FINAL INTERNATIONAL UNIVERSITY

Institute of Graduate Studies

Curriculum for ELECTRICAL AND ELECTRONIC ENGINEERING MASTER WITHOUT THESIS

Course categories: UC = University Core; FC = Faculty Core; AC = Area Core; AE = Area Elective; FE = Faculty Elective; UE = University Elective

Semester	Course Code	Course Title	Course Category	Hours			Total Credit	Pre-requisite	ECTS Credit
				Lecture	Tutorial	Lab / Prac.			
1	ELEE501	LINEAR SYSTEM THEORY	AC	3	0	0	3	-	8
1	BASC501	RESEARCH METHODS FOR BASIC SCIENCES	AC	3	0	0	3	-	8
1	ELEE5X1	AREA ELECTIVE	AE	x	x	x	x	-	7
1	ELEE5X2	AREA ELECTIVE	AE	x	x	x	x	-	7
		Total 4 Courses	TOTAL:	6	0	0	6		30
2	ELEE502	ADVANCED DIGITAL SIGNAL PROCESSING	AC	3	0	0	3	-	8
2	ELEE5X3	AREA ELECTIVE	AE	x	x	x	x	-	7
2	ELEE5X4	AREA ELECTIVE	AE	x	x	x	x	-	7
2	ELEE5X5	AREA ELECTIVE	AE	x	x	x	x	-	7
		Total 4 Courses	TOTAL:	3	0	0	3		29
3	ELEE550	PROJECT	FC	0	0	0	0	-	17
3	ELEE5X6	AREA ELECTIVE	AE	x	0	0	x	-	7
3	ELEE5X7	AREA ELECTIVE	AE	x	0	0	x	-	7
		Total 3 Courses	TOTAL:	9	0	0	9		31
			GRAND TOTAL	**18**	**0**	**0**	**18**		**90**

Area and Faculty Elective Courses

No.	Course Code	Course Title	Course Category	Hours			Total Credit	Pre-requisite	ECTS Credit
				Lecture	Tutorial	Lab/Prac.			
1.	STAT523	PROBABILITY THEORY AND STOCHASTIC PROCESSES	FE	3	0	0	3	-	8
2.	ELEE503	OPTIMIZATION THEORY	AE	3	0	0	3	-	7
3.	ELEE521	ADVANCED DATA COMMUNICATIONS AND COMPUTER NETWORKS	AE	3	0	0	3	-	7
4.	ELEE522	ADVANCED AUTOMATA THEORY	AE	3	0	0	3	-	7
5.	ELEE531	SELECTED TOPICS IN DIGITAL COMMUNICATIONS	AE	3	0	0	3	-	7
6.	ELEE533	ADVANCED DIGITAL IMAGE PROCESSING	AE	3	0	0	3	-	7
7.	ELEE534	ADVANCED INFORMATION THEORY	AE	3	0	0	3	-	7
8.	ELEE535	MOBILE COMMUNICATION SYSTEMS	AE	3	0	0	3	-	7
9.	ELEE536	SPECIAL TOPICS IN DIGITAL SIGNAL PROCESSING	AE	3	0	0	3	-	7
10.	ELEE537	SATELLITE COMMUNICATION SYSTEM	AE	3	0	0	3	-	7
11.	ELEE538	DETECTION AND ESTIMATION THEORY	AE	3	0	0	3	-	7
12.	ELEE539	SPEECH PROCESSING	AE	3	0	0	3	-	7
13.	ELEE541	MICROWAVE INTEGRATED CIRCUITS	AE	3	0	0	3	-	7
14.	ELEE542	ADVANCED ANTENNA THEORY	AE	3	0	0	3	-	7
15.	ELEE543	NUMERICAL METHODS IN ELECTROMAGNETICS	AE	3	0	0	3	-	7
16.	ELEE544	ELECTROMAGNETIC WAVE PROPAGATION	AE	3	0	0	3	-	7
17.	ELEE551	SPECIAL TOPICS IN POWER ELECTRONICS	AE	3	0	0	3	-	7
18.	ELEE552	SOLAR-THERMAL ENERGY AND ITS APPLICATIONS	AE	3	0	0	3	-	7
19.	ELEE553	ADVANCED INDUSTRIAL AND POWER ELECTRONICS	AE	3	0	0	3	-	7
20.	ELEE554	ENERGY SYSTEMS AND SUSTAINABILITY	AE	3	0	0	3	-	7
21.	ELEE561	ARTIFICIAL NEURAL NETWORKS	AE	3	0	0	3	-	7
22.	ELEE562	PATTERN RECOGNITION	AE	3	0	0	3	-	7
23.	ELEE563	ADVANCED ARTIFICIAL INTELLIGENCE	AE	3	0	0	3	-	7
24.	ELEE564	FUZZY SYSTEMS	AE	3	0	0	3	-	7
25.	ELEE571	ROBOTICS SYSTEMS	AE	3	0	0	3	-	7

Course Descriptions – I: All Area Core and Faculty/School Core courses offered by the department of the program.

Course Code	Course Title	Credit	ECTS Credit	Course Category	Pre-requisite	Teaching Language
BASC5501	RESEARCH METHODS FOR BASIC SCIENCES	(3, 0, 0)3	8	AC	-	English

Course Content

This course aims to build a strong foundation for conducting quality research in science and engineering at the graduate level. It covers scientific research methods and their implications throughout the research process. Students will learn how to effectively locate and utilize relevant sources, develop a positive research attitude, and appreciate scientific values like integrity, ethics, originality, and academic freedom. The course also focuses on honing skills in various academic genres, including research proposals, reports, journal papers, and theses, using appropriate formats, styles, and language. Additionally, students will explore the use of information technologies for literature search, data processing, written communication, presentations, and other contemporary research methods, along with practical applications.

Course Code	Course Title	Credit	ECTS Credit	Course Category	Pre-requisite	Teaching Language
ELEE501	LINEAR SYSTEM THEORY	(3, 0, 0)3	8	AC	-	English

Course Content

Linear spaces: fields, linear independence, basis, direct sum decomposition, normed linear spaces, convergence concepts, Banach spaces. Linear transformations: null and range spaces, matrix representation, block diagonal form. Linear transformations defined by a square matrix characteristic and minimal polynomial, direct sum decomposition of Cn, Jordan canonical form, functions of a square matrix. Hilbert spaces: inner product, concept of orthogonality, Hermitian matrices, projection theorem, systems of linear algebraic equations, general Fourier series. Differential equations: existence and uniqueness, linear differential equations, stability of solutions, variational equation, periodically time-varying differential equations. Difference equations

Course Code	Course Title	Credit	ECTS Credit	Course Category	Pre-requisite	Teaching Language
ELEE532	ADVANCED DIGITAL SIGNAL PROCESSING	(3, 0, 0)3	8	AC	-	English

Course Content

Design of IIR filters using Butterworth & Chebyshev approximations, frequency transformation techniques, structures for IIR systems – cascade, parallel, lattice & lattice-ladder structures, Fourier series method, Windowing techniques, design of digital filters based on least–squares method, pade approximations, least squares design, wiener filter methods, structures for FIR systems –cascade, parallel, lattice & lattice ladder structures. Estimation of spectra from finite duration observation of signals, Nonparametric methods: Bartlett, Welch & Blackman & Tukey methods, Relation between autocorrelation & model parameters, Yule-Walker& Burg Methods, MA & ARMA models for power spectrum estimation. Fixed, Floating Point Arithmetic – ADC quantization noise & signal quality – Finite word length effect in IIR digital Filters – Finite word length effects in FFT algorithms

Course Descriptions – II: All Area Elective and Faculty/School Elective courses offered by the department of the program.

Course Code	Course Title	Credit	ECTS Credit	Course Category	Pre-requisite	Teaching Language
STAT523	PROBABILITY THEORY AND STOCHASTIC PROCESSES	(3, 0, 0)3	8	AE	-	English

Course Content

Probability theory is a fundamental branch of mathematics that deals with modeling uncertainty. Its applications span diverse fields such as genetics, finance, and telecommunications. Moreover, it serves as the foundation for statistics, optimization methods, and risk modeling. This course introduces probability theory, random variables, and Markov processes. Covered topics include probability axioms, conditional probability, Bayes' theorem, discrete and continuous random variables, standard distributions, Poisson process, bivariate distributions, sequences of independent random variables, the weak law of large numbers, the central limit theorem, and Markov chains with probability transition matrices. Through this course, students gain essential knowledge and skills for understanding and analyzing uncertainty in various real-world scenarios.

ELEE503	OPTIMIZATION THEORY	(3, 0, 0)3	7	AE	-	English
Course Content	Advanced topics of optimization theory, numerical algorithms, and applications. The course is divided into three main parts: linear programming (simplex method, duality theory), unconstrained methods (optimality conditions, descent algorithms and convergence theorems, Newton's method, line search algorithms, steepest descent. Conjugate direction methods, the conjugate gradient method), and constrained minimization (Lagrange multipliers, Karush-Kuhn-Tucker conditions, active set, penalty and interior point methods. Fletcher-Reeves method. Quasi-Newtonian methods, the Davidson-Fletcher-Powell method. Constrained optimization. Equality and inequality constrains. Primal methods, feasible direction methods, penalty and barrier methods. Students will also use MATLAB's optimization toolbox to obtain practical experience with the material					
ELEE521	ADVANCED DATA COMMUNICATIONS AND COMPUTER NETWORKS	(3, 0, 0)3	7	AE	-	English
Course Content	This course provides the students with a comprehensive understanding of the protocols and technologies of Local and Wide Area Networks (LANs and WANs). Presentations and detailed analysis of computer/data networking technologies. Topics include ISO OSI layers 2 and above networking technologies, such as asynchronous transfer mode (ATM), frame relay, Ethernet networks, multi-protocol label switching (MPLS), and Internet protocol technologies, and their applications. Network architectures, protocol stacks, routing algorithms, quality of service (QoS), flow control and traffic management techniques, router/switch design, and data network applications/services will be studied. Students will use Wireshark to examine the various protocols					
ELEE522	ADVANCED AUTOMATA THEORY	(3, 0, 0)3	7	AE	-	English
Course Content	This course is dealing with the general theory, concept, and techniques related to the theory of automata. Practical examples related to programming languages are emphasized. Students will have the opportunity to utilize theoretical aspects of automata theory by performing a medium-scale design project. Topics include: Finite Automata, Transition Graphs, Non determinism, Finite Automata with Output, Context-Free Grammars, Regular Grammars, Chomsky Normal Form, Pushdown Automata, Context-Free Languages, Non-Context-Free Languages and regular expressions, context-free languages and pushdown automat, Parsing, and Turing Machines.					
ELEE531	SELECTED TOPICS IN DIGITAL COMMUNICATIONS	(3, 0, 0)3	7	AE	-	English
Course Content	Optimum receivers and the probability of error for the additive white Gaussian noise channel for binary and M-array modulations. Digital transmissions via carrier modulation such as MPSK, QAM, FSK, and MFSK. Probability of error and comparison of different modulation techniques. Coherent and no coherent techniques. Continuous phase modulation (CMP) techniques. Demodulation and detection of CPM signals, minimum shift keying (MSK). Chanel capacity and coding. Soft and hard decision decoding of block and cycling codes. Convolutional codes. Coding for bandwidth constrained channel using Trellis Coded Modulation (TCM). Spread Spectrum Communication Systems. Fast and slow frequency hopping.					
ELEE533	ADVANCED DIGITAL IMAGE PROCESSING	(3, 0, 0)3	7	AE	-	English
Course Content	Image processing has a wide range of applications such as security/authentication, remote sensing, medical imaging, machine/robot vision, pattern recognition, video processing, microscopic Imaging etc. that require processing such as image sharpening, restoration, and recognition. This course covers methods to recover the maximum amount of available information from an image including various mathematical operations used in image processing to remove obstructions from images and to recover reliable information. Topics include Two-dimensional signals and systems. Image sampling and quantization. Image Transforms: 2-D Discrete Fourier Transform, 2-D Discrete Cosine Transform. 2-D filter design. Image perception. Image enhancement. Image restoration. Image coding. Spatial Domain Processing and Frequency Domain Processing.					
ELEE534	ADVANCED INFORMATION THEORY	(3, 0, 0)3	7	AE	-	English
Course Content	Information theory is the study of the fundamental limits of information transmission and storage. The concepts of information theory extend far beyond communication theory, however, and have influenced diverse fields from physics to computer science to biology. This course, intended primarily for advanced undergraduates and beginning graduate students, offers a broad introduction to information theory and its applications: Entropy and information; lossless data compression; communication in the presence of noise, channel capacity, and channel coding; lossy compression and rate-distortion theory; Kolmogorov complexity.					

Course Descriptions – III: All Area Elective and Faculty/School Elective courses offered by the department of the program.

Course Code	Course Title	Credit	ECTS	Course	Pre-requisite	Teaching Language
ELEE535	MOBILE COMMUNICATION SYSTEMS	(3, 0, 0)3	7	AE	-	English
Course Content	This subject offers an overview of the history and development of mobile communications, focusing on modern systems. It covers the main principles of cellular communication systems, discussing system architectures and using examples from GSM and UMTS. The impact of radio wave propagation on mobile radio channel performance is explored, along with techniques to improve performance and mitigate adverse effects. Resource sharing methods like FDMA, TDMA, and CDMA are explained, and system capacity calculation methods are covered. Additionally, the course presents a roadmap for future developments, highlighting important technology trends such as LTE, Self-Organizing Network (SON), and Small cells. Through this subject, students gain insights into the dynamic and evolving field of mobile communications technology.					
ELEE537	SATELLITE COMMUNICATION SYSTEM	(3, 0, 0)3	7	AE	-	English
Course Content	This course introduces students to the fundamentals of satellite communication. To provide them with a sound understanding of how a satellite communication system successfully transfers information from one earth station to another. The topics includes Orbital aspects of satellite communication and spacecraft subsystems: orbital mechanics, look angle determination, orbital effects in communications system performance, spacecraft subsystems.) Satellite link design: basic transmission theory, down-link design, up-link design, noise power budget, design applications (INMARSAT, DBS TV). Modulation and multiplexing techniques for satellite links: Analog telephone transmission and multiplexing, analog TV transmission SNR calculations, Digital transmission and reception, TDM, BER & SER calculations. Multiple access: FDMA, TDMA, CDMA.					
ELEE538	DETECTION AND ESTIMATION THEORY	(3, 0, 0)3	7	AE	-	English
Course Content	Review of Gaussian variables and processes; problem formulation and objective of signal detection and signal parameter estimation in discrete-time domain. 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. Finite state Hidden Markov Models: forward-backward algorithm					
ELEE539	SPEECH PROCESSING	(3, 0, 0)3	7	AE	-	English
Course Content	This course covers the fundamentals of speech processing, including waveforms, spectra, spectrograms, resonance, formants, human speech production, and perception. Students will learn about perceptually-motivated frequency scales and time-frequency representations, as well as the Fourier transform and source-filter model of speech. The course includes hands-on experience with speech processing techniques. Automatic Speech Recognition (ASR) topics include speech signal parameterization, dynamic time warping, distance measures, Hidden Markov Models (HMMs), and probability theory. Students will explore Gaussian probability density functions, continuous density HMMs, Viterbi algorithm for recognition, and training methods from fully labeled data. Text-to-speech synthesis covers components of a typical synthesizer, text analysis, phonology, lexicon, waveform generation methods, and F0 and					

	duration modification techniques.					
ELEE541	MICROWAVE INTEGRATED CIRCUITS	(3, 0, 0)3	7	AE	-	English
Course Content	Two-port network characterization. Scattering matrix representation of microwave components. Planar transmission lines: Characteristics, properties, design parameters and applications. Design and realization of MIC Components. 3 dB hybrid design. Backward Directional Coupler, Hybrid ring and Power dividers. MIC filters. Kuroda transformation. K inverter, J inverter. Resonator filters. Realization using microstrip lines and strip lines. Microwave amplifier design. Power gain equations. Maximum gain design. Low noise Design. High power design. Stability considerations. Microwave oscillator design. One – port and two – port negative resistance oscillators. Oscillator design using large – signal measurements.					
ELEE542	ADVANCED ANTENNA THEORY	(3, 0, 0)3	7	AE	-	English
Course Content	This course explores the fundamentals of antenna theory and design. It covers the physical concepts of radiation, radiation patterns, near- and far-field regions, reciprocity, directivity, gain, polarization, and efficiency. Students will learn about various types of antennas, including wires, loops, aperture antennas, broadband antennas, microstrip antennas, and antenna arrays. Topics include radiation characteristics, design considerations, Huygens' principle, Babinet's principle, and smart antennas with adaptive beamforming. The course emphasizes practical applications in wireless communication, radar, and other communication systems. Students will gain the knowledge and skills necessary to design, analyze, and optimize different antenna systems for various communication requirements. Hands-on experience and problem-solving will be integral parts of the course.					
ELEE543	NUMERICAL METHODS IN ELECTROMAGNETICS	(3, 0, 0)3	7	AE	-	English
Course Content	Computational techniques for practical applications in electromagnetic fields, devices, scattering, propagation, and radiation. The course reviews the electromagnetic (EM) theory, static and dynamic fields, Maxwell's equations, boundary conditions, wave equations, Lorentz potentials, Green's functions, and basic EM-field theorems. Most popular classes of computational EM methods based on differential and integral equations are studied. Solution techniques include the method of moments, finite difference method, finite element method, physical optics and hybrid methods. Applications cover static and quasi-static problems, transmission lines, wireless propagation, scattering, radiation problems, EM compatibility, and signal integrity. The course includes about 10 computational EM projects in different techniques and different applications, using MATLAB.					
ELEE544	ELECTROMAGNETIC WAVE PROPAGATION	(3, 0, 0)3	7	AE	-	English
Course Content	This course covers fundamental concepts and theorems of electromagnetics, Maxwell's equations, and electromagnetic wave characteristics. It explores various classifications of waves, including guided waves and ground wave propagation. Topics include plane-earth reflection, space wave, surface wave, elevated dipole antenna above a plane earth, wave tilt of the surface wave, spherical earth propagation, and tropospheric waves. Additionally, the course delves into ionosphere propagation, covering the ionosphere, effective permittivity and conductivity of ionized gas, reflection, and refraction waves by the ionosphere, attenuation factor, sky-wave transmission calculations, and the effect of the earth's magnetic field on wave propagation in the ionosphere. Students will gain insights into wave propagation phenomena and their applications in communication systems and beyond.					
ELEE551	SPECIAL TOPICS IN POWER ELECTRONICS	(3, 0, 0)3	7	AE	-	English
Course Content	Characteristics of power electronic devices, switching characteristics of devices, power losses and thermal design. Classes of power converters and their operations: rectifiers; AC -AC Converters; DC-DC Converters; Inverters. Voltage and current source converters. Hard and soft-switching and resonant circuits. Power supplies (uninterruptible, switchmode) Advanced energy-efficient motor drives: review of motor theory, power electronic control principles, vector and servo drives (stepper, DC, induction, brushless PM and switched-reluctance). Modulation methods. Theory motor and drive selection and application. System design, implementation and control, and computer interfacing. EMI in Power Electronics Systems.					
ELEE553	ADVANCED INDUSTRIAL AND POWER ELECTRONICS	(3, 0, 0)3	7	AE	-	English
Course Content	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. 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.					
ELEE554	ENERGY SYSTEMS AND SUSTAINABILITY	(3, 0, 0)3	7	AE	-	English
Course Content	Interdisciplinary exploration of environmental, scientific, economic, social, and political opportunities and impacts associated with energy systems. Main fuel technologies such as fossil, hydroelectric, nuclear, photovoltaic, wind, and biomass. The supply and use of energy systems with emphasis on sustainability. Qualitative and quantitative analysis of energy resources, combustion, conversion, distribution processes in terms of environmental, social, and economic impacts. Emerging portfolios of energy systems. Investigation of local and global options. A term paper on a topic outside thesis research area. A local field trip.					
ELEE561	ARTIFICIAL NEURAL NETWORKS	(3, 0, 0)3	7	AE	-	English
Course Content	This course aims to equip students with a solid understanding of artificial neural networks and machine learning. Topics covered include the McCulloch-Pitts Model, activation functions, feed-forward and feed-back network structures, approximation of nonlinear functions, and supervised and unsupervised machine learning algorithms. Additionally, the course explores logic networks, recurrent networks, finite automata, finite state machines, harmonic analysis, weighted networks, pattern recognition, linear separability, perceptron learning algorithms, accelerating convergence, Markov Decision Processes, Dynamic Programming, and deep-learning techniques. Through this comprehensive curriculum, students will gain the knowledge and skills needed to apply artificial neural networks and machine learning algorithms effectively in various applications and problem-solving scenarios.					
ELEE562	PATTERN RECOGNITION	(3, 0, 0)3	7	AE	-	English
Course Content	Introduction to machine perception, Bayes decision theory. Parameter estimation and supervised learning; nonparametric techniques. Linear discriminant functions, unsupervised learning and clustering. Scene analysis, applications of pattern recognition. This class deals with the fundamentals of characterizing and recognizing patterns and features of interest in numerical data. We discuss the basic tools and theory for signal understanding problems with applications to user modeling, affect recognition, speech recognition and understanding, computer vision, physiological analysis, and more. We also cover decision theory, statistical classification, maximum likelihood and Bayesian estimation, nonparametric methods, unsupervised learning and clustering. Additional topics on machine and human learning from active research are also talked about in the class.					
ELEE564	FUZZY SYSTEMS	(3, 0, 0)3	7	AE	-	English
Course Content	Object-Oriented Framework. Class-objects, Virtual functions and Abstract classes, Polymorphism, Vector class, Matrix class and Neural net class. Fundamental Concepts in Neural Networks Learning paradigms, Perceptron learning, Multi-Layer Perceptron, Hebb Net, Perceptron, Adaline, Training algorithms for pattern association. Neural Net Models and Applications Derivation of Back-propagation Algorithms Clustering, Kohonen Self-Organizing Maps Counter propagation Adaptive Reasoning Theory (ART) Bidirectional Associative Memory system (BAM) Pattern Classification The self-organizing feature map, Clustering patterns, SOFM Algorithm, Pattern association, Hopfield Network Fuzzy Set Theory and Fuzzy Logic Control Sets, linguistic variables and fuzzy rules Mamdani and Sugeno-style inference Fuzzy Expert Systems FAM system architectures BIOFAM application (Inverted Pendulum) Fuzzy and neural control systems Image transform coding with adaptive fuzzy systems.					