Course Descriptions for the Master of Communications Engineering Program (Thesis Track)

[A0827701] Research Methodology
The general definition of scientific research, Research objectives, Types of research, Research algorithms, Research stages and their relationship to scientific methodology, Good research criteria, Determine the subject of research and the formulation of the research proposal, Research design, Design of research samples, Methods of data collection and analysis, Drafting and testing research hypotheses, Some modern techniques used in research developments (information technologies, advanced computer mathematical techniques).

[A0827101] Random Processes
Introduction to probability, Finite sample spaces, Conditional probability and independence, One dimensional random variables, Functions of random variables, Two and higher dimensional random variables, Further characterization of random variables, The Poisson and other discrete random variables, Some important continuous random variables, The moment generating functions, Sums of random variables and central limit theorem.

[A0827501] Electromagnetic Wave Propagation
Develop student's ability to analyze and understand time-varying electromagnetic wave propagation and reflection in different media, Propagation over flat earth, Propagation over spherical earth, Radio wave diffraction and knife edge model, Scattering and absorption of a wave by a single particle, Surface wave propagation, Ionospheric propagation, The effect of rain, snow, and ice on microwaves and millimeter waves, Millimeter-wave propagation.

[A0827401] Digital Communications
Signal representation and discrete nature of information, Signal and spectra, Bandpass modulation and demodulation (BPSK, QAM, FSK, DFSK, OOK, MSK, and M-ray), Optimum detection with MAP and ML, Rate efficient block communication, Capacity of AWGN channel, Communication and coding, Error-detecting and error-correcting codes, Linear block codes, Cyclic codes, Convolutional codes, Viterbi decoder, Trellis codes, Trellis decoding.

[A0827301] Wireless Communications
Analysis of the communication link, Capacity of fading channels, Wireless channels modeling, Noise evaluation in communication systems, Diversity (both receive and transmit), Adaptive modulation, Multicarrier modulation, Multiple access channels and their capacities, Multiuser diversity, MIMO detection algorithms like ZF, MMSE, VBLAST, Alamouti OSTBC, Other ST coding.

[A0827402] Communication Networks
The course includes several different topics starting from wireless communication basics to Mobile IP and ad hoc protocols and finally sensor networks architecture and protocols, Wireless networks and mobile systems, GPRS, UMTS, WCDMA, EDGE, Designing a wireless network, On the network layer level: broadcast and switching networks, bus, tree, and star topologies, Ethernet, Optical fiber bus networks, Ring networks, Medium access control protocols, Switching and routing concepts including circuit and packet switching, Frame relay and asynchronous transfer mode (ATM) networks.

[A0827102] Detection and Estimation
The main thrust of the course is to provide students with a solid understanding of essential topics in statistical signal processing applications: signal modeling (least squares modeling, Prony's method, ARMA models), Optimum filtering (Wiener Filters, Discrete Kalman Filter), Adaptive filtering (Steepest Descent, LMS, RLS) and spectrum estimation (Periodogram, Welch's Periodogram, Parametric Methods, MUSIC, APES).
Prerequisite: [A0827101] Random Processes

[A0827403] Advanced Digital Signal Processing
Signal representation and time domain analysis, Frequency domain analysis, Continuous time Fourier transform, Properties of Fourier transforms, Sampling theory, Quantization, Discrete time Fourier transform, z-transform, ROC, Properties of z-transforms, Inverse z-transforms, Causality, Conditions of causality, Real systems, Stability, Conditions of stability, Pole-zero representations of digital systems, system frequency response, General difference equation, Transfer function, Phase response, Magnitude response, Relationship between impulse response and frequency response, Discrete filter, Digital filter design criteria, Hardware implementation structured of filters, Direct form, cascade form, and parallel form for both FIR and IIR, Tapped delay line and transpose structures, Finite Impulse Response (FIR) Filters, Practical FIR filter implementation, Hamming, Hanning, Blackwell and Kaiser windows for FIR filter design, Fast Fourier transform algorithm.

[A0827302] Antennas and Applications
This course covers: time varying fields, retarded potentials, Poynting's theorem, reciprocity, regions of reactive, transition, and far-field, Ideal dipole, Antenna parameters: directivity, gain, and aperture, Dipole and loop antennas, Antenna self and mutual impedance, Matching techniques, Travelling wave antennas, Broadband antennas, Equivalence principle, Aperture antennas, Balanced and unbalanced antennas, Antenna polarization, Feed structures, Antenna arrays.
Prerequisite: [A0827501] Electromagnetic Wave Propagation

[A0827303] Advanced Optical Communications
Introduction and overview of the course, Optical fibers: Attenuation and dispersion, Guided wave propagation, Modes in optical fiber, Laser generation, Semiconductor lasers, Light amplifiers and their applications, Optical modulation techniques, Multiplexing methods, Optical detectors and receivers, Quantum efficiency, Responsivity and bandwidth, Optical communication systems: optical modems, Digital optical networks, Nonlinear optics and Soliton systems, Simulation techniques and practical aspects, Research project.

[A0827404] Data Transmission
Random processes and linear systems, Baseband modulation/demodulation, Optimal receivers in AWGN, Correlation and matched-filter receivers, Pulse shaping for band limited channels, Bandpass modulation techniques such as PAM, PSK, DPSK, FSK, and QAM, Introduction to error control coding, Linear block codes, Cyclic codes, Convolutional codes.
Prerequisite: [A0827402] Communication Networks

[A0827601] Special Topics in Communications
The objective of this course is to introduce advanced and new topics in one (or more) of the areas of communications engineering. The topics can be changed from one year to another depending on the instructor’s area of specialty and expertise.