INFO & COMMUNICATIONS TECHNOL (ICT)

Courses

ICT 20095 ICT Transfer (1-12 Credits)

ICT 4000 ICT Business Foundations (4 Credits)
This course provides an overview of the relationships between business needs and Information & Communications Technology solutions. The course focuses on fundamental attributes of business research and analysis in the ICT field. Applying appropriate research methods is a critical course requirement. Students demonstrate the critical skills required to define a problem, establish a business and technical context, perform appropriate research, propose and analyze alternative solutions, identify decision criteria, and make recommendations based on such considerations as benefits, technical feasibility, costs, risks, and resources. Students assess the relevance of research findings, considering the credibility of the source, relevance to the research question, and validity of the underlying data. Taking into account current industry trends and customer/user needs, students apply the product development process to create a product or service proposal, including business requirements and a detailed business case. The course establishes the professional and academic framework for the ICT master's degree program, setting a relevant industry context for all ICT concentrations.

ICT 4005 ICT Technical Foundations (4 Credits)
This course provides a substantive review of the technology at the core of the ICT industry. Coverage includes hardware, networking technology, databases, information services, applications, and content in enterprise contexts. The application development process is briefly reviewed. A framework is developed around data at rest, data in transit, and data being processed. This framework is used to detail the roles of a variety of hardware and software artifacts, and their use in the production, processing, protection, and use of organizational information. The role of the ICT user interface and web systems in providing user access to content anytime anywhere is reviewed. The security requirements associated with a variety of information types are introduced, along with the current best practices used in information security.

ICT 4007 Creative Problem Solving and Programming Concepts (4 Credits)
In this course students will develop, or improve upon, their problem-solving skills. Students will learn to use those problem-solving skills to analyze problems and determine how to create solutions. Students will document their solutions (e.g., in pseudocode or UML diagrams) and, by the end of the course, translate their solutions into running programs written in at least two languages (e.g., Python and C#). Students will learn programming concepts including the use of variables, program input and output, flow control (if-then-else, looping, etc.), and error testing. Students will learn how to set up Integrated Development Environments (IDE) such as X-code and MS Visual Studio on their personal computers in which they will write programs.

ICT 4010 Enterprise Architecture (4 Credits)
In this course, students learn how to effectively and efficiently integrate information and communications technologies to support business goals. The course provides an overview of the global, enterprise-wide architectural framework that drives business decisions regarding selection and implementation of ICT systems and solutions. Topics include supporting and transforming Global Value Chains, e-business designs; creating enterprise architecture; and the various methodologies, tools and techniques used in the design and implementation of the enterprise architecture. The course encompasses all aspects of information and communications technology including data networks, applications, operating systems, database systems, telecommunications systems, and hardware components in the context of a total enterprise-wide framework.

ICT 4015 Managing Technology for Strategic Value (4 Credits)
In this course, students acquire an in-depth understanding of the key management skills necessary to manage technology for strategic value. It concentrates on providing in-depth knowledge of strategic planning, the role of technology in business, and business process automation. It also provides students with the management skills and tools to prioritize technology investments, and manage technology products and projects. Topics include strategic planning and business alignment, managing business applications, business process automation, the role of web 2.0 in business processes, technology management, budgeting and capital investment prioritization, and build/buy decision-making in regards to custom-built and off-the-shelf solutions.

ICT 4020 Business Forecasting and Planning (4 Credits)
Business forecasting and planning brings together a wide diversity of skills: economic, financial, marketing, and technical analysis. This course brings together these concepts and extends prior coursework with coverage of budgeting, finance, costing, business planning, revenue forecasting, profit and loss statements, and balance sheet analysis as applied to information systems and services. Coverage includes the economics of software and other intellectual property, network effects, usage and sharing effects, sunk costs and monopoly effects, capacity and resource planning issues, and an introduction to the related regulatory issues. Students develop budgets or business plans for several increasingly difficult scenarios addressing a range of technology applications and services.

ICT 4025 Technology and Innovation Management (4 Credits)
Leaders of innovative firms build commitment to new directions, re-design structures to support new missions, and transform cultures. This course concentrates on the implementation of business strategy through effective structures and systems. Students learn why only 7% of companies are able to revitalize their organization once growth has stalled; students also learn what to do about it. Students analyze key aspects of strategic deployment, including organizational structure, cross-functional teams, product development, business model design, and change management. The course concludes with students developing a strategy for implementing an innovation. In this course students integrate the areas of knowledge covered in the ICT Foundations courses and the Technology Management concentration. It should be taken as the last of the four required courses in the Technology Management concentration. Prerequisites: ICT 4010, ICT 4015, ICT 4020, ICT 4100.
ICT 4030 Enterprise Architecture Frameworks (4 Credits)
This course covers the application of Enterprise Architecture (EA) frameworks as systems of methods, tools, and standards for transforming the operations of business, non-profit, and government organizations. The course concentrates on TOGAF, The Open Group Architecture Framework, as the primary instructional vehicle, but also outlines other EA frameworks and illustrates their individual purposes. The course demonstrates how EA frameworks can be combined and customized to meet specific objectives. The class starts with a high-level overview of EA, TOGAF, and other EA frameworks, then moves toward covering each component of the TOGAF framework. As the course moves through each component of TOGAF, key concepts such as governance, building blocks, views, viewpoints, and stakeholders are presented in context. Students will choose and apply EA frameworks with transition planning to current industry case studies and scenarios.

ICT 4035 Applied Enterprise Architecture Solutions (4 Credits)
This course addresses how Enterprise Architecture (EA) frameworks and associated methodologies can be combined and customized for targeted organizations for their specific, overarching EA program/capability. It then lays out how to construct a strategic architecture initiative using the customized EA capability, which will include the use of full life cycle transformation activities, leading EA graphical languages and a variety of EA planning and modeling tools. The first half of the course will provide students with the information necessary for them to develop their customized EA capability. The second half will focus on applying the capability for a robust business transformation initiative in their respective final projects. Prerequisite: ICT 4030.

ICT 4045 Information Technology Service Assurance (4 Credits)
In today’s technology-centric work environment, simply delivering IT services is no longer sufficient. Organizations must provide “assurance” that IT services and the underlying data assets are reliable, highly available and secure. IT Service Assurance or IT Quality Assurance includes many functions including IT service delivery, service level management, quality assurance testing and monitoring, change and release management, project management, security, and compliance, all within a risk management framework. This course evaluates these functions as integrated components of a service assurance program and their impact on the organization. It also investigates how service assurance is intertwined with the strategic and tactical initiatives of the organization. The use of case studies and actual IT related challenges and opportunities are utilized to anchor the course concepts. The combined in-class meetings and online course structure lend itself to ongoing interaction, collaboration, and sharing of ideas.

ICT 4100 Principles of Project Management (4 Credits)
This course is designed to provide students with practical skills in project management and the students who are continuing in the Project Management course sequence with a framework for the concepts and tools covered in the remainder of the program. The various elements of the project management processes, tools and techniques are explored, applying the software used in managing projects. Topics include a review of processes to initiate, plan, execute, monitor and control, and close a project. Project integration, scope (including requirements), time, cost management, and planning human resources are emphasized. Students learn project management skills through hands-on exercises using project management tools and techniques and project management software to emphasize the real world of managing a project.

ICT 4105 Project Contracts and Procurement (4 Credits)
This course is designed to provide students with practical skills in project contracts and procurement. This course introduces the various elements of the contract and procurement process, including exposure to procurement plans, Request for Information (RFI), Request for Quote (RFQ) and Request for Proposal (RFP), as well as the various types of contracts and change order procedures. The course builds upon the framework from the remainder of the program. Topics include how to develop a procurement plan, what type of RFs to use and why, selection criteria for vendors, and contract selection. Students learn project management skills through hands-on exercises developing procurement plans, RFQ’s and contracts. No prerequisites.

ICT 4110 Project Risk and Quality Management (4 Credits)
This course introduces students to project risk and quality management and develops advanced skills in applying the project management tools and techniques learned in ICT 4100 (prerequisite course). A focused examination of scheduling, cost, quality, and risk management processes using advanced tools and techniques is included. Emphasis is placed on the project planning, execution, and monitoring and controlling processes. This course is on the Project Management Institute’s (PMI) certification track. Prerequisite: ICT 4100 or equivalent knowledge.

ICT 4115 Project Management Dynamics (4 Credits)
This is an advanced course that applies the knowledge and skills learned in the prerequisite courses to a complex program. The planning, monitoring and controlling, and project close process groups are explored using case analyses of program and project plans. Learning is based on reading case material and the practical application of project management tools and techniques. Students receive hands on simulation experiences in planning and running subprojects, and work in Project Management Office (PMO) roles. Students develop a workable change management system, exercise project integration and communication skills, and demonstrate the ability to keep an overall program on track. They also demonstrate decision making skills, with emphasis on making tradeoffs based on solid business rationale. This course is on the Project Management Institute’s (PMI) certification track. Prerequisites: ICT 4100 and ICT 4110.

ICT 4120 Lean Six Sigma-Getting Started (4 Credits)
Students use Lean tools and techniques to define and scope a problem, determine project objectives and benefits, and create a project charter. The students also learn to define the ‘as is’ process, validate the measurement system and measure outputs, and quantify process performance.

ICT 4125 Lean Six Sigma-Analyze (4 Credits)
Students apply Lean tools and techniques to identify potential causes (x’s), investigate the significance of x’s, identify significant causes, and provide a preliminary definition of process outcomes as a function of causes [y=f(x)].

ICT 4130 Lean Six Sigma: Improve and Control (4 Credits)
Students apply Lean tools and techniques to generate potential solutions, select and test a solution, develop an implementation plan, and create a control and monitoring plan. The students also learn the methods and techniques for implementing a full scale solution and finalizing transition.
### ICT 4155 Strategic Alliances in the Technology Sector (4 Credits)
Strategic alliances are one of the key drivers in today’s global economy and have gradually replaced vertical integration as the chief method of corporate expansion. Business-to-business alliances provide organizations with a variety of benefits, including enhancing the capability of organizations and helping to extract maximum value from available resources. While applicable to any industry, strategic alliances are particularly important in the technology sector. This course defines and discusses the roles of various types of strategic alliances in the technology sector, including informal alliances, partnerships, joint ventures, and outsourcing arrangements. It also explores strategies for managing profitably and exploiting these external business relationships. Case studies will be an integral part of the learning experience. Successful and unsuccessful alliances will be analyzed from the perspective of each alliance participant, 3rd-party vendors, customers, and a variety of other stakeholders.

### ICT 4160 Advanced Methods for Complex Projects (4 Credits)
This course explores the planning and execution challenges that often cause complex projects to fail. The course provides a historical perspective regarding project management practices, and reviews evidence regarding project trends in project outcomes. For example, despite the use of commonly accepted methods for project management and systems engineering, the success rate of NASA and DoD programs, as measured by schedule, budget, and requirements performance, is trending downward. The evidence shows similar trends in commercial industries (e.g., the Airbus A380 and Boeing 787 aircraft programs). The course addresses why the methods embodied in the Project Management Institute’s (PMI) A Guide to the Project Management Body of Knowledge (PMBOK Guide) are sometimes insufficient to assure project success. The course then explores remedies drawn from recent research and cases in complex systems development and global teaming case studies. The instructor will host online reviews of readings and discussion. Students will learn and leverage visual modeling and simulation tools for the design of complex projects. Participation is voluntary, but recommended. Methods to handle complex, concurrent, and mutual dependencies across organizations and cultures will be applied. Based on case studies, the instructor will introduce Project Design methods, including student access to TeamPort project modeling and simulation software. The course culminates with teams in an online role play exercise to demonstrate collaborative planning and decision-making using these advanced methods. This exercise will require dedicated, synchronous interaction with other team members. Prerequisite: ICT 4100.

### ICT 4165 Project Collaboration with SharePoint (4 Credits)
This course focuses on the role of collaboration as a critical success factor in project planning and execution. Complex projects typically entail cross-functional teams that are often geographically distributed, culturally diverse, and require collaboration across both organizational and corporate boundaries. This course covers best collaboration practices and the use of collaborative websites to facilitate communication, create shared understanding of processes and deliverable, and apply tools to achieve successful project completion. Hands-on assignments are used to illustrate how collaborative sites allow a project team to post, edit and jointly work on documents of all types, such as project charters, project plans, WBS, requirements, budgets, schedules, procurement activities and closeout activities. Students collaborate within the course to learn how collaborative sites can be used to control project documentation and enforce the security levels associated with those documents. Students also learn how these sites can be used for such activities as assigning tasks, building a project calendar, setting up logs for gathering information, and performing other typical project management duties. The lab portion of the courses uses SharePoint as a template and shows how to set up a site to create folders, lists, tasks lists, calendars, and set the associated security levels. A SharePoint site is created for each student and students have access to both the class site and their individual sites.

### ICT 4170 Agile Techniques and Practices in Project Management (4 Credits)
Is the Agile vs. traditional project management debate over? At least in the world of software development, the debate is largely over, as evidenced by the widespread adoption of Agile methods. For example, according to Gartner, in 2012 Agile development methodologies will be used in 80 percent of all software development projects. As the term implies, however, the techniques and best practices for the successful application of Agile project management processes are not static, they will continue to evolve. And, Agile principles and practices are used across many project domains, each with their own unique characteristics and challenges. So, best Agile project management practices will continue to be dynamic. The Agile debate is now turning from the tactical to the strategic. Realizing the full benefits of Agile (e.g., faster time to market, improved responsiveness to customers, higher quality, and greater efficiency), means more than improving project execution. It requires transforming the business into an Agile enterprise. This course examines both the Agile processes and practices for delivering projects, and the cultural and programmatic challenges encountered in transforming the business into an Agile enterprise. The course content, in addition to reading assignments, uses practical assignments such as case studies, projects, and simulations to provide applied experience with Agile practices.

### ICT 4200 Cybersecurity Foundations (4 Credits)
This course will provide students with an understanding of cybersecurity and the importance of implementing sound cybersecurity policies, procedures, and systems. This course is for students who are new to cybersecurity (e.g., newly appointed managers with little cybersecurity experience) or those who need a refresher on cybersecurity fundamentals prior to taking additional courses in the concentration.

### ICT 4205 Cybersecurity Management (4 Credits)
This course will provide students with an understanding of management roles and responsibilities, including policy and process oversight, adherence to laws and regulations, and understanding of the types of reports reviewed and created by cybersecurity managers (such as reports for a Board of Directors).

### ICT 4210 Cybersecurity Policy (4 Credits)
This course will help students understand critical events that shaped the U.S. cybersecurity landscape. Students will explore the impact of international cybersecurity policy such as the European General Data Protection Regulation (GDPR) on U.S. businesses. Students will learn how to analyze new cybersecurity policies and regulations to determine their impact on organizations.
ICT 4215 Cybersecurity Risk Management and Incident Response (4 Credits)
This course covers how to manage cybersecurity risk including mitigating risk, responding to incidents, and incident reporting (in particular when governmental and regulatory agencies need to be notified). This course will also address working with a public relations team and the Board of Directors to create press statements regarding cybersecurity incidents or breaches.

ICT 4220 Cybersecurity Leadership and Strategic Planning (4 Credits)
This course covers the responsibilities of senior and strategic cybersecurity management roles, including the supervision and management of workers performing cyber-related and cyber operations work. The course also covers developing policies and plans, and advocating for changes in policy, that support organizational cyberspace initiatives or required changes and enhancements.

ICT 4225 Cybersecurity Audits (4 Credits)
This course will cover cybersecurity audits, including performing self-audits, providing external auditors with information, and penetration testing (defined and how they are conducted).

ICT 4300 Web Enabled Information Systems (4 Credits)
This course is an introduction to the design of web enabled information systems. The course reviews modern design and programming principles, introduces database design and object oriented principles, and introduces security issues and best practices related to web application development. The course introduces object-oriented modeling methods, including use cases, class, and activity diagrams that describe the informational and behavioral content of a system's objects. Basic OOM design tools are introduced. The class addresses organizational concerns around web applications, exploitation of technology in today's market, and retention of data integrity. This should be the first course taken in each of the following specialties: Software Design and Programming, Database Design and Administration, Web Design and Development, and Information Systems Security.

ICT 4305 Object-Oriented Methods (4 Credits)
This course introduces the object-oriented view of software analysis, modeling, and design. It defines all of the relevant concepts needed to understand the paradigm. A complete graphical notational scheme is taught for the purpose of diagramming objects and object interactions. The course covers the design, evolution, modification, and test/verifications phases of object-oriented development in some depth. Since project management plays a key role in the success of object-oriented development, its relation to the development process is discussed. The course also surveys the various object-oriented languages and tools available.

ICT 4310 Distributed Computing (4 Credits)
This course provides a practical introduction to client-server applications and programming. The course examines key aspects of client-server computing such as systems requirements for operating systems, middleware, networks, servers and clients. The course develops students' understanding of alternative client-server architectures to meet business requirements, the selection of application development tools, and the use of object-oriented analysis and design practices to implement client-server applications. Students also develop client applications using a variety of techniques. Prerequisite: ICT 4300.

ICT 4315 Object-Oriented Programming (4 Credits)
This course covers modern programming techniques using object-oriented methods. The course familiarizes the student with development tools and the syntax of a programming language by developing simple programs that use control flow techniques and basic input/output techniques. Basic methods to harden code against malicious attack are introduced, and basic verification techniques presented. Prerequisites: ICT 4300 and ICT 4305.

ICT 4351 .NET Programming with C# (4 Credits)
Students identify and describe the fundamentals of the .NET architecture, explain various .NET components, their respective responsibilities and functions, identify and explain .NET design issues and development solutions; identify and describe the fundamental .NET components; explain CLR execution, and have some familiarity with predominant .NET languages.

ICT 4361 Java Programming (4 Credits)
This course enhances the student's experience in object-oriented design and software development by performing and discussing object-oriented design for re-use of general purpose applications and small Java applications, including using the Java Collection API and Swing user interface classes. Topics include the use of Java as an object-oriented programming language, including encapsulation, simple inheritance, and polymorphism; design of Java classes using Java interfaces and packages; implementation of design patterns in working Java code; and use of Java Base Classes. The course also addresses the use of JAVA IDEs such as Eclipse and NetBeans. Note: This course does not address JavaScript. Prerequisites: ICT 4300, ICT 4305, ICT 4315.

ICT 4370 Python Programming (4 Credits)
This course starts with an introduction to Python programming covering basic programming concepts and Python syntax. It then continues to deepen students' knowledge of Python by teaching how to access data (text files, databases and other data storage technologies), and process and manipulate that data. Basics of creating front-end interfaces with Python are covered in order to allow students to produce more intuitive interaction with application users. Beyond core Python libraries, other commonly used Python libraries will also be utilized in the course. The course will focus on good programming practices and solving problems effectively. At the successful completion of the class, students will be able to create a number of different types of projects and execute them in Python, as well as continue learning and applying Python skills to data analytics, GIS and other areas of focus. Prerequisite: ICT 4300.
ICT 4400 Database Administration (4 Credits)
This course introduces the roles and responsibilities, as well as the critical knowledge and skills needed to function as a database administrator. The course focuses on Oracle and Microsoft SQL Server, the two dominant global database platforms. Core components include installation and configuration of both database products and implementation of appropriate account privileges. Lab environments are used for hands-on lab assignments in the course, as well as in subsequent courses in the ICT Database Design and Administration concentration. Primary job responsibilities of database administrators are examined, including monitoring, maintaining, and administering database platforms and schemas, while applying best practices in database security. Broader topics, such as metadata, business intelligence, and data warehousing are examined from an organizational perspective. Prerequisite: ICT 4300.

ICT 4405 Database Design and Implementation (4 Credits)
This course concentrates on the relational database model and the conceptual, logical, and physical phases of database design and development. Entity-relationship modeling, data normalization, and Structured Query Language programming are core components of the class. The role and responsibilities of a database administrator are explored; and the concepts of database integrity and transaction management, concurrency protocols, and security schemes are examined. In addition, emerging data warehouse technologies are introduced. The course culminates in a project that allows students to demonstrate an understanding of all phases of the database life cycle (DBLC). Prerequisites: ICT 4300, ICT 4400.

ICT 4410 Data Warehousing Design (4 Credits)
Organizations with vision and courage are gaining competitive advantage by implementing data warehouses. Under the guidance of an executive sponsor, a team of data administrators, database specialists, and organizational analysts creates these contemporary decision support environments. Building a data warehouse is fundamentally different than building a subject area database for an operational system. In this course students use such data warehouse (DW) concepts as partitioning, granularity, record of source, and metadata as they learn how to build a viable decision support environment. Students further their understanding of such topics as architect development, data migration and integration, use of operational data stores, and transactional systems. Prerequisite: ICT 4400.

ICT 4415 Database Backup and Recovery with Lab (4 Credits)
This course explores basic database backup and recovery strategies and tactics using an Oracle database system. Topics include preparing backup, recovery and disaster plans, and performing complete and incomplete database recoveries using the Oracle Export/Import utility. Using hands-on activities and labs, students also gain experience with Oracle troubleshooting utilities, RMAN architecture and setting up Oracle standby databases. Prerequisites: ICT 4300, ICT 4400, ICT 4405.

ICT 4430 Database Security (4 Credits)
Information Technology has become increasingly data-driven, requiring I.T. professionals to dramatically rethink how we protect corporate assets. This course strives to provide a perspective that intersects several technology disciplines: database administration, web-based application development, and technology management. Taking a defense-in-layers perspective, Database Security will provide students with an opportunity to gain an understanding of how data is protected from the perimeter to the data. Students will understand the nature of the types of threats and vulnerabilities to the web-based applications and underlying databases, and how to develop strategies to most effectively protect an enterprise’s data.

ICT 4450 Database Programming: Oracle PL/SQL (4 Credits)
This course builds on ICT 4405 Database Design and Programming, allowing students to transform a database schema design into a database application prototype using Oracle’s PL/SQL. Topics include advanced SQL DDL, DML, and scripting, PL/SQL constructs, stored procedures, modular design and development, software development processes, views, sequences, cursors, dynamic SQL, error handling, locking, as well as performance and tuning, and database security. Using virtual E-Labs, students design and develop a database and related PL/SQL applications.

ICT 4451 Database Programming: Oracle PL/SQL with Lab (4 Credits)
This course is an introduction to Microsoft SQL Server for both the DBA and Developer. The key new features of SQL Server are introduced and explored, and the various editions of SQL Server are contrasted. In-depth coverage is provided on how to use the new Microsoft SQL Server Management Studio for both administrative and development tasks. Special emphasis is given to query optimization techniques. An introduction to SQL Integration Services, SQL Analysis Services and SQL Reporting Services is also presented. Prerequisites: ICT 4300 and ICT 4405.

ICT 4462 Transact - SQL Programming (4 Credits)
Transact-SQL is the primary programming interface between applications and the Microsoft SQL Server database. Transact-SQL can be sent from programs or applications to the SQL Server database or can be built into reusable database stored procedures. This course focuses on Transact-SQL in a stored procedure context. Topics include: basic and advanced SQL, SQL functions, stored procedure declaration and execution, cursors, temp tables, error handling, transaction management, security, and performance issues. The course uses a combination of lecture, textbook reading assignments, and hands-on lab assignments to meet its objectives.

ICT 4485 NoSQL Databases (4 Credits)
Relational database systems have been dominant in the market for over forty years, and remain so today. However, the emergence of distributed and cloud computing, as well as the increasing need for storage of large datasets, have created the need for alternate data storage solutions. A number of different models / database management systems have been developed, that as a group are being referred to as NoSQL databases. A number of large, well-known companies use such databases. Some of the companies use more than one variety of NoSQL databases. This course will examine different non-relational (NoSQL) data models, those being Key-Value, Document, Column, Graph and the Object-Oriented database models. Students will learn about advantages and disadvantages of the different approaches. The class will include hands-on experience with a representative sample of NoSQL databases. Computing developments that spurred the existence of NoSQL databases, such as big data, distributed and cloud computing, will also be discussed. Prerequisites: ICT 4300 and ICT 4405.
ICT 4505 Website Design and Management (4 Credits)
This course extends student web design and development skills, and includes advanced HTML techniques and enhanced page design capabilities using CSS. The key to great web design is rooted in a solid foundation, which requires a plan or a "blueprint". We explore best-practices in information architecture (IA) and how to incorporate user-centered design (UCD) techniques as a standard practice in web design. Students also develop an understanding and working knowledge of Cascading Style Sheets (CSS). Through the use of readings, examples, hands-on projects, and discussions the class builds an understanding of the foundations and applications of user-centered design to plan, build and manage a website. Through participation in a project and regular discussions, class members experience working as active and contributing members of the class and knowledge-building community.

ICT 4510 Advanced Website Design and Management (4 Credits)
This course explores advanced techniques for web programming using current client-side web technologies. Use of JavaScript, jQuery and Ajax are covered. HTML5 technologies such as Forms, Local Storage and Web workers are introduced. Students create an interactive website. This is a hands-on course where students apply what they learn as they learn it. Students demonstrate mastery of the materials by applying the principles introduced in class to laboratory exercise, class discussions, and projects. Prerequisite: ICT 4505.

ICT 4515 Usability Design for Websites (4 Credits)
This course expands the student's basic knowledge of Web page and website development (ICT 4505) by providing in-depth understanding of how to design Web applications with the user in mind. Students gain knowledge about how the fields of human factors engineering and psychology (e.g., visual perception, cognition, learning, and memory) relate to usability design as well as how usability assessments are conducted. Usability guidelines, design problems and design strengths, and best practices for common functions such as Web navigation, menus, scrolling, graphics and icons are explored. The class is a combination of lectures and lab experiences, culminating in the student's developing a website, conducting a usability evaluation, and reporting on the results and recommendations from the evaluation.

ICT 4520 User Experience: A Human-Centered Approach to Product Design (4 Credits)
This course is an introduction to User Experience (UX) design. The course will take theoretical and practical approaches to guiding students through the principles, practices, process, and tools to design usable, useful, and desirable experiences. Students will explore the methods for conducting UX research to determine needs, processes for designing products that meet those needs, and effective techniques for presenting designs to stakeholders. Throughout the process, students will consider the "why" behind each phase of the approach. The course will culminate in the application of UX best practices to build a functional prototype. Prerequisites: ICT 4505 Website Design & Development.

ICT 4540 XML and Data in Application Development (4 Credits)
XML is an open, text-based markup language that provides structural and semantic information to data. This "data about data," or metadata, provides meaning and context to the application using it, and supports manipulation and display. The course focuses on techniques to make this data useful for business applications, as well as for browser display. Hands-on experience with the XML formats and manipulation, which includes programming techniques, forms the weekly assignments, culminating in a summary project. Other standards, such as JSON, are discussed, as well as use of CSS for display of XML data. Some JavaScript is introduced to illustrate the document model and techniques for integration of data. Prerequisites: Students should have familiarity with constructing HTML web pages and data concepts. Familiarity with a data manipulation or programming language will be helpful.

ICT 4555 Introduction to Animate CC (4 Credits)
This course introduces students to rich media design, animation, and interactive development for the web, desktop, mobile, and more using Adobe Animate CC. Students learn the fundamentals of working in the Adobe Animate CC authoring environment to produce web assets, small animations, and basic interactive modules for multiple target platforms.

ICT 4560 Web Graphics Production (4 Credits)
This course introduces the fundamental concepts and techniques of digital graphics creation and image processing for both online publication and website interface design. Students learn the basics of correcting and modifying images, bitmap painting tools, vector drawing tools, typography, masking, web production techniques, and advanced image compositing. Integration of images and generated code into a website layout employing CSS is also covered.

ICT 4561 Web Development with PHP (4 Credits)
This course introduces students to programming Web applications using PHP and MySQL. Topics include processing form data, file uploads, object-oriented programming and database access. Students leverage a PHP framework and learn to install and configure a local development environment to test and develop their Web applications. Prerequisite: ICT 4510 or previous programming experience.

ICT 4570 Web Scripting with JavaScript (4 Credits)
This course presents students with the principles necessary to design and develop client-side scripts used to build dynamic websites and applications. JavaScript concepts such as data types, control structures, functions and objects are discussed. Students learn how to write beginner and intermediate scripts. In addition, students are introduced to advanced JavaScript topics, including module development, distributed computing and security. Students are presented with real world examples of JavaScript and build an interactive and dynamic client-side application. Technologies covered in the course include JavaScript/ECMAScript, jQuery (a JavaScript library), JSON (a JavaScript-friendly data format), JavaScript as the J in AJAX, and JavaScript in HTML5 form interaction and validation. Prerequisite: Knowledge of HTML, ICT 4505, or previous programming experience.
ICT 4576 Native Application Development on Mobile Devices (4 Credits)
During this course students learn how to use a set of languages and tools to build business and media-centric applications that run on mobile devices such as laptops, tablets, smartphones, and eReaders running on Windows, MAC OS, iOS, and Android. This course illustrates best practices for reusing code, structuring projects, and submitting applications to app stores. Throughout the course students utilize an IDE such as FDT or IntelliJ, MXML, and ActionScript to build cross-device native applications. Students also learn how to add functionality to their Adobe AIR native applications by leveraging third-party Native Extensions to access native features. Prerequisite: ICT 4300 or previous programming experience.

ICT 4580 Mobile Application Development with Web Standards (4 Credits)
This course enables students to take advantage of web standards (HTML5, CSS3, JavaScript) along with various popular frameworks and tools in the generation of both mobile web applications for the browser and packaged mobile applications for devices. We examine the fundamentals behind good user and interaction design when targeting mobile devices and see what is appropriate for implementation on these platforms. We also employ a popular cross-compilation tool to perform distribution onto multiple platforms. Prerequisite: previous programming experience.

ICT 4585 Web Development with Ruby on Rails (4 Credits)
Ruby is a dynamic, general-purpose, object-oriented programming language that has an associated web application framework, Rails. The Ruby on Rails (RoR) web application paradigm is powerful and flexible, and has been widely adopted by other frameworks. It allows for the rapid and agile creation of dynamic web applications with little of the overhead associated with other approaches. The student learns how to quickly develop, test, and deploy dynamic web applications using RoR. The student also learns how to manage both the user experience and a backend database from within the RoR framework. Prerequisite: ICT 4510 or previous programming experience.

ICT 4605 Principles of Information Security (4 Credits)
This is a comprehensive Information Systems Security management course covering the eight basic principles of Information Assurance and Information Systems Security. The course follows the Common Body of Knowledge (CBK) convention established by the International Information System Security Certification Consortium, Inc. (ISC)². This course serves as an introduction to the eight domains of information systems security with the emphasis on management issues. It provides the foundation of information systems security and the methodologies that organizations apply to analyze and achieve their security goals. Students learn about significant computer security laws and regulations, system security engineering, the development of effective security policies, system access controls, network security, encryption and security models. The course also covers specific security measures to include, but not limited to, physical security controls, network security, cloud security, telecommunications, and cryptography. Information covered includes contemporary issues of cybercrime, and business continuity and disaster recovery planning. The course applies a systems approach to security issues to analyze and develop security solutions. All topics are discussed in the context of a total enterprise-wide framework. Prerequisite: ICT 4300.

ICT 4610 TCP/IP Networks (4 Credits)
This course explores the operation of the TCP/IP protocol stack including its history, development, current applications, and future implications. The full range of TCP/IP protocols from IP and TCP to basic RPC issues and application protocols such as DNS, SMTP, FTP, SNMP and HTTP are studied. Students also study TCP/IP capabilities, alternatives, and performance issues. Security-specific protocols including SSL and IPSec are examined along with the security aspects of all other protocols. Mechanisms for Internet connectivity for homes and businesses are also covered. The course concludes with a survey of modern topics including Real-Time Communications and IPv6.

ICT 4615 Computer and Physical Security (4 Credits)
Controlling access to computers and controlling access to a building can no longer be viewed as two separate worlds. Today, IT access control and physical security need to be integrated if organizations are to be fully protected from threats. This course concentrates on seeing IT access control as integrated with physical security within an organization. Students investigate how various technologies and methodologies can work together to manage access to computer systems; how to manage elements of physical security; and the issues involved in creating a unified and complete enterprise security system. Security technologies to physically protect an organization's people, facility and resources, access control techniques and administration, identification and authentication techniques and methods of attack are emphasized.

ICT 4670 Disaster Recovery and Operations Security (4 Credits)
This course focuses on the planning and operations security required to effectively recover from natural disasters and security attacks and to ensure the operations and integrity of computer systems and staff. Topics include defining continuity requirements, choosing appropriate recovery strategies and understanding the key elements of a continuity plan. Students create a Business Continuity Plan including business impact analysis, recovery strategies, and recovery plan implementation. The course also provides an understanding of controls over resources, facilities, hardware, systems, and the people who create, modify, and use them. Control mechanisms and operations security “best practices” are identified.

ICT 4675 Information Systems Security in Healthcare (4 Credits)
This course will introduce students to information security risks facing the healthcare industry. Students will learn how to better protect healthcare organizations and their patients’ data. Students will learn about recent security breaches, the impact of those breaches on healthcare organizations, and all of the key players involved. This course also covers the evolution of healthcare IT and the continuously evolving risk and regulatory landscape. Students will explore the regulations of HIPAA and how they relate to day-to-day operations in healthcare organizations. Additionally, this course will prepare students to support information security initiatives in order to protect the organization while furthering the advancement of healthcare IT capabilities. This is not a technical course, however we will be learning about how security is impacted by technology and what we must do across technology in order to secure our healthcare systems, our organizations, and our patients.
ICT 4680 Principles of Cryptography (4 Credits)
E-commerce has made cryptography a cornerstone of modern information systems security. Cryptology is one of the 10 domains required for the CISSP, and is a core component of all other recognized information security certifications. Surprisingly, it is the least understood of the information security disciplines. This course focuses on the terminology and concepts needed to understand how cryptographic techniques are used to protect sensitive information. Topics include: Advanced Encryption Standard (AES), the Secure Hash Algorithm (SHA), Digital Signatures and Message Authentication Codes, Diffie-Hellman Key Exchange, public key infrastructure (PKI), secure sockets layer (SSL), and IPsec among others. Lecture and reading materials are reinforced by hands-on experimentation with cryptographic software tools. Internet resources are used to tie the course material to current technology trends. No programming experience or advanced mathematical skills are required for this course. Prerequisite: ICT 4605.

ICT 4685 Cloud and Internet Law (4 Credits)
The legal ramifications of Cloud Computing, Cyber and Internet Law are effecting dynamic change in our country and all throughout the world. This course explores the laws of the new paradigm of Cloud Computing, Cyber and Internet Law and describes the types of issues and concerns that exist. Such issues include the civil and criminal laws, rules and regulation, privacy issues, contractual agreements between parties (on many levels from providers in numerous different states and countries), the impact of differing cultural standards and mores from all over the world, and legal methods of protecting companies from these issues and worries in the world of Cloud Computing, the Internet and Cyber Law.

ICT 4690 Computer Forensics with Lab (4 Credits)
This course is concerned with providing an overview of the methods and tools utilized for collecting and preserving electronic digital evidence for the computer forensic process; the forensic examination, analysis, and report writing; and preparing for courtroom testimony about the forensic results. The course is supplemented by hands-on-exercises, case studies, and a moot court exercise in which each student will testify.

ICT 4695 Application Security (4 Credits)
In this course, students explore the security principles and practices that apply to application software development throughout the entire software development lifecycle (SDLC). Topics include characteristics of secure and resilient applications, proven best practices for secure software, and designing for security and resilience. The course also provides an overview of programming best practices. Other topics include testing custom application, testing off-the-shelf commercial applications, implementing development security methodologies, and evaluating the models used to measure the maturity of software development organizations. Prerequisites: ICT 4300 and ICT 4605.

ICT 4701 Topics in Information and Communication Technology (4 Credits)
From time to time a special topics course may be offered that addresses a new issue, a developing concept, industry trends, or new technology.

ICT 4800 Network Communications and the Internet (4 Credits)
This course focuses on the fundamental concepts and technologies of communications networks and the Internet, including the information theory that is the foundation of modern communication systems. It emphasizes application of these concepts to the analysis and design of network solutions to meet various service provider and IT business requirements. Topics include network media, communications protocols and standards, LAN and WAN network architectures, the Public Switched Telephone Network, and current trends in networking via the Internet. Network components, such as modems, routers, switches, and voice communications systems are analyzed. The various transport media of copper, fiber, and wireless infrastructures are compared. Critical thinking is emphasized via discussions of current and future trends in network technology, global regulatory and political issues in voice/data/video communications, and Internet governance.

ICT 4815 Managing Global Telecommunications Projects (4 Credits)
Set in the context of today’s convergence from the traditional telco/telephony world to next generation all-IP networks brought about by the Internet revolution, the course addresses managing across borders, cultures, time zones, and continents. In addition, the course explores managing conflicts of interest between carriers and over-the-top (OTT) players such as Apple, Google/Android and Skype. Related topics include the challenges and opportunities in vendor management between the old telco vendors of the West and their new competitors from the East. Finally, the course analyzes stakeholder management at the C- and SVP-level of the organization. A variety of assignments create opportunities for students to work in teams, and at other times to work individually on a set of real-world case studies derived from typical projects at leading global network operators and telecom vendors. This course applies project management best practices to the typical challenges faced by project managers in today’s fast-paced, complex and highly competitive global telecom industry. Case studies are used to exemplify core project management challenges at an advanced level. Prerequisites: two courses in any of the following areas: Project Management, Technology Management, Telecommunications Technology.

ICT 4830 Broadband Wireless Networks (4 Credits)
This course examines the key broadband radio technologies at the center of today’s rapid innovation in wireless networks. Wireless telecommunications networks are studied with an emphasis on the challenges and the approaches to deal with the immense wireless data traffic explosion from devices such as the iPhone, iPad, Android smartphones and connected laptops, as well as broadband services like VOIP and mobile video. The dominant wireless telecom technologies and protocols are presented, including 4G LTE, 5G, OFDM, MIMO, mobile IP, WiMAX, Wi-Fi and WPANs. The “triple play” convergence of voice, video, and data over wireless networks is analyzed. The wireless telecom industry is studied from standards, carrier, and technology perspectives, with an emphasis on radio networks as well as key application use cases.
ICT 4835 Advanced Network Technologies (4 Credits)
Technological advancements in networking within the last few years are revolutionizing concepts of networking for both Enterprises and Service Providers. This course demystifies these latest advancements in network technologies. Topics include in-depth coverage of modern networking elements, network requirements, Network Virtualization technologies, Software Defined Network (SDN), and Network Function Virtualization (NFV). Coverage of latest technology requirements includes elastic traffic, big data, mobility, QoS, QoE, and more. The course discusses SDN and NFV components, architecture, protocols, and use cases. Virtualization technologies include VLANs, OpenFlow, VPNs – IPSec and MPLS-based. The course emphasizes deep understanding, analyses, and evaluation of modern network architectures. Prerequisites: ICT 4800 (required), ICT 4830 (strongly recommended).

ICT 4840 Next Generation Wireless Networks and Services (4 Credits)
The rapid innovation in wireless networks that is at the center of today’s ICT industry takes place in the four areas of broadband radio, core & edge networks, wireless services, as well as devices and smart objects. This course focuses on the key next generation technologies at the core network, service and object layers. First, the role of the Internet Protocol Multimedia Subsystem (IMS) in the core network is examined, which is at the heart of many next generation deployments. At the service layer, this course explores wireless service architecture, including popular applications such as mobile real-time messaging, TV/video and mobile web services. The Internet of Things (IoT) plays an increasingly prominent role at the object layer of modern wireless network designs. A case study approach is taken to highlight core use cases from key industries including Smart Cities, the Smart Grid and Industry 4.0. Finally, wireless product development, deployment and operations are examined in the critical context of the conflict between over-the-top (OTT) and network operator based ecosystems. Prerequisite: ICT 4800 or departmental permission.

ICT 4845 Network Security with Lab (4 Credits)
This course examines the key broadband radio technologies at the center of today’s rapid innovation in wireless networks. Wireless telecommunications networks are studied with an emphasis on the challenges and the approaches to deal with the immense wireless data traffic explosion from devices such as the iPhone, iPad, Android smartphones and connected laptops, as well as broadband services like VOIP and mobile video. The dominant wireless telecom technologies and protocols are presented, including OFDM, MIMO, mobile IP, WIMAX, LTE, and WPANs. The “triple play” convergence of voice, video, and data over wireless networks is analyzed. The wireless telecom industry is studied from standards, carrier, and technology perspectives. Important radio network concepts are addressed, including network design, cell selections and traffic concepts, mobility handoff signaling, radio resources management, location updates, roaming, as well as authentication and encryption. Prerequisite: ICT 4800 or departmental permission.

ICT 4901 Capstone Project (4 Credits)
The Capstone Project provides students the opportunity to research a topic, problem, or issue within their field of study, and work individually with a Capstone advisor. Similar in weight to a thesis, but more flexible, this final project will synthesize and apply core concepts acquired from the program. The student will select an appropriate Capstone advisor who is knowledgeable in the field of study to work closely with and who can guide the research project. Evaluation will be focused on the quality and professionalism of applied research and writing; critical and creative thinking; problem-solving skills; knowledge of research design, method, and implementation; and contribution to the field and topic of study. Please see the Capstone Guidelines for additional details. Prerequisites: A Capstone Proposal that has been approved by both the Capstone Advisor and the Academic Director, acceptance as a degree candidate, completion of at least 40 quarter-hours (including all core courses) with a cumulative GPA of 3.0 or better. A final grade of a B- or better is required to pass.

ICT 4902 Capstone Seminar (4 Credits)
The Capstone Seminar is a graduate seminar in which students utilize the knowledge and skills gained through the degree program to create a culminating work that critically addresses a problem in their degree field of study. The students produce a Capstone of 7000-8000 words that presents a position on a relevant problem, supports the position with professional and academic literature, analyzes and tests the proposed solution, and discusses the findings as related to the field of study. The seminar is dependent upon quality, collegial discussion, and feedback of students’ research and work products, under the facilitation of a faculty member. The course structure guides the students through the process of independent, secondary research and writing of a Capstone. No primary research is allowed. Students generate the course content through ongoing discussion and peer feedback on the Capstone process and individual topic areas under investigation. Students professionally and academically communicate through written work and oral presentation. Students must have: Acceptance as a degree candidate, completion of at least 40 quarter-hours (including all core courses) with a cumulative GPA of 3.0 or better. A final grade of B- or better is required in this course to meet degree requirements. Students must complete the Capstone Seminar in one quarter; no incomplete grades are assigned.

ICT 4903 Applied Capstone Seminar (4 Credits)
In the Applied Capstone Seminar, students propose, develop and deliver a cloud-based application that demonstrates the ability to apply the technical knowledge developed throughout their program of studies. In addition to demonstrating competence in applying what they have learned to date, students are challenged to expand their skills by virtue of the development environments, tools, and technologies they use to develop and deliver their projects. The primary deliverables are functional software, accompanied by representative design documents. As such, the project represents in microcosm the development processes, practices and deliverables that are typically entailed in producing robust, cloud-based software solutions. Although each student develops an individual project, the seminar also requires student collaboration via such activities as design reviews, quality reviews and peer exchanges on such topics as suggestions for solving problems and improving code. Prerequisite: To register for this course, a student must be accepted as a degree candidate, have completed at least 40 quarter-hours (including all core courses), and have a cumulative GPA of 3.0 or better. In addition, the student must be approved for registration by the course professor and the ICT Director. This seminar is limited to students in the Software Design & Programming, Web Design & Development, Mobile Application Development, and Database Design & Programming concentrations, and who are judged to have the requisite level of technical skills to be successful in this demanding seminar. A final grade of B- or better is required in this course to meet degree requirements. Students must complete the Applied Capstone Seminar in one quarter; no incomplete grades are permitted.
ICT 4980 Internship (1-4 Credits)
The ICT internship is designed to offer students a practical educational experience in an industry related setting. The internship is an individualized learning experience that is directly related to the knowledge and skills covered in the ICT master's degree program. Students are responsible for finding their own internship site and proposing their internship ideas. University College will send notification to all ICT students if they hear of internship possibilities. Students may also work through the DU career center to explore opportunities for internship experiences. The objectives, activities, responsibilities, and deliverables for the internship are defined in a training plan that is developed by the student jointly with the internship supervisor at the sponsoring organization. The training plan is approved by the academic director. Prerequisites: The student must be unconditionally accepted in the ICT degree program, have completed a minimum of 28 hours of graduate coursework, including at least two core courses, and have earned a GPA of 3.0 or better. Enrollment must be approved by the academic director.

ICT 4991 Independent Study (1-4 Credits)
This is an advanced course for students wishing to pursue an independent course of study. The student must be accepted in a degree program, have earned a grade point average of 3.0 or better, obtained the approval of the department director, and have completed the Independent Study form and filed the form with all appropriate offices before registering for the independent study. Independent Study is offered only on a for-credit basis.

ICT 4992 Directed Study (1-4 Credits)
This is an advanced course for students wishing to pursue a directed course of study. The student must be accepted in a degree program, have earned a grade point average of 3.0 or better, obtained the approval of the department director, and have completed the Directed Study form and filed the form with all appropriate offices before registering for the directed study. Directed Study is offered only on a for-credit basis.