

# INFORMATION SYSTEMS (IS)

## Information Systems (IS) Courses

### IS 1003. Unlocking Cyber. (3-0) 3 Credit Hours.

Cybersecurity is a relevant topic for everyone today, personally and professionally. This three-hour course covers core security concepts and discusses common challenges and threats faced by individuals, organizations, and nations through current events, case studies, and career profiles. We offer hands-on labs using virtualization, Linux, and Command Line tools to familiarize students with problem-solving techniques, analytical skills, and report writing, with the aim of increasing awareness of the field and its critical importance to our world. Course Fee: BISP \$10; BTSI \$15.41; LRB1 \$15.41; DL01 \$75.

### IS 1403. Business Information Systems Fluency. (3-0) 3 Credit Hours. (TCCN = BCIS 1305)

This course concentrates on a set of core computing skills that are essential to student success, such as using word processing, spreadsheets, basic data management, presentation software, and on- and off-campus internet resources. Microsoft Office is required to complete the projects assigned in the course. This is an online course. All coursework (lessons, exams, and projects) is completed online. Course Fee: BISP \$10; BTSI \$15.41; DL01 \$75; LRB1 \$15.41.

### IS 1413. Excel for Business Information Systems. (3-0) 3 Credit Hours.

This course concentrates on the use of Microsoft Office Excel as a tool for organizing, presenting, and analyzing data. This is an online course. All coursework (lessons, exams, and projects) is completed online. Microsoft Excel is required to complete the projects assigned in the course. Successful completion of this course will help prepare the student for taking the Microsoft Office Specialist (MOS): Microsoft Office Excel Core exam. Students who are MOS certified or have taken an equivalent course that specifically prepares students for the MOS Excel exam can petition for exemption for the course. Students in quantitative majors (such as Accounting, Actuarial Science, Economics, Finance, Operations and Supply Chain Management, Statistics and Data Science, and Business Analytics) are strongly encouraged to take this course in lieu of IS 1403. Course Fee: BISP \$10; BTSI \$15.41; DL01 \$75; LRB1 \$15.41.

### IS 2053. Programming I. (3-0) 3 Credit Hours.

This course introduces several fundamental programming constructs and practices, including logic, algorithms, pseudocode, syntax, and code readability. Control structures, arithmetic and logical operators, functions, arrays/lists, regular expressions, classes/objects, integrated development environments, and exception handling are covered in this course. The emphasis will be on building problem-solving and coding skills that apply to any language. (Formerly titled "Programming Languages I with Scripting"). Course Fee: BISP \$10; BTSI \$15.41; LRB1 \$15.41; DL01 \$75.

### IS 2063. Programming II. (3-0) 3 Credit Hours.

Prerequisite: IS 2053 or equivalent with a grade of "C-" or better. The course focuses on high-level programming constructs in an object-oriented framework for developing business software that employs the programming language's basic security features. Students will examine and use data structures, built-in libraries, file and text processing (which includes regular expressions), and exception handling. (Formerly titled "Programming Languages II with Java"). Course Fee: BISP \$10; BTSI \$15.41; LRB1 \$15.41; DL01 \$75.

### IS 3003. Principles of Information Systems for Management. (3-0) 3 Credit Hours.

An overview of fundamental MIS concepts within a framework for describing and analyzing managerial/organizational information needs. Includes coverage of hardware and software tools, information structures, various types of information systems, and formal problem-solving techniques. Issues related to organizational controls, security, globalization, collaboration, and ethics as a result of changing technologies are discussed. A variety of assessment methods will be assigned to illustrate the use of specific tools and techniques for problem-solving. This course has Differential Tuition. Course Fee: DL01 \$75.

### IS 3033. Operating Systems and Security. (3-0) 3 Credit Hours.

Prerequisite: IS 1003 with a grade of C- or better. IS 3033 is a hands-on course with an emphasis on the real-world security and performance challenges of operating systems (OSs). Throughout the course, students will be introduced to fundamental OS concepts such as process scheduling, memory management, I/O devices, and file systems. The lab exercises in this course provide students with a comprehensive practice in hardening the essential components of a specified OS (Unix-like or Windows) through secure operation and maintenance, secure server configuration, system-level firewalls, kernel security module, logging, anti-malware measures, and more. (Formally titled "Operating Systems Security"). This course has Differential Tuition. Course Fee: DL01 \$75.

### IS 3043. Secure Mobile App Development. (3-0) 3 Credit Hours.

Prerequisite: IS 2063 (IS 2041 and IS 2043 in previous catalogs) with a grade of C- or better. As mobile devices such as smartphones and tablets become ubiquitous, the demand for mobile apps and developers who specialize in mobile technology also surges. This course teaches students how to develop a mobile app in an advanced development environment (e.g., Android Studio) and principles of secure software engineering. The course will cover requirements analysis, interface design, functionality development, testing vulnerabilities, data security and other secure software design strategies with a focus on the usability of mobile apps in the real world. This course can be an elective for the information systems major and cyber security major and minor. This course has Differential Tuition.

### IS 3053. Fundamentals of Cyber Security. (3-0) 3 Credit Hours.

This course covers core cyber security terminology, concepts, and challenges faced by individuals, organizations, and nations through case studies and discussions. Application to business environments will be emphasized with hands-on exercises in areas such as network/device security hygiene, search techniques, incident response, and risk assessment. The overall aim of the course is to familiarize students with security techniques and strategies needed across a broad range of industry sectors. Credit for this course cannot be counted toward the B.B.A. in Information Systems or the B.B.A. in Cyber Security. This course has Differential Tuition.

### IS 3063. Database Management for Information Systems. (3-0) 3 Credit Hours.

Prerequisite: IS 1403 or IS 1413 with a grade of C- or better. A study of database management systems (DBMS) features, functions, and architecture, including database conceptual design, data models, entity relationship diagrams, database query design, and database administration. A contemporary DBMS product will be used to illustrate principles in a relational database. This course has Differential Tuition. Course Fee: ISCS \$75; DL01 \$75.

**IS 3073. Application Development. (3-0) 3 Credit Hours.**

Prerequisite: IS 2053 or equivalent with a grade of C- or better. This course examines the challenges, techniques, and methodologies involved in building, testing, maintaining, and enhancing software applications and packages. Students will address implementation and deployment issues; analysis and testing of code will be included. A brief introduction to data analytics is included with reference to how such analytics support application development and operations. This course has Differential Tuition.

**IS 3100. Signature Experience. (0-0) 0 Credit Hours.**

Prerequisite: Consent of instructor. The Signature Experience in the Department of Information Systems and Cyber Security is designed to enhance a student's degree program with a project in a category of their choice. Projects may include activities focused on leadership, research, competitions, global studies, peer mentoring, community outreach, and more. Students will work with faculty and/or staff during their Signature Experience and submit a portfolio piece that reflects their work at the end of the semester.

**IS 3413. Telecommunications and Networking. (3-0) 3 Credit Hours.**

This course presents the principles of data transmission in telecommunications and networks. Topics include network hardware and topologies, the OSI model, the TCP/IP stack, routing protocols, and IP addressing and subnetting. We will examine Ethernet, wireless, radio, mobile, SDWAN, VoIP, IoT, and cloud/edge communications and protocols alongside best practices in network management and security. Students will apply their knowledge in hands-on labs and exercises. (Formerly titled "Introduction to Telecommunications for Business." Same as IS 6113. Credit cannot be earned for both IS 3413 and IS 6113.) This course has Differential Tuition. Course Fee: DL01 \$75; ISCS \$75.

**IS 3423. Network Security. (3-0) 3 Credit Hours.**

Prerequisite: IS 3413 with a grade of "C-" or better. The course provides a foundation in networking technologies that are core to creating secure networks. Topics included in this course are basic cryptography, secure networking protocols, logical and physical security management, and security devices. Relation between these technologies and operational and implementation issues for these technologies will also be discussed. This course has Differential Tuition. Course Fee: DL01 \$75.

**IS 3433. Cyber Crime Investigation Principles. (3-0) 3 Credit Hours.**

The digital forensic investigation process involves organizational preparation, incident response, data collection, data analysis, and communication of findings. This course will teach students how to prepare for incidents, how to respond to incidents, and how to reliably collect digital data. Students will be introduced to various types of storage media and sources of volatile data. Students will also be introduced to fundamental legal issues related to digital forensics. (Formerly titled "Introduction to Digital Forensics." Same as ACC 3433. Credit cannot be earned for both IS 3433 and ACC 3433.) This course has Differential Tuition. Course Fee: ISCS \$75; DL01 \$75.

**IS 3513. Information Assurance and Security. (3-0) 3 Credit Hours.**

Prerequisite: IS 3413 with a grade of "C-" or better. This course will provide the student the opportunity to learn about the basic elements that comprise Information Assurance Security. An in-depth presentation of information assurance topics such as fraud, eavesdropping, traffic analysis, intrusion detection and prevention, hacking, viruses, cryptography, risk management, and secure architectures will be discussed. (Same as IS 6213. Credit cannot be earned for both IS 3513 and IS 6213.) This course has Differential Tuition. Course Fee: DL01 \$75.

**IS 3523. Intrusion Detection and Incident Response. (3-0) 3 Credit Hours.**

Prerequisite: IS 3513 with a grade of "C-" or better. This course will provide the student with the opportunity to learn about the elements that comprise intrusion detection and incident response. It provides an in-depth look at intrusion detection methodologies, tools, and approaches to handling intrusions when they occur. It examines the laws that address cyber crime and intellectual property issues, and includes a study of proper computer and network forensics procedures to aid in the identification and tracking of intruders and in the potential prosecution of criminal activity. (Same as IS 6223. Credit cannot be earned for both IS 6223 and IS 3523.) This course has Differential Tuition. Course Fee: DL01 \$75; ISCS \$75.

**IS 3533. Cyber Law and Legal System. (3-0) 3 Credit Hours.**

An introductory course in laws and legal issues that affect law enforcement, businesses, and investigators related to the preservation, collection, and analysis of digital data. Students will examine computer crime laws, civil and criminal laws that often involve electronic evidence, search and seizure of electronic evidence, judicial issues involving the admissibility of electronic evidence and related testimony, and legal issues involved with electronic surveillance. (Same as IS 6763. Credit cannot be earned for both IS 3533 and IS 6763.) This course has Differential Tuition. Course Fee: DL01 \$75.

**IS 3543. Cyber Analytics Policy, Law and Ethics. (3-0) 3 Credit Hours.**

There are numerous policy, legal, and ethical issues that surround the collection, warehousing, and analysis of cyber data, which includes both system and user data. Further, there are policy and legal issues that impact whether data even exists to be collected and analyzed. Students will be given the opportunity to learn how to write, implement, and apply cyber analytics policy. Legal permissions and constraints involving electronic data collection, aggregation, and analysis will be discussed. Critical analysis exercises will be provided involving privacy concerns and ethical issues that arise with cyber. This course has Differential Tuition.

**IS 3833. Cyber Operations. (3-0) 3 Credit Hours.**

Prerequisite: IS 3523 with a grade of "C-" or better. This course investigates cyber operations, defining terms and discussing modern defensive and offensive cyber security strategies. Enterprise-level network protection will be addressed in the context of the cyber security operations center (CSOC), to include capabilities and technologies as well as organization and policies. Offensive cyber operations will be discussed in the context of red teaming and aggressor operations. Recent/current events will be examined as case studies. This course has Differential Tuition. Course Fee: ISCS \$75.

**IS 4013. Information Technology Administration I. (3-0) 3 Credit Hours.**

This course educates students on host, network, platform, and enterprise-level system administration and integration through hands-on projects. Topics may include but are not limited to enterprise infrastructure design, system requirements and selection, and system configuration and management. Students will also learn about system reliability and service provision. This course has Differential Tuition. Course Fee: DL01 \$75.

**IS 4023. Applied Big Data with Machine Learning. (3-0) 3 Credit Hours.**

Prerequisite: IS 2053 with a grade of C- or better. This course provides an overview of machine learning techniques to explore, analyze, and leverage data. Students will be introduced to tools and algorithms they can use to create machine learning (ML) models that learn from data, and to scale those models up to big data problems. ML concepts covered include neural networks, support vector machines, and random forests. This course emphasizes a focus on the three major steps in the data analysis pipeline: 1) Data collection methods and techniques, 2) Data storing and feature engineering methods, and 3) Data modeling (supervised and unsupervised methods). The language of choice for this course is Python. This course has Differential Tuition. Course Fee: ISCS \$75.

**IS 4043. Natural Language Processing. (3-0) 3 Credit Hours.**

Prerequisite: IS 2053 with a grade of C- or better. Natural Language Processing (NLP) employs computational tools to process, understand, and communicate using human (natural) language. NLP is a multi-disciplinary subject applicable to computation social science, humanities, biomedical informatics, business, cybersecurity, and a wide range of other fields. In this class, students will (1) gain hands-on experience implementing traditional NLP applications, including, but not limited to, text classification, part-of-speech tagging, parsing, coreference resolution, and machine translation, and (2) practice applying NLP techniques to real-world problems. This course has Differential Tuition.

**IS 4053. Systems Analysis and Design. (3-0) 3 Credit Hours.**

Prerequisite: IS 3063 with a grade of "C-" or better. An introduction to the systems analysis and design process. Topics include project selection, feasibility analyses, project management, problem and scope definition, modeling, interface design, and system implementation. Cyber security concerns that may arise during the systems development lifecycle are also addressed. This course has Differential Tuition. Course Fee: DL01 \$75.

**IS 4063. Advanced Topics in Information Systems. (3-0) 3 Credit Hours.**

Prerequisite: 15 semester credit hours of information systems courses (excluding IS 1403, IS 1413, and IS 3003). Survey of recent developments in information technology with emphasis on the Electromagnetic Spectrum (EMS) and Radio Frequency (RF) applications. Analysis will focus on applications in the business community and theoretical developments that relate to those applications. This course has Differential Tuition. Course Fee: ISCS \$75; DL01 \$75.

**IS 4083. Agile Project Management. (3-0) 3 Credit Hours.**

This introductory course presents concepts and techniques for leading agile teams in various types of projects in organizations including software development, engineering, construction, and product development, as well as science and technology-focused efforts. The course will provide students the opportunity to develop an agile mindset and a range of adaptive skills, including agile methodologies, practices, and values that are associated with achieving higher levels of performance and customer satisfaction. This course is structured around the concepts and skills covered in the Project Management Institute's (PMI) PMI-ACP certification exam. (Same as IS 6083. Credit cannot be earned for both IS 4083 and IS 6083.) This course has Differential Tuition.

**IS 4113. Information Technology Administration II. (3-0) 3 Credit Hours.**

Prerequisite: IS 4013 with a grade of C- or better. This course educates students on advanced host, network, platform, and enterprise-level administration and integration through hands-on projects. Topics may include but are not limited to database administration, server administration, enterprise-level access control and group policy management, virtualization, enterprise data storage and retrieval, and emergent technology integration. This course has Differential Tuition.

**IS 4143. Advanced Telecommunications and Networking. (3-0) 3 Credit Hours.**

Prerequisite: IS 3413 with a grade of "C-" or better. This course covers a variety of networking technologies and protocols that intersect over wide-area networks (WANs), mobile, Internet of Things (IoT), and the cloud. Students will examine topics such as software-defined networking, various wireless protocols (cellular, Wi-Fi, Bluetooth, etc.), and personal and private/public sector uses of low-power devices. The course will also address how distributed networking technologies (e.g., fog and edge) work with the cloud to transmit data over mobile and IoT devices. (Formally titled "Wide Area Networks"). This course has Differential Tuition.

**IS 4183. Advanced Database Concepts and Applications. (3-0) 3 Credit Hours.**

Prerequisite: IS 3063 with a grade of "C-" or better. Databases play a critical role in the business operations of most organizations. This course provides an in-depth coverage on concepts governing the design and management of database systems. Topics include data modeling, database design, administration, optimization and performance evaluation, SQL language, procedures, functions and triggers. Students will have the opportunity to learn how to design and build modern database systems through a set of hands-on exercises and projects using MS SQL Server, Oracle and other contemporary database software. The course also covers some advanced topics such as database security, database connectivity and Web applications. This course has Differential Tuition. Course Fee: ISCS \$75.

**IS 4223. Emerging Network Technologies. (3-0) 3 Credit Hours.**

This class will look at various technologies that are used in data centers and networks today. Topics include cloud infrastructure, virtual machines, storage area networks, software-defined networks, and remote systems management. Security issues will be an important part of the course. New wireless technologies along with new data storage and retrieval techniques and new hardware, will be discussed. This course has Differential Tuition. Course Fee: DL01 \$75; ISCS \$75.

**IS 4233. Cloud Computing. (3-0) 3 Credit Hours.**

The course provides an introduction to cloud computing and cloud security. The course covers the foundational concepts required to securely operate in the cloud, including cloud architectures, guiding security design principles, design patterns and workflows, industry standards, and applied technologies, with an emphasis on established methodologies and best practices. Students will work with real-world case studies and hands-on exercises. This course has Differential Tuition. Course Fee: BISP \$10; BTSI \$15.51; LRB1 \$15.41; DL01 \$75.

**IS 4443. Cyber Analytics I. (3-0) 3 Credit Hours.**

Prerequisite: IS 4023 with a grade of C- or better, and IS 3523 with a grade of C- or better. This integrative course will build upon students' cybersecurity and data analytics knowledge. Students will be given an opportunity to gain valuable experience with industry standard tools, platforms, and business processes for collecting, curating, sharing, and analyzing cyber data to proactively hunt for, reactively respond to, and investigate cyber threats. Analysis of low-level data from a wide variety of devices and sensors onto cyber threat frameworks for sense making in triaging and event reconstruction will be presented. Students will have an opportunity to gain extensive hands-on experience with proprietary and open-source cyber analytics tools. This course has Differential Tuition.

**IS 4463. Web Application Security. (3-0) 3 Credit Hours.**

Prerequisite: IS 2063 with a grade of "C-" or better. The security issues related to web applications will be discussed in this course. Topics include web application, authentication, and authorization, browser and web database security principles, and API security. Various web application security risks from the OWASP 10 will be examined through case studies and labs, such as broken access controls, code injection, cross-site scripting, server-side request forgery, and insecure design. (Same as IS 6463. Credit cannot be earned for both IS 6463 and IS 4463.) This course has Differential Tuition. Course Fee: DL01 \$75.

**IS 4473. Cyber Security Policy, Compliance, and Risk Assessment. (3-0) 3 Credit Hours.**

This course will examine how policies, compliance, and risk assessments affect information assurance and cyber security practices. This course will align security with business strategy through the identification and development of administrative, physical, and technical policies to mitigate risk exposure, minimize liability, and maintain regulatory compliance for global organizations, government entities, and key industry sectors such as healthcare and finance. Cyber security frameworks, implementation issues, and current case studies will be included along with hands-on policy writing. (Same as IS 6473. Credit cannot be earned for both IS 6473 and IS 4473.) This course has Differential Tuition. Course Fee: DL01 \$75.

**IS 4483. Digital Forensic Analysis I. (3-0) 3 Credit Hours.**

Prerequisites: Students may not enroll without 60 credit hours completed and without nine (9) hours of upper-division IS and/or CS coursework. An introductory course in digital forensic analysis. This course examines the fundamental data structures, software tools, and forensic analysis techniques commonly used to locate and recover trace evidence of crimes involving computers. This course focuses on file system forensic analysis of computer hosts and associated media. The tools of collecting, examining, and evaluating data in an effort to establish intent, culpability, motive, means, methods, and loss resulting from such crimes will be examined. (Same as IS 6483. Credit cannot be earned for both IS 4483 and IS 6483.) Generally offered: Fall. This course has Differential Tuition. Course Fees: BISP \$10; BTSI \$15.41; LRB1 \$15.41; DL01 \$75; ISCS \$75.

**IS 4503. Cyber Analytics II. (3-0) 3 Credit Hours.**

Prerequisite: IS 4443 with a grade of C- or better. This capstone course integrates cybersecurity and data analytics knowledge. Students focus on the human aspect of cyber analytics, both behavioral analytics involving users and threat actors, as well as the humans to which findings need to be presented and communicated from a risk, intelligence, and business perspectives. Students will be given an opportunity to learn how to apply cyber analytics concepts holistically across multiple contexts. Additionally, students will explore advanced topics, such as the role of artificial intelligence in increasingly autonomous cyber systems for intrusion detection, prevention, investigation, attribution, and other current and potential uses. This course has Differential Tuition.

**IS 4513. Industrial Control Systems Security. (3-0) 3 Credit Hours.**

Prerequisite: IS 3513 with a grade of "C-" or better. Many of the critical infrastructure systems contain a System Control And Data Acquisition (SCADA) component. Frequently, the control systems are remotely accessed and therefore become the focal point for attack. This course examines the control system components from the standpoint of vulnerability and protection. System architectures will be discussed. Current events will also be part of the class. (Same as IS 6513. Credit cannot be earned for both IS 6513 and IS 4513.) This course has Differential Tuition. Course Fee: ISCS \$75.

**IS 4523. Digital Forensic Analysis II. (3-0) 3 Credit Hours.**

Prerequisite: IS 4483 with a grade of C- or better. This course examines advanced digital forensic analysis topics, tools, techniques, and control mechanisms. Advanced topics include operating system artifacts, non-standard file systems, mobile devices, malware, and volatile memory. Students will gain experience with state-of-the-art forensics tools and techniques needed to successfully investigate illegal activities perpetuated through the use of information technology. This course has Differential Tuition. Course Fee: DL01 \$75; ISCS \$75.

**IS 4533. Malware Analysis. (3-0) 3 Credit Hours.**

Prerequisite: IS 3033 with a grade of "C-" or better. This class is designed to introduce students to concepts, tools, and techniques associated with modern malicious code analysis. The course will examine the methods employed by malicious actors to prevent analysis and neutralization of their exploits and discuss ways of leveraging resources and tools to effectively examine malicious code. Safe handling practices for malware analysis such as sandboxing, virtualization, and system isolation will be taught/practiced throughout the course. This course has Differential Tuition. Course Fee: ISCS \$75.

**IS 4543. Cyber Attack and Defend I. (3-0) 3 Credit Hours.**

Prerequisite: IS 3413 with a grade of C- or better; students may not enroll without 60 credit hours completed and without nine (9) hours of upper-division IS and/or CS coursework. This course will bridge the concepts of implementing a secure network with actual cyber threats. Students will learn the necessary skills to implement key IT system components, create security policies, and understand the background of what hackers do to mandate such security measures. Students will conduct red team assessments against common infrastructure components, and monitor residual effects of attacks. This course has Differential Tuition. Course Fee: ISCS \$75; DL01 \$75.

**IS 4553. Cyber Attack and Defend II. (3-0) 3 Credit Hours.**

Prerequisite: IS 4543 with a grade of C- or better. This course will build on the cyber themes and skillsets learned in prior classes to conduct threat hunts to detect advanced persistent threats. Students will learn the necessary skills to detect networking, operating system, and application-level exploitation. Students will utilize advanced community penetration testing tools to emulate advanced persistent threats. Students will leverage community security monitoring and log management tools to conduct threat hunting. This course has Differential Tuition.

**IS 4563. Mobile Forensics. (3-0) 3 Credit Hours.**

Prerequisite: IS 4483 with a grade of C- or better. This course is a project-driven, hands-on study of mobile devices from a forensics perspective. Students will implement various techniques to collect and analyze information from mobile devices used in forensic investigations. Students will learn fundamental mobile device concepts, techniques, and tools needed to acquire and analyze common mobile devices in a forensically sound manner. This course has Differential Tuition.

**IS 4573. Engaged Cyber Defense. (3-0) 3 Credit Hours.**

Prerequisite: IS 2053, IS 3513, and IS 3033 with a grade of C- or better. This course introduces students to cyber threat hunting, which involves proactively searching for cyber threats and attacks on computer networks and systems. Students will learn and experience techniques and tools used in cyber threat hunting, understand threat actor tactics, techniques, and procedures, and develop skills necessary to identify, track, and mitigate cyber threats. Topics include Indicators of Compromise (IoCs), network traffic analysis, log analysis, and threat intelligence. This course has Differential Tuition.

**IS 4583. Healthcare Information Systems and Cyber Security. (3-0) 3 Credit Hours.**

This course provides students with an overview of healthcare information, as well as information technology and systems used to collect and manage such information for patient care and healthcare administration. This includes, but may not be limited to, regulated patient health information (PHI), clinical trial information, healthcare financial systems, and electronic health records (EHR). Students will also become familiar with the regulatory, privacy, and other information and cybersecurity-related controls, risks, and mitigation strategies for such information, technology, and systems. This course has Differential Tuition.

**IS 4643. Research Support for Federal Labs. (3-0) 3 Credit Hours.**

Prerequisite: Consent of the instructor. This course is a research-based course that addresses research problems that are of interest to subject matter experts (SMEs) who work for the Federal labs. Students work closely with the SME to help solve these important concerns. The research problems cover a wide variety of issues, including conducting a literature review, developing code, proposing a new approach to a solution, and/or testing a solution. Weekly coordination with a Technical Director from a Federal Lab is part of the process. This course has Differential Tuition.

**IS 4893. Cyber Security Capstone. (3-0) 3 Credit Hours.**

Prerequisites: IS 3513 with a grade of "C-" or better and 15 hours of upper-level IS courses, excluding IS 3003. This course should be taken during the final semester. This course builds upon the material in prior cyber security classes with an examination of the cybersecurity tactics, techniques, and procedures involved in executing cyber security in various business settings. Students are required to integrate their functional knowledge and understanding of the global cyber threat environment with advanced cybersecurity techniques, and determine effective ways to reduce risk, detect intrusions, and resolve complex breaches so that organizations can operate in high threat environments. Strong problem solving skills, creative analytical procedures, and effective communication in current cybersecurity scenarios are emphasized. This course has Differential Tuition.

**IS 4911. Independent Study. (0-0) 1 Credit Hour.**

Prerequisite: A 3.0 Alvarez College of Business grade point average, and approval in writing from the instructor, the Department Chair, and the Dean of the Alvarez College of Business. Independent research in an approved topic under the direction of a faculty member. May be repeated for credit, but not more than 6 semester credit hours of independent study, regardless of discipline, will apply to a bachelor's degree. This course has Differential Tuition.

**IS 4913. Independent Study. (0-0) 3 Credit Hours.**

Prerequisite: A 3.0 Carlos Alvarez College of Business grade point average, and approval in writing from the instructor, the Department Chair, and the Dean of the Carlos Alvarez College of Business. Independent research in an approved topic under the direction of a faculty member. May be repeated for credit, but not more than 6 semester credit hours of independent study, regardless of discipline, will apply to a bachelor's degree. This course has Differential Tuition.

**IS 4933. Internship in Information Systems. (0-0) 3 Credit Hours.**

Prerequisite: 6 semester credit hours of information systems courses (excluding IS 1403, IS 1413, and IS 3003), a 2.5 UTSA grade point average, and approval in writing from the instructor, the Department Chair, and the Associate/Assistant Dean of Undergraduate Studies in the Carlos Alvarez College of Business. Directed internship of at least 160 hours of work under the supervision of a professional, providing students with opportunities to apply concepts, principles, and techniques learned in the classroom. Written report required. A proposal form must be completed and approved prior to registration. Internship may not be repeated for credit. This course has Differential Tuition.

**IS 4943. Internship in Cyber Security. (0-0) 3 Credit Hours.**

Prerequisite: 6 semester credit hours of information systems courses (excluding IS 1403, IS 1413, and IS 3003), a 2.5 UTSA grade point average, and approval in writing from the instructor, the Department Chair, and the Associate/Assistant Dean of Undergraduate Studies in the Carlos Alvarez College of Business. Directed internship of at least 160 hours of work under the supervision of a professional, providing students with opportunities to apply concepts, principles, and techniques learned in the classroom. Written report required. A proposal form must be completed and approved prior to registration. Internship may not be repeated for credit. This course has Differential Tuition.

**IS 4953. Special Studies in Information Systems. (3-0) 3 Credit Hours.**

Prerequisite: Consent of instructor. An organized course offering specialized study not normally or not often available as part of the regular course offerings. Special Studies may be repeated for credit when the topics vary, but not more than 6 semester credit hours, regardless of discipline, will apply to a bachelor's degree. This course has Differential Tuition. Course Fee: DL01 \$75.

**IS 4963. Special Studies in Cyber Security. (3-0) 3 Credit Hours.**

Prerequisite: Consent of instructor. An organized course offering specialized study not normally or not often available as part of the regular course offerings. Special Studies may be repeated for credit when the topics vary, but not more than 6 semester credit hours, regardless of discipline, will apply to a bachelor's degree. This course has Differential Tuition.

**IS 4973. Special Studies in Cloud. (3-0) 3 Credit Hours.**

Prerequisite: Consent of instructor. An organized course offering specialized study not normally or not often available as part of the regular course offerings. Special Studies may be repeated for credit when the topics vary, but not more than 6 semester credit hours, regardless of discipline, will apply to a bachelor's degree. This course has Differential Tuition.