# Informatics

The Department of Informatics consists of two divisions: Information Systems and Information Technology. All Informatics degree programs are STEM degrees (STEM = Science, Technology, Engineering and Math).

The Division of Information Systems (IS) demonstrates a long history of integrating innovation, research and education at the intersection of people, information and computing technology. Our state-of-the-art curriculum, with a hands-on focus in web, social media, data science, business applications, and user experience, provides students with solid career knowledge, design and implementation skills, and leadership preparation. Students at all levels engage in research alongside distinguished professors, creating, applying and disseminating fundamental knowledge and innovative approaches. Research concentrates in two rigorous tracks -- data-intensive research and human-centered computing -- conducted by faculty who win teaching awards, highly competitive grants, best paper awards, write books, and publish extensively in very selective journals.

Information Technology (IT) is the "practitioner focused" discipline within the field of computing. The BS IT degree program, the applied computing degree at NJIT, provides a balanced approach to software and hardware applications and their conceptual underpinnings. Moreover, the program offers an array of specializations that prepare students to enter various areas of the information economy. IT courses are taught by faculty and industry professionals having years of IT experience. Students benefit from a hands-on approach that provides them with a real grasp of the actual technology, development tools, and paradigms in demand in the IT industry.

## A

Ancis, Julie, Distinguished Professor

## B

Bieber, Michael P, Professor Emeritus

C

Cartwright, Mark, Assistant Professor

Chakareski, Jacob, Associate Professor

D

Daher, Salam, Assistant Professor

Deek, Fadi, Distinguished Professor

Deek, Maura, Senior University Lecturer

## E

Egan, Richard, Senior University Lecturer

Eljabiri, PhD, Osama, Senior University Lecturer

## F

Farley, Jennifer, University Lecturer

## H

Halper, Michael, Professor, Interim Chair (Full Professor)

Hendela, Arthur, Senior University Lecturer

Hiltz, S. R, Professor Emeritus

Hoover, Amy, Assistant Professor

## J

Jones, Quentin, Associate Professor

## K

Kehoe, Donald, University Lecturer

## L

Lee, Michael, Associate Professor

Lee, Sooyeon, Assistant Professor

Lin, Lin, Senior University Lecturer, Associate Chair for Information Systems (Senior Lecturer)

## N

Nersesian, Eric, University Lecturer

## P

Patel, Dipesh, University Lecturer

## S

Scher, Julian M, Professor Emeritus

Senesy, Stanley, Senior University Lecturer

Sequeira, Marc, Senior University Lecturer

Spryszynski, Adam, University Lecturer

Statica, Robert, Senior University Lecturer

## T

Tolboom, Ryan, University Lecturer, Associate Chair for Information Technology (Associate Chair)

Toegal, Matthew, University Lecturer

U

Ullman, David, Professor of Practice, Director of Online Learning

## V

Vaish, Prabhat, Senior University Lecturer

Vinnikov, Margarita, Assistant Professor

Vohra, Rosemina, Senior University Lecturer

## W

Watrous-deVersterre, Lori, Senior University Lecturer

Wei, Hua, Assistant Professor

Weiss, Tomer, Assistant Professor

Williams, Keith, University Lecturer

Wohn,Yvette Associate Professor, Informatics

Wu, Brook, Associate Professor, Informatics

## Programs

- Business & Information Systems - B.S. (http://catalog.njit.edu/undergraduate/computing-sciences/information-systems/business-information-systems-bs/)
- Human-Computer Interaction - B.S. (http://catalog.njit.edu/undergraduate/computing-sciences/informatics/human-computer-interaction-bs/)
- Information Systems - B.A. (http://catalog.njit.edu/undergraduate/computing-sciences/information-systems/ba/)
- Information Technology - B.S. (http://catalog.njit.edu/undergraduate/computing-sciences/information-technology/bs/)
- Web & Information Systems - B.S. (http://catalog.njit.edu/undergraduate/computing-sciences/information-systems/web-information-systems-bs/)

Double Majors **(**http://catalog.njit.edu/undergraduate/academic-policies-procedures/special-degree-options/**)**

- Science, Technology and Society/Business and Information Systems - B.S. (http://catalog.njit.edu/undergraduate/computing-sciences/informatics/science-technology-society-business-information-systems-bs/)

Accelerated Programs **(**http://catalog.njit.edu/undergraduate/academic-policies-procedures/special-degree-options/**)**

- Information Technology - Accelerated B.S. and J.D. (http://catalog.njit.edu/undergraduate/computing-sciences/information-technology/accelerated-bs-jd/) (with Seton Hall School of Law)

- Data Analytics (http://catalog.njit.edu/undergraduate/computing-sciences/informatics/data-analytics-minor/)

- Design of the User Experience Minor (http://catalog.njit.edu/undergraduate/computing-sciences/informatics/human-computer-interaction-minor/)

- Business and Information Systems Minor (http://catalog.njit.edu/undergraduate/computing-sciences/informatics/bis-minor-not-computing-science-majors/) (not for YWCC majors)

- Business and Information Systems Minor (http://catalog.njit.edu/undergraduate/computing-sciences/informatics/bis-minor-computing-science-majors/) (for Computing Science majors)

- Game Development Minor (http://catalog.njit.edu/undergraduate/computing-sciences/informatics/game_development_minor/)

- Mobile and Web Minor (http://catalog.njit.edu/undergraduate/computing-sciences/informatics/web-information-systems-minor/)

- Information Technology Minor (http://catalog.njit.edu/undergraduate/computing-sciences/informatics/minor/) (not for Computing Sciences majors)

- Information Technology Minor (http://catalog.njit.edu/undergraduate/computing-sciences/informatics/minor-computing-science-majors/) (for Computing Sciences majors)

## Informatics Courses

**IS 117. Introduction to Website Development. 3 credits, 3 contact hours (3;0;0).**
This course discusses the concepts and skills required to plan, design and build websites. It will be taught in a lab to ensure hands-on experience with each of these tasks. The course begins with an overview of web technologies. Students learn to plan websites, which includes determining the business and end-user requirements for the site. Design includes learning to develop "mockups" of how the site will look and how people will use it. The major tools for building websites will be industry standard HTML and XHTML to describe webpage content, and Cascading Style Sheets (CSS) for flexibly formatting the content. Using XHTML and CSS makes it relatively simple to change formats across the entire site, as well as "future-proofs" a website, allowing it to be viewed on every major web browser (such as Firefox or Chrome) and easily adapt to changes in future browser technology. The course features substantial hands-on projects comprising websites of several interlinked pages and images, enabling students to thoroughly learn the course's important concepts and skills.

**IS 218. Building Web Applications. 3 credits, 3 contact hours (3;0;0).**
Prerequisites: (IS 117 or IT 202) and (CS 100, CS 113, or CS 115). This course provides a critical, hands-on introduction to the design of Web-based Information Systems. We will explore and discuss emerging trends, capabilities, and limitations of web technologies used to capture, store, access, and disseminate information for both businesses and online communities. Students, working in groups, will design and develop different types of web applications, which will then be analyzed and critiqued by the students as to their usability in actual public and private settings. An open-source web content management system will be utilized throughout the course.

**IS 219. Adv Website Development. 3 credits, 3 contact hours (3;0;0).**
Prerequisites: (IS 117 or IT 202) and (CS 100, CS 113, or CS 115). IS 218 is strongly encouraged as additional foundation knowledge. This course discusses the concepts and skills required to plan, design and build advanced websites, with a focus on sophisticated user interaction enabled by programming the web browser (such as Internet Explorer or Chrome). Such programming is known as client-side scripting. These interactive websites utilize forms to gather user inputs, and vary both the content and display of the webpages based on the current user tasks and preferences. This includes designing and dynamically changing tabs and menus, as well as expanding and contracting sections of pages. Students will develop a thorough understanding of website usability (designing effective sites that people like, security and user privacy, browser capability (ensuring websites work on every major web browser), and the tools and skills that web developers use to add interactive features to websites. These skills include Javascript (for programming interactive features), the Document Object Model or DOM (specifying the internal structure of web pages), JQuery (to access information utilizing this internal structure, create animations and generally streamline Javascript), browser variables (providing information about the browser characteristics), HTML input forms, form validation (ensuring correctness of user input), securing user input (to ensure user privacy), cookies (tracking user information), basic communication with the web server (which processes the information users input into forms), and AJAX ( which integrates many of these technologies). The course will be taught in a lab to ensure hands-on experience and will include substantial design and development projects.

**IS 245. Information Technology Systems: Hardware/Software. 3 credits, 3 contact hours (3;0;0).**
This course reviews hardware/software technologies in order to enable system developers to understand tradeoffs in the design of computer architectures for effective computer systems. Also covered are operating systems and systems architecture for networked computing systems. Topics include Hardware (CPU architecture, memory, registers, addressing modes, busses, instruction sets, multi processors versus single processors, and peripheral devices), Operating systems (processes, process management, memory and file system management), and Telecommunications (basic network components, switches, multiplexers and media, installation and configuration of multi-user operating systems).

**IS 247. Designing the User Experience. 3 credits, 3 contact hours (3;0;0).**
This course covers the design and evaluation of the human-computer interface in interactive computer systems. Among the topics covered are approaches to interface design such as menus, commands, direct manipulation; screen layout strategies; metaphor models; models of human information processes; evaluation approaches such as protocol for analysis, interactive monitoring, use of surveys; and requirements for documentation and help. Students are expected to design interface mockups and evaluate them.

**IS 257. Design Thinking: Addressing Structural Inequality. 3 credits, 3 contact hours (3;0;0).**
In this class, students are taught how to think like a designer. The class teaches students design thinking skills in the domain of information and computing. It leverages multiple forms of active learning, involves a significant amount of project-based learning, and helps students develop creative confidence. Students will identify and examine issues related to 'information gaps' which contribute to structural inequality. They will ideate, prototype, and iterate on designs to address these issues. Students will deliver a pitch video describing their idea(s).

**IS 265. Introduction to Information Systems. 3 credits, 3 contact hours (3;0;0).**
Information systems is the study of how organizations use information technology. This course is an overview of the information systems discipline, the role of information systems in organizations, and the changing nature of information technology. Computer tools for analysis and presentation are used. Students receiving degree credit for IS 265 cannot receive degree credit for MIS 245.

**IS 270. Designing the Multimedia Experience. 3 credits, 3 contact hours (3;0;0).**
Prerequisite: Completion of 100 level course in the computing sciences: CS 101 or CS 111 or CS 113 or CS 115 or IS 118. Multimedia combines text, graphics, sound, video, and animation in a single application. Preparation for creating multimedia information systems, and understanding the crucial issues involving technology, design and effectiveness of multimedia applications. Programming techniques for integrating video, sound, animation, and graphics, and design strategies for multimedia information systems.

**IS 310. Co-op Work Experience I. 3 credits, 3 contact hours (0;0;3).**
Prerequisites: completion of the sophomore year, approval of the department, and permission of the Office of Cooperative Education and Internships. Students gain major-related work experience and reinforcement of their academic program. Work assignments facilitated and approved by the Co-op office. Mandatory participation in seminars and completion of a report. Note: Normal grading applies to this COOP Experience.

**IS 322. Mobile Applications: Design, Interface, Implementation. 3 credits, 3 contact hours (3;0;0).**
Prerequisites: IS 218, IS 219, or IT 202. This course is a practical introduction to building applications for mobile devices. The course combines hands on design and development experience, with a conceptual overview and discussion of design and practical development issues. Taken into account will be constraints and requirements of devices with small screen sizes, limited battery power, limited computational power, etc. Tools used for building an application in the context of a specific device such as iPhone or an Android based device will be discussed. Students build a mobile application to demonstrate their understanding of mobile web constraints and tools.

**IS 331. Database Design Management and Applications. 3 credits, 3 contact hours (3;0;0).**
Prerequisites: IS 218 or IT 202. Businesses use databases extensively for analysis and decision-making because they provide efficient, large-scale information storage and rapid retrieval. Databases support the "back end functionality" of most large web systems. This course gives students extensive, pragmatic experience in designing, building, querying, updating, maintaining and managing relational databases, using the Structured Query Language (SQL). Proper database design principles are emphasized throughout the course, beginning with high level descriptions of relational databases using data modeling tools (such as entity-relationship or ER diagrams)and progressing to relational database design principles based on higher order normalizations. We will examine some poorly designed databases and show how these can be transformed into well designed databases. SQL will be extensively covered, and students will design and implement sophisticated SQL queries invoking self-joins, outer joins, correlated subqueries and related concepts. Students will explore and utilize design methodologies for input data validation and maintaining database integrity, and study issues of database privacy and security. Advanced topics to be discussed include the role of the Database Administrator (DBA), database life cycle activities, database denormalization, read-only databases and data warehouses. Hands-on experience will be gained by working with actual databases using industry-standard database management systems such as Oracle. A student receiving degree credit for IS 331 cannot receive degree credit for CS 331.

**IS 333. Social Network Analysis. 3 credits, 3 contact hours (3;0;0).**
Prerequisite: Completion of computing GUR (CS 100, CS 101, CS 103, CS 104, CS 111, CS 113, CS 115 or BNFO 135) AND statistical GUR (MATH 105, MATH 120, MATH 225, MATH 244, MATH 279, MATH 305, MATH 333, IE 331, ECE 321 or MNET 315). In this intensive hands-on course, students will learn how to design computer programs to "grab" information from social networking systems such as Facebook, and analyze this to reveal useful but hidden information about the users and their interconnections. Since math is the only language that computers understand, the goal of this class is to build connections between the human language one finds in social network postings and profiles, and mathematical formulas. The skills and techniques utilized in the course will prepare students for advanced courses in data mining and business analytics. This course requires basic statistical knowledge and Java programming skills.

**IS 344. Computing Applications in Business. 3 credits, 3 contact hours (3;0;0).**
Prerequisites: MIS 245 or IS 265 or ACCT 115 or ACCT 117 or MGMT 390. A comprehensive overview of the various types of computing applications used by businesses in order to run effectively and efficiently. All the major functional departments within organizations are examined and evaluated to see how applications are integrated to implement "business processes" that flow across department boundaries, and from suppliers to customers. Students will learn to model business situations and the design of applicable software solutions. A full-semester hands-on student project will provide experience in designing solutions to changes in the business environment.

**IS 350. Computers, Society and Ethics. 3 credits, 3 contact hours (3;0;0).**
Prerequisites: GER (CS 100, CS 101, CS 103, CS 104, CS 113, CS 115, or BNFO 135), and any History and Humanities GER 200 level course and ENGL 101. Examines the historical evolution of computer and information systems and explores their implications in the home, business, government, medicine and education. Topics include automation and job impact, privacy, and legal and ethical issues.

**IS 373. Content Management Systems. 3 credits, 3 contact hours (3;0;0).**
Prerequisites: IS 117 or IT 202. This course provides a hands-on introduction to the design and implementation of enterprise-scale web systems built upon web based content management systems (CMS). CMS manage the creation, storage, retrieval, dissemination, and collection of information in order to meet the needs of businesses, organizations and individuals. Students learn to how to create blogs, discussion boards, wiki, intranets, and dynamic websites using popular CMS packages such as Wordpress and Drupal. Throughout the course students learn how to overcome common challenges that impact the design of these systems such as security for multi-user systems, content strategy, marketing and performance.

**IS 375. Discovering User Needs for UX. 3 credits, 3 contact hours (3;0;0).**
What new digital products or services need to be developed? How do you anticipate someone's needs before they do? How do you understand how people interact with products? These are key questions that both interaction designers and start-up entrepreneurs need to answer. It's all about understanding the user. We need to work with users to investigate or "research" their needs and how they interact with the product or service. In this course, we take a deep dive into qualitative user experience (UX) research. UX research is the process of understanding why and how people use products and services. This course will teach you a set of research tools to discover user needs, investigate the user experience, and enhance the user experience by deriving design recommendations. We will cover techniques like ethnography, focus groups, interviewing, and analyzing qualitative data. We will be talking with user experience researchers at major companies and getting involved with actual user research. This practical, hands-on course will give you an insight into the psychology of user behavior and lay the foundation for students who are pursuing careers designing, evaluating, or marketing products for people.

**IS 385. Special Topics in IS. 3 credits, 3 contact hours (3;0;0).**
The study of new and/or advanced topics in an area of information systems and the computing sciences not regularly covered in any other IS course. The precise topics to be covered in the course, along with prerequisites, will be announced in the semester prior to the offering of the course.

**IS 390. Requirements Analysis and Systems Design. 3 credits, 3 contact hours (3;0;0).**
Prerequisites: CS 103, CS 113, CS 115, IS 218 or IT 202. A study of the information systems development life-cycle, from the initial stages of information requirements analysis and determination to the ultimate activities involving systems design. Theory, methodologies and strategies for information requirements analysis, including the assessment of transactions and decisions, fact-finding methodologies, structured analysis development tools, strategies of prototype development, and an overview of computer-aided software engineering (CASE) tools. Theory, methodologies and strategies for systems design, including design of user-interfaces, particularly menu-driven and keyword dialogue strategies, and issues in the proper design of computer output.

**IS 392. AI-Driven Text Analytics. 3 credits, 3 contact hours (3;0;0).**
Prerequisites: CS 100 or DS 100, and IS 331 or CS 331 or MIS 385. The Web and other unstructured/semi-structured, hyper-textual, distributed information repositories all have their unique characteristics and require different techniques to better understand them. AI-driven text analytics aims at discovering useful information and knowledge from various types of unstructured textual elements using machine learning, data mining, and artificial intelligence approaches. The outcomes can be used for site management, personalization, customer sentiment analysis, and beyond. Topics covered in this course include crawling, indexing, ranking and filtering algorithms using text and link analysis, applications to search, classification, tracking, monitoring, and Web intelligence. Natural language processing techniques for storage, classification, and topic modeling will demonstrate applications for unstructured data. Most recent developments in Large Language Models (LLMs) and prompt engineering will be discussed as well. Programming assignments give hands-on experience. A group project highlights class topics.

**IS 393. Usable Security and Privacy. 3 credits, 3 contact hours (3;0;0).**
Prerequisites: IT 230 or CS 351 or IS 247. Cybersecurity and privacy incidents are often blamed on people's choices, but what led to these decisions? If we understand the reasons for these failures and how the systems themselves contributed to them, we can create better technologies that help improve people's security and privacy. In this course, we will study how security and privacy decisions are made in the real world, how incomplete or faulty assumptions may cause mistakes to be made, and what it takes to design and develop systems that overcome these issues. The course will synthesize and present important research in security, privacy, and human-computer interaction. In addition, students will learn and practice techniques, which are commonly used by user experience researchers, that will help them independently evaluate the usability of systems.

**IS 410. Co-op Work Experience II. 3 credits, 3 contact hours (0;0;3).**
Prerequisites: IS 310 or its equivalent, approval of the department, and permission of the Office of Cooperative Education and Internships. Provides major-related work experience as co-op/internship. Mandatory participation in seminars and completion of requirements that include a report and/or project. Note: Normal grading applies to this COOP Experience.

**IS 421. Advanced Web Applications. 3 credits, 3 contact hours (3;0;0).**
Prerequisites: IS 219 and (IS 331 or CS 331). This course focuses on the design, development, and management of cloud-based web information systems, within the context of startup companies and established organizations. Within the course, we examine business, organizational and technical challenges faced by developers, project managers, and the business development professionals that create web-based software products. The course consists of readings, discussions, and a final team project that demonstrates modular design, planned scalability, maintainability, and the creation of a set of organizational processes that supports the continued support and development of the application. Some of the topics covered in the course are: continuous deployment, continuous integration, automated unit testing, modular design, software team management, agile development, Kanban, customer focused development, and the technologies used to scale cloud applications.

**IS 425. Enterprise AI Applications & Infrastructure. 3 credits, 3 contact hours (3;0;0).**
Prerequisites: IS 331 or CS 331 or MIS 385. This advanced course bridges theoretical foundations with practical applications of artificial intelligence in enterprise information systems. Students will learn to develop, deploy, and manage AI-powered solutions that address real business challenges, such as custom ChatGPT-like applications and intelligent document processing. Emphasis is placed on real-time data ingestion, advanced ETL pipelines, and vector database technology, combined with human-in-the-loop (HITL) workflows and cost-quality optimization. Through hands-on labs and projects, students will build enterprise-grade AI infrastructures ready for diverse, large-scale use cases.

**IS 448. Usability & Measuring UX. 3 credits, 3 contact hours (3;0;0).**
Prerequisites: MATH 105 or MATH 120 or MATH 225 or MATH 244 or MATH 279 or MATH 305 or MATH 333 or IE 331 or ECE 321 or MNET 315, and IS 247. Quantitative methods to measure usability and user experience design are presented via a hands-on, practical experience approach. Usability is a key aspect of user experience, reflecting the quality of how users interact with a product or service. Fundamental concepts, including quantitative experiments such as A/B testing and metrics such as Net Promoter Score (NPS) and System Usability Scale (SUS) are covered. Students will design, conduct, and analyze surveys to assess usability and user experience and apply descriptive and inferential statistics to interpret and communicate results.

**IS 455. IS Mgmt & Business Processes. 3 credits, 3 contact hours (3;0;0).**
Prerequisites: (IS 265 or MIS 245) and IS 390. This course will emphasize how information systems enable core and supportive business processes, as well as those that interface with suppliers, partners and customers. It will discuss basic administrative, management and policy issues associated with the impact of information systems on the user and organization. The second part of the course looks at business processes in organizations: what the business process view is and why it is important, how information systems can improve processes, and how Enterprise Resource Planning systems help with that improvement. Hands-on use of a major ERP system (SAP) is included.

**IS 461. Systems Simulation. 3 credits, 3 contact hours (3;0;0).**
Prerequisites: completion of a 100-level GUR course in computing; MATH 333. This course introduces computer simulation as an algorithmic problem solving technique. Includes discrete simulation models, elementary theory, stochastic processes, use of simulation languages, random number generators, simulation of probabilistic processes, design of simulation experiments, validation of models, queueing systems, and applications to the design and analysis of operational systems. The GPSS language is covered in detail.

**IS 465. Data Analytics for Business Information Systems. 3 credits, 3 contact hours (3;0;0).**
Prerequisites: (CS 100 or DS 100), and MATH 105 or MATH 120 or MATH 225 or MATH 244 or MATH 279 or MATH 305 or MATH 333 or IE 331 or ECE 321 or MGMT 116 or MNET 315, and (CS 331 or IS 331 or MIS 385). This course introduces students to the world of business analytics from an information systems perspective, focusing on the application of various data analysis techniques in business practices. We cover a wide spectrum of topics ranging from fundamental statistics to database, data warehouse, data visualization, and data mining, with a special focus on predictive analysis. Being an introductory course, our approach is "shallow and wide", emphasizing on giving students a complete view of the data analytics profession, covering as many different sub-areas as time allows while not diving too deep into any one specific domain. The goal is to serve as a "guided tour" for students to gain knowledge about the different sub-areas of data analytics and understanding of which area is a best fit for their personal developments. More in-depth materials and discussion for each sub-area will be provided upon students' requests. Course topics include the rudiments of probability and random variables, and visualization, data warehousing and OLAP analysis, dashboard, scorecard, data mining algorithms, optimization techniques, DSS and knowledge systems.

**IS 480. Data-Centric AI. 3 credits, 3 contact hours (3;0;0).**
Prerequisites: DS 100 or CS 100, and MATH 105 or MATH 333, and IS 331 or CS 331 or MIS 385, and IS 465 or CS 375. Data-centric AI focuses on the systematic design of data to improve machine learning outcomes, rather than prioritizing the design and optimization of model architectures and their parameters (model-centric AI). In this course, students will learn to enhance data quality, consistency, and relevance to boost model performance —essential skills for real-world AI applications. Course topics may include AI task design and data requirements, data acquisition, data cleaning and quality assessment, data annotation, annotator reliability, active learning, programmatic labeling, confident learning, data augmentation, data synthesis, data balancing, and data monitoring. By the end of the course, students will be able to use modern tools and frameworks to engineer effective datasets and multi-stage training pipelines to improve AI systems.

**IS 485. Special Topics in Information Systems. 3 credits, 3 contact hours (3;0;0).**
Prerequisites: junior standing and/or department approval. The study of new and/or advanced topics in an area of IS not regularly covered in any other IS course. The precise topics to be covered in the course, along with prerequisites, will be announced in the semester prior to the offering of the course. A student may register for no more than two semesters of Special Topics.

**IS 486. Topics in Information Systems. 3 credits, 3 contact hours (3;0;0).**
Prerequisites: Same as for IS 485. A continuation of IS 485.

**IS 488. Independent Study in Information Systems. 3 credits, 0 contact hours (0;0;0).**
Prerequisites: Open to students in the Albert Dorman Honors College or to any student who intends to apply to the Informatics Undergraduate Thesis program. Students need approval from the Informatics department and the Informatics faculty member who will guide the independent study. Independent studies, investigations, research, and reports on advanced topics in Informatics. Students must prepare, in collaboration with their faculty mentor and in the semester prior to enrolling in this course, a detailed plan of topics and expected accomplishments for their independent study. This must have the approval of both the department and the faculty mentor. A student may register for no more than one semester of Independent Study.

**IS 489. INFO Undergrad Thesis Research. 3 credits, 3 contact hours (3;0;0).**
Students continue their research in preparation for completing a Research Thesis.

**IS 491. Senior Project - IS. 3 credits, 3 contact hours (0;0;3).**
Prerequisites: IS 331 or CS 331. Restriction: Senior standing. Integration of knowledge and skills gained in previous information systems courses into an individual research project. The project entails investigation of current literature and the design, implementation and evaluation of an information system.

**IT 101. Introduction to Information Technology. 3 credits, 3 contact hours (3;0;0).**
The foundations of information technology (IT), including basic computer architecture, various kinds of computer hardware, and networking technology, are introduced. Various data representation schemes, such as the binary number systems, are covered. Different levels of software are examined, including aspects of the operating systems from the perspective of the IT professional. The software development process is discussed. Database management software and SQL are dealt with, as are applications and languages developed around the internet and Web infrastructure. Overall, fundamental knowledge required of today's IT professional is obtained along with an appreciation of IT's impact on business and society. Hands-on experience with some important elements of the IT field is gained through various laboratory assignments.

**IT 114. Advanced Programming for Information Technology. 3 credits, 3 contact hours (3;0;0).**
Prerequisites: CS 113 or CS 115. Problem solving techniques and program design knowledge are expanded with an eye toward IT-related applications. Various kinds of data structures are introduced, including classic containers such as lists, stacks, queues, and trees. Sorting and searching techniques are examined. The fundamentals of client/server programming and the use of sockets are covered. Recursion and its various applications are studied. The built-in class library features of an object-oriented programming language are exploited throughout.

**IT 120. Introduction to Network Technology. 3 credits, 3 contact hours (3;0;0).**
An introduction to the basics of networking in a modern operating system environment. Emphasis is placed on the application and management of networking technology. Topics to be covered include: the OSI model, network hardware and technologies, network protocols, wired and wireless networks, TCP/IP. Whenever possible, concepts will be explained through the use of hands-on exercises that reinforce the lecture material.

**IT 201. Information Design Techniques. 3 credits, 3 contact hours (3;0;0).**
Prerequisites: CS 100 or CS 101 or CS 103 or CS 104 or CS 106 or CS 113 or CS 115 or BNFO 135. This course presents an introduction to the theory and practice of information design. Topics covered include the theoretical foundations of information design, graphic design, content design, interaction design, usability, multimedia design, sound and video, animation, and an introduction to 3D modeling.

**IT 202. Internet Applications. 3 credits, 3 contact hours (3;0;0).**
Prerequisites: CS 100 or CS 113 or CS 115 or a course in a high-level programming language as approved by department. Core web technologies that underlie web-based multi-tier software architecture and applications are presented. Emphasis is on the latest versions of the languages of the web, and these are explored in a hands-on, guided development approach. The major topics include markup and styling languages such as HTML and CSS, client-side scripting languages such as JavaScript including the use of AJAX, server-side scripting languages using PHP, and database management via SQL. Web server concepts for hosting and deploying activities and projects are covered. The overall focus is on the out-of-the-box content of the various languages and technologies covered, but libraries will also be explored.

**IT 220. Wireless Networks. 3 credits, 3 contact hours (3;0;0).**
Prerequisites: IT 120 or CS 356. This course introduces the students to the applied topic of Wireless Networks, focusing on applied methods, tools and technologies, as well as practical experience in designing & implementing wireless networks. Topics include hardware, software, data, applications, communication, design & installation of wireless networks, together with the implementation, performance, security and limitations of such systems.

**IT 230. Computer and Network Security. 3 credits, 3 contact hours (3;0;0).**
Prerequisites: IT 120 or CS 356. This course introduces the applied topic of Computer Security, presenting the evolution of computer security, the main threats, attacks & mechanisms, applied computer operations & security protocols, main data transmission & storage protection methods via cryptography, ways of identifying, understanding & recovery from attacks against computer systems, various methods of security breach prevention, network systems availability, applications security, recovery & business continuation procedures and counter systems penetrations techniques and the role of the US Government in security of national computer infrastructure.

**IT 240. Scripting for System Administration. 3 credits, 3 contact hours (3;0;0).**
Prerequisites: CS 113 or CS 115. This course will introduce task automation using shell scripting in a multi-OS environment using the Shell and the Perl programming languages. Topics covered will include scripting commands, control structures, functions, scalar data and lists, regular expressions, hashing, automating administration functions and debugging. Lessons will be enhanced through the use of hands-on exercises to strengthen comprehension.

**IT 265. Game Architecture and Design. 3 credits, 3 contact hours (3;0;0).**
Prerequisites: CS 100 or CS 101 or CS 103 or CS 104 or CS 106 or CS 113 or CS 115 or BNFO 135. Course introduces students to the core concepts and design methodologies integral to designing and developing games and other Entertainment Software.

**IT 266. Game Modification Development. 3 credits, 3 contact hours (3;0;0).**
Prerequisites: CS 113 or CS 115. This course introduces students to the basic concepts of game programming and development. Students will learn how to reprogram a professional game engine, or Modification (Mod) development as it is referred to in the industry. Students will work with C intensively. Students will work on their own game projects utilizing the professional game engine.

**IT 270. 3D Modeling and Animation. 3 credits, 3 contact hours (3;0;0).**
Prerequisites: CS 100 or CS 101 or CS 103 or CS 104 or CS 106 or CS 113 or CS 115 or BNFO 135. This class introduces students to the concepts of 3D modeling and animation, and putting those concepts into action by working with software. This class will be a hands-on, project focused course, using industry standard 3D modeling tools. Students will learn how to mesh model, texture, rig, and animate characters and scenes. Topics will include photo-realistic and low polygon approaches to content creation.

**IT 286. Foundations of Game Production. 3 credits, 3 contact hours (3;0;0).**
Prerequisites: CS 100 or CS 101 or CS 103 or CS 104 or CS 106 or CS 113 or CS 115 or BNFO 135. This class introduces students to many of the tools and design methodologies needed for electronic game production. This class will focus heavily on scripting, level design and content control as applied to game development. Students will learn an industry standard game engine and its tool chain. Students will work on projects to develop the levels, controls and scripts in order to create a new game experience with a professional game.

**IT 302. Advanced Internet Applications. 3 credits, 3 contact hours (3;0;0).**
Prerequisites: IT 202 or IS 218. Previous knowledge and experience in core web development will be expanded by covering advanced web development concepts and tools. Skills necessary for the design and development of complex web applications that meet industry standards are explored. This course encompasses key facets of web application development, including the utilization of front-end frameworks as Angular, React, and Vue), the use of various libraries, seamless integration with cloud-based backend services, backend frameworks such as Express, and the incorporation of NoSQL databases. Practical applications in the form of hands-on projects and assignments will be given throughout.

**IT 303. Model View Controller Software Architecture. 3 credits, 3 contact hours (3;0;0).**
Prerequisite: IT 202 or instructor approval. The Model View Controller(MVC) software architecture or pattern separates the concerns of application or domain logic, interface design, and the view of the system presented to the user, with the objective of more effective design, development and testing. This course covers environments and frameworks for modeling, developing and programming Internet Applications with emphasis on the Model View Controller paradigm. Design and development, applicability of principles, integrated test-driven development applicability of major external libraries like JQuery and Prototype, deployment, scaling and security issues will be examined. Case studies will be used to illustrate the concepts and frameworks considered. A substantial development project will be required.

**IT 310. E-Commerce Technology. 3 credits, 3 contact hours (3;0;0).**
An overview of the technologies relevant to electronic commerce. Communications and networking, web authoring tools, system security, databases and archiving, EDI, transaction processing, and factory/warehouse data networks. Provides competency to appraise tools such as HTTP servers, secure transaction software and firewalls, low and high-end database systems, heterogeneous networks, NNTP Servers, client software, procurement systems, and intelligent agents. Covers e-commerce models including agent-based and Java-based, electronic contracts and the electronic exchange of technical data, electronic cash systems and user security.

**IT 311. Co-op Work Experience I. 3 credits, 3 contact hours (0;0;3).**
Prerequisites: Completion of the sophomore year, approval of the program coordinator, and permission of the Office of Cooperative Education and Internship. Students gain major-related work experience and reinforcement of their academic program. Work assignments facilitated and approved by the Co-op office. Mandatory participation in seminars and completion of a report. Note: Normal grading applies to this COOP Experience.

**IT 320. Virtual Instrumentation. 3 credits, 3 contact hours (3;0;0).**
Cross-listed with OPSE 310. Prerequisite: CS 113 or CS 115. Covers the basics of virtual instrumentation including use of IEEE GPIB, RS232 interfaces, and data acquisition boards. Interface a computer to various instruments for data acquisition and instrument control using a state-of-the-art software platform such as National Instrument's LABVIEW. Emphasis is on the practical aspects of interfacing a computer to various instruments including timing issues, real-time data acquisition and instrument control, instrument status, and acquisition speed.

**IT 330. Computer Forensic. 3 credits, 3 contact hours (3;0;0).**
Prerequisites: IT 120 or CS 356. This course introduces students to the applied topic of Computer Forensic, the study of obtaining and analyzing digital information from computers that have been used to commit illegal actions (computer crime), for use as evidence in civil, criminal, or administrative cases.

**IT 331. Privacy and Information Technology. 3 credits, 3 contact hours (3;0;0).**
Prerequisites: CS 100 or CS 101 or CS 103 or CS 104 or CS 106 or CS 113 or CS 115 or BNFO 135. This course will introduce the legal, social and technical issues involving information privacy. Topics covered will include the historical development of information privacy law; law enforcement, technology and surveillance; government databases and records; privacy and business records and financial information; privacy and the media; health and genetic privacy and international privacy law.

**IT 332. Digital Crime. 3 credits, 3 contact hours (3;0;0).**
Prerequisites: CS 100 or CS 101 or CS 103 or CS 104 or CS 106 or CS 113 or CS 115 or BNFO 135. Comprehensive, multidisciplinary overview of the methods and means by which technology is used by the criminal in today's society. An examination of the historical, legal, technological and sociological aspects of cybercrime. The course covers the challenges of a new era of technology has brought to combating crime of all types, including terrorism. Topics covered will include: the sociology of the white collar criminal, the criminal justice system and law enforcement, computer security and deterrence/prevention.

**IT 335. Introduction to .NET Framework. 3 credits, 3 contact hours (3;0;0).**
Prerequisite: IT 202 or equivalent. This course introduces students to .NET Framework, a new computational environment that supports more than 25 programming languages and is platform and device independent. Problem solving and system development topics are integrated into the course by using C# languages as a vehicle to illustrate the concepts.

**IT 340. Introduction to System Administration. 3 credits, 3 contact hours (3;0;0).**
Prerequisites: IT 120 or CS 356. This course will introduce the tasks and techniques required to perform as a system administrator of Linux systems. Topics to be covered include booting, process control, the file system, managing users and resources, backups, configuration management, networking, the network file system, email servers, security, hardware devices, interoperability, and daemons. Whenever possible, lectures will be augmented with hands-on exercises.

**IT 342. Cloud Administration. 3 credits, 3 contact hours (3;0;0).**
Prerequisites: IT 120. The fundamentals of cloud administration are presented. Included are cloud storage, compute engine, networking, identity and access management (IAM), billing, and security. Applications built into the cloud will also be covered. Experience using a major cloud service provider is a crucial component of the course, and hands-on labs and assignments in such a context will be given throughout.

**IT 360. Computer Graphics for Visual Effects. 3 credits, 3 contact hours (3;0;0).**
Prerequisites: CS 113 or CS 115. This course introduces students to computer graphics and interactive visual techniques. Students will learn the theory and implement code of 2D and 3D graphics algorithms for visual effects. Topics include image processing, visualization, crowd simulation, physics-based simulation, particle systems, constraints, and artificial intelligence for visual effects. Mathematical concepts such as vector and matrix operations that underlie the general concepts will be covered.

**IT 366. 2D Game Programming. 3 credits, 3 contact hours (3;0;0).**
Prerequisites: IT 266 and either IT 114 or CS 114. This course introduces students to the core concepts and skills necessary for the development of games utilizing 2D graphics. Students will learn how to set up and program their own 2D graphics based game engine. The engine will integrate 2D graphics, audio, input handling and network socket programming. Students will learn how to utilize their own custom 2D graphics and sounds into their projects. Once complete, students will have created two fully functional games.

**IT 380. Educational Software Design. 3 credits, 3 contact hours (3;0;0).**
Prerequisite: IT 201. Educational Media Design employs the instructional principles of constructivist pedagogy as the process used to develop a solution to develope courseware for K-12 audience. The course builds on the participatory design model of software engineering in order to develop integrated learning environments that support visual and verbal literacy; enables student to be able to plan, organize, and systematically develop instructional materials. This course implements instructional design theory and pedagogy in order to create an actual application for a computer-based environment. Same as STS 318.

**IT 382. Game Design for XR. 3 credits, 3 contact hours (3;0;0).**
Prerequisites: IT 201 or IT 266 or IT 286. The course presents the concepts that address hardware and software technologies and principles of perception for mixed reality (virtual and augmented reality) applications. During the course, the students will have an opportunity to build a virtual or augmented reality application and test it with Oculus, Vive, Magic Leap, or HoloLens. During this course, students will learn to design and develop immersive experiences with VR/AR headsets, stereo displays, and large projection screens. They will incorporate body and eye trackers, follow and discuss the latest AR/VR trends, explore why some games make people feel immersed, and others make people sick. Students will also explore the differences and similarities between computer and human vision. This course is hands-on; It will be utilizing Unity 3D or Unreal Engine. The end of the year project will showcase all the different skills and knowledge acquired throughout the semester.

**IT 383. Advanced Topics in Game Design for XR. 3 credits, 3 contact hours (3;0;0).**
Prerequisites: IT 201 or IT 266 or IT 286. This course concentrates on game development in cross-reality (XR). Specifically, the course looks at various user interface recommendations for virtual and augmented space including navigation, selection, and manipulation techniques. The course reviews current industry standards, design practices, evaluation approaches, and various types of documentation. By the end of the course, students will design, build, and evaluate a project they can use in their portfolio.

**IT 400. Information Technology and the Law. 3 credits, 3 contact hours (3;0;0).**
This course will provide an introduction to legal concepts, principles and terminology as applied to modern information technology. The historical background and foundations of the various principles of U.S. Statutory and Common Law will be considered and will be used to explore how such principles may be applied to encompass and govern modern legal interactions in the U.S. and internationally. Through assignments and class discussion, which will often involve the Socratic Method, students will be expected to spot potential legal issues and make logical arguments for and against various legal propositions.

**IT 411. Co-op Work Experience. 3 credits, 3 contact hours (0;0;3).**
Prerequisites: Completion of the sophomore year, approval of the program coordinator, and permission of the Office of Cooperative Education and Internship. Students gain major-related work experience and reinforcement of their academic program. Work assignments facilitated and approved by the Co-op office. Mandatory participation in seminars and completion of a report. Note: Normal grading applies to this COOP Experience.

**IT 420. Computer Systems and Networks. 3 credits, 3 contact hours (3;0;0).**
Prerequisites: IT 120 or CS 356. This course provides students with an understanding of methods, tools, and technologies required to work with computer systems and networks. It includes a detailed discussion of Internet/intranet issues, including standards, connectivity, performance, protocols, network configurations, network design, wireless technology, management, and simulation through practical cases, covering both hardware and software systems.

**IT 430. Ethical Hacking for System Administrators. 3 credits, 3 contact hours (3;0;0).**
Prerequisite: IT 340 or equivalent. This course will explore the various means that an intruder has available to gain access to computer resources. Traditional security analysis often falls short due to the rapidly evolving threats that exist. The course was developed to teach how system and network vulnerabilities are found and exploited and what steps can be taken to mitigate the risk.

**IT 466. 3D Game Programming. 3 credits, 3 contact hours (3;0;0).**
Prerequisites: IT 266 and either IT 114 or CS 114. This course introduces the core concepts and skills necessary for the development of games utilizing 3D graphics. Students will learn how to set up and program their own 3D graphics-based game engine using industry standard graphics libraries. Students will learn how to load and display custom 3D models created using existing 3D modeling tools. Students are expected to create fully functional 3D games and associated tools to work with them.

**IT 485. Special Topics in Information Technology I. 3 credits, 3 contact hours (3;0;0).**
Prerequisites: junior standing and/or advisor approval. The study of new and/or advanced topics in an area of information technology and its application not regularly covered in any other IT course. The precise topics to be covered, along with prerequisites, are announced in the semester prior to the offering of the course. A student may register for no more than two semesters of special topics courses.

**IT 486. Special Topics in Information Technology II. 3 credits, 3 contact hours (3;0;0).**
Prerequisites: same as for IT 485. A continuation of IT 485.

**IT 487. Advanced Game Production. 3 credits, 3 contact hours (3;0;0).**
Prerequisites: IT 286 or IT 266. This course will build on tools and techniques presented in Foundations of Game Production and guide students through the development of a senior game development project. This will be a hands-on class that will challenge students to apply the knowledge from previous game development courses to build a professional level game demo. Upon completion of the course, students will have built a game that is ready for publication on a distribution platform.

**IT 488. Independent Study in Information Technology. 3 credits, 3 contact hours (0;0;3).**
Prerequisites: open only to Information Technology majors who have the prior approval of the program director and the IT faculty who will guide the independent study taking the form of investigations, research, and reports on advanced topics in information technology. Students must prepare, in collaboration with their faculty mentor and in the semester prior to enrolling in this course, a detailed plan of topics and expected accomplishments for their independent study. This must have the approval of both the program director and the faculty mentor. A student may register for no more than one semester of independent study.

**IT 490. Systems Integration. 3 credits, 3 contact hours (3;0;0).**
Prerequisites: CS 113 or CS 115, IS 331 or CS 331, and IT 340. The course will introduce the major design, implementation & distributed deployment issues regarding system integration, Network Operating Systems (NOS), cross-platform database integration, e-commerce and e-business applications implementation, cross-servers & multiple locations e-sessions migration, and the related communications security.

**IT 491. IT Capstone Project. 3 credits, 3 contact hours (3;0;0).**
Prerequisites: senior standing. An opportunity for students to integrate the knowledge and skills gained in previous information technology work into a team research project. The project involves investigation of current literature as well as implementation of either a part of a large application or the whole of a small system.