



-III-
COURSE CATALOG
OF
UNDERGRADUATE PROGRAMS
SCHOOL OF COMPUTATIONAL SCIENCES AND ARTIFICIAL INTELLIGENCE

UNIVERSITY OF SCIENCE AND TECHNOLOGY
ZEWAIL CITY OF SCIENCE, TECHNOLOGY AND INNOVATION

SEPTEMBER 2023



Code	Description
CSAI 100	<p>Introduction to Computational Sciences and AI Credits: 1 (1+0)</p> <p>This course teaches students the fundamentals of Computational Sciences for solving science and engineering problems. It also discusses artificial intelligence techniques and algorithms and how they can be extended to other fields through Computational Sciences</p>
CSAI 101	<p>Fundamentals of Programming and Computer Science Credits: 2 (1+3)</p> <p>In this course, students identify how various forms of data are represented digitally, how the Program hardware components store and operate on such data, and how software is developed to control these systems. Students learn the basics of computational problem solving, algorithm design and analysis, and data structures. The course will also include an introduction to computer programming to maximize the depth of experience in designing and writing computer programs by teaching the students how to write programs using Python programming language. In the end of the course, the students should be able to use the computer to solve the problems they face in other university's courses by writing efficient Python programs.</p>
CSAI 102	<p>Digital Logic and Computer Architecture Credits: 3 (2+3)</p> <p>This course emphasizes elementary digital electronics and interfaces. Topics include gates and Boolean algebra, Karnaugh maps, flip flops, registers, counters and memories, digital components, microprocessor functions and architecture, instruction sets, D/A and A/D converters, and waveshaping. The course also covers an introduction to CMOS Integrated Circuits and CMOS logic gates.</p>
CSAI 151	<p>Object-Oriented Programming Credits: 3 (2+3) Prereq: CSAI 101</p> <p>This course aims to provide the students with an understanding of the role of computations in solving engineering and scientific problems through introducing them to different programming paradigms. The course will focus on procedure-oriented and object-oriented programming models. Topics include primitive data types, input/output, control structures, arrays and lists, built-in and user-defined functions, classes, objects, inheritance, encapsulation, and polymorphism. By the end of the course, the students will be able to differentiate between the two design approaches. In addition, they will be able to develop high quality, working software that solves real problems using any of the two programming approaches.</p>

Code	Description
CSAI 201	<p>Data Structures Credits: 3 (2+3) Prereq: CSAI 151</p> <p>This course introduces formal techniques to support the design and analysis of algorithms, focusing on both the underlying mathematical theory and practical considerations of efficiency. Introduced design approaches will be supported by some common data structures, with a focus on some advanced ones. Topics include: mathematics foundation, divide-and-conquer, dynamic programming, greedy method, NP-completeness complexity, approximation algorithms, randomized algorithms, and backSchooling algorithms. In addition to some advanced data structures: Binary trees, Heaps, Priority Queues, and Huffman Coding Trees.</p>
CSAI 202	<p>Introduction to Database Systems Credits: 3 (2+3) Prereq: CSAI 151</p> <p>The overall aim of the course is to know the basic concepts of database systems. To design and practice creating database systems using the entity-relationship model. To learn functional dependencies and practice relational model normalization. To learn and practice using SQL for relational databases programming</p>
CSAI 203	<p>Introduction to Software Engineering Credits: 3 (2+3) Prereq: CSAI 101</p> <p>This course covers the fundamentals of software engineering, combining technical focus with a course project to exploit software engineering practices in a realistic development setting.</p>
CSAI 204	<p>Operating Systems Credits: 3 (2+3) Prereq: CSAI 201</p> <p>This course explores the field of computer operating systems, emphasizing basic operating systems (OS) concepts and design principles. While stressing the fundamental principles behind them, the idea is to learn not only what operating systems are and how they work today, but also why they are designed the way they are and how they are likely to evolve in the future. This course will cover fundamental OS material such as scheduling and synchronization, threads, memory management, file system, protection, and security. Topics: •Threads & Processes •Concurrency & Synchronization •Scheduling •Virtual Memory •I/O •Disks, •File systems •Protection & Security •Virtual machines</p>
CSAI 205	<p>Fundamentals of Circuits and Electronics Credits: 3 (2+3)</p> <p>The course introduces the components of lumped electrical circuits and the laws and theories used for circuit analysis. DC and AC analysis will be covered. After that, the course introduces semiconductors, diodes, and transistors.</p>

Code	Description
CSAI 251	<p>Algorithm Design and Analysis Credits: 3 (2+3) Prereq: CSAI 201</p> <p>Algorithm analysis is essential to judge different algorithms and to build efficient ones for different applications. This course covers: Analysis and complexity bounds of basic algorithm classes. Algorithm design methodologies: Brute force, Transform and Conquer, Divide and conquer, and Greedy methods. It also covers: Dynamic Programming, BackSchooling and Branch and Bound methods. The students apply what they learn on common problems such as traveling salesperson, knapsack, optimal merge patterns and graph algorithms.</p>
CSAI 252	<p>Introduction to Computer Networks Credits: 3 (2+3)</p> <p>This course gives an introduction to the concepts and general principles of computer networks. It covers the following topics: the structure and components of computer networks, packet switching, and layer architectures, TCP/IP, reliable transfer, flow control, and congestion control, the network layer (names and addresses, routing), local area network (LAN), wireless networks and network security. The course also introduces the student to wireless and mobile networks</p>
CSAI 253	<p>Machine Learning Credits: 3 (2+3) Prereq: CSAI 201, MATH 105</p> <p>Machine learning is one of the most powerful tools that is used for data-driven decision making. Topics covered include: regression, classification, clustering, prediction, learning reinforcement, and dimensionality reduction. Selected applications in data mining, pattern recognition, and text and language processing.</p>
CSAI 301	<p>Artificial Intelligence Credits: 3 (2+3) Prereq: CSAI 201</p> <p>The course addresses key concepts underlying intelligent systems, which are increasingly deployed in consumer products and online services. Topics include problem solving, state-space representation, heuristic search techniques, game playing, knowledge representation, logical reasoning, automated planning, reasoning under uncertainty, decision theory and machine learning. These concepts will be examined in the design of intelligent agents in the context of several applications.</p>

Code	Description
CSAI 302	<p>Advanced Database Systems Credits: 3 (2+3) Prereq: CSAI 202</p> <p>This course covers advanced database management topics such as database architecture, storage manager, data models (row, columnar), indexing (tree-based, hash tables), transaction processing (ACID, concurrency control), crash recovery, parallel architectures (multi-core, distributed), query Processing and optimization, and database security. Moreover, students will extend their database programming skills they gained in the first database course using stored procedures and triggers.</p>
CSAI 351	<p>Principles and Practices for Secure Computing Credits: 3 (2+3) Prereq: CSAI 201</p> <p>This course describes computing practices that one should adopt to improve security in all computer work. It describes the use of cryptography, without getting into crypto algorithms, such as MD5, SHA1. Topics include secure deletion of files, secure wireless connections, Covert channels, Steganography, Sandboxes, Zombie Machines, DDoS and Man-in-the-Middle Attacks.</p>
CSAI 399	<p>Internship Credits: 4 (0+12)</p> <p>The main objective of Internship is to enable engineering students a real life engineering workplace to earn practice skills. It is planned in summer after the students complete their third year. For a period of 120 working hours the students receive training from industrial companies, research institutions, consultancy offices, government ministries, and NGO or foreign research institute related to their field of specialization. The student, supervised by the training organization, has to submit at the end a technical report to his/her Program. At present it is a 2 credits course and is graded "PASS" or "NOT PASS". The internship program is coordinated by the Industrial Liaison Office.</p>
CSAI 498	<p>Senior Project - Part 1 Credits: 1 (0+3)</p> <p>Students must undertake an independent Program senior design project during the last two terms of their program. The purpose of the project is to demonstrate students' abilities to practice in their chosen area of expertise, using knowledge gained from their academic and industrial training experiences. The first part of the project will include problem identification, generation and selection of solutions and time management. Incorporation of technical and economic issues in the solution for the project will be required. Requirements include: proposal, progress report, and a final report containing recommendations for part two of the project.</p>

Code	Description
CSAI 499	Senior Project - Part 2 Credits: 3 (0+9) Prereq: CSAI 498 A continuation of CSAI 498. The final design of the Program senior design project proposed in CSAI 498 will be undertaken. The purpose of this phase of the project is to carry out a detailed technical design of the solution proposed in CSAI 498. Requirements of this part of the two-term project include a final report. Students will present their thesis project at the graduation seminar orally or in a poster session.
DSAI 103	Data acquisition in data science (ETL) Credits: 3 (2+3) Prereq: CSAI 101 This course introduces students to the process of data acquisition including obtaining pertinent business information, translating it into the needed business format, and feeding it into the target system. A data acquisition process involves the extraction, transformation, and loading of data.
DSAI 104	Knowledge Representation and Reasoning Credits: 3 (2+3) Prereq: CSAI 101 This course teaches students: Knowledge representation is a symbolic form that is suitable for automated reasoning, and associated reasoning methods, Knowledge Representation in Social Context. Abductive Reasoning, Qualitative Reasoning, Constraint Satisfaction, Representation of Actions, Reasoning with Actions, Abstraction, Reformulation and Approximation
DSAI 201	Data Mining and Information Retrieval Credits: 3 (2+3) Prereq: CSAI 202 Data mining involves the analysis of massive volumes of data to extract trends, patterns, correlations and even anomalies. The extracted information can be used to increase revenues, cut costs, improve customer relationships, reduce risks and more. Topics covered in this course include: Introduction to the fundamental concepts of knowledge discovery and data mining, data pre-processing, frequent pattern mining, clustering, classification, predication, Software tools used for data mining, Real-life applications of data mining, text and web mining, and case studies from different applications.
DSAI 202	Data Governance Credits: 2 (1+3) Prereq: DSAI 203 In this course, Students will learn the principles, goals, and business drivers of data governance. Topics include metadata, data quality, master and reference data management, and appropriate uses of data and ethics. Students will evaluate various implements of data governance in organizations

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DSAI 203	<p>Data Integration and Visualization Credits: 2 (1+3) Prereq: DSAI 103</p> <p>The amount and complexity of data is constantly increasing in most of scientific and business applications. Data integration and visualization improves interpretation and comprehension of data, and supports decision making. This course gives an introduction to the software platform and the principles for data selection, analysis, design, integration, and creation of dynamic visualizations. I discusses the consolidation of data from multiple sources, eliminating redundancies, and removing errors before storing it in a single location. It discusses visual representation methods and techniques that increase the understanding of complex data. The course introduces tools for visualization of data from a variety of fields, and programming of interactive visualizations.</p>
DSAI 305	<p>Interpretability & Explainability in AI Credits: 2 (1+3) Prereq: CSAI 301</p> <p>In this course We explain the key differences between explainability and interpretability and why they're so important for machine learning and AI. The course then elaborates several techniques and methods for improving machine learning interpretability and explainability.</p>
DSAI 307	<p>Statistical Inference Credits: 3 (2+3) Prereq: MATH 105</p> <p>In this course the students learn how to use statistics to draw conclusions about some unknown aspect of a population based on a random sample from that population. Topics include: variability, distribution, and asymptotics, sampling distribution, point and interval estimation, methods of moments and maximum likelihood estimation, confidence intervals, hypothesis testing, Uniformly Most Powerful (UMP), generalized likelihood ratio tests and order statistics</p>
DSAI 308	<p>Deep Learning Credits: 3 (2+3) Prereq: CSAI 253</p> <p>This course provides an introduction to deep Learning, how to build efficient neural networks, and how to apply deep learning to applications. Topics covered in this course include convolutional networks, RNNs, LSTM, GAN, Adam, Dropout, and more. Students will be able to build, train and apply fully connected deep neural networks. They will study the key parameters in a neural network architecture and learn how to implement efficient neural networks. They will work on case studies from autonomous driving, image generation, natural language processing, and more. They will master the theory and practice the ideas.</p>

Code	Description
DSAI 325	<p>Introduction to Information Theory Credits: 3 (2+3) Prereq: MATH 105</p> <p>This course introduces the principles and applications of information theory: Topics include: probability and uncertainty, basics of information theory (Shannon entropy, mutual information, Kullback-Liebler divergence), error correcting codes, communication complexity, data compression, data structures, and optimization. It discusses relations and applications to probability, statistics, machine learning, biological and artificial neural networks, genomics, quantum information, and blockchains.</p>
DSAI 352	<p>Computer Vision Credits: 3 (2+3) Prereq: DSAI 308</p> <p>This course provides an introduction to the field of computer vision. Some of the topics covered in the class are: Image and Camera Fundamentals, Fourier Transform & Convolution, Image enhancement, Image Segmentation, Image Feature Extraction, Object recognition, Stereo-vision, Motion analysis, and latest topics in computer vision.</p>
DSAI 353	<p>Natural language processing Credits: 3 (2+3) Prereq: DSAI 308</p> <p>This course provides an introduction to the field of Natural Language Processing. Some of the topics covered in the class are Text Similarity, Part of Speech Tagging, Parsing, Semantics, Question Answering, Sentiment Analysis, and Text Summarization. The course includes programming assignments in Python.</p>
DSAI 402	<p>Reinforcement Learning Credits: 3 (2+3) Prereq: DSAI 308</p> <p>The course focuses on the area of machine learning where an agent learns how to behave in an environment by performing actions and assessing the results. Topics covered by this course include: fundamentals and practical applications of reinforcement learning, Reinforcement learning framework, Bandit problems and action selection, Dynamic programming, Monte Carlo methods, Temporal difference learning, Function approximation for generalization, Multi-agent reinforcement learning, Training agents and performance evaluation</p>

Code	Description
DSAI 403	<p>Nature inspired computation Credits: 3 (2+3) Prereq: CSAI 251</p> <p>This course introduces students to nature-inspired computing methods. Methods that are inspired by both biological and non-biological systems are considered. Students learn how to apply these methods to solve problems in various areas of computing such as optimization, machine learning, and robotics. They study examples of nature-inspired computing methods including cellular automata, neural networks, evolutionary computing, swarm intelligence, artificial life, and complex networks.</p>
DSAI 406	<p>Machine Learning Engineering for Production (MLOps) Credits: 3 (2+3) Prereq: DSAI 308</p> <p>Machine Learning Engineering for Production (MLOps) integrates machine learning's core concepts with modern software development and engineering roles' functional expertise. MLOps course teaches students how to design, implement, and maintain integrated production systems. Production systems, in contrast to typical machine learning modelling, must deal with constantly changing data. Furthermore, the production system must operate continuously at the lowest possible cost while delivering the highest possible output. Students will learn how to: -Design an ML production system end-to-end, -Establish a model baseline, -Build data pipelines, -Apply techniques to manage modeling resources, -Use analytics to handle model fairness and resolve bottlenecks. -Apply best practices to keep operating production system running.</p>
DSAI 413	<p>Multimedia Analytics Credits: 3 (2+3) Prereq: DSAI 308</p> <p>This course introduces the students to tools for multimedia information analysis. Students learn to extract meaningful features from different types of multimedia data, to implement semantic multimedia content classification and annotation, apply speech and speaker recognition techniques, and perform video indexing and summarization.</p>
DSAI 414	<p>Social Analytics Credits: 3 (2+3) Prereq: DSAI 308</p> <p>Social media has changed the way information is being produced, transferred and consumed. This course is concerned with techniques for social media modeling, analytics and optimization. It teaches students how to: collect massive amounts of social media data via custom scripts, handle incomplete and missing data, computationally identify and quantify social influencers, extract and School the flow of interesting pieces of information and identify trending topics, visualize social networks data and analysis results, deal with unreliable and often conflicting information</p>



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DSAI 415	<p>Cloud software development Credits: 3 (2+3) Prereq: DSAI 308</p> <p>The course teaches students how to develop cutting-edge cloud applications for cloud environments. Topics include: Basics of software development for the cloud. Develop secure and scalable cloud applications for multi-cloud environments. Use AWS SDK/Azure/GCP development tools to develop secure, scalable cloud applications. Refactor legacy, on-premises monolithic application into a serverless microservices architecture. Understand a variety of programming languages. Implement and manage web apps. Key concepts and best practice in software development. Monitor, troubleshoot and optimize software development solutions.</p>
DSAI 416	<p>GIS and spatial Analytics Credits: 3 (2+3) Prereq: DSAI 308</p> <p>This course introduces Geographical Information Systems (GIS) and helps the students to expand their knowledge of spatial information science and GIS procedures. The course helps the students to understand GIS concepts and spatial analysis techniques in an interdisciplinary setting, to Identify and source data for use in evidence-based decision making, to apply ArcGIS for spatial data preparation, analysis and visualisation with sophisticated skills of vector and raster processing and to demonstrate proficiency in integrating GIS data analysis with simple statistical analysis.</p>
DSAI 417	<p>Chatbots Credits: 3 (2+3) Prereq: DSAI 456</p> <p>This course aims to teach students how to build, analyze and deploy chatbots. It covers the following topics: Evolution of chatbot, Current landscape – adoption and technology, Principles of good chatbot design, Key features of a chatbot development platform (Dialogflow), Integrating the platform with user interfacing apps and backend systems, Natural language processing, Chatbot development lifecycle (from requirements to deployment), Chatbot Training, Creating a FAQ chatbot with no coding and Creating a reservation chatbot with basic coding.</p>

Code	Description
DSAI 418	<p>Conversational Agents Credits: 3 (2+3) Prereq: DSAI 456</p> <p>This course focuses on the design, development, deployment, and evaluation of conversational agents. Topics include: Conceptual and technical foundations of conversational agents, Introduction to research areas, such as spoken dialogue systems, multi-modal interaction, natural language processing, and human-robot interaction (HRI), Relevant theories of human-computer interaction, Design guidelines for different classes of conversational agents, Human-centered design approach adapted to the design of conversational agents, Conversational agents development lifecycle (from requirements to deployment), Qualitative and quantitative evaluation approaches, Design, Development, and evaluation of a conversational agent using contemporary technology tools (e.g., Google Dialogflow, Microsoft Bot Framework, Rasa)</p>
DSAI 427	<p>Big Data Analytics Credits: 3 (2+3) Prereq: CSAI 253</p> <p>The course is designed to give the students in-depth knowledge of the Big Data framework using Hadoop and Spark. They will learn the principles of HDFS, YARN, and MapReduce. They will learn to use Pig and Hive to process and analyze large datasets stored in the HDFS and to use Sqoop and Flume for data ingestion. They will be introduced to HBase, a distributed column-oriented database to use when require real-time read/write random access to very large datasets. They will learn real-time data processing using Spark, understanding parallel processing in Spark, and using Spark RDD optimization techniques and SparkML.</p>
DSAI 431	<p>Fuzzy logic and fuzzy system Credits: 3 (2+3) Prereq: MATH 308</p> <p>This course introduces the fuzzy logic and fuzzy system which is a branch of many-valued logic based on the paradigm of inference under vagueness. Topics include: Fuzzy connectives, Fuzzy logic, fuzzy reasoning, fuzzy implications, paradoxes and probability. It includes also industrial applications such Intelligent control of complex systems.</p>
DSAI 433	<p>Game Theory Credits: 3 (2+3) Prereq: CSAI 301</p> <p>The aim of this course is to study the branch of mathematics concerned with the analysis of strategies for dealing with competitive situations where the outcome of a participant's choice of action depends critically on the actions of other participants. It has a wide range of applications, including psychology, evolutionary biology, war, politics, economics, and business. Covered topics include: analysis of competitive strategy and game theory including Nash equilibrium and its refinements, subgame perfection, Bayesian equilibrium, and information uncertainty, repeated games, and game theory applications to various economic themes such as in trade, labor, industry, education, stock markets, insurance, and R & D.</p>



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DSAI 456	<p>Speech recognition Credits: 3 (2+3) Prereq: DSAI 308</p> <p>This course provides an introduction to speech analysis, synthesis and recognition. The course introduces the production of human speech, vocal tract, the hearing system, the units of speech, methods of analysis for speech signals, speech recognition technology, and computerized speech synthesis. It provides a basic understanding of multidimensional techniques for speech representation and classification methods. Students will learn to express the speech signal in terms of its time domain and frequency domain. They will learn to derive expressions for simple features used in speech classification applications. Topics include Introduction to speech processing, time-frequency analysis, spectral analysis, speech Modeling , Linear Predictive Analysis, pitch Extraction, Human Auditory System, Speech Enhancement, Clustering and Gaussian Mixture models, Speaker Recognition, Hidden Markov models & Neural networks, and speaker and speech recognition.</p>
DSAI 473	<p>Data warehousing Credits: 3 (2+3)</p> <p>The main objective of this course is to provide students with an in-depth understanding of the design and implementation of database warehousing. Topics include: Difference between a data mart and data warehouse, Data Warehouse Architecture, Kimball and Inmon methodologies, From native data stores to a data mart or warehouse (Extract, Transform, and Load (ETL)), Granularity impacts on Extract, Transform, and Load (ETL) processes. Entity Relationship Diagram and snowflake schema for a data mart or warehouse, analyzing the telemetry and technical debt of IT, Analyzing the telemetry and technical debt of vertical versus horizontal scaling of a massively concurrent application product, Working with a document management database deployed in MongoDB, eXtensible Stylesheet Language Transformation (XSLT) for XML documents, XQuery, Scheduling Extract, Transform, and Load (ETL) processes</p>
DSAI 490	<p>Selected Topics in Data science and AI Credits: 3 (2+3)</p> <p>Selected topics in Data Science and AI of interest of faculty and Program students, not covered elsewhere in the curriculum. The course can be repeated for credit more than once on the condition that course topics are different</p>

Code	Description
ENGL 156	<p>Technical English 1 Credits: 2 (2+0)</p> <p>The focus of the course is twofold, the first will be different types of oral public communications and presentation in different settings. This part of the course focuses on presentation skills and the oral articulation of scientific concepts and ideas. The second part of the course introduces the meaning and strategies of rhetoric; it aims to enhance the students' skills in identifying, comprehending, evaluating, and producing different elements and types of spoken and written arguments. Students will practice critical thinking, reading, writing in addition to debating skills; they will develop research skills in which they will identify and evaluate primary and secondary sources that include different types of evidence to support their own stance towards a controversial topic.</p>
ENGL 157	<p>Technical English 2 Credits: 2 (2+0) Prereq: ENGL 156</p> <p>This course covers the following topics: Recognize and evaluate the technical writing landscape, Ethical and legal considerations, Determine and implement steps for effective writing process, Level of technical and subject-matter expertise, Synthesize evidence and develop conclusions, Cite/attribute sources, Persuasive techniques, Determine appropriate format, Document Outline and organization, Draft and revise, Design principles: proximity, alignment, repetition, Use of color, symbols, graphs, diagrams, numeric information, Project reports, Funding proposals, Magazine and trade articles, Technical reports, and Journal articles, Peer review and critical assessments</p>
IT 101	<p>Shell and Script Programming with UNIX Credits: 2 (1+3) Prereq: CSAI 101</p> <p>This course covers a suite of tools for solving problems and carrying out a wide range of tasks, including shell, sed, awk, Python, and Perl scripting languages. The course explores in detail the Bash shell. By the end of the course, the students should be able to: Use common UNIX/Linux tools to generate shell scripts. For example; Vi, Vim, Emacs, Use regular expressions in scripts, Apply simple filters for managing, editing, comparing, searching, and formatting file contents from bash or Python scripts, Use your knowledge of Unix/Linux utilities to build complex and specialized bash scripts for solving a variety of problems, Demonstrate capability with Perl scripts and write basic Perl script, Write basic Python scripts that use lists, dictionaries, functions, and regular expressions, Write Python classes and objects, and incorporate other object-oriented concepts, Interact with a database from a Python program</p>

Code	Description
IT 102	<p>Ethical Hacking and Defense Credits: 2 (1+3) Prereq: CSAI 101</p> <p>This course discusses techniques used by malicious hackers to attack computers and networks, and teaches students how to develop the appropriate defenses for such attacks. Topics include: Introduction to ethical hacking, Protecting ethical hackers, the TCP/IP protocol suite (protocol stack, IP addressing), Network and computer attacks (Malware, Viruses and worms, Trojans, Spyware and adware), Port scanning types (SYN, Connect, NULL, XMAS, ACK, FIN, UDP), Port scanning tools (NMAP, UnicornScan, Nmap, Nessu), Enumeration (finding resources, accounts, and passwords) on Microsoft and Unix/Linux targets, Scripting and coding for security professionals, Microsoft operating systems vulnerabilities, Linux operating system vulnerabilities, Hacking web servers, Hacking wireless networks, Protecting networks with security devices</p>
IT 103	<p>Fundamentals of Information and Communication Systems Credits: 2 (1+3)</p> <p>Analysis and design of communication systems with an emphasis on digital communications based on time and frequency domain analysis. Fourier transform techniques, linear systems, and filtering are reviewed. Power and energy spectral density of communication signals. Sampling and quantization of analog signals. Baseband and binary bandpass digital modulation including line coding, pulse shaping, and both pulse and carrier modulation techniques. Wireless communication system concepts including link budgets and multiple access. Transmitter and receiver design concepts. Signal-to-noise ratio, bit error rate, and their relationship. Analog techniques such as Amplitude Modulation (AM) and Frequency Modulation (FM) radio will be reviewed for conceptual and comparative purposes</p>
IT 205	<p>Enterprise System Architecture Credits: 2 (1+3)</p> <p>Enterprise system architecture is the key part of managing and evolving IT systems, and therefore the business operations, of an organization. Topics covered by this course include: Enterprise architecture design, The principal design strategies and tools for constructing the modern information system. Requirements analysis, Software and systems lifecycle methodologies, Unified Modeling Language, Analysis and design methodologies and other related topics. The interactions among these components. Project activities expose students to the full design and specification of IT systems to meet a variety of business and technical problems, as well as prepare them for their capstone course experiences.</p>
IT 206	<p>Fundamentals of IT Governance and Risk Management Credits: 2 (1+3)</p> <p>This course shows how the design and implementation of an IT governance system can transform IT from an expense to a profitable investment. Essential to IT governance is risk management.</p>

Code	Description
IT 220	<p>Networks installation and Maintenance Credits: 2 (1+3) Prereq: CSAI 252</p> <p>The objective of this course is to provide the knowledge and practice of maintenance and installation of computer hardware and networking, enabling the student to identify and rectify the computer hardware components, software and network related problems either in data centers or distributes on premise. With the help of this course the participant will be able to understand the network and hardware specifications that are required to run operating system and various application programs. Also, upgrading of existing network components and the associated hardware/software as and when required</p>
IT 222	<p>Fundamentals of Multimedia Creation, Storage and Transfer Credits: 2 (1+3) Prereq: CSAI 252</p> <p>This course introduces the concepts and principles of digital multimedia and the tools and techniques of capture, creation, manipulation, transfer and integration for digital multimedia. The curriculum provides a study of composition, layout, storage, capture and output of digital multimedia using industry-standard tools.</p>
IT 308	<p>Cloud Computing Architecture Credits: 2 (2+1) Prereq: CSAI 201</p> <p>The focus of this course is on the design of architectural solutions for cloud computing-based environments, which are inherently distributed and service-based. Course outcomes include: Understanding cloud computing architectural principles, constraints, and best practices, Selecting appropriate architectural designs that meet customer requirements and deliver quality cloud-based solutions, Designing cloud-based architectures that are highly scalability and that achieve infrastructure automation, decoupling, and web-scale storage, Handling important design issues related to cloud computing such as: security, reliability, performance efficiency and cost optimization.</p>
IT 309	<p>IT User-Experience Design Credits: 3 (2+3)</p> <p>This course teaches students how to design and develop successful user experiences (UI/UX) for mobile devices. Topics include: Overview of user experience design (UX) and user interface design (UI), The difference between UX and UI, The UX process, Information architecture/mental models, analysis of users needs and behaviors, User scenarios, Use cases, Taxonomy, Workflow diagrams, Sketches, Site maps, Content hierarchy, Usability testing, Evaluation of existing user experience designs.</p>

Code	Description
IT 310	<p>Foundations of Cybersecurity and Security Management Credits: 3 (2+3) Prereq: CSAI 252</p> <p>This course focuses on the terms, philosophies, technologies, and strategies related to cybersecurity. Topics covered include: Access control models (MAC, DAC, RBAC), Common attacks and appropriate actions to take to mitigate vulnerability, Denial of Service/Distributed Denial of Service, Remote access technologies (802x1x, VPN, RADIUS, TACACSIPSec), Internet security (SSL/TLS, HTTPS, IM), Network devices security, Network media and security, Cryptographic algorithms, Key management and certificate lifecycles, Physical security, Security policies and procedures, Security-related documentation.</p>
IT 401	<p>Data Centers Credits: 3 (2+3) Prereq: CSAI 252</p> <p>This course is designed to prepare students for employment in data centers or companies that support data center function as a technician, operator and/or technologist. Topics include: Importance of data centers, Evolution of data centers, Data centers core components and how do it work, Types of data centers (enterprise, managed-services, cloud-based, colocation, edge, hyperscale) , Data centers infrastructure (Tier I to Tier IV data centers), Data centers management (facilities management, inventory or asset management, infrastructure management and monitoring, Technical support, Energy consumption and efficiency). Data centers security and safety. Data center vs. the cloud vs. a server farm.</p>
IT 402	<p>Fundamentals of Cybersecurity and Encryption Credits: 3 (2+3) Prereq: MATH 308</p> <p>The nature, scope and importance of cyber security are explained, and key concepts are justified and explored. This includes examining the types of threat that cyber security must address, as well as the range of mechanisms, both technological and procedural, that can be deployed. The role of cryptography and encryption in providing security is explored, including how algorithms and keys play their part in enabling cyber security. The key supporting function played by key management is identified, including why the use of cryptographic functions depends on it</p>
IT 411	<p>Enterprise Resources Planning Credits: 3 (2+3)</p> <p>This course focuses on Enterprise Resource Planning (ERP) systems and utilizes SAP to illustrate how ERP systems are employed in business organizations to support business processes. At the end of the course, students will have an overview of ERP characteristics, components and benefits; they will be familiar with the SAP graphical user interface (GUI) and navigation.</p>

Code	Description
ITCC 301	<p>Linux System Administration Credits: 2 (1+3)</p> <p>This course teaches students about the installation/configuration, operation, and maintenance of secure Linux based computer systems. Topics include: Linux installation plan, Linux command line, File management, Local users and groups management, Linux file system and file permissions, Software packages Installation and maintenance, Linux processes management and monitoring, Control services and daemons, System monitoring and security through logs, Linux networking (configuration and troubleshooting) , Linux server maintenance, Linux server security issues</p>
ITCC 302	<p>Cloud Infrastructure Administration Credits: 3 (2+3) Prereq: IT 308</p> <p>This course provides an overview of digital transformation, role of Cloud to help organizations address the current IT challenges to meet their overall digital transformation objectives. Topics include: Transitioning from a classic data center to a virtual data center and then to the Cloud, Essentials of Cloud characteristics, Cloud deployment and service models, Key benefits of Cloud computing, Components of the Cloud reference architecture, Need for application transformation, Modern application characteristics, Cloud administration & orchestration, Key IT infrastructure components, Virtual infrastructures, Software defined infrastructure, Converged and Hyper converged infrastructure, Cloud security administration, Cloud service management, Key elements of successful transformation</p>
ITCC 403	<p>Security Testing for Cloud Applications Credits: 3 (2+3) Prereq: IT 310</p> <p>This course aims at providing the foundations behind security testing for cloud applications, including attack models and taxonomy, static analysis for vulnerability detection and test case generation</p>
ITCC 404	<p>Windows Enterprise Administration Credits: 3 (2+3)</p> <p>This course focuses on multi-domain and enterprise-wide planning and implementation tasks that are to be performed by the system administrators of that enterprise. The course enhances the students' ability to choose the appropriate Windows and to perform domain-wide administration tasks. Topics covered: Planning for Active Directory, Network Infrastructure, Advanced Active Directory Issues, Active Directory Administration, Deploying Windows to the Small/Medium Office, Using Remote Desktop Services and Application Setup, Securing the Network, Supporting PKI, Virtualization Solutions, Windows Updates, Making Data Secure and Available</p>

Code	Description
ITCC 405	<p>Virtualization and Cloud Security Credits: 3 (2+3) Prereq: IT 308</p> <p>This course discusses the capabilities and limitations of modern approaches to virtualization and the variety, complexity, and capabilities of modern cloud platforms and cloud security. On completion of this course, the student should be able to: Describe the technical mechanisms by which virtualization is implemented in a variety of environments and their implications for cyber operations, Enumerate and describe the different interfaces between the hypervisors, VMs, physical and virtual hardware, management tools, networking, storage, and external environments, Select appropriate cloud service models and delivery modes, Develop and deploy a workload in an appropriate cloud environment, Explain the industry security standards, regulations, audit policies and compliance requirements for Cloud based infrastructures, Identify security requirements for the Web/Mobile applications and Internet of Things (IoT) deployments on Cloud.</p>
ITCC 406	<p>Migrating Data and Applications to the Cloud Credits: 3 (2+3) Prereq: IT 308</p> <p>This course focuses on how to migrate data and applications to the cloud, identify good candidates for migration, select the right target platform. Topics include: Introduction to Cloud Migration, Understanding the business case, Understanding the risks, Public cloud migration, Private cloud migration, Selecting the Workloads, Good candidates for migration, Using categories, Picking the Target Platform, Public clouds, Private clouds, Hybrid clouds, Other options, Cloud-Based Tools, AWS, Microsoft, Google, Setting Up a Migration Factory, Workload triage, Selecting tools, Considering DevOps, Creating a process, Migration at Scale, Organization and skill considerations, Security considerations</p>
ITCC 407	<p>Cloud Services Management Credits: 3 (2+3) Prereq: IT 308</p> <p>The course is designed to teach students how to optimize their use of the cloud by understanding different services and how they fit into cloud-based solutions. Topics include: Cloud Planning and Design Considerations, Cloud Service Lifecycle and Management Considerations, Financial Planning, Traditional and Modern Cloud Approaches, Cultural Transformation, Governance Planning, Cloud governance, Impact of service and deployment models, Risk Management for Cloud Services, Choosing a cloud service provider, Cloud compliance standards, Security for Cloud Services, Introduction to Multi-Cloud Strategy, Hybrid cloud vs. multi-cloud, Multi-cloud Considerations and Best Practices, Multi-cloud management, Traditional IT versus Digital IT, Public cloud provider experience, Agile, DevOps, CI/CD, Infrastructure as Code, Value Stream Mapping.</p>

Code	Description
ITCC 408	<p>Application Development and Scripting in the Cloud Credits: 3 (2+3) Prereq: IT 308</p> <p>This course provides guidance to create contact center scripts that assist the agents to process inbound and outbound interactions. The course also explains the types of scripts you can design. In this course, you will also learn to create complex scripts and get familiar with industry best practices related to scripting tasks.</p>
ITCC 410	<p>Software Development Operations in Cloud Environments Credits: 3 (2+3) Prereq: CSAI 203, IT 308</p> <p>This course teaches student fundamentals of software development lifecycle in the cloud environment.</p>
ITCC 411	<p>SaaS, IaaS and PaaS Credits: 3 (2+3)</p> <p>This course discusses different cloud computing service models, Software-as-a-Service (SaaS), Infrastructure-as-a-Service (IaaS) and Platform-as-a-Service (PaaS) are all covered in details and students learn the key difference between them and when to choose which according to business requirements.</p>
ITCC 412	<p>Advanced Cloud Security Credits: 3 (2+3) Prereq: IT 308, IT 310</p> <p>This is an advanced, hands-on, cloud security course. Students Learn advanced techniques for designing, deploying and managing secure cloud architectures and being well prepared for incident response.</p>
ITCC 413	<p>IT Security and Policy Planning Credits: 3 (2+3) Prereq: IT 310</p> <p>This course introduces students to the technologies and policies that support confidentiality, integrity and availability and covers Industry standards for security architecture, operational security, policy and governance. It teaches students how to acquire fundamental knowledge of Computer Policies for information Security. Topics include: Threats, Vulnerabilities, Technologies used to prevent cyber attacks (encryption, security devices, software, authentication and identity protocols), Policy Planning, E-mail and Employee Privacy, Labor Organization Activities (Fair Use), Avoiding Discrimination and Harassment, Copyright, Defamation, Spamming, Trade Secrets & Confidential Information, Attorney-Client communication via E-mail, Computer Security, Preventing Waste of a Computer Resources, Essentials for Good Policy, and Ensuring Compliance.</p>

Code	Description
ITCC 414	<p>IS Strategy Management and Acquisition Credits: 3 (2+3)</p> <p>In this course, students learn the fundamental concepts associated with high-level IS infrastructure and the systems that support the operational, administrative, and strategic needs of an organization. The course explores the acquisition, development, and implementation of plans and policies to achieve efficient and effective information systems.</p>
ITNS 301	<p>Network Administration Credits: 2 (1+3) Prereq: CSAI 252</p> <p>This course prepares students with the technical knowledge and skills required to design, install, administer, and maintain LANs and WANs.</p>
ITNS 302	<p>IoT Systems and Application Development Credits: 3 (2+3) Prereq: CSAI 252</p> <p>This course introduces students to the Internet of Things and then explores modern IoT services, and then students will dive deep into topics such as the device gateway, device management, the device registry, and shadows. They will also discuss security features and implications, core and edge computing capabilities and benefits, and the use of HTTP and MQTT as communications protocols. Lastly, they will discuss the integration of IoT solutions with analytics tools, which will allow you to analyze the IoT data being collected by your fleet of device</p>
ITNS 403	<p>Storage Area Networks Credits: 3 (2+3) Prereq: CSAI 252</p> <p>This course covers a range of storage technologies from local and network-attached to enterprise storage area networks. Topics include: Understanding of underlying storage concepts, technologies, and products. Understanding logical and physical components of storage infrastructures. Evaluating different storage architectures and selecting the most appropriate one. Understanding related concepts like: backup, recovery, disaster recovery, business continuity, and replication. Examining storage networking technologies such as FC-SAN, IP-SAN, NAS. Data Protection - RAID : RAID Implementation Methods, RAID Array Components, RAID Techniques, RAID Levels, RAID Impact on Disk Performance, RAID Comparison. Storage area networks management and monitoring. Securing the Storage Infrastructure: Information Security Framework, Risk Triad, Storage Security Domains. Security Implementations in Storage Networking.</p>

Code	Description
ITNS 404	<p>Network Performance Monitoring and Troubleshooting Credits: 3 (2+3) Prereq: CSAI 252</p> <p>This course teaches students how to design network operation KPIs, perform continuous network monitoring and help them to troubleshoot not just hard failures but slowdowns as well. They can also apply metrics such as throughput, latency, packet reordering, and jitters to ensure efficient network performance.</p>
ITNS 406	<p>Network Resilience and Hardening Credits: 3 (2+3) Prereq: CSAI 252</p> <p>In this course students learn how to provide and maintain an acceptable level of network service in the face of faults and challenges to normal operation and how to handle threats and challenges that range from simple misconfiguration to targeted attacks. The also learn network hardening by to secure a system by reducing its surface of vulnerability.</p>
ITNS 407	<p>IT Audit and Risk Management Credits: 3 (2+3)</p> <p>The goal of this course is to investigate the principles of information system audit and explains the role of information technology governance in business organizations. IT audit process, risk assessment and IT Governance, Frameworks, Standards, and Regulations are introduced and discussed. The students will learn the life cycle of auditing different IT systems including the operating system, database, computer network</p>
ITNS 408	<p>Network Security Credits: 3 (2+3) Prereq: IT 310</p> <p>This course provides an introduction to the core security concepts and skills needed for the installation, and monitoring of network devices to maintain the integrity, confidentiality, and security. Topics include: Security threats in modern network infrastructures, Securing network routers, Authentication, Authorization, Accounting (AAA), The TACACS+ and RADIUS protocols and AAA, Threat mitigation using access control lists (ACLs), Building and deploying ACLs, Secure network management and reporting, Preventing layer 2 attacks, Firewall implementation, Zone-based firewalls, Intrusion prevention systems (network-based and host-based), IPsec building blocks and functions, IPsec site-to-site VPN configuration and verification.</p>

Code	Description
ITNS 410	<p>Penetration Testing Credits: 3 (2+3)</p> <p>This course gives a strong foundation in most hacking or penetration testing fields. It teaches students how to detect, prevent and secure systems from the discussed attacks. Topics include: Penetration Testing Process, Introduction to Web Applications, HTTP/S Protocol Basics, Encoding, Information Gathering, Fingerprinting frameworks and applications, Cross-Site Scripting, SQL Injection, Authentication and Authorization, Common Vulnerabilities, Bypassing Authorization, Session Security, Flash Security, HTML5, File and Resource Attacks, Other Attacks, Web Services, XPath, Penetration Testing Content: Management Systems, Penetration Testing: NoSQL Databases</p>
ITNS 411	<p>Network Programming Credits: 3 (2+3)</p> <p>This course teaches the methods and tools used for network programming. Topics include: Review of relevant network protocols (IP, TCP, UDP, Ethernet, etc.), Overview of TCP sockets, Operating System support for network protocols (process management, memory management, mutual exclusion), Inter-process communication mechanisms (pipes, sockets, Remote Procedure Call), Design of client and server sides of network applications, UDP sockets, multicast and broadcast, Case Study: Apache Web Server, Network security: Authentication and encryption, Secure Socket Layer (SSL)</p>
ITNS 412	<p>IT Compliance and Quality Management Credits: 3 (2+3)</p> <p>This course focuses on IT Compliance and Quality management. It teaches students the activities and tasks needed to maintain a desired level of excellence. This includes the determination of a quality policy, creating and implementing quality planning and assurance, and quality control and quality improvement</p>
ITNS 413	<p>Emerging Networking Technologies Credits: 3 (2+3)</p> <p>This course teaches students how to install, configure, and troubleshoot basic networking hardware, protocols, and services and to describe the features and functions of networking components</p>
ITNS 414	<p>Cyber Forensics Credits: 3 (2+3) Prereq: IT 310</p> <p>This course is designed to expose students to legal and technical aspects of cyber forensics. Topics include: Introduction to the fundamental concepts of digital forensics and cybercrime, Recovery and analysis of digital evidence, Methods of digital evidence collection, preservation, analysis and presentation, Privacy and confidentiality, Legal requirements and liability, Cyber forensics investigation, procedures for the identification, preservation and extraction of electronic evidence, Proper usage of difference forensic tools, Analyze the log file as part of a forensic investigation</p>



Code	Description
ITNS 415	<p>Wireless Security Credits: 3 (2+3) Prereq: IT 310</p> <p>This course teaches students methods and techniques to secure wireless networks against threats and attacks. The topics include Understanding security and cryptography and network security protocols, Investigating network vulnerabilities, Analyzing network operations risks, Evaluating various network countermeasures for various types of wireless networks including: traditional wireless networks, voice-oriented wireless networks, data-oriented wireless networks, wireless lan, wireless ad hoc network, nad mobile networks security.</p>
MATH 103	<p>Calculus for Computational Sciences Credits: 3 (2+2)</p> <p>In this course, students study both major branches, differential calculus and integral calculus. The course covers: Limits. Continuity derivatives and integrals. Implicit differentiation. Differentiation of trigonometric, exponential, and logarithmic functions. Applications of derivatives to optimization problems. Applications of derivatives: related rates, linear approximations, the Mean Value Theorem, l'Hopital's Rule. Definite and indefinite integrals. Fundamental theorem of calculus; application of definite integrals for computations of areas (length, surface) and volumes.</p>
MATH 104	<p>Linear Algebra Credits: 3 (2+2)</p> <p>In this course, students are introduced to systems of simultaneous equations and the use of matrices to describe multidimensional spaces, matrix algebra, vector spaces and bases sets, eigenvalues and eigenvectors. The course covers the following topics: Systems of linear equations, matrix algebra, vector spaces and Bases, eigenvalues and eigenvectors, orthogonality and least squares, applications.</p>
MATH 105	<p>Probability and Statistics Credits: 3 (2+2) Prereq: MATH 103</p> <p>This course introduces the students to the basic concepts of probability and statistics that can be used in computational science and artificial intelligence fields and in the analysis of experimental data. The examples and exercises emphasize applications in these fields. During practice sessions, students will learn how to solve statistics problems using software tools and packages. The course covers the basic tools for the collection, analysis, and presentation of data. Emphasis on principles of mathematical statistical reasoning, underlying assumptions, and careful interpretation of results is considered. Topics covered include Tools for describing central tendency and variability in data; random variables, their distributions, expectations and correlations, methods for performing inference on population means and proportions via sample data; statistical hypothesis testing and its applications to group comparisons. While there are some formulae and computational elements to the course, the emphasis is on interpretations and concepts.</p>

Code	Description
MATH 307	<p>Numerical Methods Credits: 3 (2+2) Prereq: MATH 104</p> <p>Numerical methods are techniques by which mathematical problems are formulated so that they can be solved with arithmetic operations. Although there are many kinds of numerical methods, they have one common characteristic: they invariably involve large numbers of tedious arithmetic calculations. It is little wonder that with the development of fast, efficient digital computers, the role of numerical methods in engineering problem solving has increased dramatically in recent years. The course will develop numerical methods aided by technology (programming using MATLAB) to solve algebraic, transcendental, and differential equations, and to calculate derivatives and integrals numerically. It also shed a light on curve fitting including regression and interpolation models and optimization for constrained and unconstrained problems. The course will also develop an understanding of the elements of error analysis for numerical methods and certain proofs. The course will further develop problem solving skills needed in engineering and science.</p>
MATH 308	<p>Discrete Mathematics Credits: 3 (2+2)</p> <p>This course demonstrates the usefulness and importance of using discrete mathematics as mathematical tools for real world problems that emerged in science and engineering. The course covers the following topics: Proofs, mathematical induction, recursion. Efficient exponentiation and multiplication Greatest common divisor, Euclid algorithm. Prime numbers, modular arithmetic, Fermat Little theorem. Public-key cryptography, RSA. Counting, the binomial theorem, elementary probability theory. Generating random numbers with their factorization. Elementary graph theory: connectivity, trees, planarity. De Bruijn sequences and Gray codes</p>
MATH 404	<p>Linear and Nonlinear Programming Credits: 3 (2+2) Prereq: MATH 103</p> <p>This course emphasizes data-driven modeling, theory and numerical algorithms for optimization. Topics covered by this course include: formulation of linear programming problems, graphical solutions, simplex method, duality theory, sensitivity analysis, integer programming, deterministic dynamic programming, combinatorial optimization problems such as scheduling, matching, resource allocation, network and assignment problems, with real life applications.</p>
PHYS 103	<p>Physics 1 Credits: 3 (2+3) Prereq: MATH 103</p> <p>This course introduces students to principles and applications of mechanics, heat, and sound. The course contains lab work to develop an understanding of the scientific method.</p>



Code	Description
PHYS 104	<p>Physics 2 Credits: 3 (2+3) Prereq: PHYS 103</p> <p>This course discusses principles and applications of light, electricity, and magnetism. The course contains lab work to develop an understanding of the scientific method.</p>
SCH 163	<p>Sustainability, Social and Ethical Issues in Computing Credits: 2 (2+0)</p> <p>Sustainability means meeting our own needs without compromising the ability of future generations to meet their own needs. In addition to natural resources, we also need social and economic resources. This course covers some ethical and social considerations of computing, and explores practical approaches to them. Topics include: Social implications of computing, Ethical argumentation and theories, Code of Ethics, Intellectual property, Case studies to illustrate professional challenges of computing.</p>
SCH 261	<p>Project Management and Economics Credits: 2 (2+0)</p> <p>This course prepares students for a professional role in the management of engineering projects by providing students with an understanding of both the people-related and technical requirements necessary for the successful management of engineering projects, as well as the organizational and strategic aspects. The course also stresses the processes that are used to produce, process and service engineering-based innovation projects from idea through relevant analyses to launch, relate innovation to improvements in products, processes and competitive advantage and explain how intellectual property is protected and exploited.</p>
SCH 264	<p>Entrepreneurship and Small Business Management Credits: 2 (2+0)</p> <p>The course is designed to provide preliminary guidance for entrepreneurs to understand business nature, spot business opportunities, conduct market research, make a marketing plan and put pricing strategies of products, work on financial aspects of the business plans, and create business plans.</p>
SCH 273	<p>Cognitive Psychology Credits: 2 (2+0)</p> <p>This course studies how people perceive, learn, think and remember. Topics include: Introduction to cognitive psychology, Methods and the brain, Low-level vision, High-level vision, Visual attention, Auditory attention, Central attention, Visual and verbal representations, Sensory memory and short term memory, Episodic memory, Memory in the real world, Semantic memory, Deductive reasoning, Inductive reasoning, Decision making, Problem solving, Learning, Language learning, Culture and Cognition, Individual differences, Extraordinary cognitive abilities</p>

Code	Description
SW 151	<p>Computer Architecture and Organization Credits: 3 (2+3) Prereq: CSAI 102</p> <p>The objective of this course is to explain how computers are designed and how they work. Students are introduced to modern computer principles using a typical processor. They learn how efficient memory systems are designed to work closely with the processor, and how input/output (I/O) systems bring the processor and memory together with a wide range of devices. The course emphasizes system-level issues and understanding program performance. Topics include Harvard and Von Neumann microprocessors architectures, instruction sets, X86 and ARM assembly language, internal data representation, computer arithmetic, processor datapath and control, memory hierarchy, I/O devices and interconnects, CISC and RISC architectures, and an introduction to DSP architecture and GPUs.</p>
SW 251	<p>User Experience and Interaction Design Credits: 3 (2+3) Prereq: CSAI 203</p> <p>A fundamental part of the design of any program should take into consideration how people use, interact and work with that program. This course teaches students how to generate and develop designs for interactive programs that are concerned with all the elements that affect the user's perceptions of the whole system. The course introduces HCI theories to analyze and enhance program designs.</p>
SW 252	<p>Embedded Systems Credits: 3 (2+3) Prereq: SW 151</p> <p>This course introduces students to the fundamentals of embedded systems hardware and firmware design. Topics include: embedded processor selection, hardware/firmware partitioning, glue logic, embedded code debugging and development, firmware architecture, firmware design, and firmware debugging</p>
SW 301	<p>Object-Oriented Analysis and Design Credits: 3 (2+3) Prereq: CSAI 151</p> <p>This course teaches students how to apply the object-oriented paradigm and concepts including modeling, requirements development, analysis, and design of an application, system, or business. Students will recognize the difference between writing programs and doing analysis and design.</p>
SW 302	<p>User Interface Development Credits: 3 (2+3) Prereq: SW 251</p> <p>This course addresses techniques for building user interfaces including prototyping tools, input models, output models, model-view-controller, layout, constraints, and toolkits. Techniques for evaluating and measuring interface usability, including heuristic evaluation, predictive evaluation, and user testing are discussed as well.</p>

Code	Description
SW 401	<p>Parallel and Distributed Computing Credits: 3 (2+3) Prereq: CSAI 151</p> <p>This course covers a broad range of topics related to parallel and distributed computing, including parallel and distributed architectures and systems, parallel and distributed programming paradigms, parallel algorithms, and scientific and other applications of parallel and distributed computing.</p>
SW 402	<p>Software Project Management Credits: 3 (2+3) Prereq: CSAI 203</p> <p>This course explains the methodologies and standards used in managing the full software life cycle. The course discusses the latest methodologies and standards of software development, including how to evaluate initial development costs and schedules, methods to define test and prototype activities, how to determine risk management approaches, and different models to manage the full software life cycle.</p>
SWAPD 301	<p>Software Systems Requirements Development Credits: 3 (2+3) Prereq: CSAI 203</p> <p>This course teaches students about the requirements development process, including how to perform software requirements elicitation, modeling, specification, analysis, documentation, and review.</p>
SWAPD 351	<p>Software Architecture and Design Credits: 3 (2+3) Prereq: SWAPD 301</p> <p>This course help students understand the principles and concepts of analyzing and designing enterprise-scale software-intensive systems, considering functional and non-functional requirements, and system environment. It covers how to develop and evaluate different software architectures, apply different design techniques, select appropriate architectural styles and appropriate software design patterns, use UML to express the analysis and design of an application, and understand and perform a design review.</p>
SWAPD 352	<p>Web Applications Development Credits: 3 (2+3) Prereq: CSAI 202</p> <p>The aim of this course is to help students master the fundamentals of web development and gain the skills needed to become web developers. The following topics are covered: Web architecture, Multi-tier and multi-layer web applications, Web design guidelines and evaluation, HTML, CSS, and JavaScript, front end frameworks, back end frameworks, and working with databases.</p>



Code	Description
SWAPD 401	<p>Software Testing, Validation, and Quality Assurance Credits: 3 (2+3) Prereq: SWAPD 301</p> <p>This course introduces software verification, validation and testing techniques and discusses software quality assurance and techniques used to assess software quality.</p>
SWAPD 402	<p>Mobile Application Development Credits: 3 (2+3) Prereq: CSAI 201</p> <p>In this course, students are introduced to the foundations of mobile application development and its unique requirements and constraints. The course provides students with the design and programming skills to build a variety of mobile applications.</p>
SWAPD 451	<p>Software Maintenance Credits: 3 (2+3) Prereq: CSAI 203</p> <p>This course aims to make students aware of the challenges inherent in the maintenance and evolution of software systems. It teaches students the techniques and best practices for changing software safely and efficiently, including defect management, evolution and categories of maintenance, refactoring of software systems, and regression testing</p>
SWAPD 452	<p>Enterprise Application Development Credits: 3 (2+3) Prereq: CSAI 202</p> <p>This course focuses on the key aspects of enterprise applications. It teaches students how to develop and deploy applications for large enterprise-wide settings, covering topics such as enterprise application architecture, enterprise design patterns, transaction processing, concurrency problems and resolutions, load balancing and tuning, and application installation and deployment issues.</p>
SWAPD 453	<p>IoT Applications Development Credits: 3 (2+3) Prereq: CSAI 252</p> <p>This course introduces students to the Internet of Things and then explores modern IoT services. The course covers topics such as the device gateway, the device registry, and shadows. They will also discuss security features and implications, core and edge computing capabilities and benefits, and the use of communications protocols. Students will discuss the integration of IoT solutions with analytics tools, which will allow to analyze the IoT data being collected.</p>

Code	Description
SWGCG 301	<p>Computer Graphics and Multimedia Systems Credits: 3 (2+3) Prereq: CSAI 201</p> <p>This course covers many aspects of interactive multimedia production and computer graphics. Students will learn about multimedia systems topics such as storage, processing and interaction of different media (graphics, video, sound, images, etc.); and computer graphics topics such as building 2D / 3D models, linear algebra for graphics, viewing and camera control, windowing and clipping, viewport transformation and hidden surface removal, rasterization.</p>
SWGCG 351	<p>Game Design and Development Credits: 3 (2+3) Prereq: CSAI 251</p> <p>This course covers areas related to game design such as: digital media, digital design, game production, game engine programming, interactive entertainment, storytelling, character and plot development, animation, and more</p>
SWGCG 352	<p>Computer and Physics-Based Animation Credits: 3 (2+3) Prereq: SWGCG 301</p> <p>This course explores computer animation and physics-based animation for several phenomena and materials such as rigid and deformable solids, liquids, explosions, cloth, and hair. The course will also investigate topics like inverse kinematics, physical simulation, and motion capture.</p>
SWGCG 401	<p>Design and Geometric Modeling for Visualization and Communication Credits: 3 (2+3)</p> <p>In this course introduce students to the basic design elements and principles focusing on visual thinking. It also covers geometric analysis and modeling to produce computer models for graphic visualization and communication.</p>
SWGCG 402	<p>Visual Effects Production Credits: 3 (2+3) Prereq: SWGCG 352</p> <p>This course covers aspects related to visual effects production, from pre-production, planning and visualization, through to acquisition and post production. The course explains topics such as visual effects and compositing principles, visual effects acquisition and tools, visual effects workflows, paths and processes, storyboarding, character sculpture, dynamic effects, and expression and scripting.</p>
SWGCG 451	<p>Model Creation and Character Animation Credits: 3 (2+3) Prereq: CSAI 201</p> <p>This course introduces students to the production of 3D characters including organic modeling, character setup, texturing, skeleton buildings and animation.</p>



Code	Description
SWGCG 452	<p>Physics-Based Vision and Rendering Credits: 3 (2+3) Prereq: SWGCG 301</p> <p>This course teaches students how to model and analyze the light and color phenomena around us, to create realistic images and render realistic scenes. Topics covered by this course include: physical fundamentals of visual appearance; approximations for diffusion and scattering; physics-based rendering; ray tracing, simple shading, and geometric representations; texture mapping and procedural textures; direct illumination, and rendering wave effects.</p>
SWGCG 453	<p>Mobile and Casual Game Development Credits: 3 (2+3) Prereq: CSAI 201</p> <p>This course focuses on games designed for everyone and have simple rules, shorter sessions, and a low barrier to entry. The course covers topics such as game genres: (Platformer, Fighting, RPG, Strategy, Puzzle, Casual), mobile hardware features and limited resources, and patterns of casual game development. The course also discusses how to design icons, menus, and interfaces for mobile games, sound effects, and game engines.</p>
SWHCI 301	<p>Prototyping Algorithmic Experiences Credits: 3 (2+3) Prereq: CSAI 251</p> <p>This course introduces students to iterative prototyping methods in Human Computer Interaction. The course focuses on data-driven algorithmic systems, machine learning, spatial computing, and IoT. The course helps students evaluate whether a given prototyping approach is a good fit for a given design or research question.</p>
SWHCI 351	<p>Statistical Graphics and Visualization Credits: 3 (2+3) Prereq: MATH 105</p> <p>Visualizing quantitative information helps represent and interpret data and statistical models, which became a key component in decision-making. This course introduces the student to the most common forms to create, critique, and present graphics in a concise and statistically sound way, and their uses and misuses. The course covers advanced graphical methods such as interactive graphics, computer-generated animations, maps, network graphics, etc.</p>

Code	Description
SWHCI 352	<p>User-Focused Sensing Systems Credits: 3 (2+3) Prereq: SW 251</p> <p>Everybody is now surrounded by smart devices that are packed with sensors. Such sensors potential is not fully utilized yet. This course focuses on building and evaluating user-focused sensing systems. It introduces students to various fields for building and understanding smart sensing devices; such as embedded computing, computer vision, distributed systems, machine learning, signal processing, security, and privacy. The students will gain practical experience in developing sensing systems in different application domains, such as activity recognition, health sensing, gestural interaction, etc. They will learn about embedded systems and understand the advantages and limitations of different platforms. They will learn about sensors and how to interface them with the real world to be able to get useful and actionable data. They will learn how to build a network of sensors that can communicate with each other. They will also learn about storing the sensor data for visualization, analysis and presentation both locally and to the cloud.</p>
SWHCI 401	<p>Human Information Processing and Artificial Intelligence Credits: 3 (2+3) Prereq: CSAI 301</p> <p>This course will examine human information processing capabilities and limitations as they relate to the design, development, and implementation of information systems. Artificial intelligence methodologies for the emulation and enhancement of human information processing will be examined. Expert systems, neural networks, and natural language processing will be discussed.</p>
SWHCI 402	<p>AI Based Products and Services Credits: 3 (2+3) Prereq: CSAI 301</p> <p>In this course students will work with different AI technologies to understand what AI can do to practice design processes working with AI as a design tool to for new AI enhanced products and services.</p>
SWHCI 451	<p>Cognitive Modeling for HCI Credits: 3 (2+3) Prereq: SCH 273</p> <p>This course deals with simulating human problem-solving and mental processing in a computerized model. The course discusses advantages and practical uses of cognitive models, cognitive modeling software tools and qualitative comparisons, category learning, parameter estimation techniques.</p>
SWHCI 452	<p>Designing Extended Reality Experience Credits: 3 (2+3) Prereq: SW 251</p> <p>This course introduces students to the basics of Extended Reality (XR), hardware, different applications, psychology, and the challenges of the medium.</p>



Code	Description
SWHCI 453	Human Factors Credits: 3 (3+0) This course provides students with a fundamental understanding of human factors that must be taken into account in the design and engineering of complex systems, such as human sensory systems (vision, hearing, psychophysics, etc.), perception to detection, and human motor performance.