and construction. 6. Complete multiple types of packaging concepts of portfolio quality design and craftsmanship. Course fee required. Prerequisites: DES 2300 (Grade C or higher); AND DES 2710 (Grade C or higher). SP.

DES 4750. Package Design. 3 Hours.
The course explores the various facets and theories of package design while applying design principles to create effective packaging solutions for a variety of products. Students will take design projects from concept phase to three-dimensional working prototypes. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Analyze and identify the elements of successful branding and package design. 2. Describe current production methods and terminology. 3. Relate various legal, regulatory, pricing, materials and construction issues. 4. Construct professional mockups and prototypes. 5. Evaluate and critique packaging design and construction. 6. Complete multiple types of packaging concepts of portfolio quality design and craftsmanship. Course fee required. Prerequisites: ART 1130 (Grade C or higher); AND DES 2300 (Grade C or higher); AND DES 2710 (Grade C or higher). SP.

DES 4900R. Independent Research. 1-3 Hours.
For students pursuing a degree in Design with advanced standing who wish to pursue a specific focus of study related to their degree emphasis and/ or research interest not otherwise available in the current Design curriculum. Students are closely supervised by appropriate faculty in the design and successful completion of the course. The course is dependent upon a formal contractual arrangement with the faculty member that is submitted at the beginning of the semester in which coursework is undertaken, and is contingent upon the department chair's approval. Students meet with the faculty mentor each week and provide progress reports for feedback. Students are required to meet the university requirement of 45 hours of work per credit. Variable credit 1.0 - 3.0. Repeatable up to 3 credits subject to graduation restrictions. Offered by arrangement. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Analyze and solve design challenges. 2. Categorize and synthesize a project exploring new topics and emerging areas of the industry. 3. Articulate project goals both orally and in writing. 4. Critique and articulate research and project findings to instructors and peers. Course fee required.

DES 4920. Internship. 3 Hours.
Designed to integrate Design students into working environments that increase aptitude, skills, and networking. The internship setting will nurture a mentor learning relationship with the student, and assist them in preparation for after graduation. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Analyze and solve design problems from an employment perspective. 2. Survey new topics and emerging areas of the practice of design. 3. Evaluate and critique personal work and the work of others. 4. Demonstrate ability to effectively collaborating on projects while working in teams. 5. Communicate findings and research to instructor and employers. Prerequisite: DES 2300 (Grade C or higher); AND Instructor Permission. FA, SP, SU.

DES 4990. Special Topics in Design. 3 Hours.
For students wishing instruction that is not available through other regularly scheduled courses in this discipline. Occasionally, either students need some type of non-traditional instruction, or an unanticipated opportunity for instruction presents itself. This course may include standard lectures, travel and field trips, guest speakers, laboratory exercises, or other nontraditional instruction methods. Repeatable for credit as topics vary, up to 6 credits. Offered by arrangement. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Identify, complete and analyze portfolio quality work. 2. Describe and assess specialized insights and practices to design challenges using the design thinking method. 3. Articulate findings both orally and in writing. Course fee required. Prerequisites: Instructor permission.
IT 1100. Introduction to Unix/Linux. 3 Hours.
Required of all Computer and Information Technology majors, and open to students with a general interest in computer operating systems. Introduces operating system concepts, including file systems, process management, user management, and security. Students will install and configure LINUX and MAC OS. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Use basic Linux commands to interact with directories, files, processes, and the system. 2. Demonstrate that they understand the Ubuntu file system hierarchy. 3. Manipulate files using a text editor from the command line. 4. Analyze log files and make informed decisions as to what log files are telling them. 5. Write basic shell scripts. 6. Perform basic administration tasks like installing programs, adding users, connecting to the network, formatting a file system, etc. Course fee required. FA, SP.

IT 1200. A+ Computer Hardware/Windows OS. 3 Hours.
This course covers installation, repair and maintenance of computer hardware. It also discusses installation, repair and maintenance of the Microsoft Windows operating system. This course prepares the student to take the CompTIA A+ certification exams. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Select and configure PC computer hardware. 2. Install, repair and support PC computer hardware. 3. Install, repair and support the Microsoft Windows operating system. 4. Pursue TestOut PC Pro certification. 5. Pursue COMPTIA A+ (220-901 & 220-902) certification. Course fee required. FA, SP.

IT 2400. Intro to Networking. 3 Hours.
Required of all Computer Science and Computer and Information Technology majors, and open to students with a general interest in computer networking. Introduces fundamental concepts of computer networks, including physical, transport, and application layers through completion of assignments predicting and measuring the behavior of computer networks under various conditions. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Pursue the CompTIA Network+ certification. 2. Explain how the Internet works. 3. Design, connect and implement a computer network. 3. Define and use different Internet protocols. 4. Describe the TCP/IP and OSI protocol stacks and what happens at each layer. 5. Use networking tools to troubleshoot network problems. Course fee required. Prerequisite: IT 1100 (Grade C- or higher). FA, SP.

IT 2500. Cloud Computing. 3 Hours.
Cloud Architecting covers the fundamentals of building IT infrastructure on Amazon Web Services and other cloud providers. The course is designed to teach solutions architects how to optimize the use of the Cloud by understanding cloud services and how these services fit into cloud-based solutions. Because architectural solutions can differ depending on industry, type of applications, and size of business, this course emphasizes best practices for the cloud, and it recommends various design patterns to help you think through the process of architecting optimal IT solutions. It also presents case studies throughout the course, which showcase how some cloud customers have designed their infrastructures, and the strategies and services that they implemented. Finally, this course also provides opportunities to build a variety of infrastructures via a guided, hands-on approach. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Discuss cloud-based concepts and terminology. 2. Evaluate business needs and propose cloud solutions. 3. Utilize current cloud technologies to develop and implement computing solutions. 4. Successfully pass an AWS accreditation exam. Course fee required. Prerequisite: IT 2400 (Grade C- or higher). FA.

IT 3100. Systems Design and Administration I. 3 Hours.
Required of Computer and Information Technology majors and students with an emphasis in Information Technology. Covers system administration topics for managing Internet facing services, including DNS, SMTP, and HTTP. Students will install, configure, and test services in a server environment. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Perform a system installation. 2. Perform user and filesystem administration. 3. Perform configuration of DNS, web, email and database services. 4. Perform securing network and local services. 5. Perform shell scripting. Course fee required. Prerequisites: CS 1400 (Grade C- or higher); AND IT 2400 (Grade C- or higher). FA.

IT 3110. System Automation. 3 Hours.
Enhances student administrative skills by promoting use of programming structures to manipulate, configure, and maintain systems. Image creation, collection, and dissemination will also be covered. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Provision a DHCP server and automate clients to interact with DHCP server. 2. Provision, configure, and manage systems through the use of automated scripts and tools. 3. Capture and deploy operating system images without manual intervention. 4. Collect and rotate logs from various servers in a central location. 5. Develop scripts that will automate various tasks. Course fee required. Prerequisite: IT 3100 (Grade C- or higher). SP.

IT 3150. Windows Servers. 3 Hours.
Students will learn Windows's server management techniques to support a small to medium-sized business. Topics covered will include DHCP, DNS, IT, Windows Roles, Workgroups, Active Directory, and Domain Management. File and printer sharing will also be discussed. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Install and configure Windows Server. 2. Administer effectively Windows Server. 3. Configure communication and replication between Windows servers. 4. Deploy, integrate and configure Hyper-V into the network. 3. Describe the purposes and implementations of various Windows Server roles, role services and features. 4. Install and configure Active Directory. 5. Implement and deploy Group Policies. 6. Pursue the Microsoft Installing and Configuring Windows Server (70-740) certification exam. Course fee required. Prerequisites: IT 1200 and IT 2400 (both Grade C- or higher). SP.
IT 3300. DevOps Virtualization. 3 Hours.
Full Operating System virtualization as well as container or application virtualization topics will be covered. Automated deployment using configuration files. Management topics such as load-balancing, auto-failover, and high availability will also be discussed. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Manage and configure enterprise virtualization requirements. 2. Describe and explain the different types of virtualization. 3. Provide redundancy and failover solutions for virtual environments, practice migration. 4. Write automated deployment scripts to provide virtual environments. Prerequisite: IT 2400 (Grade C- or higher). FA.

IT 3400. Intermediate Computer Networking. 3 Hours.
Building upon basic networking concepts, this course covers VPNs, remote connectivity, mobile networking, unified communication, IoT hardening and network monitoring. Hands on labs are a significant portion of the course. At the end of this course, students will be ready for the CompTIA Network+ certification exam. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Describe and configure virtual private networks. 2. Design, deploy and manage Virtual LANs. 3. Classify and summarize WAN technologies such as SONET, MPLS, and remote access methods. 4. Manage and secure mobile and IoT devices on the network. 5. Deploy and administer network monitoring tools. 6. Prepare for and pass the CompTIA Network+ Certification exam. Course fee required. Prerequisites: IT 2400 (Grade C- or higher). FA, SP.

IT 4060. Big Data Analytics. 3 Hours.
Course focuses on a theoretical and hands-on exploration of business intelligence and analytics. It covers current best practices in statistical and quantitative analysis using large-scale data sets, exploratory and predictive models, and evidence-based methods to improve business decisions and actions. Dual listed with ISA 4060 (students may only take one course for credit). **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Identify the key components and concepts associated with big data analytics. 2. Apply big data and statistical best practices to collect, clean, transform, and store large-scale data for subsequent analysis. 3. Analyze large-scale data sets to identify hidden patterns. 4. Evaluate data models using best practices. 5. Create recommendations for improving business decisions based on the data analysis. Prerequisites: STAT 2040 OR MATH 1040 (Grade C- or higher). FA.

IT 4070. Data Visualization and Storytelling. 3 Hours.
A focus on the methods, tools and processes to effectively visually encode and present insights discovered from previously analyzed data. It includes practice transforming simple and complex data analysis outputs into relevant, accurate, and effective visual displays to improve communication and decision making. Dual listed with ISA 4070 (students may only take one course for credit). **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Identify the key components and concepts associated with data visualization. 2. Recognize the ethical and financial consequences of poor data visualization techniques. 3. Differentiate between effective and ineffective methods in data analysis reporting. 4. Create graphically encoded data into useful formats from previously analyzed data. 5. Demonstrate the accurate communication of statistical findings for real world big data problems to decision makers with diverse skill levels. SP.

IT 4100. Files Systems and Storage Technologies. 3 Hours.
Classic, virtualized, and cloud storage will be covered. Topics such as RAID, NAS, SAN will be covered. Business continuity for backup and replication of storage. Local vs. Remote file systems. We will explore older and newer OS filesystems and compare them (such as fat32, ntfs, ext3, ext4, btrfs). **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Evaluate key filesystems technologies (both local and remote) and implement these filesystems. 2. Evaluate storage architectures and key data center elements in classic, virtualized, and cloud environments. 3. Explain physical and logical components of a storage infrastructure including storage subsystems, RAID, and intelligent storage systems. 4. Articulate business continuity solutions backup and replication, and archive for managing fixed content. Course fee required. Prerequisite: IT 3100 (Grade C- or higher). FA.

IT 4200. DevOps Lifecycle Management. 3 Hours.
Takes students through the DevOps lifecycle. Students will develop practical skills in continuous integration, cloud provisioning, configuration management, continuous deployment, continuous monitoring, and continuous feedback. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Create and sign certificates, and run an SSL enabled server. 2. Describe and configure continuous integration. 3. Describe and configure continuous delivery. 4. Use automated tools for provisioning and configuration. 5. Utilize a version control system. Course fee required. Prerequisites: CS 1400 (Grade C- or higher) AND IT 2400 (Grade C- or higher) OR CS 2810 (Grade C- or higher). FA.

IT 4300. Database Design & Management. 3 Hours.
Required of students pursuing an Information Technology emphasis. Covers administration of database management systems, logical database design, implementation of database designs, and application development using a DBMS. Students will design, manage, and implement databases and applications that use databases. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. 1. Design an effective database system. 2. Demonstrate the proper use of database normal forms. 3. Demonstrate the proper use of the SQL programming language. Course fee required. Prerequisites: CS 1400 (Grade C- or higher) AND IT 1100 (Grade C- or higher) OR CS 1410 (Grade C- or higher). FA, SP.

IT 4310. Database Administration. 3 Hours.
This course covers the database architecture and environment. Students will be able to manage user access control. Students will be able to perform backup, restore, and recovery operations. Students will be able control performance and optimization issues. It covers updating and upgrading of a database system. Students will be able to perform the importing and exporting of data to/from a database. Dual listed with CS 4310 (only one course may be taken for credit). **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Manage and organize data into a database. 2. Backup and restore a database. 3. Tune a database for better performance performance. 4. Import/export data to and from a database. Course fee required. Prerequisites: IT 4300 (Grade C- or higher). FA.
IT 4400. Network Design & Management. 3 Hours.
Required of students pursuing an Information Technology emphasis. Covers the design, management, and monitoring of a network. Hands-on configuration experience of layers 1, 2, and 3 will be given on both LAN and WAN levels. The successful student will be prepared to successfully complete the CCNA exam. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Create and assign subnets and vlans. 2. Manage Cisco Devices. 3. Manage a small network. 4. Explain and implement different routing protocols. Course fee required. Prerequisite: IT 3400 (Grade C- or higher). FA.

IT 4500. Information Security. 3 Hours.
Required of students pursuing an Information Technology emphasis. Reviews current security exploits, vulnerabilities, and countermeasures. Covers general security models and architectures, encryption and forensics. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Pursue CompTIA Security+ certification (SY0-501). 2. Describe the fundamentals of Information Security. 3. Identify security vulnerabilities in networks, operating systems, and other computer-related environments. 4. Explain the legal and ethical aspects of computer security. 5. Respond to active and passive security attacks. Course fee required. Prerequisites: CS 1400 (Grade C- or higher); AND IT 3100 (Grade C- or higher). FA.

IT 4510. Ethical Hacking & Network Defense. 3 Hours.
This course provides an in-depth, hands-on experience in effectively protect networks. Students will learn the tools and penetration testing methodologies used in ethical hacking. Additionally, cyber-ethics regarding piracy, intellectual property, and fair information practices will be discussed along with state, federal, and international laws governing information technology. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Define ethical hacking. 2. Enumerate threat vectors and proper defense mechanisms against them. 3. Examine emerging areas of cloud, development, and mobile hacking. 4. Develop defense skills against malware, DoS, backdoors and more. Course fee required. Prerequisites: CS 1410 (Grade C- or higher); AND IT 2400 (Grade C- or higher). SP.

IT 4600. Senior Project. 3 Hours.
Required of students pursuing an Information Technology emphasis. Students will complete an aggressive information technology project. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Prepare for and pass two industry-level certifications. 2. Produce a resume. 3. Network with industry professionals. 4. Demonstrate interactive skills by participating in mock interviews. Course fee required. Prerequisite: Senior status. SP.

IT 4920R. Internship. 1-3 Hours.
Internship course in Information Technology. Variable credit 1.0 - 3.0. Repeatable up to 3 credits subject to graduation restrictions. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Apply IT skills in producing an IT project in a real world environment. 2. Design a real IT project that follows budget, timeline and technology guidelines and restrictions. 3. Collaborate with IT supervisors, team leaders and team members in an IT project. 4. Align an IT project with stated business objectives. 5. Analyze a project outcome to improve future efficiency and innovation. 6. Present a comprehensive project reflection report comparing objectives to outcomes. Prerequisite: Instructor permission. FA, SP, SU.

IT 4990. Special Topics in Information Technology. 3 Hours.
For students wishing instruction that is not available through other regularly scheduled courses in this discipline. Occasionally, either students need some type of non-traditional instruction, or an unanticipated opportunity for instruction presents itself. This course may include standard lectures, travel and field trips, guest speakers, laboratory exercises, or other nontraditional instruction methods. Repeatable for credit as topics vary, up to 12 credits. Offered by arrangement. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Demonstrate learning through original and creative ideas. 2. Use appropriate strategies and tools to represent, analyze, and integrate seminar-specific knowledge. 3. Develop the ability to think critically about course content. 4. Apply knowledge from seminar to a range of contexts, problems, and solutions. Course fee required. Prerequisite: Instructor permission.

IT 4991. Seminar in Information Technology. 0.5-3 Hours.
For students wishing instruction that is not available through other regularly scheduled courses in this discipline. Occasionally, either students request some type of non-traditional instruction, or an unanticipated opportunity for instruction presents itself. This seminar course provides a variable credit context for these purposes. As requirements, this seminar course must first be pre-approved by the department chair; second, it must provide at least nine contact hours of lab or lecture for each credit offered; and third, it must include some academic project or paper (i.e., credit is not given for attendance alone). This course may include standard lectures, travel and field trips, guest speakers, laboratory exercises, or other nontraditional instruction methods. Note that this course in an elective and does not fulfill general education or program requirements. Fees may be required for some seminar courses and instructor permission will be optional at the request of the instructor. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Develop and build computerized systems using a specific methodology or set of tools. 2. Extrapolate the specialized insights and practices of a specific computational system to a wider field of practice. 3. Apply general purpose problem skills in system construction and problem solving to a specific problem domain.
WEB 1400. Web Design I: Fundamentals (ALCS). 3 Hours.

For students pursuing a degree in Computer and Information Technology. Covers fundamental principles of front-end web design, including beginner's hands-on experience with HTML and CSS in planning, organizing, analysis, and designing websites. Introduces key foundation concepts such as Internet infrastructure, web page creation and publishing, wire framing, layout techniques, multimedia, content, color, typography, and accessibility. This course is designated as an Active Learning Community Service (ALCS) course. Students provide service in areas of public concern in a way that is mutually beneficial for both the student and community. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Demonstrate an understanding of the general workings of the Internet and infrastructure. 2. Use web authoring and design environment - tools, browsers, servers. 3. Apply current and past web markup & styling languages and their differences. 4. Compare careers within web design & development. 5. Apply the development process. 6. Use multimedia optimization and preparation. 7. Apply design principles to the web. 8. Apply user interaction and communication. Course fee required. FA, SP.

WEB 3200. Web Application Development I. 3 Hours.

For students pursuing an emphasis in Web Design & Development, or other students interested in writing applications for the modern web. Covers the fundamentals of three-tier web applications, including client-side code for modern browsers, server code using representative languages, and integration with database systems; also covers the protocols that connect these components and the environments in which they run. Dual listed with CS 3200 (students may only take one course for credit). **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Develop modern web applications using both client-side and server-side languages and technologies. 2. Integrate database technologies into the ecosystem of a web application at a fundamental level. 3. Deploy the environments and infrastructure required by web application servers and related systems. 4. Implement the architectures, protocols and standards necessary to interconnect the client-side and server-side components. Course fee required. Prerequisites: CS 1410 (Grade C- or higher); AND WEB 1400 (Grade C- or higher). FA, SP.

WEB 3400. Web Design II: Essentials (ALCS). 3 Hours.

For students pursuing a degree in Computer and Information Technology. Covers intermediate concepts of front-end web design and development, including essential hands-on experience with HTML, CSS, JavaScript, and other web publishing tools. Essential concepts such as domain and hosting infrastructure, modern web design frameworks & libraries, user interface and experience, e-commerce, web promotion, legal models, development environments, and interactivity are all examined. This course is designated as an Active Learning Community Service (ALCS) course. Students provide service in areas of public concern in a way that is mutually beneficial for both the student and community. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Use internet infrastructure, hosting, and tools. 2. Apply current web markup, styling, and scripting languages, and supporting front-end web technologies. 3. Implement commercial web site development and team implementation strategies. 4. Design for web accessibility. 5. Apply basic backend development practices. 6. Communicate a message through a rich user interface and experience. 7. Design for various web environments. 8. Improve online web promotion. 9. Know current web security, legal, social, and professional issues. Course fee required. Prerequisites: DES 1300 (Grade C- or higher); AND WEB 1400 (Grade C- or higher). FA, SP.

WEB 3450. Software Engineering. 3 Hours.

Students will take on a challenging team project. Students will also learn about the software lifecycle and its phases. Dual listed with CS 2450 (students may take only one course for credit). **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Explain software engineering knowledge and skills and of the professional standards necessary to begin practice as a software engineer. 2. Apply and compare appropriate theories, models, and techniques that provide a basis for problem identification and analysis, software design, development, implementation, verification, and documentation. 3. Construct reliable software artifacts, both individually and as part of a team. 4. Evaluate trade-offs in software engineering practices and determine appropriate balances in project decision making. 5. Employ new models, techniques, and technologies as they emerge and appreciate the necessity of such continuing professional development. Course fee required. Prerequisites: WEB 3200 (Grade C- or higher); AND WEB 3400 (Grade C- or higher). FA, SP.

WEB 3500. Tech Entrepreneurship. 3 Hours.

For students pursuing a Computer & Information Technology degree. Also open to other interested students. Covers concepts and principles of electronic commerce from an interdisciplinary approach, including computer sciences, marketing, consumer behavior, finance, economics, and information systems. Specifics include electronic commerce process steps, Internet infrastructure, demographics, marketing and market research, advertising, promotion, strategy development, financing, competitive analysis, technical development, Web site review, launch, and on-going innovation. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Demonstrate the ability to identify a problem, then analyze and prepare a solution essential to successful problem solving. 2. Exhibit the ability to synthesize multiple sources of information to solve problems, and use one's experiences and other sources of information to create new insights and generate better problem solving approaches. 3. Demonstrate the ability to create, think, design, and/or build prototype solutions for problems or product ideas. 4. Facilitate the constant change of technology by fostering intellectual curiosity and the ability to access information from diverse sources as well as relating knowledge to daily life and defining issues within larger contexts. 5. Demonstrate an awareness and an understanding of these issues as the apply to technology entrepreneurship by articulating and integrating relevant ethical, legal, social, and technical concerns into their projects and exhibiting an openness to ideas different from or in conflict with one's own, including assumptions, prejudices, and privileges. 6. Demonstrate the ability to function effectively in teams to accomplish stated goals. using advanced knowledge skills in problem solving positive work ethic, effective use of technology, and understanding team-centric workplace culture, improved social behavior and competent professional skills to obtain and maintain successful employment within an organization, business, or other entity. 7. Demonstrate convincing technical communications skills, both orally and in writing by exhibiting the ability to be a useful team member, capable of working in groups on strategic problems. 8. Apply and understand technology entrepreneurship process elements including (a) opportunity assessment, (b) market research, (c) competitive assessment, (d) strategy development, (e) finance development, (f) risk assessment, (g) technology development, (h) web review, (i) launch, and (j) ongoing innovation. Course fee required. FA, SP.
WEB 3550. Online Marketing and SEO (ALCS). 3 Hours.
For students interested in Internet Marketing and Search Engine Optimization (SEO). Introduces key online marketing concepts such as target demographics, pay-per-click advertising, social media outreach, AB testing, re-targeting, keyword optimization, link building, site analytics, and industry standard methods/tools to increase online traffic, conversions, and site goals. This course is designated as an Active Learning Community Service (ALCS) course. Students provide service in areas of public concern in a way that is mutually beneficial for both the student and community. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Implement Internet Marketing Strategies through PPC, social media, content curation, blogging, re-targeting, video, reviews, subscription based, Search Engine Algorithms, Onsite and Offsite SEO, and emerging techniques. 2. Use industry standards and practices. 3. Analyze and track data to measure and quantify web traffic, goals, and conversions. Course fee required. FA, SP.

WEB 4200. Web Application Development II. 3 Hours.
For students pursuing an emphasis in Web Design & Development, or other students interested in writing applications for the modern web. Covers advanced concepts and topics in client-side and server-side web application development. Students will be introduced to a variety of modern software frameworks, languages, architectural patterns, and techniques in order to create interactive, data-centric web applications. Dual listed with CS 4200 (students may only take one course for credit). **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Develop modern web applications using both client-side and server-side languages and technologies. 2. Assess the makeup of various client-side and server-side web application frameworks and their constituent components. 3. Create an interactive user experience using a client-side framework and interaction with a web service. 4. Implement the architectural and design patterns used by web application frameworks, and justify how they are used to produce maintainable and scalable web applications. Course fee required. Prerequisites: WEB 3200 (Grade C- or higher). SP.

For students pursuing a degree in Computer and Information Technology. Covers mastery-level web design and development practices. Hands-on experience developed using advanced technologies such as HTML, CSS, JavaScript, content management systems, advanced web frameworks & libraries, and other advanced front-end technologies. In-depth web topics are covered including: advanced design techniques, user interface and experience, interactivity, animation, and other web related concepts are covered. This course is designated as an Active Learning Community Service (ALCS) course. Students provide service in areas of public concern in a way that is mutually beneficial for both the student and community. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Develop design & implement industry standard & professional websites. 2. Create front end web scripting, styling, and structure. 3. Animate interactive web elements. 4. Develop various content manage systems. 5. Create user interface, experience, and interaction design in relation to the web. 6. Use current libraries & framework systems. Course fee required. Prerequisites: DES 3500 (Grade C- or higher); AND WEB 3400 (Grade C- or higher). FA.

WEB 4600. Senior Project. 3 Hours.
For students pursuing a degree in Computer and Information Technology. Emphasizes application of skills to commercial projects through design of or contribution to various private sector or university internet projects, print, and multimedia projects. Includes portfolio development. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Identify and plan a meaningful project, break down the project into workable items, and then attach timelines to project elements to ensure student/project work accountability. 2. Produce prototypes, designs, code, and user experiences as needed by the project or product or design using iterative processes and feedback to demonstrate continuous improvement overtime. 3. Identify and assemble necessary resources for the completion of project work. 4. Plan and implement all aspects of the instructor approved project. 5. Demonstrate the ability to function effectively in teams to accomplish stated goals. Students will demonstrate advanced knowledge skills in problem solving positive work ethic, effective use of technology, and understanding team-centric workplace culture. 6. Demonstrate convincing technical communications skills, both orally and in writing exhibiting the ability to be useful team members, capable of working in groups projects and also initiating self learning and independent work as is necessary for the approved project. 7. Demonstrate accountability and responsibility with development processes by submitting weekly project updates on hourly workload, meaningful project progress, iterative changes, new learning, and project challenges. Course fee required. Prerequisite: Senior standing. SP.

WEB 4900R. Independent Research. 1-3 Hours.
For students pursuing an emphasis in Web Design and Development with advanced standing who wish to pursue a specific focus of study related to their degree emphasis and/or research interest not otherwise available in the current Web Design and Development curriculum. Students are closely supervised by appropriate faculty in the design and successful completion of the course. The course is dependent upon a formal contractual arrangement with the faculty member that is submitted at the beginning of the semester in which coursework is undertaken, and is contingent upon the department chair's approval. Students meet with the faculty mentor each week and provide progress reports for feedback. Students are required to meet the university requirement of 45 hours of work per credit. Variable credit 1.0 - 3.0. Repeatable up to 3 credits subject to graduation restrictions. Offered by arrangement. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Analyze and solve web problems within a development environment. 2. Research new topics and emerging areas of the industry. 3. Communicate findings and research to instructors. Course fee required. Prerequisite: Senior standing. SP.

WEB 4920. Internship (ALPP). 3 Hours.
For students pursuing a degree in Computer and Information Technology. Designed to integrate Web Design & Development students into working environments that increase aptitude, skills, and networking. The internship setting will nurture a mentor learning relationship with the student, and assist them in preparation for after graduation. This course is designated as an Active Learning Professional Practice (ALPP) course. This course allows students to explore and apply content learned in the course in a professional experience away from the classroom. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Analyze and solve web problems from an employment environment. 2. Research new topics and emerging areas of the business. 3. Communicate findings and research to employers. Prerequisite: Instructor permission. FA, SP, SU.
WEB 4990. Special Topics in Web Development. 3 Hours.
For students wishing instruction that is not available through other regularly scheduled courses in this discipline. Occasionally, either students need some type of non-traditional instruction, or an unanticipated opportunity for instruction presents itself. This course may include standard lectures, travel and field trips, guest speakers, laboratory exercises, or other nontraditional instruction methods. Repeatable for credit as topics vary, up to 6 credits. Offered by arrangement. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Develop and build web or mobile systems using a specific software framework or methodology. 2. Extrapolate the specialized insights and practices of a specific development system to a wider field of practice. 3. Apply general purpose problem solving skills to a specific problem domain.