Faculty of Engineering

Department of Computer Engineering

ELEGANT Project: Computer Engineering Curriculum Improvement

The CE program provides the following track options:

1. Artificial Intelligence and Machine Learning (19 Credits): a. Mandatory track base (10 Credits): COMP 215, COMP 364, and COMP 501 and COMP 502 (A Capstone Design Project in Machine Learning and Artificial Intelligence)
b. Track cap (9 Credits): Select three elective courses from the following mandatory list: COMP 477, COMP 534, COMP 560, COMP 564, COMP 565, COMP 568, COMP 474, COMP 551

2. Networks and Cybersecurity (19 Credits): a. Mandatory track base (10 Credits): COMP 454, COMP 543, and COMP 501 and COMP 502 (A Capstone Design Project in Networks and Cybersecurity)
b. Track cap (9 Credits), select three elective courses from the following mandatory list: COMP 431, COMP 455, COMP 477, COMP 510, COMP 512, COMP 529, COMP 554, COMP 555, COMP 556, COMP 559, and COMP 567.

Students not joining a track can freely select their major elective courses.

Artificial Intelligence Track

Course	Title	New/Updated	Credits	Pre-/Co-Requisites
Core				
COMP215	Programming For Engineers	Updated	3	COMP 208
Comp364	Introduction To Artificial Intelligence And Machine Learning	Updated	3	COMP 215
COMP501	Final Year Project 1		1	Pre/Co-req: COMP 500
COMP502	Final Year Project 2		3	COMP 501
Technical				
COMP477	Emerging Trends In Computer Engineering		3	COMP 325 OR COMP 232
COMP 534	Pattern Recognition	Updated	3	COMP 231
COMP 560	Deep Learning	Updated	3	COMP 364
COMP 564	Natural Language Processing		3	COMP 364
COMP 565	Computer Vision		3	COMP 364
COMP 568	Soft Computing		3	COMP 232
COMP 474	Introduction To Robotics	New	3	COMP 325 Or COMP 326 Or COMP 328
COMP 551	Machine Learning	New	3	COMP 364

Courses Description

Core Courses

COMP 215 PROGRAMMING FOR ENGINEERS (3Crs.: 2Lec, 2Lab): Programming in Python for engineers: language, use of external libraries, runtime analysis, applications from data analysis and engineering. Topics include expressions, functions, conditionals and iteration, modeling information as data, object-oriented programming, and useful programming practice like source control, and testing. ***Pre-req.: COMP 208.***

COMP 364 INTRODUCTION TO ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING (3Crs.: 2Lec, 2Lab): Introduction to Artificial intelligence and Machine Learning, supervised and unsupervised learning, search and constraint satisfaction. search algorithms. Knowledge representation and reasoning, knowledge representation for diagnosis. Introduction to neural networks. Implementation using various machine learning tools. ***Pre-req.: COMP 215***

COMP 501 FINAL YEAR PROJECT I (1Cr) / COMP 502 FINAL YEAR PROJECT II (3Crs): After completing 120 credits of course work, the student becomes eligible to sign up for the Final Year Project (FYP) that extends over two semesters; beginning in Fall-semester and ending in the following Spring-semester. The FYP experience requires students to work in teams to complete a specific project, submit a technical report, and give a presentation on a significant, relevant, and comprehensive engineering problem. The FYP is intended to stimulate student creativity and critical thinking, and build skills in formulating, designing, developing, building, communicating, and managing engineering projects. The project aims to provide students with a transitional experience from the academic world to the professional world. ***Pre/Co-req.: COMP 500***
Refer to the Final Year Project Policy for more details.

Technical Courses

COMP 477 EMERGING TRENDS IN COMPUTER ENGINEERING (3Crs.: 2Lec, 2Lab): This course covers current technology in computer Engineering. Topics will vary every year. ***Pre-req.: COMP 325 or COMP 232***.

COMP 534 PATTERN RECOGNITION (3Crs.: 2Lec, 2Lab): Pattern recognition techniques are used to design automated systems that improve their own performance through experience. This course covers the methodologies, technologies, and algorithms of statistical pattern recognition from a variety of perspectives. Topics including feature extraction, Bayesian decision theory, nearest-neighbor rules, clustering, support vector machines, neural networks, classifier combination, and syntactic pattern recognition techniques such as stochasticcontext-free grammars will be presented. ***Pre-req.: COMP 231.***

COMP 560 DEEP LEARNING (3Crs.: 2Lec, 2Lab): Introduction to artificial neural networks. Data convolutional neural network architectures, invariance learning, deep unsupervised learning and non-convex optimization. Mathematical, statistical and computational challenges of building stable representations for high-dimensional data, such as images, text. Practical implementations under Practical implementations under MATLAB and Python. ***Pre-req.: COMP 364***.

COMP 564 NATURAL LANGUAGE PROCESSING (3Crs.: 3Lec, 0Lab): Language modeling, part-of-speech tagging, speech recognition, speech synthesis, prosodic analysis, conversational dialogue, context-free

grammars, syntactic parsing, coreference, text classification, sentiment analysis, and machine translation. Applications on Arabic, English and other languages. Programming in Python. ***Pre-req.: COMP 364***.

COMP 565 COMPUTER VISION (3Crs.: 3Lec, 0Lab): Computer vision fundamentals: image formation, camera imaging geometry, feature detection and matching, stereo, motion estimation and tracking, image classification, scene understanding, and deep learning with neural networks. Methods for applications: finding known models in images, depth recovery from stereo, camera calibration, image stabilization, automated alignment, tracking, boundary detection, and recognition. Practical implementations using tools, such as MATLAB and Python. ***Pre-req.: COMP 364***.

COMP 568 SOFT COMPUTING (3Crs.: 3Lec, 0Lab): Soft computing techniques. Fuzzy sets, membership functions, fuzzy logic, fuzzy rules, fuzzy reasoning, fuzzification and defuzzification. Probabilistic reasoning, Bayesian network, evolutionary computation, genetic algorithms, simulated annealing, swarm intelligence, continuous optimization, combinatorial optimization, real-world problems. Practical implementations under MATLAB and Python. ***Pre-req.: COMP 232***.

COMP 474 INTRODUCTION TO ROBOTICS (3Crs.: 2Lec, 2Lab): Kinematics and dynamics for mobile and articulated robots. Description models applicable for robot system, such as homogeneous transforms etc. Sensors, actuators and other robot hardware. Algorithms for calculation of inverse kinematics, robot dynamics, trajectories and planning. Software architectures for robot systems and simulators. Ethical and industrial aspects. **Pre-req.: COMP 325 or COMP 326 or COMP 328**

COMP 551 MACHINE LEARNING (3Crs.: 2Lec,2Lab*):* Machine learning and statistical pattern recognition. Applications of machine learning in robotic control, data mining, autonomous navigation, bioinformatics, speech recognition, and text and web data processing. Also, includes supervised learning, generative/discriminative learning, parametric/non-parametric learning, neural networks, support vector machines; unsupervised learning, clustering, dimensionality reduction, kernel methods. ***Pre-req.: COMP 364***

Network and Cybersecurity Track

Course	Title	New/Updated	Credits	Pre-/Co-requisites
Core				
COMP 454	Computer Networks		3	COMP 225
COMP 454L	Computer Networks Lab		1	Co-req: COMP454
COMP50	Final Year Project 1		1	Pre/Co-req: COMP 500
COMP502	Final Year Project 2		3	COMP 501
Technical				
COMP 431	Queuing and Modeling	Updated	3	MATH 381
COMP 455	Mobile Computing		3	COMP 210
COMP477	Emerging Trends In Computer Engineering		3	COMP 325 OR COMP 232
COMP 510	Internet Engineering		3	COMP 454
COMP 512	Web Programming		3	COMP 344
COMP 529	Hardware Security		3	COMP 428
COMP 554	IoT Platform Design and Implementation	Updated	3	COMP 454
COMP 555	Wireless Security		3	COMP 454
COMP 556	Sensor Networks		3	COMP 454
COMP 559	Internet Security		3	COMP 454
COMP 567	Blockchain Network Programming		3	COMP 454
The student should choose 4 courses of the listed Network and Cybersecurity courses.				

Courses Description

Core Courses

COMP 454 COMPUTER NETWORKS (3Crs.: 3Lec, 0Lab): The OSI Model. The TCP/IP stack. Application Layer protocols. Transport Layer protocols. Network Layer protocols. Data Link Layer protocols. Frame format: character stuffing, bit stuffing. Error control. Automatic-repeat request and sliding-window protocols. Local area networks: Ethernet, token ring and FDDI, wireless LANs. Circuit switching versus packet switching. Routing and forwarding algorithms. Network Address Translation (NAT). SSH Port Forwarding/Tunneling. ***Pre-req.: COMP 225.***

COMP 454L COMPUTER NETWORKS Lab (1Cr.: 0Lec, 3Lab): The lab materials cover topics discussed in COMP 454. ***Co-req.: COMP 454.***

COMP 501 FINAL YEAR PROJECT I (1Cr) / COMP 502 FINAL YEAR PROJECT II (3Crs): After completing 120 credits of course work, the student becomes eligible to sign up for the Final Year Project (FYP) that extends over two semesters; beginning in Fall-semester and ending in the following Spring-semester. The FYP experience requires students to work in teams to complete a specific project, submit a technical report, and give a presentation on a significant, relevant, and comprehensive engineering problem. The FYP is intended to stimulate student creativity and critical thinking, and build skills in formulating, designing, developing, building, communicating, and managing engineering projects. The project aims to provide students with a transitional experience from the academic world to the professional world. ***Pre/Co-req.: COMP 500***
Refer to the Final Year Project Policy for more details.

Technical Courses

COMP 431 QUEUING AND MODELING (3Crs.: 2Lec, 2Lab): Random variables, Performance measures. Markov processes. Birth/death processes. Solving Markov models. Continuous and discrete queuing models: M/M/1, M/M/m, M/M/m/m, M/M/1/K, M/G/1. Little's law. Networks of queues. Burke's theorem. Jackson's theorem. Stochastic Petri nets. GSPN. ***Pre-req.: MATH 381.***

COMP 455 MOBILE COMPUTING (3Crs.: 2Lec, 2Lab): A general introduction to mobile computing with astrong focus on application development for the Android operating system. Students will complete a major projectwith the objective of publishing an application/service on the Google Play store. Android development environment, user interfaces, activities, intents, persistence, networking, location, sensors, graphics, and other Android features, tools, and capabilities. ***Pre-req.: COMP 210.***

COMP 477 EMERGING TRENDS IN COMPUTER ENGINEERING (3Crs.: 2Lec, 2Lab): This course covers current technology in computer Engineering. Topics will vary every year. ***Pre-req.: COMP 325 or COMP 232***.

COMP 510 INTERNET ENGINEERING (3Crs.: 2Lec, 2Lab): This course provides a comprehensive coverage of the major advancements in the Internet architecture with a focus on routing protocols and their design and a deep analysis of the internals of the Transmission Control Protocol (TCP) and the Internet Protocol (IP). The course also discusses recent developments on the Internet such as software-defined networking. ***Pre-req.: COMP 454***.

COMP 512 WEB PROGRAMMING (3Crs.: 2Lec, 2Lab): Introduction to HTML, CSS and JavaScript. Server-side programming: Web Servers, Web-Server Scripting language (PHP/ASP/JSP), Website development using Content Management Systems. ***Pre-req.: COMP 344.***

COMP 529 HARDWARE SECURITY (3Crs.: 3Lec, 0Lab): Hardware perspective of security and trust: vulnerabilities in modern digital system design flow, physical attacks, building secure and trusted hardware.

Development of hardware security cores (special purpose processors, ASIPs, pipelined, and partitioned implementations) with optimized performance characteristics (area, speed, power consumption, etc.). Provably correct hardware security and formal engineering methods. ***Pre-req.: COMP 428***.

COMP 554 IOT PLATFORM DESIGN AND IMPLEMENTATION (3Crs.: 2Lec, 2Lab): Overview of IoT prominent architectures and blueprint designs. Setting up IoT scenarios and workflow models. IoT sensor design with Arduino and Wi-Fi-controlled microchips. IoT and Cloud integration. Developing IoT applications with Raspberry Pi and Android. Python programming in IoT implementations. IoT Protocols: HTTP, CoAP, MQTT, AMQP, 6LoWPAN. Artificial Intelligence and machine learning models in IoT automation. Designing for Quality of Service and security in IoT architectures. ***Pre-req.: COMP 454.***

COMP 555 WIRELESS SECURITY (3Crs.: 2Lec, 2Lab): A course that discusses wireless network security protocols and applications. Security challenges in mobile and cellular networks. Security problems facing current and future wireless networks. Security attacks on mobile ad hoc networks, vehicular networks, naming, addressing, and routing. Trust and privacy in the context of wireless networks. Wireless sensor network security challenges and solutions. ***Pre-req.: COMP 454.***

COMP 556 SENSOR NETWORKS (3Crs.: 2Lec, 2Lab): Wireless communication fundamentals, Short range radio communication standards (IEEE802.15.x protocols, e.g., Bluetooth, ZigBee), Architecture of wireless sensor networks (Node structure, types, network topologies), Operating systems for wireless sensor networks (TinyOS, Contiki), Network supported process measurements, MAC protocols for sensor networks, Routing protocols for sensor networks, Transport protocols for sensor networks. ***Pre-req.: COMP 454.***

COMP 559 INTERNET SECURITY (3Crs.: 3Lec, 0Lab): This course covers advanced concepts in network security and the different attack models at the 5 TCP/IP network layers. It comprehensively discusses the various security threats, the vulnerabilities in networking protocols and the attacks that exploit such vulnerabilities. The main topics covered in the course include the following: the security of Email and Web applications, the SSL protocol, the IPSec protocol, VPNs, SNMP security, intrusion detection mechanisms, intrusion backtracking, and firewalls. Practical attack generation, defense, and system hardening components will be considered in student projects as well as some Internet security research aspects. ***Pre-req.: COMP 454***.

COMP 567 BLOCKCHAIN NETWORK PROGRAMMING (3Crs.: 2Lec, 2Lab): The course presents a general overview of Blockchain, from applications and administration to programming and infrastructure. Its main emphasis is on programming techniques for Blockchain decentralized distributed systems. The topics include overview of Blockchain, decentralized apps and smart contracts, Ethereum, IBM Hyperledger, Blockchain storage systems, Digital Currency systems. ***Pre-req.: COMP 454***.