University of Tripoli
Faculty of Engineering

COMPUTER ENGINEERING DEPARTMENT
Graduate programs

General Information

Computer engineering department is originally conceived in 1978. The department gives students operations analysis and evaluation, measurement, design, testing, production and maintenance of devices and computer systems. The department of computer engineering offers programs leading to the degree of Master of Science in Computer Engineering. This postgraduate program course is intended for students who wish to gain the hardware and software skills and knowledge necessary to design and implement computer-based engineering systems. These computer-based systems range from simple domestic appliances to aero-engine controllers; from communications switching systems to process controllers on chemical plants; and from programmable logic controllers (PLCs) to transputer arrays. The program is designed to prepare students for a wide range of career paths in the creative industries. Opportunities exist to work in teaching in higher education.

Vision

The department vision is to achieve distinguished teaching, learning and scientific research in a supportive atmosphere and encouraging context according to the national recognized standards. In order to meet the needs of society and the labor market.

Mission

To provide qualified researches with the capabilities and necessary knowledge to successfully contribute to multidisciplinary studies and practices in the fields involving computers, communications, control and electronics.

M.Sc. programs

The computer engineering department offers two graduate programs leading to the degrees of Master of Science in Computer Engineering. Both of the following programs includes Computer Networks, Computer based-control systems and Computer system design areas.

1- ***Program I*** *M.Sc. in Computer Engineering* ***by thesis-based research***
2- ***Program** II* *M.Sc. in Computer Engineering* ***by courses***

OBJECTIVES	Graduates of the computer engineering programs are expected to demonstrate: 1. An ability to work (individually or in teams) to analyze and design engineering systems and produce solutions that meet specified needs. 2. An ability to identify and solve complex engineering problems by applying principles of engineering and science. 3. An ability to recognize ethical and professional responsibilities. 4. An ability to acquire and apply new knowledge as needed using appropriate learning strategies.

Program I *M.Sc. in Computer Engineering* ***by thesis-based research***
(8 courses, seminar and Thesis)

In this program, only one compulsory course (EC636: *Stochastic and Random Processes*) is required to satisfy faculty requirement. Students select their coursework program with the help of their thesis supervisors assigned once students admitted to the graduate program. At least three core courses must be taken from the list of department core courses, advanced computer architecture is one of these courses. In addition, four other courses are to be selected from the lists of core and elective courses with the consent of thesis supervisor.

After satisfactory completion of the taught part courses (based on examinations, course work, case studies, laboratory sessions and project design study), each student proceeds to do a research project and submit a thesis, and this is assessed by an examination committee, including an external examiner.

Code	Title	Credits	Hours	ECTS
Faculty Requirements (3 credits)				
GE604	Advanced Engineering Mathematics	3	4	8
EC636	Stochastic and Random Processes **	3	4	8
Department Requirements (9 credits)				
EC610	Advanced Electronic Devices	3	4	8
EC635	Digital Communication	3	4	8
EC637	Computer Networks	3	4	8
EC646	Modern Digital Control Systems	3	4	8
EC681	Advanced Computer Architecture	3	4	8
EC684	Embedded systems	3	4	8
Elective courses (13 credits)				
EC611	Optoelectronic Devices	3	4	8
EC627	Coding theory	3	4	8
EC633	High Speed Computer Network.	3	4	8
EC639	Optimization in engineering	3	4	8
EC644	Robotics	3	4	8
EC648	Adaptive Signal Processing	3	4	8
EC649	Robust and Large-Scale Systems	3	4	8
EC655	Image processing and Computer Vision	3	4	8
EC658	Cryptography and Network Security	3	4	8
EC672	Neural Networks and Deep Learning	3	4	8
EC674	Soft Computing	3	4	8
EC675	Machine Learning	3	4	8
EC682	Computer Systems Design	3	4	8
EC697	Special Topics	3	4	8
EC698	Graduate Seminar **	1	2	10
***Thesis* (6 Credits)**				
EC699	M. Sc. Thesis	6	**0**	**50**
	Total	***31***	***0***	***124***

*** Mandatory Courses* *ECTS: European Credit Transfer and Accumulation System*

Program II *M.Sc. in Computer Engineering* ***by courses only***

This program is designed for students who want to pursue their computer engineering education beyond the undergraduate level but are looking for an alternative to a thesis-based research program. The program requires students to complete coursework without completing a supervised project. As faculty requirement, Students are required to take only two compulsory course (EC636: *Stochastic and Random Processes*) and (GE601 Seminar in Research Methodology). At least five core courses must be taken from the list of department core courses. Students are free to choose seven courses with additional to Graduate Seminar from the list of department elective courses. Student will grant M.Sc. degree after satisfactory completion of the taught part courses (based on examinations, course work, case studies, laboratory sessions and project design).

Code	***Title***	***Credits***	***Hours***	***ECTS***
Faculty Requirements (4 credits)				
GE601	Seminar in Research Methodology **	1	2	10
GE604	Advanced Engineering Mathematics	3	4	8
EC636	Stochastic and Random Processes **	3	4	8
Department Requirements (15 credits)				
EC610	Advanced Electronic Devices	3	4	8
EC635	Digital Communication	3	4	8
EC637	Computer Networks	3	4	8
EC646	Modern Digital Control Systems	3	4	8
EC681	Advanced Computer Architecture	3	4	8
EC684	Embedded systems	3	4	8
Elective courses (22 credits)				
EC611	Optoelectronic Devices	3	4	8
EC627	Coding theory	3	4	8
EC633	High Speed Computer Network.	3	4	8
EC639	Optimization in engineering	3	4	8
EC644	Robotics	3	4	8
EC648	Adaptive Signal Processing	3	4	8
EC649	Robust and Large-Scale Systems	3	4	8
EC655	Image processing and Computer Vision	3	4	8
EC658	Cryptography and Network Security	3	4	8
EC672	Neural Networks and Deep Learning	3	4	8
EC674	Soft Computing	3	4	8
EC675	Machine Learning	3	4	8
EC682	Computer Systems Design	3	4	8
EC697	Special Topics	3	4	8
EC698	Graduate Seminar **	1	2	10
Total		***41***	***0***	***124***

*** Mandatory Courses* *ECTS: European Credit Transfer and Accumulation System*

Description of the Graduate Course

GE 6091 Seminar in Research Methodology (1 Credits – 2 Hours)

This graduate course introduces research methodology in Science and their specific application in Engineering. Definition and development of science, scientific research approach, literature survey, research design, quantitative and qualitative research methodologies, data gathering, writing techniques for thesis, project, and scientific article, ethical principles to be followed when conducting research, ethical principles to be followed when publishing, citation ethics, tips for a successful presentation, students' presentations within the scope of some topics in engineering fields.

GE604 Advanced Engineering Mathematics (3 *Credits* – 4 Hours)

Review of ordinary differential equations; linear differential equation of the first order; linear differential equations with constant coefficients; particular solutions by variations of parameters. Power series solutions; method of Frobenius; Legendre's equation; Fourier-Legendre Series; Bessel's equation; modified Bessel equation. Fourier methods; Fourier series; Sturm-Liouville theory; Fourier integral; Fourier transformation. Partial differential equations; heat conduction equation; separation of variables; waves and vibrations in strings; wave equation; D'Alembert's solution; longitudinal vibrations in an elastic rod; two dimensional stress systems; solution of Navier's equations by the application of Fourier transforms; Laplace equation

EC636: Stochastic and Random Processes (3 Credits – 4 Hours)

The course emphasizes probabilistic techniques as a modeling tool for stochastic phenomena. This concept will be delivered over a number of topics that will be conducted in the following order: probability theory review, convergence concepts, Markov chains, Poisson processes, continuous-time Markov chains, renewal processes, and stationary processes.

Learning outcomes

- students will have a rigorous and fairly comprehensive view of probability, random variables and random signals (or stochastic processes),
- students will get exposed to the notions of conditional probabilities and expectations and will learn when to use the right assumptions for any phenomena of interest, such as Central Limit Theorem and/or Laws of Large Numbers,
- students will have learned the usage of significant probabilistic models, such as Markov chains, and had a good understanding of the underlying structure associated with stochastic processes; also, they will have gained the necessary background to have a solid foundation to work in applications involving stochastic phenomena.

EC610 Advanced Electronic Devices (3 Credits – 4 Hours)

Topics

- Review of classical semiconductor physics and devices: Basics of semiconductors, *pn* junction.
- Metal-semiconductor and semiconductor Heterojunctions, 2D electron gas formation.
- MOS capacitor, volatile memory (DRAMs), Floating gate MOSFET transistor, Non-volatile memories.
- High-frequency transistors: Metal-semiconductor (MESFET), Modulation-doped FET (MODFET) or High electron-mobility transistor (HEMT), Gunn effect and related devices (Gunn Diode and Tunnel diodes).
- Power devices: Power diodes, Double diffused metal-oxide semiconductor (DMOS) transistor, Vertical metal-oxide semiconductor (VMOS) transistor and Thin film transistors
- Optoelectronic devices: Light emitting diodes and solid-state lasers
- Imagers: CCDs and active pixel arrays

Learning outcomes**:** at the end, students should be able to

- Describe the operating principles of modern semiconductor devices and their applications.
- Describe the terminal properties and their internal structure.
- Understand how terminal properties of different types of devices will change with operating conditions.

EC611 Optoelectronic Devices (3 Credits – 4 Hours)

Topics

- Electronic structure of semiconductors
- Heterostructures and the effects of heavy doping
- Optical processes in semiconductors
- Heterojunction band alignment and quantum wells
- Propagation of light
- Semiconductor lasers
- Photodetectors and integrated photonics
- Solar cells
- Demonstrations and projects related to optoelectronic device phenomena.

Learning outcomes

1. Analyze optoelectronic device characteristics in detail using concepts from quantum mechanics and solid-state physics.
2. Describe techniques to improve the operation of optoelectronic devices and device characteristics that have to be optimized for new applications by employing their understanding of optoelectronic device physics

Required knowledge

Fundamentals in semiconductor materials

EC627 Coding Theory (3 Credits – 4 Hours)

Ideal coding concept, Shannon's nosy coding theorems, PCM bandwidth, PCM channel capacity, Information theory, measure of information and source entropy, conditional entropy, rate of information, information channels, binary symmetrical channel (BSC), information rate over noisy channels, code properties, instantaneous codes, the Kraft inequality, Finite Field arithmetic, the extension of the binary fields(Galois field),source coding, run length coding ,variable length coding ,Huffman coding, the LZW sting compression algorithm, arithmetic coding, channel coding, Hamming codes, Hamming distance, linear block codes, a systematic codes and decoding, cyclic codes, systematic cyclic codes and decoding, Reed Solomon Codes, decoding Reed Solomon Codes, convolution codes, polynomial representation , Trials representation, distance measures, maximum likelihood decoding.

Learning outcomes

The course aims to introduce to the students the concepts of amount of information, entropy, channel capacity, rate of information over noisy channels, source coding (data compression), error-detection and error-correction codes, block coding, Reed Solomon coding and decoding, Convolutional coding, and Viterbi decoding algorithm.

EC633 High Speed Computer Networks (3 Credits – 4 Hours)

This course is designed to provide the various technologies used in high speed computer networks, including Fiber Channel, Switching, Frame Relay Networks, Asynchronous transfer mode, High Speed Local Area Network, flow and congestion control. Performance issues, Queuing Analysis, Quality of Service and Research Topics will be covered in this course.

Topics

1. Network Performance Evaluation Models: Introduction, Overview of Probability and Stochastic Processes, Queuing Analysis.
2. Frame Relay Network: Introduction, Packet-Switching Networks, Frame Relay Networks High Speed LANs: Fast Ethernet LAN, Gigabit Ethernet, Wireless LAN.
3. Asynchronous transfer mode: ATM Protocol Architecture and Logical Connection, ATM Cells, ATM Service Categories, ATM Adaption Layer.
4. Congestion Management: Congestion, An Overview, Effects of Congestion, Congestion Control, Traffic Management.
5. TCP Traffic and Congestion Control: TCP Flow control, TCP Congestion Control, Performance of TCP over ATM.
6. ATM Traffic and Congestion Control: ATM Traffic and Congestion Control.
7. Integrated Services: Integrated Service (IntServ) Model and Differentiated Services:
8. Differentiated Service Architecture.
9. Protocols for Quality of Service (QoS) Support.

Learning outcomes

At the end, students should be able to:

1. Understand the basics of high-speed networking technologies.

2. To facilitate the students on the basis of ATM and Frame relay concepts and explain the various types of high-speed LAN.
3. Introduce the concept of queuing analysis and the concepts behind traffic management and congestion control.
4. Enable the students to know techniques involved to support real-time traffic and congestion control.
5. Understand the QoS architectures and mechanisms.
6. Provided with Protocol for quality of service to different applications.

EC635 Digital Communications (3 Credits – 4 Hours)

The course presents fundamental principles underlying the transmission and reception of digital information, and studies the different parts of a modern digital communication system. Specifically, the course will touch upon different digital modulation schemes, as well as design and performance analysis of optimum receivers for additive white Gaussian noise (AWGN) channels. Some concepts of information theory and channel coding will also be studied. Further, techniques for carrier and symbol synchronization will be presented. Communication over band limited channels will also be explored, and the effects of inter-symbol interference (ISI) and channel equalization techniques will be considered.

Topics

- Introduction to digital communication systems
- Review of probability and stochastic processes
- Digital modulation techniques and vector space representations
- Optimum receiver design and performance analysis for AWGN channels
  Carrier and symbol synchronization
- Transmitter and receiver design for digital communication over band limited channels
  Inter-symbol interference, channel equalization.
- Basic information theory concepts and channel coding.

Learning outcomes

1. course is to help graduate students acquire the necessary theoretical background to
   understand the components of a digital communication system,
2. Design a digital communication system.
3. Analyze its performance both analytically and numerically.

EC637 Computer networks (3 Credits – 4 Hours)

This course is designed to give a clear understanding of how networks, from local area networks, to the massive and global Internet, are built and how they allow us to use computers to share information and communicate with one another. The course implements a down-top approach to teach the details about each layer and the relevant protocols used in computer networks

Topics

- Review of computer networks layering concepts and service models
- Network performance and quality of service requirements.
- Physical layer: transmission media and signal encoding techniques.
- Data link layer: error detection and correction, ARQ strategies, flow control, multi-access protocols, switches, Ethernet, wireless and mobile networks.
- Network layer: virtual circuits, routers, routing algorithms, internet network protocols, Congestion Control, quality of service.
- Transport layer protocols: transport services, socket programming, flow and congestion control algorithms.
- Application layer protocols.
- Network security.
- Studying a number of related papers.

Learning outcomes

At the end, students should be able to do:

1. Master the concepts of protocols, signal encoding techniques, network interfaces, and design/performance issues in local area networks and internet.
2. Describe, analyze and compare a number of data link, network, and transport layer protocols.
3. Understand the QoS architectures and mechanisms.
4. Familiarize with contemporary issues in networking technologies.
5. Understand various aspects about computer networks security.
6. Familiarize with current topics in the area of computer networks.

EC639 Optimization in Engineering (3 Credits – 4 Hours)

Modeling optimization problems existing in engineering design and other applications; optimality conditions; unconstrained optimization (gradient, Newton, conjugate gradient and quasi-Newton methods); duality and Lagrangian relaxation; constrained optimization (Primal method and an introduction to penalty and augmented Lagrangian methods). The emphasis of the course is on applications in engineering applications such as control systems, computer vision, machine learning, pattern recognition, financial engineering, communication and networks.

Topics

- Modeling Optimization Problems
- Unconstrained Optimization
- Univariate Optimization
- Basic Descent Methods
- Conjugate Gradient Method
- Quasi-Newton Methods
- Constrained Minimization
- Primal Methods
- Linear Programming

- Other Methods

Learning outcomes

The course objective is to provide graduate students in Computer Engineering with a basic understanding of optimization problems, viz., their formulation, analytic and computational tools for their solutions, and applications in different areas.

EC644: Robotics (3 Credits – 4 Hours)

Basic Concepts in Robotics, classification and structure of Robotic systems, Kinematic analysis and Coordinate transformation of a Robotic system ,Inverse Manipulator Kinematics, Jacobians : velocities and static forces, Manipulator Dynamics, Trajectory planning and Generation, Position control of manipulators, Force control of Manipulators, Robot control : Lagrangian and Hamiltonian formulation, Introduction to non-linear control with application to robotics , Feedback Linearization, Design via Lyapunov's second method ,Singular perturbation , Robustness of adaptive control, Sensors and Intelligent Robots, Programming and Interfacing , Mini project.

Learning outcomes

Upon successful completion of the course, students should be able to:

1. Investigate the integration of analog and digital electronics at the system level and learn about sensors and actuators .
2. Know about different representations of configuration of a rigid body and how to convert between them, apply transformations in 3D.
3. Derive models for the forward and inverse kinematics of a manipulator.
4. Describe the dynamics of a manipulator, know how to write down the equations of motion of a manipulator using Lagrangean mechanics and solve direct and inverse position and velocity kinematics problem of a manipulator,
5. Understand the different control schemes for controlling a robot manipulator, Know how to formulate and solve a robot control problem, Implement simple robot control laws , understand the real-time control issues.
6. Write the kinematics of wheeled robots and use it for solving mobile robot localization/control problems.
7. Know basic motion planning techniques for manipulators and mobile robots.
8. Implement kinematic analysis, dynamic analysis, and control algorithms for manipulators in computer programs.

EC646 MODERN DIGITAL CONTROL SYSTEMS (3 Credits – 4 Hours)

Topics

- Review of a Z transform analysis of discrete time control systems
- Design of a Discrete time Control Systems By Conventional Methods:
  Mapping between the S-plane and the Z-plane, stability analysis of closed loop

systems, transient response and steady state response, a design based on the root locus method, design based on the frequency response .

- State space analysis: state space representations of discrete time systems, pulse transfer function matrix, discretization of continuous time space equations. Liaypnov stability analysis.
- Pole Placement and Observer Design: Controllability, Observer ability, design via pole placement, state observer, servo systems.
- Optimal Control: Quadratic optimal control, steady state quadratic optimal control, Quadratic optimal control of servo systems. Kalaman filter.
- System Identification: Off line parameter estimation, first order systems and higher order systems - On Line Parameter estimation.
- Nonlinear Systems: Phase plane analysis, Fundamental of Lypunov Theory, Feedback linearization.
- Case studies.

Learning Objectives

1. To present the control engineering methods using the essential mathematical tools and to stress the application procedures and skills by giving insight into physical system behavior and characteristics.
2. To present the analysis and design of a discrete control system problems.

EC648 Adaptive Signal Processing (3 Credits – 4 Hours)

The goal is to present the theory of adaptive signal processing and cover several engineering applications. The major topics will be the concept of adaptation, performance measures and the implementation of adaptive algorithms. Both the LMS and the RLS will be covered in detail. Adaptation of the signal bases will also be covered, such as Eigen decompositions with on-line algorithms, and adaptation of generalized feedforward filters. Adaptive filtering in reproducing kernel Hilbert Spaces (RKHS).

Topics

- Adaptation as function approximation
- Filters as Function approximators
- Wiener Filter Theory
- Iterative algorithms
- Theory of adaptation: properties, search, measures
- Adaptive algorithms: LMS, RLS
- Frequency domain LMS
- Eigen decompositions
- Whitening transforms
- Adaptation in signal spaces (Generalized Feed, forward Filters, Lattice structures, Adaptation in RKHS, KLMS and KRLS)

EC649 Robust and Large-Scale System (3 Credits – 4 Hours)

This course is an introduction to the control of large-scale systems: decentralized fixed mode characterization/computation, interconnected systems, decentralized control, decentralized pole assignment, decentralized robust servomechanism problem, expanding system control problem.

Topics

- Introduction: Centralized Control, Centralized Fixed Modes, Minimal Realization, Transmission Zeros.
- Model Reduction Techniques.
  - Model analysis approach, mathematical development.
  - Subspace projection methods, projection error minimization, and derivation of reduced model.
  - Optimal order reduction, problem formulation, conditions of optimality.
  - Extension to discrete systems, two model reduction techniques, output error minimization.
  - Decentralized Fixed Modes, Numerical Methods to Find DFMs.
  - Analytical Methods to Find DFMs.
- Approximate Decentralized Fixed Modes.
- Decentralized Pole Assignment.
- Stabilization of Decentralized Control Systems, Quotient Fixed Modes.
- Structurally Fixed Modes.
- Centralized and Decentralized Robust Servomechanism Problem.
- Optimal Decentralized Control Design.
- Applications

Learning outcomes

1. to apply knowledge of control systems to analyze and design a large-scale control system.
2. The student will perform a systematic study of multi-input, multi-output systems and different closed-loop control methods for such systems.
3. Show deep understanding of mathematical methods to analyze multivariable dynamic systems and dynamic systems with uncertainty descriptions.

EC655 Image Processing and Computer Vision (3 Credits – 4 Hours)

This course provides an introduction to computer vision including fundamentals of image formation, camera imaging geometry, feature detection and matching, stereo, motion estimation and tracking, image classification and scene understanding. Development of basic methods for applications that include finding known models in images, depth recovery from stereo, camera calibration, image stabilization, automated alignment, tracking, boundary detection, and recognition. This course encompasses a practical side in a form of analysis of recent papers or implementation of course project. The focus of the practical side is to develop the intuitions and mathematics of the methods in lecture, and then to learn about the difference between theory and practice.

Learning Objectives

Upon completion of this course, students should be able to:

1. Recognize and describe both the theoretical and practical aspects of computing with images. Connect issues from Computer Vision to Human Vision.
2. Describe the foundation of image formation and image analysis. Understand the basics of 2D and 3D Computer Vision.
3. Become familiar with the major technical approaches involved in computer vision. Describe various methods used for registration, alignment, and matching in images.
4. Get an exposure to advanced concepts leading to object and scene categorization from images.
5. Build computer vision applications.

EC658 Cryptography and Network Security (3 Credits – 4 Hours)

Topics

- Introduction
- Math Background
- Classical Cryptography
- Symmetric Ciphers
- Block Ciphers (DES, AES)
- Public-Key Cryptography
- Hash and MAC Algorithms
- Digital Signatures
- Key Management
- Web Security: IPSec, SSL and TLS
- Email Security: S/MIME and PGP

Learning Objectives

This course will provide students with a practical and theoretical knowledge of cryptography and network security. By the end of the course, students should be able to:

1. Understand the fundamentals of networks security, security architecture, threats and vulnerabilities
2. Apply the different cryptographic operations of symmetric cryptographic algorithms
3. Apply the different cryptographic operations of public key cryptography
4. Apply methods for authentication, access control, intrusion detection and prevention
5. Understand various Security practices and System security standards.

EC672 Neural Networks and Deep Learning (3 Credits – 4 Hours)

Course Description

In this course, the history of neural networks and state-of-the-art approaches to deep learning are introduced and examined. Students will learn to design neural network architectures and training procedures via hand-on assignments. Current research articles are assigned as reading tasks to appreciate state-of-the-art approaches as well as to question some of the hype that comes with the resurgence of popularity. A critical software tool for modern deep learning: Tensor Flow and advanced python language library are to be used in the practical part of the course.

Topics

1. Intro to machine learning and neural networks: supervised learning, linear models for regression, basic neural network structure, unsupervised neural network, simple examples and motivation for deep networks.
2. Neural networks: forward propagation, cost functions, error backpropagation, training by gradient descent, bias/variance and under/overfitting, regularization.
3. Self-organization map neural network
4. Convolutional Neural Networks.
5. Recurrent Neural Networks.
6. Limitations of deep learning (e.g. data-hungry, results are at most as good as the data, ethical issues, advanced topics.

Learning Objectives

Upon successfully completing the course, the student will be able to:

1. Understand generic machine learning terminology
2. Understand the choices and limitations of a model for a given setting
3. Apply deep learning techniques to practical problems
4. Critically evaluate model performance and interpret results
5. Write reports in which results are assessed and summarized in relation to aims, methods and available data.

EC674 Soft Computing (3 Credits – 4 Hours)

Soft computing is an integrated and an innovative approach that can usually utilize specific techniques within the scope of computational intelligence to construct generally satisfactory solutions to real world problems. This course addresses the concept and application of soft computing techniques. It covers three main parts of soft computing as well as their integration to develop hybrid intelligent systems. The three main parts are fuzzy systems, neural networks, and genetic algorithms. While individual parts have been applied successfully to solve real problems, the current trend is to create combination of these parts. Soft computing techniques are aimed at solving real world problems such as decision-making, modeling, recognition, classification, and control problems. In particular, course put equal emphases on theoretical aspects of covered methodologies, as well as empirical observations and verifications of various applications in practice.

Topics

- Introduction to soft computing
- Fuzzy Set Theory: Fuzzy set, Membership, Operations, Properties, Fuzzy Relations.
- Fuzzy Systems: Fuzzy Logic, Fuzzification, Fuzzy Inference, Fuzzy Rule Based System, Defuzzification.
- Fundamentals of Neural Network: Model of Artificial Neuron, Architectures, Learning Methods, Taxonomy of NN Systems, Single-Layer NN System, Applications.

- Back Propagation Network: Background, Back-Propagation Learning, Back-Propagation Algorithm
- Fundamentals of Genetic Algorithms: Introduction, Encoding, Operators of Genetic Algorithm, Basic Genetic Algorithm.
- Hybrid Systems: Integration of Neural Networks, Fuzzy Logic and Genetic Algorithms, GA Based Back Propagation Networks, Fuzzy Back Propagation Networks.

Learning Objectives

- Develop an overview of the field of soft computing and its applications.
- Understand the concept and the fundamental of soft computing techniques and how to implement them.
- Lead students to specialization in the particular parts of soft computing.

EC675: Machine Learning (3 Credits – 4 Hours)

Description

This course covers a wide variety of topics in machine intelligence: pattern recognition, statistical modeling. It covers the mathematical methods and theoretical aspects; however, a primarily focus is on algorithmic and practical issues.

Topics

- The basic concept of patterns, feature space, classification.
- Linear classifiers: perceptron, LMS, Regression: Linear – Logistic.
- Bayes Decision Theory and Optimal Classification.
- Parametric and non-parametric estimation.
- Overview on optimization methods in learning: gradient-based methods, second-order methods, and Expectation-Maximization.
- Non-linear classifiers with linear parameterizations: basis-function methods, boosting, support vector machines
- Unsupervised Learning
- Exploring applications in vision, speech, language, forecasting, and biological modeling.

Learning Objectives

In addition to the theoretical and mathematical material to be taught in this course, students are expected to solve analytical and computational (programming) problems, present a research paper tackling a state-of-the-art research subject in the PAMI area, and submit a course project in which students apply/implement some PAMI learned techniques on a real problem. Exams are, also, applicable.

EC681 Advanced Computer Architecture (3 Credit – 4 Hours)

Computer Architecture is the science of designing, and interfacing hardware components to create a computer system that meets functional, high performance, energy consumption, cost and other specific goal. The course deals with the design and performance evaluation of advanced high-performance computer systems.

Topics

- Computer Evaluation and Performance
- Instruction Set Architecture (ISA)
- Memory Hierarchy Design
- Pipelining
- Instruction-Level Parallelism
- Data-Level Parallelism
- Thread-Level Parallelism

Learning objectives

- Familiarize students with functional principles and design of different computer architectures indicating strengths and weaknesses inherent in each.
- Explain differences between computer organization and computer architecture.
- Explain the reasons and strategies for different computer architectures.
- Identify some modern techniques for high-performance computing, such as multi-core and distributed architecture.
- Understand the inner working and performance capabilities of advanced microprocessors.
- An ability to select appropriate computer system for given application domains.
- Understand cache coherence issues.
- An ability to design advanced memory hierarchies.
- Learn the differences among multiscalar, super pipelined, multithreaded, vector, and multicore processors.

EC682 Computer System Design (3 Credits – 4 Hours)

Learning Objectives

In this course students will learn the advanced concepts of modern multicore-based computers, and will learn how design decisions affect energy efficiency and performance. By the end of the course, students should be able to understand:

- The anatomy of a multicore-based computer
- Advanced design concepts used in future multicore-based computers
- How computer design affects how energy-efficiently and fast a program can execute on future computer systems
- How taught design concepts are used in modern multicore-based computer systems

Topics

- Multicore systems
- Microarchitecture fundamentals.
- Memory systems fundamentals.
- Performance fundamentals.
- Energy fundamentals.
- Baseline model and out-of-order completion.
- Branch prediction and Exception handling.
- Speculative execution.
- Fundamentals of memory design.

- The 3C model.
- Replacement algorithms.
- Prefetching algorithms.
- Memory systems (Virtual memory and virtualization).
- Multicore design challenges.
- Multithreading fundamentals and design alternatives.
- Cache coherence concepts.
- Interconnection concepts.

EC684 Embedded Systems (3 Credits – 4 Hours)

Learning Objectives

At the conclusion of this course, the student will be able to:

1. Write a computer program in assembly language.
2. Write code to handle interrupts.
3. Debug a computer program using both hardware and software tools.
4. Interface peripherals to a microcontroller or microprocessor using a bus.
5. Document the hardware and software of an embedded systems design.

Topics

- Microprocessor/Microcontroller Architecture
- Machine and Assembly Language
- Instruction Set Architecture
- I/O Ports
- Timers
- Serial Communication
- Interrupts
- Busses
- Semiconductor Memory
- A/D and D/A conversion
- Miscellaneous peripherals

***GeoE697 Special Topics** (3 Credits – 4 Hours)*

The topics are not listed in department programs and may vary from year to year according to interests of students and instructors.

M.S. students choose and study a topic under the guidance of the department coordinator. Typical contents include advanced fields of study according to recent scientific and technological developments in the related areas. Also, it could be studied from other related departments after getting the permission.

GeoE698 Graduate Seminar (1 Credits - 2 Hours)

This course help students to develop their research proposals, establishing and expanding their research skills and implementing their work through scholarly writing, which can be achieved through the seminar.

The seminar course must to be taken in the second semester of the registration and managed by an instructor who is responsible to prepare the final grade list of all the registered students.
Students must prepare and present their chosen topics through a scientific term paper, which can be shared and discussed with other students and department staff to gain their feedback.

EC699 Thesis (6 Credits)

The student works full time on a research project in a laboratory under supervision of one or two of the department staff members. A dissertation describing the research project is submitted to the department as a partial fulfillment of the M.Sc. degree in computer engineering.

الاعتماد			
البيان	منسق الدراسات العليا بالقسم	رئيس القسم	مدير مكتب الدراسات العليا بالكلية
الاسم			
التاريخ	2022 / 09 /	2022 / 09 /	2022 / 09 /
التوقيع			
الختم			

اعداد / لجنة دليل الدراسات العليا 2022