

# MASTER OF SCIENCE PROGRAM IN ELECTRICAL-ELECTRONICS ENGINEERING

## COURSE CONTENTS

### **EEE 500 Research Methods and Scientific Ethics**

Thesis necessities, Scientific Research, Scientific Research Methods, Ethics of Science are some of the basic topics of the lectures, details are given at the weekly flow.

### **EEE 501 Advanced Scientific Computing**

Introduction to Scientific Computing, Solution of Nonlinear Equations, Solution of Linear Systems, Interpolation, Numerical Differentiation, Numerical Integration, Ordinary Differential Equations, Partial Differential Equations and applications

### **EEE 502 Linear System Theory**

Normal Matrices, Quadratic Forms and Semidefinite Matrices, Inner Product and Norm Spaces, State Space Descriptions for Continuous and Discrete Time Systems, Controllability, Observability, Stability, Realization Theory

### **EEE 503 Nonlinear System Analysis**

Linear versus nonlinear systems, Basic nonlinear analysis, Nonlinear ordinary differential equations, second order systems, Poincare-Bendixon theorem, Limit cycles, Stability in the sense of Lyapunov, Input-output stability, passivity, small gain theorem, Input-output stability, passivity, small gain theorem, Singular Perturbations, Differential geometric methods.

### **EEE 504 Random Processes**

The basic concepts of random variables, random vectors, stochastic processes. Common random processes including the white noise, Gaussian processes, Markov processes, Poisson processes, and Markov random fields. Moment analysis (including Karhunen- Loeve Transform), the frequency-domain description. Linear systems applied to stochastic processes. Elements of estimation theory and optimal filtering including Wiener and Kalman filtering.

### **EEE 505 Digital Communications**

Detection theory: binary M-ary hypothesis testing. Estimation theory. Representation of stochastic processes: Karhunen-Loeve expansion. Detection and estimation of signal parameters in white and colored noise. Wiener-Hopf equation and its solution. Optimum receivers. ML detectors. Channel capacity. Coding.

### **EEE 506 Wireless Communications**

Characterization of wireless communication channels and modulation methods under the constraints of both noise and finite bandwidth. Design and analysis of wireless communication systems under fading conditions. Wireless channel capacity. Diversity systems. Interference channels and equalization. Multi-channel and multi carrier systems. Spread spectrum techniques and multi user communications.

### **EEE 507 Digital Signal Processing**

Discrete Time Fourier Transform, Discrete Cosine Transform, Wavelet Transform. Discrete time random processes. Wiener Filter. Spectrum estimation (Minimum Variance, Maximum Entropy, MUSIC, PCA methods). Adaptive filters (LMS, RLS, Kalman).

### **EEE 508 Digital Image Processing**

Introduction to human visual system. Image formation. Various image transforms, Image enhancement, image restoration methods. Image segmentation. Image compression. Introduction to digital video. Hot topics in image processing.

### **EEE 509 Medical Imaging Systems**

Two dimensional signals and systems, multidimensional signal processing, multidimensional Fourier Transform. X-ray imaging systems. Digital angio systems. Mathematical foundations of computed tomography. Methods of image creation in computed tomography. Fundamentals of ultrasound and color imaging, ultrasound devices, hardware and software of color Doppler ultrasonography. Nuclear medicine and gamma cameras, reducing noise in gamma cameras. Magnetic resonance imaging systems, magnetic resonance imaging, magnetic resonance systems hardware and software.

### **EEE 510 Computational Electromagnetics**

Review of Electromagnetic Theory, Analytical Methods, Finite Time Difference Method, Variational Method, Finite Element Methods, Applications.

### **EEE 511 Electromagnetic Compatibility**

Introduction to Electromagnetic Compatibility, Non ideal behavior of components, Cross-talk and cables, Digital circuit radiation, Shielding, Grounding, EMC standards, Open area test sites, radiated interference measurements, Conducted interference measurements, Pulsed interference immunity, Projects.

### **EEE 512 Advanced Wave Propagation and Modeling**

Properties of Electromagnetic Waves, Propagation Mechanisms, Fundamentals of Antenna, Basic Propagation Models, Terrestrial Fixed Links, Satellite Fixed Links, Macrocells, Microcells, Picocells, Antennas for Mobile Systems, Projects.

### **EE 513 Computer Networks**

Five layered internet architecture and their protocols. Cloud computing, content delivery centers, multimedia delivery. Data warehouses. Security in computer networks.

### **EEE 514 Data Compression**

Information theoretic fundamentals of lossless data compression. Huffman coding, arithmetic coding, dictionary methods. Information theoretic fundamentals of lossy data compression. Scalar quantization, vector quantization, predictive coding, transform coding. Introduction to video coding.

### **EEE 515 Digital Image Forensics**

Digital image formation and human visual system. Steganography, watermarking and steganalysis techniques. Source identification, integrity and manipulation detection of digital images.

### **EEE 516 Bio-electromagnetic Interaction and Dosimetry**

Electromagnetic Fields, sources and interaction with matter, Maxwell equations, electromagnetic power absorption rate, polarization, electrical properties of the body, power absorption mechanism and calculating, exposure assessment, bio-electromagnetic dosimetry, international application of limits electromagnetic waves on medical fields. Epidemiological exposure assessment. Medical applications of electromagnetic waves.

### **EEE 517 Electromagnetic Fields in The Working Environments and Measurement Techniques**

Electromagnetic Fields and propagation, polarization, far field and near field, Application of electromagnetic fields on medical and industrials, the categories of working environment, describing of EM fields in the environments, Medical and transport systems, GSM transmitters, RFID, dielectric heatings, microwave drying, electricity production and distribution, electrochemical processes, welding, summation rules, specific calculation rules, directives of national and international, determination of EM pollution risk, measurement of controls and evaluation.

### **EEE 518 Microwave Engineering and Applications**

Electromagnetic Fields and propagation, Electromagnetic power and energy, features of microwaves, microwave applications, properties of microwave propagation, transmission lines and wave guides, types of medium, mode analysis of circular waveguides. microstrip line, microwave components, microwave tubes, amplifiers, microwave measurements, antenna systems, radar systems, microwave radiation hazards and protection.

### **EEE 519 Remote Sensing**

General Introduction, Physical Bases of Remote Sensing, Radiation Characteristics of Natural Phenomena, Sensors, Sensors Platform, Interpretation and Processing of Data, Introduction to Geographic Information Systems, Modeling Studies, Projects.

### **EEE 520 The Effects of Electromagnetic Fields on Human Health**

Sources of Electric and Magnetic Fields, Bio-effects of Electromagnetic Fields, Epidemiological Assessment Studies, Regulatory Activities and Safety Trends, Protection Guidelines and Site Surveys, Internal Field Dosimetry, Bio-effects of Optical frequencies, Projects.

### **EEE 580-589 Selected Topics**

In depth study of a selected topic in the area of Electrical-Electronics Engineering.

### **EEE 581 Digital System Design with FPGAs**

Introduction to FPGA technology and logic synthesis. Explanation of Hardware Description Language concept. Arithmetic and logic circuits for FPGAs. Controller and data path design. FPGA design laboratory project(s).

### **EEE 582 VLSI Design**

Fabrication processes for MOS technology. Layout design rules and examples. Introduction to interconnect and wiring effects, logical effort. Design choices considering power, area and speed. Introduction to data path design and arithmetic circuits considering VLSI design specifications.

### **EEE 590 Graduate Seminar**

A series of lectures in electrical-electronics engineering is given by faculty or outside speakers.

### **EEE 595 M. S. Thesis**

### **EEE 596 Term Project**