Jordan Universrsity of Science and Technology
Faculty of Graduate Studies

Course Curriculum for Master Degree in Electrical Engineering/Wireless Communications

The Master Degree in Electrical Engineering/Wireless Communications, is awarded by the Faculty of Graduate Studies at Jordan University of Science and Technology (JUST) upon the fulfillment of the following requirements:

1. **Compliance with the J.U.S.T. Master Degree regulations approved by the Dean Council (No. 31/2006), dated 8/8/2006,and its amendmants.**

2. **Successful completion of (34) credit hours in one of the following tracks:**

First: Thesis Track

1. Compulsory Requirements: (13) credit hours as follows:

Course Symbol and Number	Course Name	Credit
EE 705	Random Processes	3
EE 751	Digital Data Transmission	3
EE 770	Wireless Networking	3
EE 781	Wireless Communications	3
EE 795	Seminar in Wireless Communications	1

2. Elective Requirements: (12) credit hours from the following* :

Course Symbol and Number	Course Name	Credit
EE 700	Antennas and Radio Wave Propagation	3
EE 720	RF Circuit Design of Wireless System	3
EE 752	Error Control Coding	3
EE 757	Spread Spectrum Communications	3
EE 768	Digital Signal Processing for Communications	3

EE 771	**Computer Networks**	**3**
EE 772	**Wireless Systems Security**	**3**
EE 775	**Performance Analysis of Communications Networks**	**3**
EE 782	**Advanced Wireless Communications**	**3**
EE 789	**Special Topics in Wireless Communications**	**3**

*** The student may study not more than 3 credit hours from courses of 700 or 800 level offered by other programs related to his field of study upon approval of the Dean of Graduate Studies based on the recommendation of the departmental committee.**

3. Master Thesis (EE 799): total of 9 credit hours as follows:

Course Symbol and Number	Course Name	Credit
EE 799 A	**Master Thesis**	**9**
EE 799 B	**Master Thesis**	**6**
EE 799 C	**Master Thesis**	**3**
EE 799 D	**Master Thesis**	**0**

Second: Comprehensive Exam Track

1. Compulsory Requirements: (13) credit hours as follows:

Course Symbol and Number	Course Name	Credit
EE 705	**Random Processes**	**3**
EE 751	**Digital Data Transmission**	**3**
EE 770	**Wireless Networking**	**3**
EE 781	**Wireless Communications**	**3**
EE 795	**Seminar in Wireless Communications**	**1**

2. Elective Requirements: (21) credit hours from the following* :

Course Symbol and Number	Course Name	Credit
EE 700	**Antennas and Radio Wave Propagation**	**3**
EE 720	**RF Circuit Design of Wireless System**	**3**
EE 752	**Error Control Coding**	**3**

EE 757	**Spread Spectrum Communications**	**3**
EE 768	**Digital Signal Processing for Communications**	**3**
EE 771	**Computer Networks**	**3**
EE 772	**Wireless Systems Security**	**3**
EE 775	**Performance Analysis of Communications Networks**	**3**
EE 782	**Advanced Wireless Communications**	**3**
EE 789	**Special Topics in Wireless Communications**	**3**

*** The student may study not more than 6 credit hours from courses of 700 or 800 level offered by other programs related to his field of study upon approval of the Dean of Graduate Studies based on the recommendation of the departmental committee.**

3. Passing the Comprehensive Exam (EE 798): zero credit hour.

COURSES NAMES AND DESCRIPTION

EE 700: Antennas and Radio Wave Propagation (3 credit hours)

The Wireless Communication Channel, Properties of Electromagnetic Waves, Propagation Mechanisms, Antenna Fundamentals, Basic Propagation Models, Terrestrial Fixed Links, Satellite Fixed Links, Macrocells, Megacells Shadowing, Narrowband Fast Fading, Wideband Fast Fading, Microcells, Picocells, Diversity.

EE 705: Random Processes (3 credit hours)

Review of probability and random variables. Moments and characteristic function. Random vectors. Random processes: definition of a random process, specifying a random process, examples of random processes, stationary and wide-sense stationary processes, cyclostationary processes, mean and autocorrelation functions, power spectral density, time averages and ergodicity, response of linear systems to random signals. Optimum linear systems. Markov chains. Introduction to queueing theory.

EE 720: RF Circuit Design of Wireless Systems (3 credit hours)

Circuit design for gain and filtering at radio frequencies. Integrated circuit (IC) implementation of RF circuits for wireless communications. Interfacing between baseband processing systems and antennas. Transceiver architectures for current wireless communications standards, active/passive device technologies for

RFIC implementations, digital modulation and coding, detectors, phase-locked loops, effects of noise. The course involves circuit design at the IC level (FPGA using Verilog HDL). Design of a wireless transceiver functional block component RFIC chip.

EE 751: Digital Data Transmission (3 credit hours)

Elements of communication theory and information theory applied to digital communications systems. Characterization of noise and channel models. Characterization of communication signals and systems, representation of digitally modulated signals and spectral characteristics. Optimum receivers for AWGN channels: evaluation of error rate performance and channel bandwidth requirements. Channel capacity and coding theorem. Block and convolutional channel codes. Broadcast and Multiple access channels.FDMA, TDMA, and CDMA.

EE 752: Error Control Coding (3 credit hours)

General Introduction. Algebraic concepts. Linear block codes. Cyclic codes, error trapping, decoding of cyclic codes. BCH codes, majority-logic decoding of cyclic codes, finite geometry codes, burst error correcting codes. Convolutional codes. Maximum likelihood decoding. sequential decoding and majority-logic decoding of convolutional codes. Burst error correcting convolutional codes. Automatic repeat request strategies. Trellis coded modulation . Turbo codes. Low density parity check codes.

Pre.: EE 751

EE 757: Spread Spectrum Communications (3 credit hours)

Types of spread spectrum systems, FH and DS-SS, Hybrid DS/FH-SS. Pseudo noise generators: statistical properties of M sequences, Galois field construction, Gold codes. Code tracking loops, initial synchronization of the receiver spreading code. Performance in jamming environments. Performance in fading channels. DS and FH Code division multiple access systems

Pre.: EE 751

EE 768 :Digital Signal Processing For Communications (3 credit hours)

DSP fundamentals, such as DFT, FFT, IIR, and FIR filters, and DSP algorithms (ZF,ML,MMSE), DSP applications in wireless communications. Various physical layer issues in wireless communications are addressed, including channel estimation, adaptive equalization, synchronization, interference cancellation, OFDM, multi-user detection in CDMA, space-time coding, and smart antenna.

Pre.: EE 705

EE 770: Wireless Networking (3 credit hours)

Introduction to wireless and mobile networks. Types of networks, performance criteria. Queueing and analysis of networks. Internet Protocol (IP). Transmission Control Protoco (TCP/IP). Local area networks, Wireless local area networks (WLAN), protocols and performance analysis of CSMA-CD. Mobile networks, Cellular Wireless Networks Ad hoc networks and its routing Protocol. Sensor networks, Bluetooth network. Transport protocols for wireless networks, WAP, Wireless network security

EE 771: Computer Networks (3 credit hours)

Analysis of loosely coupled computer communication, communication protocols and network services. Layered open systems interconnection model (OSI) with emphasis on transport, network and data-link layers. Constraints on intercomputer communication and network services. Networking trends and concepts, network architecture, high speed LANs. Network Congestion Control, traffic management, routing techniques. Multicast protocols. Quality of service over IP and RTP protocols.

Pre.: EE 770

EE 772: Wireless Systems Security (3 credit hours)

Wireless systems and their unique vulnerabilities to attack; system security issues in the context of wireless systems, including satellite, terrestrial microwave, military tactical communications, public safety, cellular and wireless LAN networks; security topics: Confidentiality/privacy, integrity, availability, and control of fraudulent usage of networks. Issues addressed include jamming, interception and means to avoide them. Encryption: Sysmeteric and asymmetric key systems, message authentication, public key crypto systems, key distribution centers, and digital signature.

Pre.: EE 751

EE 775: Performance Analysis of Communications Networks (3 credit hours)

Communication Networks and Protocols: fundamentals and standards; Mathematical analysis: Queeues, Birth-Death processes, elementary queueing theory, Markov chains; Computer simulation: simple token passing discrete event, fixed assigned and random TDMA slotted systems, Input process: m-Erlang, Weibull,Normal,lognormal, geometric and Poisson distributions; Event graphs for simulation; Network system analysis using discrete-time Markov chain; Traffic analysis in LANs.

Pre.: EE 705

EE 781: Wireless Communications (3 credit hours)

Digital signaling over channels with intersymbol interference and AWGN. Cellular systems design fundamentals: cell and frequency reuse concepts, handoff strategies, cell splitting, cell Sectoring, interference and system capacity analysis. Wireless multipath channel models: time and frequency dispersive channels, level crossing and average fade duration. Diversity concepts: modeling and error probability performance evaluation. Spread spectrum in digital transmission over multipath fading channels, performance analysis and fading mitigation techniques.

Pre.: EE 751

EE 782: Advanced Wireless Communications (3 credit hours)

Wireless techniques and their performance: capacity of wireless channels, digital modulation techniques and their performance, diversity. Adaptive modulation: practical considerations. Multiple-input multiple output (MIMO) systems. Adaptive equalization. Multicarrier modulation and OFDM. Spread spectrum, CDMA, and multiuser systems. Introduction to wireless networks.

Pre.: EE 781

EE 789: Special Topics in Wireless Communications (3 credit hours)

This course treats topics in wireless communications that are not fully covered in other courses. An instructor-proposed syllabus has to be approved by the department council.

Pre.: EE 781

EE 795: Seminar in Wireless Communications (1 credit hour)

This course focuses on current research issues in wireless systems.

EE 798: Comprehensive Exam

EE 799A: Thesis Research

EE 799B: Thesis Research

EE 799C: Thesis Research

EE 799D: Thesis Research