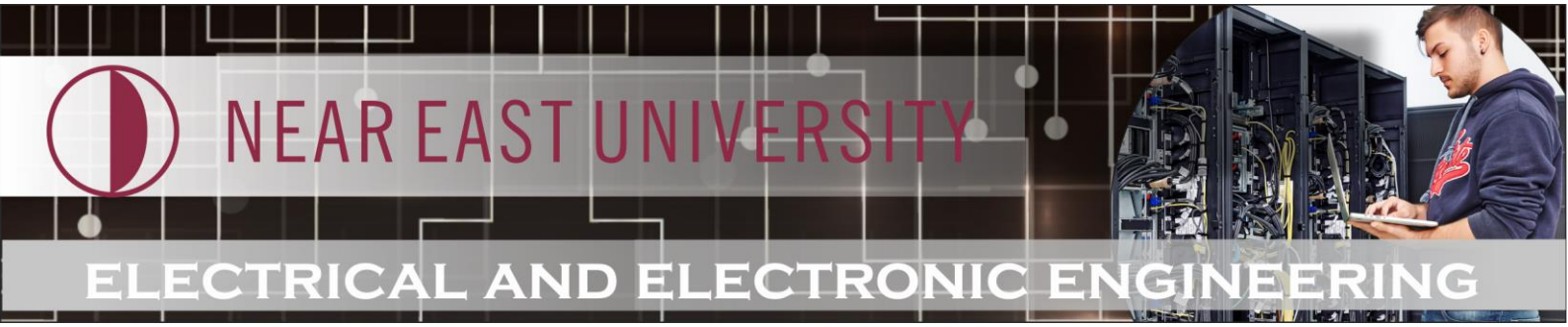

General information

Electrical and electronic engineering is a discipline with various career paths. Electrical and electronic engineers have long worked in areas such as integrated circuits, telecommunication systems, image processing and computer vision, automation and robotics, as well as electrical power systems.

Faculty research activities at the graduate level include: Telecommunications, error-correcting codes, wireless communications, signal processing, signal transmission, computational intelligence, high voltage engineering, insulation design of gas insulated systems, load break switches, circuit breakers, power electronics, drive systems, renewable energy sources, software engineering, assisted living, digital image processing, medical imaging, artificial neural networks, pattern recognition, intelligent vehicles, stereo vision and electromagnetics.

Profesional accreditation:

EEE is accredited by European Accreditation Agency (**ASIIN**).

Program Objective:

- To assist graduate students in developing skills for scientific research
- To help graduate students develop leadership skills necessary for managing engineering projects
- To provide graduate students skills for development of solutions to electrical engineering problems

Learning outcomes of the Master's degree program:

- Ability to apply fundamental knowledge of science and electrical engineering.
- Ability to identify, formulate and solve complex electrical engineering problems.
- Ability to design and conduct experiments related to electrical engineering, as well as to analyze and interpret data.
- Be able to design a complex system, component, or process to meet desired needs within realistic constraints.
- Be able to develop solutions that meet the desired needs within the economic, manufacturing and sustainability borders.
- Be able to use the techniques, skills, and modern engineering tools necessary for electrical engineering practice and research.
- Be able to function and communicate effectively in multidisciplinary teams.

Graduation Requirements:
Final examinations of graduate courses will be assessed over 100 (one hundred) full points by the faculty member(s) carrying out the exam. In order to pass the final exam, master's students must earn a minimum score of 70 (seventy) out of 100 (one hundred) points.

Cumulative grade point average must be 80 (eighty) over 100 (one hundred) or 3.00 (three) over 4.00 (four) to earn a master's or doctoral degree.

Master's Program With Thesis:

The aim of the master‟s program with thesis is to enable students to acquire the ability to conduct scientific research leading to the acquisition, evaluation and interpretation of knowledge. A master‟s program with thesis is comprised of a minimum of seven courses, not being less than 21 credits, one seminar course, other educational activities and thesis study. The seminar course and thesis study are compulsory. Students may take a maximum of two undergraduate courses on the condition that the courses have not been taken during the undergraduate program. Students may also take courses from other institutions of higher education upon the recommendation of the Department Chairperson and approval of the Graduate School Administrative Board.

Master's Degree Diploma:

A student who has passed the thesis examination, completed all other requirements, and submitted at least four bound copies of the thesis to the Graduate School within one month after taking the thesis examination will be conferred the Master‟s Degree Diploma on condition that the thesis meets the format requirements. The Master‟s Degree Diploma will bear the official name of the program completed and the Master of Science title awarded .

MODULES

Core Modules:

EE 500 Master's Thesis

EE 535 Master's Seminar

Elective Modules:

EE 501 Linear System Theory, 3 credits, 3 credits, 10 ECTS
Mathematical modeling of linear systems. Time invariant systems. Lyapunov theory. Decomposition of Kalman. Controllability and observability of composite systems. Controller and observer design. Pole-placement design. Problems using Matlab.

EE 502 – Random Variables and Stochastic Processes, 3 credits, 10 ECTS
Stochastic properties of random signals. Stationary and nonstationary process. Ergodic process. Correlation function and spectrum of random signals. Guassian process. Noise calculations. Markov chains. Linear and Kalman filtering. Problems using Matlab.

EE 503 Advanced Digital Signal Processing, 3 credits, 10 ECTS
Digital processing of the continuous time signals. Discrete Fourier transforms. Fast-Fourier transform. FIR and IIR filters design. Limit cycles. Adaptive filtering. Adaptive digital filters in communication. Adaptive line enhancement and equalization. Adaptive delta and differential pulse code modulations. Problems using Matlab.

EE 504 Wireless & Personal Communication Systems, 3 credits, 10 ECTS
Cellular communication concepts. Roaming. Cells splitting. Access technology. FDMA, TDMA and CDMA. Radio interface. Spread spectrum techniques. Up-link and down-link. Architecture of mobile switching center. Mobile and base stations call processing. Authentication. Encryption and information security. North American, Japanese and European cellular systems. Iridium-66 and globstar-48 systems. Laboratory experiments

EE 505 Information Theory and Coding, 3 credits, 10 ECTS
Entropy. Markov source. Information channels. Mutual information. Channel capacity. Fundamentals of channel coding. Hamming distance and minimum distance. Maximum likelihood decoding rule. Rings and fields. Linear codes. Syndrome decoding of linear codes. Low-density parity-check codes. Convolutional codes. The Viterbi algorithm. Turbo codes. Cyclic codes. Encoding and decoding of cyclic codes.

EE 506 – Advanced Data Communications, 3 credits, 10 ECTS
Introduction to data communications. Equalizing. Carrier and bit synchronization. Error detection and correction standards. Data compression. Integrated switched digital network ISDN. Architecture. Protocols. Broadband ISDN. Frame relay. Protocol, services, congestion control. Asynchronous transfer mode ATM. Protocols, traffic and congestion control.

EE 507 – Computer Networks and Internet, 3 credits, 10 ECTS
Paket transmission. LAN topology. Hardware addressing and frame type identification. Fiber modems, repeaters, bridgers, and switches. WAN technology and routing.Network performane characteristics. Protocols and layering. Internetworking. Architecture and protocols. TCP/IP protocols. Encapsulation, fragmentation and reassembling. Error reporting mechanism. Packet loss and adaptive retransmission. Reliable transport servises. File transfer and remote file access. WWW pages and browsing. GGI technology. Network security and encryption techniques.

EE 508 Artificial Neural Networks, 3 credits, 10 ECTS
Lectures will cover: Introduction to machine intelligence, biological neurons and computer models of neuron, supervised and unsupervised learning, Kohonen's self-organizing maps (SOM), learning algorithms and topologies of Perceptrons and Backprogation networks, applications of ANN, Input/output data coding, examples of designing neural networks for classification, neurocomputing for pattern recognition. Assignments are an important part of the course and will provide experience in technical writing and practical knowledge of designing a working neural network. Software simulation of ANN can be done using C-language or MATLAB.

EE 509 – Speech Processing, 3 credits, 10 ECTS
Speech modeling. Speech acquisition, sampling and quantizing techniques. Speech analysis. Speech coding. Linear predictive code. Adaptive predictive coding. Adaptive quantizer. LMS algorithm. Speech interpolation. Speech compression. Speech and speaker recognitions. Speech enhancement. Problems using Matlab. Laboratory Experiments.

EE 510 Image Processing, 3 credits, 10 ECTS
Image modeling. Two-dimensional signal analysis. Image processing techniques. Image enhancement. Image compression. Image manipulations. Image recognition. Region extractions and edge detections. Problems using C++ and Matlab. Laboratory Experiments.

EE 511 – Artificial Intelligence, 3 credits, 10 ECTS
Main characteristics of artificial intelligence systems (AIS). Classifications. Knowledge representations and acquisitions. Inference engine. Searching mechanism. Expert systems. Parallel and distributed AIS. Uncertainty knowledge and decision making. Learning, neural network. AIS application in control and communication systems. Problems using Prolog, C++ and Matlab.

EE 512 Electromagnetic Wave Propagation, 3 credits, 10 ECTS
Fundamental Concepts and Theorems; Maxwell Equations; Electromagnetic Waves;Classifications of Waves; Guided Waves;Ground wave propagation;-Plane-earth reflection,-Plane-earth reflection,-Space wave,-Surface wave,-Elevated dipole antenna above a plane earth,-Wave tilt of the surface wave,-Spherical earth propagation,-Tropospheric waves,Ionospheric Propagation;-The ionosphere,-Effective permittivity and conductivity of an ionised gas,-Reflection and refraction waves by the ionosphere,-Attenuation factor for ionospheric propagtion,-Sky-wave trnasmission calculations,-Effect of the earth's magnetic field,-Wave propoagtion in the ionosphere.

EE 514 – Radar Systems, 3 credits, 10 ECTS
General design principles and performance evaluation of pulsed radars. Statistical detection theory and radar cross-section of targets. CW, FM and Doppler radars. Target tracking radars. Radar receiver design. High power microwave generation and amplification; Radar antennas. Detection of radar signals in noise and waveform design. Propagation of radar wave.

EE 515 – VLSI Design, 3 credits, 10 ECTS
Practical considerations. Technology. Device modeling. Circuit simulation. Basic integrated circuit building blocks. Amplifiers. Operational amplifiers. Digital circuits. Analog systems: analog signal processing, digital-to-analog converters, analog-to-digital converters, filters. Analog signal processing circuits: modulators, multipliers, oscillators, phase-locked loops. Structured digital circuits and systems. Laboratory Experiments.

EE 516 – Integrated Sensors and Sensing Systems, 3 credits, 10 ECTS
Fundamental principles, operation, and design of integrated solid-state sensors and sensing systems. Sensor technology, micromachining and wafer bonding. Microstructures for the measurement of visible and infrared radiation, pressure acceleration, temperature, gas purity, and ion concentrations. Merged process technologies for sensors and circuits. Data acquisition circuits and advanced sensing systems. Microactuators and integrated microsystems.

EE 517 – Process Control Instrumentation Technology, 3 credits, 10 ECTS
Process control characteristics. Analog and digital signals conditioning. Thermal, mechanical, optical sensors and design considerations. Final control. Discrete-state process control. Controller principles. Controllers. Control loop characteristics. Industrial control networks. Servomotor technology in motion control systems. Robots.

EE 518 – Optimal and Adaptive Control, 3 credits, 10 ECTS
Optimal control problems. Calculus of variations. Pontryagin's maximum principle. Linear quadratic regulator. Riccati equation. Parametric and non parametric identifications. Optimal estimation. Kalman filters. Adaptive control. Model reference and self-tuning adaptive control.

EE 519 – Fuzzy Systems, 3 credits, 10 ECTS
Fuzzy sets. Representation and properties of fuzzy sets. Fuzzy relations and functions. Fuzzy arithmetic. Fuzzy modeling. Decision making in fuzzy conditions. Fuzzy control systems. Design examples. Computer simulations of fuzzy systems. Problems using C++ and Matlab.

EE 520 – Optimization, 3 credits, 10 ECTS
Mathematical preliminaries on functions of several variables. Convexity and convex functions. Unconstrained minimization problems. Computational algorithms. Newton and quasi-Newton methods. Constrained minimization problems and Kuhn-Tucker theory. Fundamental theorems of linear optimization. Simplex algorithm.

EE 521 – Estimation Theory, 3 credits, 10 ECTS
Review of probability and stochastic processes. Gauss-Markov process and stochastic differential equations. Bayesian estimation theory. Maximum likelihood, linear minimum variance and Least-mean square estimations. Properties of estimators; error analysis. State estimation for linear systems. Kalman and Wiener filters. Smoothing and prediction. Nonlinear estimation. Realizations of filters.

EE 522 – Intelligent Control, 3 credits, 10 ECTS
Uncertainty models and information representation: types of uncertainties and uncertainty measures. Intelligent control methodologies: learning control, fuzzy control, neurocontrol.

EE 523 – Robotics Systems, 3 credits, 10 ECTS
Evolution of robots, elements of robotic systems, mathematics of manipulators. Homogeneous transformations, end effectors position and orientation. Kinematics of robotic systems. Manipulator dynamics. Tree-structured manipulators. Multiple manipulators. Leading robot hands. Hand gross motion control. Obstacle avoidance techniques. Collision free wrist path planning. Hand preshape analysis. Grasp planning. Contact analysis. Hand fine motion control. Manipulability and stability of robotic systems.

EE 524 Advanced Static Power Conversion, 3 credits, 10 ECTS
Overloaded modes of operation of rectifiers, characteristics. Reactive power and harmonics in ac-dc converters, cascade use of converters. Commutation techniques in inverters; McMurray circuit and its modified forms. Voltage control and harmonic elimination. ASCII inverters. Chopper structures. Improving the performance and optimization of circuit elements.

EE 525 – Theory and Design of Electrical Machines, 3 credits, 10 ECTS
Generalized machine concept. Matrix equation of electrical machines. Measurement of machine parameters. Steady state, transient, balanced and unbalanced operations. Approximate models of electrical machines. Induction machine. Classification, design principles, electric and magnetic loading, determination of dimensions, selection of slot numbers, reduction of parasitic torques, windings, calculation of parameters. Synchronous machine design. Transformer design.

EE 526 Power Electronics, 3 credits, 10 ECTS
Advanced power electronic converters, techniques for modeling switching circuits, resonant and multi-level converters, Pulse-Width-Modulation (PWM) techniques, soft switching methods, low-voltage high-current design, Multi-phase, controlled and uncontrolled rectifiers and inverters with various operating techniques and their design and control, Includes extensive computer-aided circuit simulation and power supply control.

EE 527 – Advanced High Voltage Techniques, 3 credits, 10 ECTS
Insulation principles in HV equipment. Mechanism of lightning discharges and over voltages generated in HV systems. Mechanism of corona discharges and corona loss calculations. Electromagnetic interference generated by HV systems. Pollution flashover problem of HV insulators. Construction and operational principles of over voltage limiting devices, high voltage insulators, bushings and circuit breakers. Insulation design of high voltage transformers, cables and capacitors. Testing of HV equipment.

EE 528 – Advanced Microprocessor, 3 credits, 10 ECTS
Introduction to microprocessors, 8-bit microprocessor architecture, 8085 and Z80 instruction sets, microprocessor programming examples,16-bit microprocessor architecture, 8086 instruction set, programming examples, microprocessor interfacing techniques, memory, input-output, and interrupts.

EE 529 – Data Communication and Networking, 3 credits, 10 ECTS
Basics of data communications, and computer networks, ISO/OSI basic reference model. Physical, data link, network and transport layers. Routing, flow control, congestion control. Internetworking. TCP/IP suite of protocols. Higher layer protocols. Contemporary network architectures.

EE 530 – Mechatronics, 3 credits, 10 ECTS
Introduction to Mechatronics systems. Electric circuits and components. Microcontroller programming and interfacing. Data Acqusition, Quantising theory, A-D converters, D-A converters. Sensors and Actuators. Mechatronic systems-control architectures and case studies.

EE 531 Flexible AC Transmission Systems, 3 credits, 10 ECTS
Power Transmission control, FACTS solutions. Transient stability control CSC, SSSC, SVC and STATCOM. Protection for EHV transmission lines with FACTS devices. FACTS development and applications.

EE 532 Pattern Recognition, 3 credits, 10 ECTS
Introduction to pattern recognition, definitions and approaches. Statistical Pattern Classification: Decision Theoretic approach: Template Matching (Convolution, Correlation and OCR), Feature Analysis (Stroke Analysis and Geometric Features Analysis), Linear and Nonlinear Decision surface approach. Probabilistic Approach: Bayes Classifier and Gaussian distribution. Syntactic Pattern Classification: Parsing, Pattern Grammar Analysis and Representation, Language analogy grammar and Picture description grammar. Neural Networks Pattern Classification: Neural networks in brief, Activation functions and Topologies. Training strategies (algorithms) and examples of Intelligent Pattern Recognition. Assignments will be given to design an Intelligent Pattern Recognition System. This is an important part of the course and will provide experience in technical writing and practical knowledge. Software simulation of your IPRS can be done using C-language or MATLAB.

EE 533 –Electricity Outages and Load Management, 3 credits, 10 ECTS
Review of fundamental power system operation, Load (Demand) Management, Load sensitivity analysis for avoiding outages(How loads affect the security margin to voltage collapse,How loads affect the power flows on each line to avoid cascading line outages), Regulated and Deregulated environments for the electricity sector, Electricity Markets.

EE 538 Telecommunication Networks, 3 credits, 10 ECTS
Proper design and operation of efficient communication networks is becoming more important as the digital telecommunication services of today are constantly growing. This course provides an introduction to communication networks. Specific topics to be covered include layered network architectures, error recovery and retransmission (ARQ), medium access control, routing and addressing, resource allocation and quality of service (QoS).

EE 540 Expert Systems, 3 credits, 10 ECTS
The evaluation of artificial intelligence systems. Decision making. Expert System (ES) characteristics. Architecture of ES. Hybrid ES. Knowledge representation in ES. Representation of knowledge by Object-attribute value triplets, Semantic networks, Frames, Logic programming, Neural networks, Production rules. Inference engine, forward and backward chaining mechanisms. Knowledge acquisition. Uncertainty, fuzzy ES. ES shells. Application of ES for solving different problems.

EE 541 Advanced Symmetrical Components and Rotating Field Theory , 3 credits, 10 ECTS
Unbalanced voltage. Current Systems. Unbalanced impedances. Rotating field with space and time harmonics. Induced emf between clip rings. Induced emf between stationary and rotating brushes

EE 572 – HighVoltage Insulation Coordination 3 Credits
Introduction and general philosophies of Insulation Coordination. Generation of over-voltages; lightning surges and switching surges. Propagation of surges; reflaction and refraction. Bewley-Lattice analysis of travelling surges. Protection against over voltages and protective devices.