

M.Tech. (Electronics & Communication Engineering)

Approved and adopted in year 2018 (Board of Studies, August 3, 2018)
by 23rd Academic council (Agenda no-3.2 d)

Subject Code	Subject Name	L	T	P	Cr
1st Semester					
EC-501	Signal Theory	3-	1-	0	4
E-C503	Digital Communication	3	- 1	- 0	4
EC-505	Computer Communication and Networks	3	- 1	- 0	4
EC-507	Digital Signal Processing	3	- 1	- 0	4
EC-551	Lab.-I	0	- 0	- 4	2
EC-581	Seminar	0	- 3	- 0	2
2nd Semester					
EC-502	Information Theory & Coding	3	- 1	- 0	4
EC-504	Microwave Theory & Circuits	3	- 1	- 0	4
EC-506	Communication Hardware	3	- 1	- 0	4
EC-52_	Elective-I	3	- 1	- 0	4
EC-552	Lab.-II	0	- 0	- 4	2
EC-582	Seminar	0	- 3	- 0	2
3rd Semester					
EC-601	Optical Communication System	3	- 1	- 0	4
EC-603	Detection & Estimation Theory	3	- 1	- 0	4
EC-605	Antenna Theory & Techniques	3	- 1	- 0	4
EC-62_	Elective-II	3	- 1	- 0	4
EC-651	Lab.-III	0	- 0	- 4	2
EC-671	Minor Project	0	- 0	- 4	2
4th Semester					
EC-692	Dissertation	0	- 0	- 28	14
	Grand Total				74

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List of Electives	
Elective 1	Elective 2
EC-521 Statistical Signal Processing	EC-621 CAD of RF and Microwave Circuits
EC-522 Microwave Propagation & System	EC-622 Protocol Engineering
CSMT-524 Network Security	EC-623 Millimeter wave integrated Circuits
EC-523 Network Management	EC- 624 Recent trends in Communication Engineering
EC-524 Numerical techniques in Electromagnetics	EC-625 Telecommunication Technologies
EC- 525 Optical Data Processing	EC-626 Wireless Communication
EC- 526 Fading Channel	CSMT-622 Embedded systems

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EC-501: SIGNAL THEORY

Representation of deterministic signal: Orthogonal representation of signals. Dimensionality of signal spaces. Construction of orthogonal basis functions. Time-bandwidth relationship: RMS duration and bandwidth, uncertainty relations. Random Processes: Definition and classification, stochastic integrals, Fourier transforms of random processes, correlation functions. Ergodicity power spectral density, transformations of random processes by linear systems. Representation of random processes (via sampling, K-L expansion and narrow band representations), special random processes (white Gaussian noise, Wiener-Levy processes, shot-noise processes, Markov processes). Optimum Filtering: Matched filters for deterministic signals in white and colored Gaussian noise. Wiener filters for random signals in white and colored Gaussian noise. Discrete and continuous time filters.

EC-503: DIGITAL COMMUNICATION

Characterization of communication signals, signal space representation, equalisation, matched filtering, binary. Coherent & non coherent detection, carrier & symbol synchronization, bits vs symbol error probability, bandwidth efficiency, Spread spectrum modulation: Pseudo noise sequences, DS & FH spread spectrum.

Sampling process: Base-band and band-pass sampling theorems, reconstruction from samples. Practical aspects of sampling and signal recovery. TDM. Waveform coding. Techniques: PCM. Channel noise and error probability. DPCM and DM. Coding speech at low bit rates. Prediction

and adaptive filters. Base band shaping for data transmission. PAM signals and their power spectra. Nyquist criterion. ISI and eye pattern. Equalization. Digital modulation techniques: Binary and Mary modulation techniques. Coherent and non-coherent detection. Bit vs. symbol error probability and bandwidth efficiency. Spread-spectrum modulation: Pseudo noise sequences. Direct sequence and frequency-Hop spread spectrum, Signal-space dimensionality and processing gain, data networks.

EC-505: COMPUTER COMMUNICATION AND NETWORKS

Review of data communication techniques. Data transmission, line coding, error control coding. Data switching, circuit switching, message and packet switching. Network model ISO-OSI model, primitives and services. Queuing, pipelined and sliding window protocols, X 25 data link layer, Random access techniques. Pure, slotted and finite population ALOHAs, Routing and congestion control static, adaptive, centralized and distributed routing procedures, congestion control, LAN topologies and protocols, IEEE 802.x protocols, High speed LANs, Transport layer Session and presentation layer, data compression data security.

EC-507: DIGITAL SIGNAL PROCESSING

Discrete time signals & systems, Z transforms, structures for digital filters, Design procedure for FIR and IIR filters. Frequency transformations, Linear phase design, Introduction to DFT and its properties. Decimation in time and decimation in frequency FFT algorithms, discrete cosine transform. Methods for fast computation of DFT including FFT, NTT and WTFA. Noise analysis of digital filters. Power spectrum estimation. Multi-

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rate digital filtering: Introduction to
multidimensional DSP. Examples of
applications of DSP in communications.

EC-502: INFORMATION THEORY & CODING

Shannon's fundamental coding theorems, Differential entropy & mutual information for discrete & continuous ensembles, source coding, Rate distortion theory. Measures of Information, Information contents of discrete sources, the entropy function, Communication channel Modules, Source coding: Prefix codes, Block codes and Tree codes for data compaction, Discrete-time Channels and their capacity, the Random Coding Band, Block Codes and tree for data transmission, Algebraic codes; Hamming, BCH, Reed-Solomon and Reed-Muller Codes, Algebraic Geometric Codes: Goppa codes and Codes over elliptic curves, signaling with and without bandwidth constraint, combined coding and Modulation: Trellis Coded Modulation (TCM, One and two dimensional modulations for TCM, Multidimensional TCM, Lattice Codes.

EC-504: MICROWAVE THEORY AND CIRCUITS

Review of EM Theory: Maxwell's equations, plane waves in dielectric and conducting media, energy and power. Transmission lines and waveguides: closed and dielectric guides, planar transmission lines and optical fiber. Network analysis: scattering matrix and other parameters, signal flow graphs and network representation. Impedance matching and tuning. Analysis of planar transmission lines. Analysis and design of passive components.

EC-506: COMMUNICATION HARDWARE

Introduction: Basic line circuits in telephony and telegraphy; long-haul communication circuits; principles of circuits switching & signaling: schemes, CCS7, Review of transmission systems – cable, radio, microwave optical, satellite, tropo-scatter. Review: Strowger's and crossbar switches; space-time and space time division switching; single stage and multistage switching network + example, principles of large scale switch design. Properties of connecting networks: mathematical models of network states, rearrange ability: wide-sense and strict sense non-blocking criteria, Slepian-Duguid Theorem, Paul's Theorem. Traffic Engineering and Tele-traffic Theory: Markov processes representing traffic, calculation of blocking probability, stationary probability measures for Markov processes, combinatorial interpretation, calculation of blocking probability. Switching Network Control and management, data networks and protocols, ISDN, Message Handling systems/intelligent networks, multi-service broadband switching fabrics-ATM.

EC-601: OPTICAL COMMUNICATION SYSTEM

Introduction to optical communications, Optical signaling schemes viz. IM, PL, PCM, PCM/PL, digital PPM, PRM, PFM etc., video signal, electro-optic modulators, Various receiver configurations, noise sources in optical communication, direct detection receiver, optimum gain in APD, signal-to-noise ratio(SNR) calculations, Optimization of SNR, optical preamplifier design, Optical line coding schemes, performance evaluation of various optical receivers and their comparative study,

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Applications of optical amplifier in the system. Optical fiber link design-power budget, time budget and maximum link length calculation, hybrid fiber co-axial/microwave links, fiber-in-the loop (FITL)-FTTH/FFTB, FTTC. **Classification of optical sensors. Intensity modulated, phase modulated and spectrally modulated sensors.**

EC-603: DETECTION & ESTIMATION THEORY

Hypothesis testing Bayes, Minimax and Neyman-Pearson criteria. Types of estimates and error bounds. General Gaussian problem. Detection and estimation in colored noise. Elements sequential and nonparametric detection. Wiener-Hopf and Kalman filtering. Applications to communication, radar and sonar systems.

EC-605: ANTENNA THEORY AND TECHNIQUES

Review of the theory of electromagnetic radiation. Introduction to various antenna types, wire, loop and helix antennas, analysis using assumed current distribution. Aperture antennas: slot, waveguide, horn, reflector and printed antennas. Analysis using field equivalence principle and Fourier transform methods. Linear arrays. Broadband antennas. Antenna measurements, **Printed antennas: Feeding methods, transmission line & cavity models, analysis and design of rectangular & circular microstrip antenna. Arrays: pattern synthesis, planar arrays, phased arrays. Active antennas and arrays.**

Electives

STATISTICAL SIGNAL PROCESSING

Mathematical preliminaries. Wiener filtering and MMSE estimates. Linear prediction, Levinson-Durbin algorithm and lattice. Filters: Overview of Spectral Estimation Methods. Adaptive Algorithms: LMS Algorithm, Convergence Analysis, Adaptive Noise Canceller; Least Squares Algorithm: General Weighted Least Squares Methods, Recursive Least Squares Algorithm, Fast Least Squares Algorithm to AR modeling case. Special Topics.

CAD OF RF AND MICROWAVE CIRCUITS

Small signal amplifiers – low noise, maximum gain, stability, Broad band amplifiers- matching circuits, travelling wave amplifiers. Power amplifiers – Efficiency, CAD, Device modeling, measurement. Mixers- Single ended, balanced, double balanced, different configurations for micro strip, waveguides., noise properties, simulation using harmonic balance, Oscillators- various configurations depending on active device, stability and noise, resonators, VCO, transient analysis using SPICE, harmonic balance analysis, frequency synthesis using DDS, PLL. **MICROWAVE PROPAGATION AND SYSTEMS**

Frequency bands and allocations. Earth and its effects on propagation. Atmosphere and its effects on propagation. Attenuation of millimeter waves. Line-of-sight communication links: system configuration, multiplexing, link design. Topo-scatter propagation and links: Fading and diversity reception, path profile and path loss, link design, signal design for fading channels.

NETWORK SECURITY

Introduction, OSI Security Architecture, Attacks, Services, Mechanisms, Model for Internetwork

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Security, Internet Standards the Internet Society. Cryptography, Symmetric Encryption, Public-Key Cryptography and Message Authentication, Digital Signatures. Security applications, IP Security, Architecture. Web Security, Web Security Requirements, Secure Sockets Layer and Transport Layer Security, Secure Electronic Transaction. Network Management Security, SNMP, SNMPv1 Community Facility, System Security, Intruders, Intrusion, Malicious Software.

NETWORK MANAGEMENT

Network planning, network initialization and configuration management, fault management, usage accounting and security, Current network and management systems and the role played by network management protocols and products.

FADING CHANNELS

Fading channel models and characterization: Scatter model. Scattering function. Classification of channels (dispersive only in time, only in frequency, doubly dispersive). Modulation and demodulation: Optimum receiver principles, structure of modulators and demodulators. Combining techniques. General principles of linear combining, selection combining, maximal ratio combining and equal gain combining. Decision oriented diversity, optimum combining. Coding for fading channels. Trivial repetitive coding, Interleaved coding, dual-k convolution codes and trellis codes for fading channels. Performance evaluation. Random coding bound for coded systems, probability of error. Bandwidth and complexity. Performance of linear combining systems. Examples of fading channels: Discussion on mobile communication channels and tropo-scatter channels.

OPTICAL DATA PROCESSING

Review of Fourier optics, coherent and incoherent imaging transfer functions, equivalence of optical and electrical systems, spatial filtering, holographic data processing, optical memories, application to synthetic aperture radar and biological signal processing. Hybrid opto-digital signal processing.

TELECOMMUNICATION TECHNOLOGIES

Data Networks, ISDN, SS7, Access-WILL/RILL, DECT, FITL, WAN-Frame Relay, ATM. Telecommunication Management Network (TMN), Tele traffic Theory and Network analysis, Network planning and design.

PROTOCOL ENGINEERING

Principles, stages, specification formalisms (UML, SDL, ASN-1) of telecom protocol design, protocol software development process, computer aided protocol engineering, verification and testing of protocols, object oriented techniques in protocol development

MILLIMETER WAVE INTEGRATED CIRCUITS

Analysis of basic transmission lines for millimeter wave frequencies. Integrated finline, image guide and its variants, non-radiative guide, H-guide and groove guide. Millimeter wave devices for generation and detection. Transitions, bends and discontinuities. Measurement techniques. Design of millimeter wave devices couplers, power dividers, filters, oscillators, mixers, switches, phase shifters and amplifiers.

NUMERICAL TECHNIQUES IN ELECTROMAGNETICS

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Review of analytical methods: Separation of variables conformal transformation: Green's function. Finite difference method: Iterative solution: relaxation and acceleration processes: different boundary conditions. Variational method: Derivation of variational expression; Euler-Lagrange equation: Rayleigh-Ritz method. Finite element method: Discretization of solution region: shape functions: element matrices and global matrix: method of solution Method of moments; Basis functions; weighted residuals; method of least squares; numerical integration.

WIRELESS COMMUNICATIONS

Cellular Concepts. Mobile Radio Propagation. Co-channel Interference. Modulation Techniques. Diversity. Channel Coding. Multiple Access. Cellular Coverage Planning. Wireless Networking. Wireless Systems and Standards.

AUDIT COURSE

1. Signals & Systems

Signal representation: Signal classification, Fourier Series, Fourier transform, Laplace

transform. LTI System, transform analysis of LTI System. Transfer function. Time domain description and conversion. Transfer function and frequency response, impulse response, stability criteria, Bode plot, Phase and gain margin.

2. Communication System

Random Signal analysis. Random process, ergodicity, power spectral density. Auto- and Cross correlation. AWGN channel, Analog modulation techniques: AM, DS, BSC, SSB, narrow and wide band FM, Demodulation of AM & FM Signals, Pulse Analog modulation, PAM, PWM & PPM, spectral analysis TDM, FDM.

3. Transmission lines and waveguides

Maxwell's equation: a review. Wave equation, uniform plane waves. Transmission line equation, characteristic impedance, VSWR, Single and double stub matching s-parameters. Switch front. Waveguides, rectangular and circular waveguide, cavity resonators.