

INFORMATION SYSTEMS PROGRAM

INFO 5000 C Programming and Development (4 SH)

Serves as an introduction to the C programming language and the Unix operating system. Basic C programming language topics include data types, basic I/O, selection-control structures, loop structures, subroutines and modular design, arrays, strings, structures, advanced I/O, and Unix system calls. Discusses pointers in the context of parameter passing, array manipulation, and dynamic memory allocation. Unix topics include the file system, basic commands and utilities, utilities useful for program development, and shell scripting. Covers recursion and basic list structures.

- *Prerequisite: Engineering students only.*
- *Equivalent: INFO 0900.*

INFO 5100 Application Engineering and Development (4 SH)

Covers the basics of Java programming such as arrays, control structures, class definitions, class hierarchies, inheritance, objects, streams, constructors, collections, and GUI components. Describes how to develop and execute Java applications and incorporates several programming projects, which strengthen the understanding of object-based and event-driven programming. Provides the student with the opportunity to achieve a strong working competency in object-oriented programming using the Java programming language.

- *Prerequisite: Junior, senior, or graduate standing; engineering students only.*

INFO 5976 Directed Study (1 to 4 SH)

Offers theoretical or experimental work under the direction of members of the department on a chosen topic. Course content depends on instructor.

- *Prerequisite: Junior, senior, or graduate standing.*
- *Repeatability: May be repeated without limit.*

INFO 5978 Independent Study (1 to 4 SH)

Offers work performed under individual faculty supervision.

- *Prerequisite: Junior, senior, or graduate standing.*
- *Repeatability: May be repeated without limit.*

INFO 5984 Research (1 to 4 SH)

Offers an opportunity to conduct research under faculty supervision.

- *Prerequisite: Junior, senior, or graduate standing.*
- *Repeatability: May be repeated without limit.*

INFO 6150 Web Design and User Experience Engineering (4 SH)

Exposes students to both conceptual and technical aspects of Web design. User experience design is the discipline of creating a useful and usable website or application that is easily navigated and meets the needs of both the site owner and its users. Covers Web standards and best practices. Studies the fundamental concepts, techniques, practices, work flows, and tools associated with the practice of user-experience design in Web interfaces. Offers students an opportunity to learn the core principles of information architecture, usability, marketing hierarchy, and user experience for contextual, value-driven websites. Additional areas of focus include typography, color theory and composition, responsive design, CSS3 concepts, basic scripting, and JavaScript libraries to create functional, effective, and visually appealing websites.

- *Prerequisite: INFO 5100 (may be taken concurrently).*

INFO 6205 Program Structure and Algorithms (4 SH)

Presents data structures and related algorithms, beginning with a brief review of dynamic memory allocation. Discusses the fundamental data structures in detail, including the abstract representation, supporting algorithms, and implementation methods. Focuses on understanding the application of the abstract data structure and the circumstances that affect implementation decisions. Covers lists, stacks, queues, trees, hash tables, and graphs. Covers recursion and searching and sorting algorithms in detail. Emphasizes data abstraction and encapsulation in code design. Explores external storage structures, time permitting.

- *Prerequisite: INFO 5100; engineering students only.*

INFO 6210 Data Management and Database Design (4 SH)

Studies design of information systems from a data perspective for engineering and business applications; data modeling, including entity-relationship (E-R) and object approaches; user-centric information requirements and data sharing; fundamental concepts of database management systems (DBMS) and their applications; alternative data models, with emphasis on relational

design; SQL; data normalization; data-driven application design for personal computer, server-based, enterprisewide, and Internet databases; and distributed data applications.

- *Prerequisite: Engineering students only.*

INFO 6215 Business Analysis and Information Engineering (4 SH)

Covers computer information systems and the decision-making process, determination of information requirements, system development life cycle, and system modeling and analysis. Uses a hands-on approach to introduce the student to software engineering methodologies and practices, business requirements specification, business process design, model-driven object oriented design, software development, and maintenance. Emphasizes the effective leverage of the Unified Modeling Language (UML) to transform business issues and objectives to concrete software solutions that meet business needs and usability and user interface design as critical elements of a successful software engineering engagement.

- *Prerequisite: Engineering students only.*

INFO 6220 Operating Systems (4 SH)

Covers basic concepts of operating systems and system programming, such as utility programs, subsystems, and multiprogram systems. Main topics include processes, interprocess communication, and synchronization; memory allocation, segmentation, and paging; loading, linking, and libraries; resource allocation, scheduling, and performance evaluation; file systems, storage devices, and I/O systems; and protection, security, and privacy. Emphasizes key concepts through code design and development.

- *Prerequisite: INFO 6205.*

INFO 6225 Networks, Telecommunications, and Distributed Systems (4 SH)

Introduces the student to basic principles of data communication networks and distributed computer. Includes network goals and applications; architecture, topologies, and protocols; layered communications protocol design; layer functions, interlayer interfaces, and peer processes; performance measures; data communication techniques; wide area and local networks; channel interfaces and access schemes; routing and congestion control; naming schemes; client-server computing, workstations, and server nodes; Internetworking; security; distributed computing mechanisms; distributed synchronization, performance, and modeling. Emphasizes Internet standards and implementations in code design and development.

- *Prerequisite: INFO 6205; engineering students only.*

INFO 6240 C++ Object-Oriented Design (4 SH)

Introduces the basic concepts of C++ and object-oriented design for engineering software design and information systems. Topics include data abstraction, constructors and destructors, inheritance, the C++ I/O library, overloaded operators, virtual functions and polymorphism, and the reference data type. Applications of C++ programming are shown in order to emphasize the use of classes in problem solving with computers.

- *Prerequisite: INFO 6205.*

INFO 6245 Planning and Managing Information Systems Development (4 SH)

Provides an overview of the most popular information systems needs' assessment methodologies including portfolio analysis, stage assessment, business systems planning, and the Alloway survey technique. Topics include utilities IS strategic plan prioritization techniques of business goal alignment, architectural compatibility, and cost/benefit and risk analysis to demonstrate how businesses match needs to budgetary constraints. Describes and evaluates options for the placement of the IS function within the organization and a variety of methods to manage the function. Introduces a generic application development and project planning methodology used as a model to facilitate the development of a four-stage project plan for a prototype project. Uses the Project Management Institute's PMBOK and Harvard Business School case studies extensively.

- *Prerequisite: INFO 6215; engineering students only.*

INFO 6250 Web Development Tools and Methods (4 SH)

Explores the tools necessary to construct and maintain World Wide Web pages for use in e-commerce. Offers students the opportunity to learn the basics of the hypertext markup language (HTML, a scripting language for formatting Web pages), DHTML (dynamic HTML), JavaScript (an object-based language for clientside processing), PHP scripting, XML, Flash, and Java applets. Students are asked to complete several assignments culminating in an extensive WWW project that uses all the tools discussed in class.

- *Prerequisite: INFO 5100.*

INFO 6255 Software Quality Control and Management (4 SH)

Examines techniques for the management and evolution of software systems. Topics include managing software as an asset; life cycle development and rapid development technologies; maintainability; quality assurance of software systems including testing strategies and problem analysis; software risk analysis; analysis of software project failures; process models, such as CMM and ISO 9001; configuration management; and the impact of new development technologies on software management.

• *Prerequisite: INFO 6215.*

INFO 6260 Business Process Engineering and Management (4 SH)

Provides a practical laboratory class, applying what students have learned in database design, Web programming, and software development to a series of real projects for real users. Students are asked to work in teams to carry through the implementation of Web-based database applications from analysis of existing systems or prototypes, consideration of alternative designs and implementation, through comprehensive software and database development, to testing and deployment. Teams present their designs, implementation plans, and progress for peer review by the class and others. The objective is to have these real projects fully functional and deployed on the Web by the end of the semester.

• *Prerequisite: INFO 6215; engineering students only.*

INFO 6350 Smartphones-Based Web Development (4 SH)

Covers application development for mobile devices using the Java 2 Micro Edition (J2ME). Focuses on how to write J2ME applications using cross-platform development tools and processes. Topics covered include user interfaces, the midlet life cycle, persistent storage, networking using sockets and HTTP, and mobile/handheld data applications. A final project is required.

• *Prerequisite: INFO 5100.*

• *Equivalent: CSYE 7225.*

INFO 6640 People, Processes, and Products: Ethics for Engineers (2 SH)

Addresses the topic of ethical engineering and the various contexts in which ethical situations present themselves. Analyzes the three major normative ethical theories— virtue ethics, deontology, and utilitarianism—and discusses various cases in which a moral dilemma is created. Applies these moral conflicts directly to the practice of engineering, covering issues such as professional liability to consumers, employees, and employers; workplace safety; environmental issues; cross-cultural legal obligations; and social issues. Applying critical thought to difficult situations may prepare students to react thoughtfully in cross-cultural, morally ambiguous workplace situations. Also seeks to develop students' verbal and written communication skills.

• *Prerequisite: Engineering students only.*

INFO 6650 People, Problems, and Patents: Basics of Intellectual Property (2 SH)

Addresses subjects that support successful engineering careers by offering students an applied understanding of the fundamentals of intellectual property and the American legal system. Topics include an introduction to types of intellectual property (patents, trade secrets, trademarks, copyrights) and fundamentals of the American legal system (sources of American law, contracts, torts, intellectual property, antitrust). Covers at minimum the difference between “freedom to operate” patent analysis and patentability analysis, best practices for obtaining valuable patent coverage, and the role of patents in developing successful business planning. Also seeks to develop students' applied critical thinking, communication, and presentation skills.

• *Prerequisite: Engineering students only.*

INFO 6660 People, Problems, and Patents: Ethical Principles and Basics of Intellectual Property (4 SH)

Seeks to support successful engineering careers by offering students an applied understanding of ethical principles in the workplace and fundamentals of intellectual property and the American legal system. Seeks to increase students' awareness of the ethical implications of their work and to influence colleagues to think and act in a socially cognizant manner. Introduces ethical principles and codes of professional ethics; types of intellectual property (patents, trade secrets, trademarks, copyrights); and fundamentals of the American legal system (sources of American law, contracts, torts, intellectual property, antitrust). Offers students an opportunity to practice verbal communication and presentation skills; develop an applied understanding of the relationship and differences between legal liability and ethical behavior; and develop applied critical thinking, communication, and presentation skills.

• *Prerequisite: Engineering students only.*

INFO 6960 Exam Preparation—Master's (0 SH)

Offers the student the opportunity to prepare for the master's qualifying exam under faculty supervision.

INFO 6964 Co-op Work Experience (0 SH)

Provides eligible students with an opportunity for work experience.

- *Prerequisite:* ENCP 6000.
- *Repeatability:* May be repeated without limit.

INFO 7205 Advanced Application Engineering and Development (4 SH)

Offers students an opportunity to master advanced software design and programming techniques for building complex software applications quickly. The engineering issues addressed assume the business problems are difficult to understand and manage in a practical manner—the system capacity must support thousands or even millions of users in a multitude of roles. Addresses high performance computing requirements, such as concurrency and control, scalability, replication, and failover.

- *Prerequisite:* INFO 5100; engineering students only.

INFO 7225 Accounting and Budgetary Systems for Engineers (4 SH)

Covers the latest engineering principles necessary for building complex software systems that comply with recognized standards in the financial industry. With automated business processes today, risk and responsibility are shifting to information technology (IT) systems. Offers students an opportunity to learn how to incorporate information-based controls related to the financial industry that signal trouble, detect violations, and provide accountability, as well as a working approval process. Emphasizes software design. Seeks to help engineers construct complex software from a sophisticated engineering perspective. Examines how to put together cutting-edge organizational systems that people in the financial world can put to good use. Designed to prepare students for jobs in the building, maintaining, and employment of such information systems.

- *Prerequisite:* Engineering students only.

INFO 7245 Agile Software Development (4 SH)

Offers students an opportunity to achieve a high level of practical understanding of software development life cycle (SDLC) with emphasis on agile and adaptive incremental methodologies. Examines techniques for the management and evolution of software systems, including project planning from requirements gathering, analysis, estimation, and releasing using a hands-on approach to implement agile methodologies. Also covers maintainability, including software risk analysis, project retrospectives, and process models such as capability maturity model, configuration management, and their practical implementation.

- *Prerequisite:* INFO 5100; engineering students only.

INFO 7250 Engineering of Big-Data Systems (4 SH)

Introduces a general framework for thinking about big data. Services such as Web analytics and intelligent e-commerce have promoted a rapid increase in the volume of data generated, analyzed, and archived. In order to solve the problems related to big data, a newer type of database product has emerged. Covers how to apply technologies like Hadoop, Accumulo, MongoDB, and various NoSQL databases to build simple, robust, and efficient systems to manage and analyze big data. Also describes an easy approach to big data systems that can be built and run by a small team of students. Guides students through the theory of big data systems, how to implement them in practice, and how to deploy and operate them once they are built.

- *Prerequisite:* INFO 6250.

Course Descriptions 369

NORTHEASTERN UNIVERSITY

INFO 7260 Business Process Engineering (4 SH)

Addresses the question of how to understand and specify the flow of work responsibility and movement of information throughout the enterprise. For businesses to maximize the benefits of technology, they must transform their ad-hoc and often poorly defined ways of doing things to formal business processes. Analyzes the specification and implementation of complex information systems that integrate well into core business operations. Offers students an opportunity to learn how to use agile process specification techniques, dynamic process execution, and real-time measurement and reporting to support continuous business improvement and change.

- *Prerequisite:* Admission to the Graduate School of Engineering.

INFO 7265 Enterprise Systems Architecture and Engineering (4 SH)

Extends the rudiments of C and Unix covered in . Geared for students who want to explore the Unix operating system and deepen their understanding of the fundamentals of Unix. Topics include popular Unix tools and programs (vi, emacs, pipes, grep, and so on); Unix system calls (fork, exec, read, and write); introduction to Unix shells and scripting; static and dynamic libraries; use of make files; and software engineering project management from the perspective of the system developer. Requires a major term project using coding with advanced C/Unix techniques.

• *Prerequisite: INFO 6245 and INFO 6260; engineering students*

INFO 7270 PERL Programming (4 SH)

Focuses on PERL programming language fundamentals. Discusses and demonstrates applications of the language using programming assignments and projects. Topics include data types, control structures, subroutines and functions, string manipulation, file processing, networking, and CGI. Recommended for students who are pursuing a career in Unix/Windows programming, Web development, or system administration.

• *Prerequisite: INFO 5100.*

INFO 7275 Advanced Database Management Systems (4 SH)

Introduces the skill set required to become a serious database applications developer. Offers an overview of the Oracle9i object relational database system for those who have mastered the fundamental principles of database design and are competent with basic SQL. Gives students the opportunity to develop a strong understanding of the PL/SQL programming language, which is used to create triggers, user-generated functions, stored procedures, and packages for programming Oracle objects. Emphasizes advanced SQL features and Oracle-specific SQL enhancements. Covers optimization and tuning issues. Covers corresponding material for Transact-SQL (used for Microsoft SQL Server and Sybase database systems) as time and resources permit.

• *Prerequisite: INFO 5100 or INFO 6210; engineering students only.*

INFO 7280 Model-Driven Architecture (4 SH)

Develops the skills to utilize new software modeling and management techniques in each state of the life cycle of component-based software systems. Applies and extends a basic knowledge of the Unified Modeling Language (UML). Introduces and applies metamodel management concepts using the OMG metaobject facility as a technology baseline. Develops a component-based software project throughout the course using C++ or Java; grading primarily based on the software project and its public presentation.

• *Prerequisite: INFO 6205; engineering students only.*

INFO 7285 Organizational Change and IT (4 SH)

Focuses on the change effort needed to integrate a project into the firm's organizational structure, culture, business, and process metrics. Geared for students undertaking enterprise resource planning systems, or those involved in small or large organizational reengineering projects designed to make IT a primary focus of the firm's business strategy. Topics include management theories and organizational design principles; strategy and critical success factor formulation; methods to reach information systems maturity; business process modeling techniques; quality, the mindset, and the problem-solving tools; human resource, cultural, and technical change enablers; how to plan a business reengineering project; and implementation of major organizational change.

INFO 7290 Data Warehousing and Business Intelligence (4 SH)

Examines the technical and management aspects of building a data warehouse. Explores the architecture, infrastructure, processes, data quality, database design, and data analysis involved in building the data warehouse for business analysis. Management issues include business goals, tool selection, project management, personnel skills, training, and user requirements. Topics include dimensional data modeling, extraction/transformation/load processes, data quality problems, datamarts, operational data stores (ODS), staging databases, and online analytic processing (OLAP).

• *Prerequisite: INFO 5100 or INFO 6210; engineering students.*

INFO 7290 Data Warehousing and Integration (4 SH)

Effective Summer Full 2015

Examines the technical and management aspects of building a data warehouse. Explores the architecture, infrastructure, processes, data quality, database design, and data analysis involved in building the data warehouse for business analysis. Management issues include business goals, tool selection, project management, personnel skills, training, and user requirements. Topics include dimensional data modeling, extraction/transformation/load processes, data quality problems, datamarts, operational data stores (ODS), staging databases, and online analytic processing (OLAP).

• *Prerequisite: INFO 5100 or INFO 6210; engineering students*

INFO 7300 Engineering Secure Software Systems (4 SH)

Addresses design and implementation issues critical to producing secure software systems by using a software development perspective. Deals with the question of how to make the requirements for confidentiality, integrity, and availability integral to the software development process from requirements gathering to design, development, configuration, deployment, and ongoing maintenance. Covers emerging software life-cycle practices that address both security problems caused by bad software practices that leave software vulnerable to attack and other software vulnerabilities that are caused by deficiencies in modeling of security requirements, architecture, and design issues.

• *Prerequisite: INFO 5100 and INFO 6250; engineering students only.*

INFO 7305 System Architecture and Technology Management (4 SH)

Aimed at information systems students aspiring to become software project managers or system or product architects in software and high-technology organizations. Designed to deepen the student's understanding of system architectures and engineering, product development processes, and dynamics of innovation in high-technology industries. Responds to the question of how technology managers and software architects might work together to oversee and control these three critical areas. Covers the following topics in detail: software product design and engineering processes, systems architecture, modular and integral product paradigms, commonality and reuse, options thinking and prioritization strategies, as well as the identification and delivery of value for the user.

• *Prerequisite: INFO 6215.*

INFO 7310 Introduction to Distributed Security (4 SH)

Provides the student with the skills to understand and solve the difficult problems associated with securing broadly distributed systems. Examines the new security paradigms that have been developed to solve the problem of securing Web Services and compares and contrasts them with the more traditional security paradigms. Covers both the theory and practical aspects of basic distributed security principals, transport and message-based security, trust management, PKI, security specifications, risk management as applied to security, advanced access control, digital signature, XML encryption, security policy, and privacy.

• *Prerequisite: INFO 6205.*

INFO 7315 Web Services/Service-Oriented Architecture (4 SH)

Describes how a solid foundation to support a true electronic business infrastructure is being laid using new paradigms, such as an interoperable language and a new architectural way of looking at electronic business. Supporting these paradigms are Service Oriented Architecture (SOA) and Web Services. Covers the latest heterogeneous models for carrying out large-scale distributed computing for Web Services. The models use loose coupling based on XML, which is independent of computing platform and language. Explores the fundamentals of XML, XML schema, and SOAP using tools from Microsoft, IBM, and Sun. Uses the principals of an SOA and Web Services to describe how to architect large-scale distributed systems.

• *Prerequisite: INFO 6205.*

INFO 7320 Global Technology Outsourcing (3 SH)

Examines the critical issues in global outsourcing of technology: Why outsource, what can be outsourced, criteria for identifying elements for outsourcing, organizing for outsourcing, where to outsource, and managing the outsourcing operation to maximize global profit. Today, large numbers of white-collar and highly technical jobs, including software development and research activities, are increasingly being performed offshore. This practice could become even more pervasive and perhaps a standard feature of all businesses in the United States. Offered jointly by the D'Amore-McKim School of Business and the College of Engineering, this course is team taught by professors from both colleges with supplemental guest lecturers from appropriate industries.

• *Prerequisite: INFO 6260; engineering students only.*

INFO 7325 Introduction to Information Technology Auditing (4 SH)

Designed to provide a foundation for the study and professional career development of information technology (IT) auditing.

Introduces the fundamentals of IT auditing, core reasons why this is a specialized area of auditing, and the principle objectives of IT auditing and its relationship to integrated financial or operational auditing. Offers an insight into management's objectives regarding IT risk management. Uses the Cobit governance and control framework to emphasize management issues regarding control of IT and the achievement of value through managed IT processes. Introduces three primary types of IT audits: the audits of computerized information systems, IT processing environments, and the process of developing and implementing information systems.

- *Prerequisite: Engineering students only.*

INFO 7330 Information Systems for Healthcare-Services

Delivery (4 SH)

Addresses the important information systems questions facing the delivery and assessment of healthcare services from administrative, financial, and clinical perspectives. These include the use of electronic medical records; health information exchanges; and performance evaluation of providers, patients, and payers. Provides an introduction on how healthcare is delivered. Also focuses on various information management tools being implemented as well as those needed to move care delivery and quality forward.

- *Prerequisite: Open to students in the Graduate School of Engineering and in other Northeastern graduate schools.*

INFO 7365 Enterprise Architecture Planning and Management (4 SH)

Defines IT strategies for implementing business-driven and technology-based modernization programs, companywide. Covers how to institute improved IT infrastructures to facilitate strategically informed decisions, at all hierarchical levels, across all business units and functional boundaries. Studies the strategies, programs and projects, business models, methods, and technologies needed to bring about deliberate enterprise-scale change as business strategies evolve. Offers students an opportunity to learn how to construct enterprise architectures and use them as road maps to budget scarce capital investment resources to IT development projects. Topics include system interoperability, business and technology alignment, system flexibility and adaptability to change, IT planning, and effective communication with the management leadership.

- *Prerequisite: Admission to the Graduate School of Engineering.*

INFO 7374 Special Topics in Information Systems (1 to 4 SH)

Covers state-of-the-art material of current interest.

- *Prerequisite: Engineering students only.*
- *Repeatability: May be repeated without limit.*

INFO 7390 Advances in Data Sciences and Architecture (4 SH)

Covers a wide range of skills and responsibilities that are necessary for managing complex business performance and operational data. Such data tend to be fragmented, poorly organized, and often flawed. Offers students an opportunity to learn how a more up-to-date mapping of complex data works and to be alerted to the care and attention they must give to such a task as well as the implications of the results. Covers best practices for managing all aspects of the data transformation life cycle, covering broad areas such as requirements gathering, meta-model design, data integration and transformation, as well as implementation and ongoing operations. Discusses tools for mapping fragmented data into business intelligence solutions that guide successful strategies.

- *Prerequisite: Engineering students only.*

INFO 7420 Drug Development Processes and Information Systems Compliance (4 SH)

Begins with the recognition that information technology (IT) has transformed the way that new drugs are developed today. From preclinical studies to small Phase-I clinical trials all the way up to large global Phase-III pivotal trials, virtually every aspect of drug development is evolving due to technological advances. Each of these advances carries with it technological, procedural, and regulatory challenges and uncertainties. This course explores many of today's most pressing and challenging IT questions facing the pharmaceutical/biotechnology industry and the FDA regarding the use of electronic records, databases, and information management systems that have become an integral part of development programs and regulatory submissions.

- *Prerequisite: Open to graduate students in the College of Engineering and in selected other colleges.*

INFO 7976 Directed Study (1 to 4 SH)

Offers theoretical or experimental work under the direction of members of the department on a chosen topic. Course content

depends on instructor.

- *Repeatability: May be repeated without limit.*

INFO 7978 Independent Study (1 to 4 SH)

Offers work performed under individual faculty supervision.

- *Prerequisite: Engineering students only.*
- *Repeatability: May be repeated without limit.*

INFO 7990 Thesis (1 to 8 SH)

Offers theoretical and experimental work conducted under the supervision of a departmental faculty.

- *Repeatability: May be repeated without limit.*

INFO 7994 Thesis Continuation—Part Time (0 SH)

Continues thesis work conducted under the supervision of a departmental faculty member.

- *Prerequisite: INFO 7990.*
- *Repeatability: May be repeated without limit.*