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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 2022

Code	Description
CSAI 100	Introduction to Computational Science and AI Credits: 1 (1+0) This course teaches students the fundamentals of computational science 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 science
CSAI 101	Fundamentals of Programming and Computer Science Credits: 2 (1+3) 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.
CSAI 102	Digital Logic and Computer Architecture Credits: 3 (2+3) 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.
CSAI 151	Object-Oriented Programming Credits: 3 (2+3) Prereq: CSAI 101 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.
CSAI 201	Data Structures Credits: 3 (2+3) Prereq: CSAI 151 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, divided-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.

Code	Description
CSAI 202	Introduction to Database Systems Credits: 3 (2+3) Prereq: CSAI 151 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
CSAI 203	Introduction to Software Engineering Credits: 3 (2+3) Prereq: CSAI 101 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.
CSAI 204	Operating Systems Credits: 3 (2+3) Prereq: CSAI 201 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
CSAI 205	Fundamentals of Circuits and Electronics Credits: 3 (2+3) 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.
CSAI 251	Algorithm Design and Analysis Credits: 3 (2+3) Prereq: CSAI 201 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.
CSAI 252	Introduction to Computer Networks Credits: 3 (2+3) 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

Code	Description
CSAI 253	Machine Learning Credits: 3 (2+3) Prereq: CSAI 201, MATH 301 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.
CSAI 301	Artificial Intelligence Credits: 3 (2+3) Prereq: CSAI 201 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.
CSAI 302	Advanced Database Systems Credits: 3 (2+3) Prereq: CSAI 202 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.
CSAI 351	Principles and Practices for Secure Computing Credits: 3 (2+3) Prereq: CSAI 201 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.
CSAI 399	Internship Credits: 4 (0+12) 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.

Code	Description
CSAI 498	Senior Project - Part 1 Credits: 1 (0+3) 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.
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: MATH 104 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.

Code	Description
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
DSAI 203	Data Integration and Visualization Credits: 2 (1+3) Prereq: DSAI 103 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.
DSAI 305	Interpretability & Explainability in AI Credits: 2 (1+3) Prereq: CSAI 301 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.
DSAI 307	Statistical Inference Credits: 3 (2+3) Prereq: MATH 301 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
DSAI 325	Introduction to Information Theory Credits: 3 (2+3) Prereq: MATH 301 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.

Code	Description
DSAI 352	Computer Vision Credits: 3 (2+3) Prereq: DSAI 308 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.
DSAI 353	Natural language processing Credits: 3 (2+3) Prereq: DSAI 308 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.
DSAI 308	Deep Learning Credits: 3 (2+3) Prereq: CSAI 253 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's 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.
DSAI 402	Reinforcement Learning Credits: 3 (2+3) Prereq: DSAI 308 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. Topic 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
DSAI 403	Nature inspired computation Credits: 3 (2+3) Prereq: CSAI 251 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.

Code	Description
DSAI 406	Machine Learning Engineering for Production (MLOps) Credits: 3 (2+3) Prereq: DSAI 308 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.
DSAI 427	Big Data Analytics Credits: 3 (2+3) Prereq: CSAI 253 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.
DSAI 456	Speech recognition Credits: 3 (2+3) Prereq: DSAI 308 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.

Code	Description
ENGL 156	Technical English 1 Credits: 2 (2+0) Prereq: ENGL 004, if the student was placed in ENGL 003 or ENGL 004 after the English placement exam. This course provides the student with the knowledge required to develop technical communication; this is achieved by focusing on two main types of technical writing and one type of oral communication. The first part of the course introduces the meaning, types and features of technical communications; it takes the students through the journey of identifying, comprehending, and evaluating the language features of technical writing. It further introduces the various types of audiences, explicit and implicit purposes, and tones constituting a technical communication process. This part of the course will assist the students to identify and evaluate primary and secondary sources in addition to the various types of evidence needed to communicate technically. Based on the first part of the course, the second part entails developing the skills and instilling the deeper insights required to produce descriptive and problem-solution written communication to address a variety of purposes and audiences. Moving to the third and last part of the course, it will address the public speaking skills that are now of incremental significance to technical verbal communication.
ENGL 157	Technical English 2 Credits: 2 (2+0) Prereq: ENGL 156 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
IT 101	Shell and Script Programming with UNIX Credits: 2 (1+3) Prereq: CSAI 101 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

Code	Description
IT 102	Ethical Hacking and Defense Credits: 2 (1+3) Prereq: CSAI 101 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, Netscantools Pro, 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
IT 103	Fundamentals of Information and Communication Systems Credits: 2 (1+3) 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
IT 205	Enterprise System Architecture Credits: 2 (1+3) 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.
IT 206	Fundamentals of IT Governance and Risk Management Credits: 2 (1+3) 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.

Code	Description
IT 220	Networks installation and Maintenance Credits: 2 (1+3) Prereq: CSAI 252 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
IT 222	Fundamentals of Multimedia Creation, Storage and Transfer Credits: 2 (1+3) Prereq: CSAI 252 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.
IT 308	Cloud Computing Architecture Credits: 2 (2+1) Prereq: CSAI 201 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 optimisation.
IT 309	IT User-Experience Design Credits: 3 (2+3) 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.

Code	Description
IT 310	Foundations of Cybersecurity and Security Management Credits: 3 (2+3) Prereq: CSAI 252 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.
IT 402	Fundamentals of Cybersecurity and Encryption Credits: 3 (2+3) Prereq: MATH 308 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
IT 411	Enterprise Resources Planning Credits: 3 (2+3) 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.
ITCC 301	Linux System Administration Credits: 2 (1+3) 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
ITCC 302	Cloud Infrastructure Administration Credits: 3 (2+3) Prereq: IT 308 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

Code	Description
ITCC 403	Security Testing for Cloud Applications Credits: 3 (2+3) Prereq: IT 310 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
ITCC 404	Windows Enterprise Administration Credits: 3 (2+3) 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
ITCC 405	Virtualization and Cloud Security Credits: 3 (2+3) Prereq: IT 308 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.
ITCC 407	Cloud Services Management Credits: 3 (2+3) Prereq: IT 308 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.

Code	Description
ITCC 408	Application Development and Scripting in the Cloud Credits: 3 (2+3) Prereq: IT 308 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.
ITNS 301	Network Administration Credits: 2 (1+3) Prereq: CSAI 252 This course prepares students with the technical knowledge and skills required to design, install, administer, and maintain LANs and WANs.
ITNS 302	IoT Systems and Application Development Credits: 3 (2+3) Prereq: CSAI 252 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
ITNS 403	Storage Area Networks Credits: 3 (2+3) Prereq: CSAI 252 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. Understating 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.
ITNS 404	Network Performance Monitoring and Troubleshooting Credits: 3 (2+3) Prereq: CSAI 252 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.

Code	Description
ITNS 406	Network Resilience and Hardening Credits: 3 (2+3) Prereq: CSAI 252 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.
ITNS 407	IT Audit and Risk Management Credits: 3 (2+3) 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
ITNS 408	Network Security Credits: 3 (2+3) Prereq: IT 310 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.
MATH 103	Calculus for Computational Science Credits: 3 (2+2) 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.
MATH 104	Linear Algebra Credits: 3 (2+2) 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.

Code	Description
MATH 301	Probability and Statistics Credits: 3 (2+2) Prereq: MATH 103 This course introduces the students to the basic concepts of probability and statistics that can be used in many engineering fields and in particular in the analysis of experimental data. The examples and exercises emphasize applications in engineering as general and space, physics, chemical, and mineral resources in particular. MINITAB will be used during tutorial Lab. The course covers the basic tools for the collection, analysis, and presentation of data in all areas of engineering. 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; ANOVA; correlation, and regression. While there are some formulae and computational elements to the course, the emphasis is on interpretations and concepts.
MATH 307	Numerical Methods Credits: 3 (2+2) Prereq: MATH 104 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.
MATH 308	Discrete Mathematics Credits: 3 (2+2) 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

Code	Description
MATH 404	Linear and Nonlinear Programming Credits: 3 (2+2) Prereq: MATH 103 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.
PHYS 103	Physics 1 Credits: 3 (2+3) Prereq: MATH 103 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.
PHYS 104	Physics 2 Credits: 3 (2+3) Prereq: PHYS 103 This course discusses principles and applications of light, electricity, and magnetism. The course contains lab work to develop an understanding of the scientific method.
SCH 163	Sustainability, Social and Ethical Issues in Computing Credits: 2 (2+0) 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.
SCH 261	Project Management and Economics Credits: 2 (2+0) 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.
SCH 264	Entrepreneurship and Small Business Management Credits: 2 (2+0) 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.

Code	Description
SCH 273	Cognitive Psychology Credits: 2 (2+0) 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
SW 151	Computer Architecture and Organization Credits: 3 (2+3) Prereq: CSAI 102 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.
SW 251	User Experience and Interaction Design Credits: 3 (2+3) Prereq: CSAI 203 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.
SW 252	Embedded Systems Credits: 3 (2+3) Prereq: SW 151 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
SW 301	Object-Oriented Analysis and Design Credits: 3 (2+3) Prereq: CSAI 151 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.

Code	Description
SW 302	User Interface Development Credits: 3 (2+3) Prereq: SW 251 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.
SW 401	Parallel and Distributed Computing Credits: 3 (2+3) Prereq: CSAI 151 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.
SW 402	Software Project Management Credits: 3 (2+3) Prereq: CSAI 203 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.
SWAPD 301	Software Systems Requirements Development Credits: 3 (2+3) Prereq: CSAI 203 This course teaches students about the requirements development process, including how to perform software requirements elicitation, modeling, specification, analysis, documentation, and review.
SWAPD 351	Software Architecture and Design Credits: 3 (2+3) Prereq: SWAPD 301 This course help students understand the principles and concepts of analysing 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.
SWAPD 352	Web Applications Development Credits: 3 (2+3) Prereq: CSAI 202 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.

Code	Description
SWAPD 401	Software Testing, Validation, and Quality Assurance Credits: 3 (2+3) Prereq: SWAPD 301 This course introduces software verification, validation and testing techniques and discusses software quality assurance and techniques used to assess software quality.
SWAPD 402	Mobile Application Development Credits: 3 (2+3) Prereq: CSAI 201 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.
SWAPD 452	Enterprise Application Development Credits: 3 (2+3) Prereq: CSAI 202 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.
SWAPD 453	IoT Applications Development Credits: 3 (2+3) Prereq: CSAI 252 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.
SWGCG 301	Computer Graphics and Multimedia Systems Credits: 3 (2+3) Prereq: CSAI 201 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.
SWGCG 351	Game Design and Development Credits: 3 (2+3) Prereq: CSAI 251 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

Code	Description
SWGCG 352	Computer and Physics-Based Animation Credits: 3 (2+3) Prereq: SWGCG 301 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.
SWGCG 401	Design and Geometric Modeling for Visualization and Communication Credits: 3 (2+3) 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.
SWGCG 402	Visual Effects Production Credits: 3 (2+3) Prereq: SWGCG 352 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.
SWGCG 451	Model Creation and Character Animation Credits: 3 (2+3) Prereq: CSAI 201 This course introduces students to the production of 3D characters including organic modeling, character setup, texturing, skeleton buildings and animation.
SWGCG 452	Physics-Based Vision and Rendering Credits: 3 (2+3) Prereq: SWGCG 301 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.
SWGCG 453	Mobile and Casual Game Development Credits: 3 (2+3) Prereq: CSAI 201 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.

Code	Description
SWHCI 301	Prototyping Algorithmic Experiences Credits: 3 (2+3) Prereq: CSAI 251 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.
SWHCI 351	Statistical Graphics and Visualization Credits: 3 (2+3) Prereq: MATH 301 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.
SWHCI 352	User-Focused Sensing Systems Credits: 3 (2+3) Prereq: SW 251 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.
SWHCI 401	Human Information Processing and Artificial Intelligence Credits: 3 (2+3) Prereq: CSAI 301 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.
SWHCI 402	AI Based Products and Services Credits: 3 (2+3) Prereq: CSAI 301 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.

Code	Description
SWHCI 451	Cognitive Modeling for HCI Credits: 3 (2+3) Prereq: SCH 273 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.
SWHCI 452	Designing Extended Reality Experience Credits: 3 (2+3) Prereq: SW 251 This course introduces students to the basics of Extended Reality (XR), hardware, different applications, psychology, and the challenges of the medium.
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.