Department of Electrical & Electronic Engineering

Eastern Mediterranean University

Electrical and Electronic Engineering (Graduate Program)

Spring 2021- 2022

EASTERN MEDITERRANEAN UNIVERSITY
DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

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GRADUATE CATALOGUE

INTRODUCTION

The Department of Electrical and Electronic Engineering was one of the first departments to be established in the University. It has its own site on the University campus, with modern buildings and well-equipped laboratories. The Department aims at providing contemporary training in various fields of Electrical and Electronic Engineering, and it offers programs of study leading to degrees of Bachelor of Science (B.S.), Master of Science (M.S.), and Doctor of Philosophy (Ph.D.). The undergraduate programs in the department are the Electrical and Electronic Engineering Program, Biomedical Engineering Program, and Information Systems Engineering Program.

The undergraduate Electrical and Electronic Engineering Program is designed to train students in basic and engineering sciences, convey up-to-date professional knowledge, as well as to encourage individuals to develop confidence in engineering practice. Graduates of the program become a part of highly demanded class of professionals in their native countries. They may choose to continue their studies in the graduate programs of our department or other prominent international universities or pursue a broad range of careers in the field.

The Department offers a wide range of facilities for training and research in Electrical and Electronic Engineering. The University Library provides the most recent publications as well as the classical textbooks and reference books. It has a good collection of the major international periodicals in almost all fields of Electrical Engineering.

Research interests of the department include: Network and system theory; mobile communications, indoor wireless local area networks, optimal and inverse optimal control, digital communications, digital signal processing, biomedical engineering, image processing, adaptive filtering; robotics and control systems, solar energy conversion; computer networks, wireless mobile multimedia systems, software engineering, distance learning; optoelectronics, laser theory, linear systems theory; circuits and systems; microwaves, antennas, numerical electromagnetics, satellite communication systems, modeling of physical systems, power electronics, power systems , renewable energy , robotics and artificial intelligence.

ACADEMIC STAFF MEMBERS

ABOU RAJAB Hasan, Assistant Professor, BSc, MSc, PhD, Middle East Technical University.
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His current research interests are digital communication systems, coding theory and coded modulation techniques.

AMCA Hasan, Professor, BEng, Higher Technological Institute (EMU), MSc, University of Essex; PhD, Bradford University.
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Web Page: http://www.emu.edu.tr/amca
His research interests include indoor and outdoor mobile communications, telephony, multi user detection of CDMA, Multi-carrier systems, digital signal processing, adaptive equalization, radio and TV broadcasting, information technology.

AZIZI ALIKAMAR Shahla, Assistant Professor, BSc and MSc, Amirkabir University of Technology, PhD, Tehran University of Medical Science.
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Her current research interests are biomedical engineering, neuroscience, neurorehabilitation, signal and image processing.

DEMİREL Hasan, Professor [Vice Rector], BSc, Eastern Mediterranean University, MSc, King's College London, PhD and DIC Imperial College London.
Ext. No: 1580, e-mail: hasan.demirel@emu.edu.tr
Web Page: http://faraday.ee.emu.edu.tr/hdemirel
His current research interests include; resolution enhancement in images/video, facial expression recognition, pattern recognition, facial image processing, feature detection, tracking, segmentation and recognition.

HOCANIN Aykut, Professor [Rector], BSEE, Rice University, MEng Texas A&M University, PhD Boğaziçi University.
Ext. No: 1201, e-mail: aykut.hocanin@emu.edu.tr
Web Page: http://faraday.ee.emu.edu.tr/hocanin
His current research interests include wireless communication, channel and source coding, detection and estimation theory, CDMA, multi-user detection, spectral estimation, adaptive filtering.

İNCE Erhan, Professor, BSc and MSc, University of Bucknell, PhD, University of Bradford.
Ext. No: 2778, e-mail: erhan.ince@emu.edu.tr
Web Page: http://faraday.ee.emu.edu.tr/eaince
His research interests include channel coding, multi-carrier techniques, WiMAX/LTE/LTE-A/LTE-Pro, image and video processing, and statistical signal processing.

KÜKRER Osman, Professor, BSc, MSc, PhD, Middle East Technical University.
Ext. No: 1304, e-mail: osman.kukrer@emu.edu.tr
His research interests include feedback control of single phase and three phase inverters, uninterruptible power supplies, PWM ac/dc converters, high power factor rectifiers, ac and dc drivers, adaptive filtering.

ÖZKARAMANLI Hüseyin, Professor [Dean], BSc, MSc, PhD, Tufts University.
Ext.No: 1381/2776, e-mail: huseyin.ozkaramanli@emu.edu.tr
In the area of Digital Signal Processing: Construction of M-Band wavelet basis, multiple wavelets, Sub-band transforms and their applications in data/image compression and signal denoising. In the area of VLSI: Signal integrity problems associated with the different interconnect technologies in ultra high speed integrated circuits.

RUNYI Yu, Professor, BSc, Shanxi University, MSc, PhD, Beijing University of Aeronautics and Astronautics.
Ext. No.: 1382, e-mail: runyi.yu@emu.edu.tr
His current research interests include singular systems, sampled-data control, filter bank theory and design, wavelet transforms and their applications in signal/image processing.

SIRJANI Reza, Associate Professor [Vice Chair]**,** BSc, KNToosi University of Technology, MSc, Tehran Science and Research Branch of Islamic Azad University, PhD, The National University of Malaysia.
Ext. No: 1436/2197, e-mail: reza.sirjani@emu.edu.tr
His research interests include electric power systems, optimization techniques, power transmission lines, reactive power compensation, renewable energy, power quality improvement.

SOLYALI Davut, Associate Professor [Vice Dean]**,** BSc, Eastern Mediterranean University, MSc, PhD, University of Bath.
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His research interests include electrical demand, generation, transmission and its interaction with renewable energy technologies.

UYGUROĞLU Mustafa K., Professor, BEng, Higher Technical Institute (EMU), MS, PhD Eastern Mediterranean University.
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He is conducting research in the field of robotics, mechatronics and mathematical modeling.

UYGUROĞLU Rasime, Associate Professor [Chair], BEng, Higher Technical Institute (EMU), MS, PhD, Eastern Mediterranean University.
Ext. No: 1300, e-mail: rasime.uyguroglu@emu.edu.tr
Her research interests are Computational methods in electromagnetics, FDTD analysis of microstrip antennas, Rotman Lens antennas, implantable and wearable antennas for biomedical applications

UYSAL Şener, Professor, BEng, Higher Technical Institute (EMU); MSc, PhD, University of London.
Ext. No:2772, e-mail: sener.uysal@emu.edu.tr
His research interests are microwave integrated circuits, design of microwave antennas, radar.

ADMINISTRATIVE STAFF MEMBERS

NAKIŞÇI Yeliz, Departmental Secretary	Ext.:1301	e-mail: yeliz.nakisci@emu.edu.tr
CENGİZ Cem, Lab. Technician	Ext.:2783	e-mail: cem.cengiz@emu.edu.tr

LABORATORIES

Basic Circuits Laboratory

Intended to familiarize students with the fundamental laboratory procedures of electrical measurements. In addition to demonstrating the uses of voltmeters, ammeters, watt-meters, signal generators and oscilloscopes, experiments are designed to illustrate basic electrical circuit theory concepts for linear and non-linear DC circuits, simple time-invariant circuits, and single-phase and three-phase linear AC circuits.

Instrumentation and Measurement Laboratory

Facilities for undergraduate education and training in electrical and electronic measurements and instrumentation.

Control Systems Laboratory

Provides experimental facilities to help students grasp the theory and applications of feedback control systems. The equipment includes electro-pneumatic sets, electro-hydraulic sets, servo systems, a computer based servo fundamental training system, DC servo mechanism and other electronic apparatus that can be used as basic elements to construct open- or closed-loop systems of various orders. The set-up allows for a number of experiments to demonstrate techniques of system modeling, analysis and design in control engineering.

Electronics Laboratory

Well equipped for undergraduate electronics experiments, this laboratory is used to familiarize students with electronic devices, amplifiers and analogue and digital electronic circuits. It also provides facilities for undergraduate and graduate research projects.

Telecommunications Laboratory

Equipped with analogue and digital communication kits, measuring instruments, signal generators and analyzers for undergraduate courses. There are also many HF to UHF frequency range transmitters and receivers.

Electrical Machines and Power Electronics Laboratory

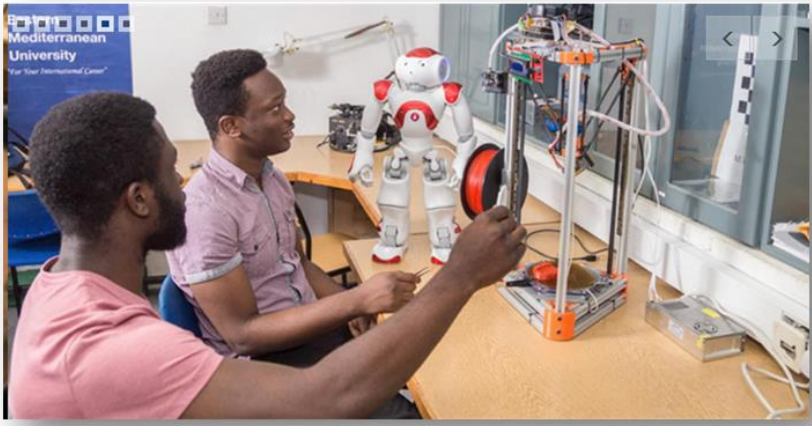
Equipped for experiments on all types of rotating AC and DC machines, stepper motors, universal motors and single and three-phase transformers. Facilities are available for testing and measuring motor characteristics. Several types of generalized machine sets are available for undergraduate and graduate research studies. This laboratory is also equipped with several sets and rectifier/inverter units suitable for undergraduate power electronics experiments.

Microprocessor Laboratory

Provides facilities for performing experiments on microprocessors and single-board microcomputers. The equipments include microprocessor development and training sets based on the true 16-bit 8086 microprocessor. The training sets incorporate RS232 serial port, two programmable peripheral interface (PPI), programmable interval timer (PIT) and programmable interrupt controller (PIC) chips. Application boards can be connected to the microprocessor training boards to provide real time interfacing by using the following I/O units: optical fiber receiver/transmitter, optical speed/position sensor, numerical keypad, heater/temperature sensor, dc motor, LED displays and speakers.

Logic Circuit Design Laboratory

Intended for teaching the fundamentals of combinational and sequential logic circuits. The equipment includes a logic analyzer, several boards with power supplies, clock generators and LED displays.



Microwave and Antenna Laboratory

Equipped with microwave and antenna training sets including gun oscillators, waveguide and wave propagation equipment sets, waveguide matching, lecher lines, transmitting antenna, receiving antenna and complex antenna systems for undergraduate courses.

Undergraduate Computer Laboratories

There are two general purpose undergraduate computer labs housing a total of 50 PC based networked systems. These workstations allow access to the Departmental Lab and student server machine. A variety of engineering software is accessible from these workstations. Internet access is available from all workstations. A networked printing facility is also available. Lab classes or individual student study are available using these facilities. Late opening of these facilities is provided.

Computer Networks Research and UNIX Laboratory

A laboratory/research facility intended to support graduate computer network studies and provide a platform for research and development in these areas. Several networking simulation software including OPNET is available in this laboratory for teaching and research. It also has 10 PC based Linux systems for UNIX and networking undergraduate laboratory studies.

Simulation Computer Laboratory

A separate computer based simulation laboratory is provided which provides a platform consisting of 25 networked PCs for student based term projects as well as formal teaching of Integrated Circuit Design courses. A number of engineering software is available including the Xilinx Software for VLSI Design.

Multimedia Enabled Teaching Laboratories (MMETL)

There are two general-purpose multimedia enabled teaching laboratories with a total of 52 networked multimedia PCs. A platform for Internet access and data projection system is available for technology based teaching to undergraduate and graduate classes.

Undergraduate Project Laboratory

This is a new facility made available for student graduation projects. It houses number of equipment including testing, measurement, prototyping (breadboards) and PC based interfacing for project implementation.

Graduate Computer Research Laboratory

Housing the departmental local area network servers and the Unix server, this laboratory is intended to provide a general purpose research center with wider computational facilities. It also incorporates 3 Unix workstations, 10 fast Pentium and other PCs including some with CD-ROM devices and two laser printers.

DSP and Multimedia Laboratory

The DSP laboratory is intended to serve the undergraduate students in their courses and project related work. The lab is designed to provide services to students in three groups. These are the Signals and Systems course, which is a core course, Introduction to Digital Signal Processing, which is a technical elective and any multimedia systems related technical electives. The Lab will enable the students in these classes to acquire data (image, speech etc.) in digital format and provide them with the means to process their data using software tools such as MATLAB ® or C programming language. TI based TMS320 DSP hardware platforms are also available for practical implementations.

High Voltage Laboratory

High Voltage Laboratory serves as independent, non-industrial, university center for high voltage engineering. The mission of the Laboratory includes research, evaluation, testing and education activities. The laboratory is equipped with 100 kV, 5 kVA test transformer, 100 kV, 5 kVA, 50 Hz AC test set, 140 kV, 20 mA DC test set.

OTHER FACILITIES

IEEE Student Branch

IEEE EMU student branch was established in January 1995 and currently has approximately 100 members from the Departments of Electrical and Electronic Engineering and Department of Computer Engineering as well as other related disciplines. It is the center of the information exchange between members of the Institute of Electrical and Electronics Engineering students in Eastern Mediterranean University.

Electronic Club

The electronic club is established by the students in the department in order to share knowledge, experience and enthusiasm. The club has a dedicated office, which contains books, electronic parts and testing and monitoring equipment for the practical works of the students. The club creates an environment where the students can get together to talk about their profession and exchange views on different projects.

EESTEC (Electrical Engineering Students' European Association)

The Electrical Engineering STudents' European assoCiation (EESTEC) is an organization of and for electrical engineering and computer science students from universities, institutes or technical schools in Europe that award an engineering degree. It was founded in Eindhoven, the Netherlands in 1986. Since 1995 it is a recognized association seated in Zürich, Switzerland. From year 2002 the EESTEC seat returned to the Netherlands, but now in Delft. A Local Committee is a local branch of EESTEC International. Currently there are 39 LCs in more than 20 countries with over 1700 members.

Student Representatives Office

Through a democratic election system the students elect their representatives in the department. The student representatives are given opportunities to reflect the problems and requests of the students to the departmental administration. The student representations' Office is allocated for the use of the student representatives and all the students.

Departmental Library

This is a Departmental Library is managed by the IEEE Student Branch in collaboration with the department and houses IEEE periodicals as well as a limited number of books. It has a photo copying facility and an internet enabled PC for Library search operations. It also provides a quiet area for individual study.

Multimedia Enabled Classrooms (MMEC)

The department has 5 MMECs that use the latest instructional technology.

EEE Amphitheater (Seminar/Conference Hall)

A fully equipped modern amphitheater is available within the departmental building. This facility seats 150 people and is used mainly in seminar courses as well as seminar/conferences.

THE MASTER OF SCIENCE (M.S.) AND DOCTOR OF PHILOSOPHY (Ph.D.) PROGRAMS IN ELECTRICAL AND ELECTRONIC ENGINEERING

Research is an integral part of an institution of higher education. Following the establishment of the graduate programs in the Department of Electrical and Electronic Engineering, there has been rapid development in graduate studies, complemented by an active research environment. The objective of the graduate program is to establish firm background knowledge and cultivate initiative abilities in students that will enable them to engage in advanced applied and theoretical research.

Candidates enrolled in the Master of Science (M.S.) program are required to successfully complete a minimum of seven graduate courses and a thesis in at most two academic years, in order to fulfill degree requirements.

Candidates enrolled in the Doctor of Philosophy (Ph.D.) program are required to complete a minimum of six courses. After the completion of the coursework all Ph.D. candidates take a two-part qualifying exam. After the successful completion of the qualifying exam, all candidates undertake research work on an original research topic for their dissertation. All candidates are expected to publish their original findings in journals scanned by the Science Citation Index Expanded (SCI-E).

Candidates fulfilling these requirements are awarded the degree of Master of Science or Doctor of Philosophy in Electrical and Electronic Engineering respectively.

The following broad research fields are available in the Electrical and Electronic Department:

1. Biomedical Engineering
2. Power Electronics and Electrical Machines
3. Power Systems and Renewable Energy
4. Circuits and Systems
5. Communications and Signal Processing
6. Electromagnetics
7. Computers and Computer Networks
8. Control Systems

Further information may be obtained from staff research interests section and the Departmental Research Publications link at the following URL: http://www.ee.emu.edu.tr

COURSES OFFERED

The following courses are offered in the department. Sometimes, the spring semester courses can be offered in the fall semester or vice versa, depending on the number of students enrolled in the program who wants to take that course. Students, whose research fields necessitate study of topics offered through courses from other developments, can take these courses from other departments of the EMU, with the approval of the Graduate Committee and the Head of Department.

Fall Semester

EENG511 Data Communications and Computer Networks
EENG515 User Interface Programming
EENG517 Automata Theory
EENG521 Linear System Theory I
EENG525 Stability Theory of Dynamical Systems
EENG527 Discrete-time Systems
EENG529 Circuits and Systems Analysis

EENG535 Advanced Electromagnetic Theory
EENG537 Microwave Integrated Circuits
EENG541 Optoelectronics
EENG543 Special Topics in Power Electronics
EENG558 Power Systems Operation and Management
EENG561 Theory and Applications of Phase-Locked Loops
EENG565 Selected Topics in Digital Communications
EENG567 Advanced Digital Signal Processing
EENG568 Information Theory
EENG569 Mobile Communication Systems
EENG571 Probability Theory and Stochastic Processes
EENG581 Solar-Thermal Energy and its Applications
EENG611 Current Topics in Computer and Communication Networks

Spring Semester

EENG512 Design, Analysis and Performance of Computer Networks.
EENG514 Queueing Theory for Communication Systems
EENG516 Software Design for Embedded Systems
EENG520 Optimal Control and Stochastic Estimation
EENG522 Linear System Theory II
EENG524 Robust Control
EENG526 Discrete Event Systems
EENG532 Antenna Theory
EENG534 Numerical Methods in Electromagnetics
EENG542 Advanced Industrial and Power Electronics
EENG544 Advances on VLSI Design
EENG559 Power System Protection and Control
EENG562 Error Control Coding
EENG564 Special Topics in Digital Signal Processing
EENG566 Satellite Communication Systems
EENG572 Optimization Theory
EENG574 Detection and Estimation Theory
EENG576 Three-Dimensional Mechanical Systems
EENG582 Artificial Neural Networks
EENG583 Digital Image Processing
EENG584 Digital Speech Processing

COURSE DESCRIPTIONS

EENG511: Data Communications and Computer Networks
Principles of data communications. Study of communication systems. Information transfer and computer communications. Transmission and switching. Network characteristics and performance. New technologies. Classification and study of computer networks and their applications. Network structures, architectures and protocols. The OSI reference model and the layer concept. Services and network standardization. Communication models. Error and flow control. Addressing and routing. Network interconnection and interworking issues.

EENG512: Design, Analysis and Performance of Computer Networks
Network components and transport technologies. Transmission links and procedures. Performance engineering. Graph theory and queuing theory primers. Mean network delay. Network design. Access networks and backbone design. Capacity assignment. Congestion in computer networks. Congestion and flow control. Routing. Simulation and applied techniques. Monte Carlo and discrete event simulations. Measurement analysis.

EENG514: Queueing Theory for Communication Systems
Review of Markov chains. Elements of queuing systems. Steady-state solutions for single-station Markovian queuing systems. Multi-stream Markovian queuing systems. Introduction to non-Markovian queuing systems theory. Queuing networks. Applications of queuing theory to modeling stochastic processes in telecommunications systems including traffic modeling, network optimization, quality of service, (QoS), cost of service etc.

EENG515: User Interface Programming
Event driven programming and Messages. Windows programming environment. Basic user interface elements and controls. Multitask and multithread programming. Synchronization. Microsoft foundation classes and MFC programming. OLE, COM/COM+ and ActiveX. Database support and ODBC. MAPI & TAPI. Programming with WinSocks.

EENG516: Software Design for Embedded Systems
Hardware fundamentals. Embedded design life cycle. Hardware/software partitioning and integration. The development environment. Survey of software architectures. Function-queue-scheduling architecture. Real-time operating systems. Software techniques for embedded systems. Memory-mapped access and interrupts. Polling loop and interrupt driven routines. Nested interrupts and re-entrancy. Design methodologies. Basic tools for software development. Firmware debugging. Testing and integration of embedded software. Performance analysis.

EENG517: Automata Theory
Formal grammars and languages. Deterministic and non-deterministic finite automata. Regular languages and regular expressions. Limitations of finite automata. Context-free languages and pushdown automata. Parsing. Introduction to Turing machines. Unrestricted grammars. Chomsky hierarchy. Computability and unsolvability.

EENG520: Optimal Control and Stochastic Estimation
State estimation and pole placement problem. Linear quadratic optimal regulation (LQR) of continuous and discrete-time systems in time and frequency domains. Kalman filtering. Continuous and discrete-time multivariable frequency response methods for optimal filter. Application of Kalman filter to radar tracking filters. Close-form solutions to the exponentially correlated velocity and acceleration (ECV & ECA) radar tracking filters. Further applications of LQR and Kalman filtering.

EENG521: Linear System Theory I
Linear spaces and linear operators. Dynamical system representation, system properties. Linear differential system, impulse response matrices, the adjoint system. Linear time-invariant differential system: modal decomposition, controllability and observability, canonical decomposition.

EENG522: Linear System Theory II
Irreducible realizations: Hankel Method, singular value decomposition method, coprime fraction method. Polynomial matrix description, strict system equivalence. Identification of discrete-time systems. Canonical representations. Multivariable state feedback, decoupling. Linear time-invariant composite systems.

EENG524: Robust Control
Norms for signals and systems: 2-norm. Basic concepts: internal stability, performance. Uncertainty and robustness: plant uncertainty, robust stability, robust performance. Stabilization: controller parameterization, coprime factorization. Design constraints: algebral constraints, analytic constraints. General configurations and solutions. Design projects.

EENG525: Stability Theory of Dynamical Systems
Second order systems, Bendixson's and Poincare-Bendixson theorems, limit cycles. Nonlinear differential equations. Describing function, singular perturbation. Stability in the sense of Lyapunov. Input-output stability, Popov's criteria, circle criteria.

EENG526: Discrete Event Systems
Introduction to discrete event systems. Untimed models: language and automata, Petri nets, grafcets, analysis of untimed models, supervisory control. Timed models: timed automata, Timed Petri nets, dioid algebra. Stochastic models: stochastic processes, stochastic timed automata, Markov chains, queueing theory.

EENG527: Discrete-time Systems
Introduction to sampled-data systems. Time-domain representations. Time-domain analysis. z-transformation. State variable representation. z-domain analysis. Design: time-domain synthesis, z-transform method, controllability and observability, digital controllers, pole placement by state feedback.

EENG529: Circuits and Systems Analysis
Definitions of physical systems, Component characterization. Elements of graph theory, basic postulates: circuit and cut-set equations. Formulation of system equations in matrix form. Branch, chord, mixed and state-space formulations. Solution of system equations, time-domain, s-domain solutions. Various applications to physical systems.

EENG532: Antenna Theory
Basic antenna parameters. Transmission loss, radar equation. Retarded potentials, thin linear wire antennas. Hertzian dipole, small dipole, finite length and half-wavelength dipoles. Vector potentials, field equivalence principle. Rectangular and circular apertures. Horns. Induced current, parabolic reflectors. Array antennas, uniform and non-uniform aperture distributions, scanning arrays, pattern synthesis, planar arrays.

EENG534: Numerical Methods in Electromagnetics
Review of main analytical and numerical methods for field problems. Method of moments applied to static field, scattering and antenna problems. Hallen's and Pocklington's integral. The finite-difference method for static and time-varying fields. Variational methods, the Rayleigh-Ritz method. The finite-element method. Absorbing boundary conditions.

EENG535: Advanced Electromagnetic Theory
Fundamental concepts of Electromagnetics; theorems and concepts; plane wave function; cylindrical wave functions and spherical wave functions.

EENG537: Microwave Integrated Circuits
Fundamentals of MICs; MIC technologies; coupled lines and directional couplers; filters and multiplexers; mixers; phase shifters; amplifiers; oscillators; T/R module; microwave systems.

EENG541: Opto-electronics
Introduction to electronic displays. Characterization, major design factors and human factors. Methods of addressing. Light-emitting diodes, AC plasma displays, liquid-crystal displays, electrochronic displays, electrophonetic displays, DC electroluminescent displays. Laser devices and applications.

EENG542: Advanced Industrial and Power Electronics
Single-phase and three-phase controlled rectifiers, Distortion, displacement and power factor. Commutation overlap. Firing control. Voltage-fed inverters, the McMurray and McMurray-Bedford inverters. Voltage control in inverters, PWM control techniques. Current-fed inverters; load-commutated, force-commutated, auto-sequential-commutated inverters. DC and AC drives; scalar and vector control methods, slip power recovery control.

EENG543: Special Topics in Power Electronics
Single-phase and three-phase controller rectifiers, Distortion, displacement and power factor. Communication overlap. Firing control. Voltage-fed inverters, the McMurray and McMurray-Bedbord inverters. Voltage control in inverters, PWM control techniques. Current-fed inverters; load-commutated, force-commutated, auto-sequential-commutated inverters. DC and AC drives; scalar and vector control methods, slip power recovery control.

EENG544: Advances on VLSI Design
Various aspects of the design stages of VLSI (Very Large Scale Integration). Mathematical background, combinatorics, graph theory and geometry. Layout and wire-routing problems of the design. Examples on computer networks and VLSI realization of neural networks.

EENG558:Power Systems Operation and Management
An overview of the traditional operation of modern power systems. An introduction to the functions within a typical Energy Management System. An overview of issues in the real time modelling of power networks. The topics of operations scheduling and generation control. The physical phenomena affecting power system stability and system security. Several algorithms that may be used to carry out on-line dynamic security assessment of the more demanding steady state, transient and voltage stability problems. The commercial operation of market-based electricity industries (case studies from United Kingdom).

EENG559: Power System Protection and Control
Symmetrical and unsymmetrical faults in power systems; protection systems overview; protective devices; coordination and sequencing of relays; methods of power systems operation and control; transient stability; load-frequency control; economic dispatch; unit commitment and optimal power flow.

EENG561: Theory and Applications of Phase-Locked Loops
Survey of analog phase-locked loops (PLLs). Implementation of loop components. Baseband models. Analysis of PLLs in time and frequency domains. Nonlinear theory and linear analysis of sampling digital PLLs. Analysis of hybrid systems. PLL applications.

EENG562: Error Control Coding
An overview of random processes. Study of channel models and Shannon-Hartley Capacity Theorem. Minimum distance, vector algebra, and binary fields. Block coding principles such as generator matrix description, systematic codes, parity check matrix, syndrome calculation, cosets, and standard array decoding. Convolutional codes (CC): encoders, generator polynomials, constraint length, state and trellis diagrams. Decoding of CC: hard decoding, Viterbi algorithm, M-algorithm, Soft Output Viterbi Algorithm (SOVA), BCJR algorithm. Cyclic Codes; systematic codes, BCH and Reed Solomone codes. Turbo Codes: parallel concatenation, puncturing, interleavers, iterative decoding.

EENG564: Special Topics in Digital Signal Processing
Lectures and discussions related to advanced topics and new areas of interest in the theory and practice of Digital Signal Processing, including information theory, coding theory, speech, image and video processing.

EENG565: Selected Topics in Digital Communications
Optimum receivers and the probability of error for the Additive White Gaussian Noise Channel for binary and M-ary modulations. Digital transmission via carrier modulation such as MPSK, QAM, FSK and MFSK. Probability of error and comparison of different modulation techniques. Coherent and noncoherent detection techniques. Continuous Phase Modulation (CPM) techniques, demodulation and detection of CPM signals, Minimum Shift Keying (MSK). Channel capacity and coding: Channel capacity, bounds on communication, coding for reliable communication. Generator and parity check matrices for linear block codes. Soft and hard decision decoding of block and cyclic codes. Convolutional codes: basic properties, optimum decoding of convolutional codes and the Viterbi Algorithm. Coding for bandwidth constrained channels using Trellis-Coded Modulation (TCM). Spread Spectrum Communication Systems: Direct-sequence Spread Spectrum (DS-SS) systems. Some applications of DS-SS, generation of PN sequences. Frequency-Hopped spread spectrum. Fast and slow frequency hopping.

EENG566: Satellite Communication Systems
System description. Ground segment. Wave propagation in satellite communications links with fading and shadowing. Space segment. Modulation and coding in satellite communications. Multiple-access techniques. Link-budget calculations.

EENG567: Advanced Digital Signal Processing
Review of fundamentals: z-transforms, convolution, DFT and FFT. IIR and FIR filters. Parametric signal processing, deterministic and stochastic techniques; AR, MA, ARMA, ARMAX models. Spectrum estimation techniques, parametric and non-parametric methods. Adaptive IIR, FIR and lattice filters. Fast algorithms for DSP. Applications to image and signal processing.

EENG568: Information Theory
Modeling of information sources and measure of information. Joint and conditional entropy. Relative entropy, mutual information. Asymptotic Equipartition property (AEP) and consequences of AEP on data compression. Source Coding: Huffman, Lempel Ziv coding and arithmetic coding. Maximum Entropy and Spectral Estimation. The Rate distortion theory. Modeling of communication channel and the Channel Capacity Theorem. Scalar and vector quantization and Transform coding. Coding of discrete information sources: Block codes, cyclic codes, convolutional codes. Combined modulation and coding, trellis coded modulation (TCM).

EENG569: Mobile Communication Systems
Mobile communications systems, multipath propagation, fading, modulation and detection techniques, diversity, mobile antennas, equalization, spread spectrum, cellular radio, GSM, ADS, PDC, mobile Sat-Com, wireless LANs.

EENG571: Probability Theory and Stochastic Processes
Probability theory. Random variables, distribution and density functions, expectation, moments, characteristic functions, functions of random variables, sequences, convergence concepts. Weak and strong law of large numbers, the central limit theorem. Stochastic processes, mean, autocorrelation, autocovariance, cross-correlation, cross-covariance. Orthogonal and independent processes. Stochastic differential equations. Ergodicity. Power spectral density. Gaussian, Poisson, Markov processes.

EENG572: Optimization Theory
Linear programming, the simplex method. Unconstrained optimization. Basic descent methods, Newton's method, line search algorithms, steepest descent. Conjugate direction methods, the conjugate gradient method, Fletcher-Reeves method. Quasi-Newtonian methods, the Davidson-Fletcher-Powell method. Constrained optimization. Equality and inequality constraints. Primal methods, feasible direction methods, penalty and barrier methods.

EENG574: Detection and Estimation Theory
Decision theory: Binary hypothesis testing, M-ary testing, Bayes, Neyman-Pearson, Min-Max. Performance. Probability of error, ROC. Estimation theory: linear and nonlinear estimation, parameter estimation. Bayes, MAP, maximum likelihood, Cramér-Rao bounds. Bias, efficiency, consistency. Asymptotic properties of estimators. Orthogonal decomposition of random processes and harmonic representation. Waveform detection and estimation. Wiener filtering and Kalman-Bucy filtering. Recursive algorithms. Spectral estimation.

EENG576: Three-Dimensional Mechanical Systems
Use of matrices in vector algebra, matrix representations. Euler’s theorem. Kinematics of particles, rigid bodies and interconnected rigid bodies. Terminal equations of an ideal rigid body in motion as a multiterminal component. Restricted motions of rigid bodies. Power and energy of rigid bodies. The most general mathematical model of a rigid body. Kinematic chains with active joints. Mathematical model of a system of interconnected rigid bodies. Algorithmic calculation of equations of motion.

EENG581: Solar-Thermal Energy and its Applications
Solar insulation; measurements and metrological data. Solar heating; direct and indirect methods of water and space heating. Solar cooling; desiccant, roof-pond and evaporative methods of space cooling. Heat gain and heat loss criteria, backup systems for heating and cooling. System simulation, meteorological date files and data processing, integration algorithms, modeling.

EENG582: Artificial Neural Networks
Neural Network Concepts: what is a neural network? biological neuron, artificial neuron, neural network topologies. Learning in Neural Networks: types of learning, learning rules, error correction learning, Hebbiab learning, competitive learning, Bolztman learning. Application Tasks: function approximation, classification, association, application examples. Feadforward Networks: perceptron, multi-layer perceptron, radial basis function network, self-organizing map. Feedback Networks: Hopfield network, Boltzman machine, real-time recurrent network.

EENG583: Digital Image Processing
Image acquisition, sampling and quantization. Image enhancement: Spatial and frequency domain techniques. Image restoration: Inverse, Wiener and mean filtering. Color image processing: color models, color transformations and color segmentation. Image compression: Compression models, elements of information theory, error-free and lossy compression. Morphological image processing: Dilation, erosion, opening and closing, basic morphological algorithms. Image segmentation: Thresholding and region-based segmentation. Object recognition. (Prerequisite: Consent of the Instructor).

EENG584: Digital Speech Processing
Waveforms, spectra, spectrograms, resonance, pitch, formants, human speech production and perception, frequency contents of vowels and consonants; the Fourier transform, time vs. frequency representations, conversion between the two; source-filter model of speech; Feature extraction; Linear predictive analysis and cepstral coefficients; speech recognition, components of a typical recognizer, parameterization of the speech signal, dynamic time warping, distance measures, Bayes theorem, Gaussian probability density function, Viterbi algorithm, the Hidden Markov Model; speech based applications.

EENG611: Current Topics in Computer and Communication Networks
This is an advanced level reading/seminar course on computer and communication networks. Each student is required to give 2 seminars on current topics/papers chosen in consultation with the instructor during the course semester. Each student will be required to review 3 of the papers presented. This will involve completing and submitting a standard conference review form (as used by program committees). As part of each review, students will comment on strong/weak points, major research contributions and suggestions for further work. Students will also be required to undertake a literature survey on the chosen topic and produce a paper of their own based on the literature survey. This, together with the seminar presentations will form the basis of course evaluation of students.

Note that the **EENG521, Linear System Theory I** is a compulsory course and every student enrolled in the M.S. programs has to take and pass this course with a minimum grade of "C".

GRADUATE REGULATIONS

Academic regulations have been laid down by the Northern Cyprus Educational Trust to govern and guide the functioning of the Eastern Mediterranean University (EMU). An official copy of the Academic Regulations can be obtained from the University Bookstore upon request; a summary of the main regulations of interest to graduate students is given below. All the current by-laws and the related forms are available at the official website of the Institute of Graduate Education and Research: http://grad.emu.edu.tr

Admissions
Applications to the graduate programs at E.M.U. are accepted twice a year, prior to the beginning of each semester. All applicants for whom English is a second language may be required to pass a proficiency examination, or present a valid TOEFL score, or GCE “O” Level grade of “C” or demonstrate proficiency in the English Language. Bachelor’s degree requirements for Master’s level programs are as specified in the program descriptions below; PhD program requirements in addition to the Master’s qualification, prior to entry, include a minimum CGPA of 3.00 in the undergraduate study.

Prospective applicants are required to fill out an application form available at the Registrar’s Office and at the university web address, and submit the completed form, together with at least two reference letters and an official transcript of all graduate and undergraduate coursework completed up to the time of application. Candidates, who are not citizens of the Turkish Republic of Northern Cyprus or the Republic of Turkey, are required in addition to submit a document of financial guarantee showing that sufficient funds are available for tuition and living expenses. Applications are evaluated by the Departmental Postgraduate Committee.

APPENDIX A

PH.D. QUALIFYING EXAM

The Ph.D. Qualifying Exam is comprised of two parts: **written exam** and **demonstration of research capability** through a progress report as well as its oral presentation.

I. Exam Types

- The Ph.D. Qualifying Exam is to be comprised of two parts:
  Part I: Written Exam aiming at assessing a student's preparedness for advanced research work

  Part II: Research Progress Report (RPR) and its **oral presentation** aiming at **demonstration of research capability**. It will be based on the student's preliminary work in the chosen research topic.

II. Exam Format and Coverage

- **Part I Exam** - *(Written part)*
  The aim of the examination is to assess the student's formation, background knowledge and readiness for an advanced research study.

  Part I of the qualifying exam is:
  - Divided into **two sections** but is offered as ONE paper:
  - Exam duration will be **3 hours** with total number of questions to be answered is **6** out of 12.
  - All questions will have the same weight.
  - The level of the exam will be at the Postgraduate course level.

  - **Section I.1** is a "***general section***" consisting of 6 questions and the student is expected to answer **3** questions.
    This will be in the field of Electrical & Electronic Engineering that is fundamental to all sub-fields. In this section, Linear System Theory and Probability and Stochastic Processes are the two main subject areas to be included.

  - **Section I.2** is the "***specific section****"* consisting of 6 questions in the specific area of interest of the candidate and the candidate will be required to answer **3** questions.
    This will be in the sub-area(s) of specialization of the student (e.g. Communications, Power, Computers etc.). If the research interest of the candidate falls into more than one specialization area (minor and major specialization areas), then a "joint interest paper" will be set by the PG committee (PGC). The examination areas will be decided by the PGC and the student will be informed.

- **Part II Exam** – (*Research Progress Report - RPR)* and the oral presentation of student's preliminary work in the chosen research topic.
  The aim of this examination is to assess the research potential of the candidate. It is expected that the candidate has already been working on his/her topic of research for some time and has carried out the preliminary work including literature survey. A critical literature survey is expected. The research problem should be stated in the general manner and defended. Preferably, possible routes to solution and techniques to be used are to be proposed and justified. Ideally, the candidate may have carried out work on developing potential solutions through preliminary assessment of the

solution techniques and some preliminary data may be available for presentation. In all these, an understanding of the fundamental issues should be looked for. All the above findings are expected to be written up in a **mini-thesis format** and submitted well in advance to the PG committee chair for distribution to the members of the jury. A copy of the Research Progress Report (RPR) should also be submitted to the Department for recording of the student's work.

III. Exam Evaluation

1. Overall, the Departmental PG Committee is responsible from preparing, arranging and overseeing the running of these exams.
2. The responsibility of assessing the student's overall performance is with the ***Ph.D. Qualifying Exam Jury*** as specified in the by-laws.
3. **Part I Examination:** (Written exam):- The examination paper will be set by the extended PGC formed by the PGC and Qualifying Exam Jury. The extended committee will be responsible for marking and evaluating the written part of the examination. The Head of the Department, the Ph.D. Qualifying Exam Jury and the PGC will be informed about the outcome of the exam. A student will not be allowed to sit the Part II Examination unless a pass level is indicated by the examination committee.
4. **Part II Examination:** (RPR and its presentation):- this exam will be carried out by the Ph.D. Qualifying Exam jury. The formation, appointment and examination details are as specified in the by-laws. The oral presentation is expected to be based on the RP-Report and it will involve the presentation of progress underway to the jury members. (This examination will be held only if the student has obtained a passing mark in the Part I Examination). A student passing Part I and failing Part II will only repeat Part II within the specified (3 months) period. The Ph.D. QE-Jury will make the overall assessment on the student's standing based on the two (Parts I&II) exam results. Students must pass both parts (Part-I and Part-II Exams) separately in order to pass the whole exam. A **Jury Report** will be submitted to the Head of the Department and the PG Committee will be informed. The PG Committee will meet to decide the status of the student; a new exam date will be set for re-sit if this is the student's first attempt; otherwise the PG Committee will finalize the status of the student.

In the Part-II examination, the jury is expected to assess the student's progress, with respect to knowledge of the subject, understanding of the concepts, demonstrated skills, capability and potential for continuing research in the field specified or applying the techniques suggested. The jury may also make suggestions for new directions, additional investigations or the use of a new/additional technique. These will be noted by the candidate and the supervisor. This presentation and examination will be used for student's benefit and clearing of any misty ideas or uncertainty in the research or the use of inappropriate techniques or approaches for the problem solution as far as possible.

A record of the evaluation by the jury will be kept as RPR-Evaluation Form, which will be signed and submitted to the Departmental PG Committee.

III. Procedures and Administration

Application and evaluation rules for the Ph.D. Qualifying Exam are specified in the by-laws. Areas which are not specified or clearly defined will be done so by the PG Committee.

APPENDIX B

COURSE REFERENCE CODES OF M.S. AND PH.D. PROGRAMS

M.S. Program			
Ref. Code	**Crs. Code**	**Course Name**	**Cr.**
215D1	DEF1		3
215D2	DEF2		3
215D3	DEF3		3
215D4	DEF4		3
215D5	DEF5	Deficiency courses (if required)	3
215D6	DEF6		3
215D7	DEF7		3
215D8	DEF8		3
215D9	DEF9		3
215R0	EENG500	Master Thesis	0
215R1	EENG521	Linear System Theory – I (Must Course)	3
215R2	REQ2	Required Graduate Course	3
215R3	REQ3	Required Graduate Course	3
215R4	REQ4	Required Graduate Course	3
215R5	REQ5	Required Graduate Course	3
215R6	REQ6	Required Graduate Course	3
215R7	REQ7	Required Graduate Course	3
215RS	EENG598	Seminar	0

Ph.D. Program			
Ref. Code	**Crs. Code**	**Course Name**	**Cr.**
216D1	DEF1		3
216D2	DEF2		3
216D3	DEF3		3
216D4	DEF4		3
216D5	DEF5	Deficiency courses (if required)	3
216D6	DEF6		3
216D7	DEF7		3
216D8	DEF8		3
216D9	DEF9		3
21699	EENG699	Ph.D. Qualifying Exam	0
216R0	EENG600	Ph.D. Thesis	0
216R1	REQ1	Required Graduate Course	3
216R2	REQ2	Required Graduate Course	3
216R3	REQ3	Required Graduate Course	3
216R4	REQ4	Required Graduate Course	3
216R5	REQ5	Required Graduate Course	3
216R6	REQ6	Required Graduate Course	3
216R7	REQ7	Required Graduate Course	3