

Information Technology

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Degree Offered: B.S. in Information Technology

Information Technology (IT) is an evolving interdisciplinary subject that has been driven and shaped by the rapid development of computing, communication, and Internet-related technologies and their tremendous impact on our daily lives. In contrast to the more traditional Information Systems discipline, Information Technology deals with the development, utilization, interrelation, and confluence of computers, networking, telecommunication, business, and technology management in the context of the global Internet. As we enter the Information Age of the 21st century, society will be increasingly dependent on Information Technology and demand for IT professionals will remain high throughout the decades to come.

The *Bachelor of Science in Information Technology* program at New Mexico Tech is administered jointly by the *Computer Science & Engineering* and *Management* departments. The curriculum includes relevant computer science, management, and engineering courses and emphasizes secure information systems and information assurance that are among the areas of research at Tech's Institute for Complex Additive Systems Analysis (ICASA) where IT students may find employment or internship opportunities. Students must also take a sequence of 12 hours of technical electives to broaden or deepen their knowledge in an IT area of their interest. Graduates of the IT program will be well prepared for immediate industry employment or graduate study in an IT-related discipline.

Undergraduate Program

Bachelor of Science in Information Technology

Minimum credit hours required—120

In addition to the General Education Core Curriculum (page 88), the following courses are required:

- IT 101 (2), IT 113 (4), 122 (3), 213 (3), 221 (3), 263 (3), 321 (3), 326 (3), 330 (3), 353 (3), 373 (3), 382 (3), 462 (3), 466 (3), 481 (3), 482 (3)
- CSE 222 (3), 241 (3)
- MATH 283 (3)
- PSY 121 (3) (can be applied as a social science course in the general education core curriculum)
- Technical Electives: a sequence of 6 hours of computer science, information technology, or management courses numbered 300 or higher, *pre-approved* by the student's advisor and an IT Program Coordinator, with no more than one course numbered IT 485. Students are encouraged to select a coherent set of courses as technical electives that will prepare them for a specific focus in their career, for instance, IT 441 & 463 for cybersecurity focus and MGT 302 & 472 for management focus.
- Each of the above courses must be completed with a grade of C or better.

Sample Curriculum for the Bachelor of Science Degree in Information Technology

Semester 1

4 MATH 131 (calculus)
 1 IT 101 (intro to comp sci & information tech)
 4 IT 113 (intro to programming)
 4 CHEM 121 & 121L (general chemistry I)
 3 ENGL 111 (college English)
 17 Total credit hours

Semester 2

4 MATH 132 (calculus)
 3 IT 122 (algorithms and data structures)
 4 CHEM 122 & 122L (general chemistry II)
 3 ENGL 112 (college English)
 14 Total credit hours

Semester 2.5 (Summer)

4 Chem 122 & 122L (general chemistry II)
 4 Total credit hours

Semester 3

- 3 IT 221 (computer and network organization)
- 3 IT 263 (information protection and security)
- 3 CSE 241 (foundations for computer science)
- 5 PHYS 121 & 121L (general physics I)
- 3 PSY 121 (general psychology)
- 17 Total credit hours

Semester 4

- 3 CSE 222 (systems programming)
- 3 IT 213 (intro to object oriented programming)
- 3 MATH 283 (introduction to applied statistics)
- 3 Humanities
- 5 PHYS 122 & 122L (general physics II)
- 17 Total credit hours

Semester 5

- 3 IT 321 (internet and web programming)
- 3 IT 330 (management & organization behavior)
- 3 IT 353 (introduction to computer networks)
- 3 IT 373 (intro to database design and management)
- 3 ENGL 341 (technical writing)
- 15 Total credit hours

Semester 6

- 3 IT 326 (software engineering)
- 3 IT 382 (legal and ethical info technology issues)
- 3 IT 492 (systems, risk and decision analysis)
- 3 IT 466 (project management)
- 3 Social Science
- 15 Total credit hours

Semester 7

- 3 Technical Electives
- 3 IT 481 (senior secure system design project)
- 4 Biology/Earth Science/Engineering with Lab
- 3 Humanities
- 13 Total credit hours

Semester 8

- 3 Technical Electives
- 3 IT 482 (senior secure system design project)
- 6 Humanities/Social Science
- 12 Total credit hours

Information Technology Courses:

In the following, each prerequisite requires a grade of C or better.

IT 101, Introduction to Computer Science & Information Technology, 2 cr, 2 cl hrs

Brief overview of the discipline of computer science and information technology topics including computer architecture, operating systems and networks, automata and models of computation, programming languages and compilers, data structures, algorithms, databases, security and information assurance, artificial intelligence, graphics, and social/ethical issues of computing. (Same as CSE 101.)

IT 107, Introduction to Computer Programming using Python, 4 cr, 3 cl hrs, 2 lab hrs

Co-requisite: Math 103

The course is designed to introduce programming and its applications to scientists and engineers. The first part of the class focuses on problem solving, algorithm development, top-down design, modular programming, debugging, testing, data types, flow-control, looping, iteration and recursion, fundamental data structures, and an introduction to object oriented programming. The second part of the class explores data analysis with Python. (Same as CSE 107.)

IT 113, Introduction to Programming, 4 cr, 3 cl hrs, 3 lab hrs

Co-requisite: MATH 131

The course is designed to introduce problem solving and programming in C to Computer Science majors and those interested in applications of the language that involve dynamic structures and memory management. Topics include algorithm development; top-down design; modular programming; debugging; testing; control structures including selection, iteration and recursion; number systems; data representation; data types including arrays, strings, pointers and dynamic structures involving memory management. Concepts implemented through extensive programming using good programming style. (Same as CSE 113)

IT 122, Algorithms and Data Structures, 3 cr, 3 cl hrs

Prerequisite: IT 113 with a grade of C or higher

Corequisite: Math 132

Fundamental data structures including linked lists, trees, hash tables, and graphs. Algorithms for sorting, searching, and other fundamental operations. Introduction to mathematical foundations for analysis of iterative and recursive algorithms and for basic correctness proofs. Analysis of algorithms. Implementation of selected algorithms using sound programming methodologies. (Same as CSE 122.)

IT 213, Introduction to Object Oriented Programming, 3 cr, 3 cl hrs

Prerequisite: IT 101, 113, 122 each with a grade of C or higher

Introduction to programming in an object oriented language (e.g., Java): review of problem solving, algorithm development, top-down design, modular programming, debugging, testing, control structures including selection, iteration and recursion, data types including arrays, strings, pointers, and dynamic structures. Object oriented concepts will include: objects, classes, inheritance, instances, methods, interfaces, packages, encapsulation, and polymorphism. Concepts implemented through extensive programming using good programming style. (Same as CSE 213.)

IT 221, Computer System Organization, 3 cr, 3 cl hrs

Prerequisite: IT 101, 122 each with a grade of C or higher

The hardware/software interface. Basic organization of computers, operating systems, and computer networks. Memories, buses, interrupts, input and output, and instruction set architecture. Basics of assembly language programming. (Same as CSE 221.)

IT 263, Information Protection and Security, 3 cr, 3 cl hrs

Prerequisite: IT 101, 113 each with a grade of C or higher

Corequisite: IT 221

Concepts of information, message and data. Storage and transmission, retrieval and communications. Authorized users and penetrators. Threats to information confidentiality, integrity, availability, and accountability. Attacks. Degrees of security and costs. Protection mechanisms and security precautions. Authentication and authorization. Encryption. Secure operating systems, communications and networks. Defenses against viruses, worms, and hostile code.

IT 311, 311D, Human Information Processing and Decision Making, 3 cr, 3 cl

Prerequisite: PSY 121 with a grade of C or higher and upper division standing in the IT program

Recent advances in knowledge about how people process and act upon information are presented. Models of human decision making are analyzed in the context of secure information systems and used to assess ways to best manage the people and technology associated with secure information systems.

IT 321, Internet and Web Programming, 3 cr, 3 cl hrs

Prerequisite: IT 213 with a grade of C or higher

This course has a practical emphasis on the design and techniques for developing internet-based applications, mainly focusing on web programming. Topics include HTML, client-side scripting language (JavaScript), server-side programming (e.g., Servlets, JSP, and J2EE), and XML/web services (e.g., Java and .NET). This course will also cover some important topics needed for internet-based application developments, such as Internet architectures, basic object-oriented programming (OOP) concepts, and web security. Course work includes substantial programming homework and team-based projects. (Same as CSE 321.)

IT 326, Software Engineering, 3hrs

Prerequisites: IT 122, 213 each with a grade of C or higher

This course provides the introductory overview of software engineering, concentrating on large-scale software system design and implementation. Topics include software life cycle, UML-based design language, design tools and techniques, design documentation, software testing, and software project management. Course work includes a team-based project. (Same as CSE 326.)

IT 328, Secure Software Construction, 3 cr, 2 cl hrs, 1 lab hr

Prerequisite: CSE 222, IT 213 each with a grade of C or higher

Formal methods and practical techniques for the specification, design, implementation, and validation of computer software. Current software engineering and management practices, with emphasis on ensuring software reliability, safety, and security. Course work includes a team project to develop a sizeable, real-world application software. (Same as CSE 328.)

IT 330, Management and Organizational Behavior, 3 cr, 3cl hrs

Prerequisites: ENGL 112 and upper-class standing or consent of instructor

Classical and contemporary organization theories, interpersonal and organization behavior, motivation, communication, leadership, decision process in organizations. (Same as MGT 330.)

IT 351, Modeling and Simulation Technologies for Information Systems, 3 cr, 3cl hrs

Prerequisites: IT 122; CSE 241 each with a grade of C or higher

Fundamentals and techniques for designing and using simulation, modeling, and optimization algorithms with applications in system performance modeling, business infrastructure modeling, and distributed and parallel computing. An introduction to advanced complex systems models. (Same as CSE 351.)

IT 353, Introduction to Computer Networks, 3 cr, 3 cl hrs

Prerequisites: CSE 222 with a grade of C or higher

Usually offered fall semester

Introduction to computer networking, the ISOOSI protocol stack, LAN, MAN, and WAN. Physical layer: transmission media (wireline and wireless); data signaling, modulation, and coding; multiplexing. Fiber optics networking technology: protocols & examples. Data link Layer: error/flow control— protocols design issues; MAC protocols for channel access and allocation. Wireless technology and protocols standards — IEEE 802.11 physical layer and MAC sublayer protocols. Network layer: subnet switching (CS/DG/VC) & routing protocols (Non/Adaptive); Congestion Control and QoS protocols. ISO vs. (TCP-UDP)/IP the Internet protocol stacks. Internet relays and protocols, e.g., routers, gateways, etc. Introduction to network security. Application layer protocols, E.G., DNS, E-mail, etc. (Same as CSE 353.)

IT 373, Introduction to Database Systems, 3 cr, 3 cl hrs

Prerequisite: IT 122; CSE 241 each with a grade of C or higher

Conceptual modeling and database design using the entity-relationship model. The relational model; relational algebra and relational query languages; design theory for relational databases. Database integrity. Physical data organization. Introduction to problems of concurrency control, recovery, security, and distributed databases. Course work includes a project using SQL and the Oracle Database Management System. (Same as CSE 373.)

IT 382, 382D, Ethical and Social Implications of Information Technology, 3 cr, 3 cl hrs

Prerequisite: IT 326 with a grade of C or higher

Philosophy of ethics. Social and ethical issues associated with computing and information technologies. Ethics and the responsibilities of computing professionals. Legal ramification will be explored whenever possible. (Same as CSE 382.)

IT 441, Cryptography and Applications, 3 cr, 3 cl hrs

Prerequisites: IT 122; CSE 241 each with a grade of C or higher

This course provides an introductory overview of modern cryptographic theory and techniques, mainly focusing on their application into real systems. Topics include number theory, probability and information theory, computational complexity, symmetric and asymmetric cryptosystems, one-way functions, block and stream ciphers, Kerberos authentication systems, public key infrastructure (PKI), secure socket layer/transport layer security (SSL/TLS), and cryptographic protocols/applications in many real systems. (Same as CSE 441.)

IT 451, 451D, Introduction to Parallel Processing, 3 cr, 3 cl hrs

Prerequisites: CSE 122 or IT 122 with a grade of C or higher

Introduction to supercomputers and massively-parallel machine architecture, models of parallel computation, parallel algorithms, synchronization, parallel languages, data and functional parallelism, parallel performance analysis, popular interfaces, and parallel debugging. Students will gain experience in parallelization of sequential algorithms and implementation of parallel algorithms. (Same as CSE 451.)

IT 453, Advances in Computer Networks and the Internet, 3 cr, 3 cl hrs

Prerequisites: CSE 353 with a grade of C or higher

In depts. Coverage of layering protocols; stacks (ISOOSI and TCP/IP) and computer networks architectures, modern examples of LANs, MANs, WANs protocols/architectures. Recent developments in Fiber optics technology — protocols and architectures. High speed “all-fiber-optics” networks. Internetworking: global addresses/ names and translation, virtual networks and tunnels, routing, subnetworks switching protocols, IPv6, multicasting, Mobile IP. End-to-end protocols, TCP and UDP. Advances in Congestion control and resource allocation. Client-server models & applications. The QoS mechanism integrated/differentiated, ATM QoS. Network security: information and link security, encryption, internetworking security, IPsec, firewalls, VPN, wireless security. Analysis of networks protocols. (Same as CSE 453.)

IT 462, 462D, Systems, Risk and Decision Analysis, 3 cr, 3 cl 3 hrs

Prerequisites: MATH 283 or 382 with a grade of C or higher; upper division standing

Analysis of systems and managerial decisions under conditions of risk or uncertainty. Optimal project evaluations and ranking of alternatives using expected value and expected utility criteria. Topics include risk sharing, Bayesian revision of probabilities, value of information, and preference assessment procedures. (Same as MGT 462.)

IT 463, Information Assurance, 3 cr, 3 cl hrs

Prerequisite: Senior standing

Defense and offensive information warfare. Information system security. Computer break-ins, hacking, and other attack methods. Vulnerability and risk analysis. Theory and applications of cryptography. Intrusion detection and incident response. Security planning and management. (Same as CSE 463.)

IT 466, 466D, Project Management, 3 cr, 3 cl hrs

Prerequisite: MATH 283, MGT 472 each with a grade of C or higher, or consent of instructor

Development of work breakdown structures and multi-factor project simulations to be used in dynamic resource allocations. Assessment and evaluation of project models over time. (Same as MGT 476.)

IT 476, Visualization, 3 cr, 3 cl hrs

Prerequisite: CSE 222 with a grade of C or higher, or consent of instructor

This course presents application of graphical visualization to current problems, with a focus on extracting and representing information in multidimensional data sets using 2D and 3D graphics. Topics include visualization tools and techniques, human vision and perception, color mapping, sound, data representation for insight extraction, time visualization, visual analytics, volume rendering, surface extraction and rendering. Students will develop visualizations of real world problems. (Same as CSE 476.)

IT 481 / IT 482, Senior Secure System Design Project, 3 cr, 3 lab hrs ea

Prerequisite: must have completed all junior-level IT courses each with a grade of C or higher

A substantial system and security-related project taken over 2 regular semesters, under the supervision of a faculty member.

IT 485, Undergraduate Seminar on Special Topics 3 cr, 3 cl hrs

Prerequisite: Senior standing, one semester of upper division courses in computer science/information technology, and consent of the instructor

A research seminar for undergraduate students with a focus either on special topics in computer science/information technology or on the methodology and skills required for research in computer science/information technology. *Use as a technical elective is limited (see requirements above), but may be taken multiple times as a general elective.*

Faculty Research Interests

Anselmo—Agent-Based Financial System Modeling and Simulation, Non-Financial Risk Modeling and Analysis
 Liebrock—Computer Forensics, Information Assurance, Parallel Processing, Well Posedness Analysis, Visualization
 Mazumdar—Mobile and distributed databases: Integrity, Privacy, Security; Information Systems, Software Integrity
 Rezgui —Cloud Computing, Service-based computing, Energy-aware cellular networks
 Shin— System security, Usable Security, Applied Cryptography, Software Engineering
 Soliman—Computer Networks — fiber/wireless modern technologies and protocols, Sensor Networks — modern technologies and protocols, Computer/Sensor Networks Security, Programming Languages, Neural Networks — applications in image compression, cloud computing management, and sensor networks
 Sueyoshi—Management Science, Data Envelopment Analysis, Risk and Policy Analysis
 Wedeward—Adaptive Control, Robotic Systems
 Zheng—Mobile Computing, Computer and Network Security, Machine Learning and its Applications