M. Tech.

in

COMMUNICATION ENGINEERING AND NETWORKS

CURRICULUM 2022-23

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

NATIONAL INSTITUTE OF TECHNOLOGY KARNATAKA,

SURATHKAL – 575025

NATIONAL INSTITUTE OF TECHNOLOGY KARNATAKA, SURATHKAL

Vision

To facilitate transformation of students into good human beings, responsible citizens & competent professionals, focusing on the assimilation, generation and dissemination of knowledge.

Mission

- Impart quality education to meet the needs of profession and society, and achieve excellence in teaching-learning and research.
- Attract and develop talented and committed human resources, and provide an environment conducive to innovation, creativity, team-spirit and entrepreneurial leadership.
- Facilitate effective interactions among faculty and students, and foster networking with alumni, industries, institutions and other stake-holders.
- Practice and promote high standards of professional ethics, transparency and accountability.

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Vision

To be a model for academic excellence in the area of Electronics & Communication Engineering.

Mission

M1. Impart quality teaching-learning-experience with state-of-the-art curriculum.

M2. Enhance Research, Consultancy and Outreach activities.

M3. Increase the visibility of academic programs globally and attract talent at all levels.

M4. Foster sustained interaction with the alumni, industries, R & D organizations, world class universities and other stakeholders to stay relevant in the globalized environment.

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

M. Tech. in Communication Engineering and Networks (CE&N)

Program Educational Objectives (PEOs)

PEO1: To be empowered to pursue a successful professional career in the field of Communication Engineering and Networks and contribute to the profession in Industry / Research and Development / Academia / Consulting / Policy making / Government service and other professional vocation.

PEO2: To inculcate an attitude in pursuing state-of-the-art research in the broad areas of Communication and Networks.

PEO3: To demonstrate effective communication skills, leadership qualities, commitment to professional ethics, responsibilities and norms of Communication.

Program Outcomes (POs)

PO1: An ability to independently carry out research / investigation and development work to solve practical problems.

PO2: An ability to write and present a substantial technical report / document.

PO3: An ability to demonstrate a degree of mastery over Communication Engineering and Networks.

PO4: An ability to analyse and apply appropriate concepts, techniques and modern engineering tools in design and implementation of systems in the domain of Communication Engineering and Networks.

PO5: An ability to develop customized prototype solutions and / or communication system testbed solutions in the global and societal contexts to contribute to sustainable social development

M. Tech. in Communication Engineering and Networks (CE&N)

Suggested Plan of Study:

Sl. No.	Semester			
	I	II	III	IV
1	EC731	EC733	EC759	EC760
2	EC732	EC734		
3	EC791	EC758		
4	EC793	EC736		
5	EC757	Elective 2		
6	Elective 1	Elective 3		

Credit Requirements:

Category	Minimum Credits to be Earned
Program Core (Pc)	26
Elective Courses (Ele)	12
Mandatory Learning Courses (MLC)	04
Major Project (MP)	12
Total	**54**

Program Core (Pc)

EC731 Wireless Communication & Networks (4-0-0) 4
EC732 RF Circuit Design (4-0-0) 4
EC733 Optical Networks and Switching (4-0-0) 4
EC734 Signal Detection and Estimation (4-0-0) 4
EC736 Communication & Networking Lab (0-0-3) 2
EC791 Linear Algebra and Stochastic Processes (4-0-0) 4
EC793 Signal Analysis and Processing (4-0-0) 4

Electives (Ele)

(At least ONE elective must be chosen from this list)

EC831 Spread Spectrum Communication Systems (4-0-0) 4
EC832 MIMO Communication Systems (4-0-0) 4
EC833 Internet of Things (4-0-0) 4
EC834 Error Control Coding (4-0-0) 4
EC835 Algorithms for Parameter and State Estimation (4-0-0) 4
EC836 Radar Signal Processing (4-0-0) 4
EC837 Advanced Radiating Systems (4-0-0) 4
EC838 Multi Target Tracking and Multi-Sensor Information Fusion (4-0-0) 4
EC839 Nano-Photonics (4-0-0) 4
EC840 Millimetre Wave Communications (4-0-0) 4
EC841 Cryptography (4-0-0) 4
EC842 Information Theory (4-0-0) 4
EC843 Broadband Communications (4-0-0) 4
EC844 Electromagnetic Interference and Compatibility (4-0-0) 4
EC845 Principles of Communication Systems Simulation (4-0-0) 4
EC846 Computer Communication Networks (4-0-0) 4
EC847 Selected Topics in Communication Engineering (4-0-0) 4
EC848 Signal Processing Techniques for Software defined Radios (4-0-0) 4
EC849 RF Transceiver Systems Design for Wireless Communication (4-0-0) 4
EC850 Design and Integrated Circuits for Wireless Communication (4-0-0) 4
EC851 Smart Antennas for Mobile Communication (3-1-0) 4
EC852 Synchronization in Wireless Communication Systems (3-1-0) 4
EC853 Channel Modelling and Equalizer Design for Wireless Communications (3-1-0) 4

Mandatory Learning Courses (MLC)

EC757 Seminar 2
EC758 Minor Project 2

Major Project (MP)

EC759 Major Project - I 6
EC760 Major Project - II 6

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING
M.Tech. in Communication Engineering and Networks

EC731 WIRELESS COMMUNICATION & NETWORKS (4-0-0) 4

Course Contents

Introduction to Wireless Communication Systems, Channel Modeling- Pathloss, large-scale fading, small-scale fading; Power budget of mobile links - Doppler spread and coherent time, delay spread and coherent bandwidth; flat fading and frequency selective fading. Digital Modulation and its various aspects, Channel Coding- forward error correction (FEC) coding, Network Architectures, Medium Access Schemes, Communication Protocol Layers, Routing Strategies, Network Reliability, Congestion Issues, Advanced Topics in Wireless Research-MANETs, Sensor Networks, Cellular Network Concepts, SDN, Existing Wireless Systems –GSM and its evolution.

References

A. Goldsmith, Wireless Communications, Cambridge University Press, 2005.
T. S. Rappaport, Wireless Communications Principles and Practice (2nd edition) Pearson, 2010.
Haykin & Moher, Modern Wireless Communications Indian Edition, Pearson, 2011.
James F.Kurose, Computer Networking: A Top own Approach, 5th Ed., Pearson, 2012
A. Kumar, D. Manjunath and Joy Kuri, Communication Networking: An Analytical Approach, Morgan Kauffmann, 2004.

EC732 RF CIRCUIT DESIGN (4-0-0) 4

Course Contents

Review of Basic Transmission Line Theory, Planar Transmission Lines Microwave Network Analysis - Microwave network representation, Impedance Matching Techniques, Binomial and Chebyshev approximations, Basic Passive Components, Analysis and design of stripline/ microstrip components- Equivalent circuit and Characteristics, Basic series and shunt switches in microstrip; SPST and SPDT switches, Switched line, branch line coupled and loaded line phase shifters in microstrip. Applications in phased arrays. MIC Filters, Examples-Realization of lumped elements and filters in MMIC, Realization of planar transmission lines and filters in MEMS.

References

D.M. Pozar, Microwave Engineering, 2 Edition, John Wiley & Sons, 1998.
Michael Steer, "Microwave and RF Design: A Systems Approach", First Edition, Yes Dee Publishing 2012.
Peter Rizzi, Microwave Engineering-Passive Circuits, Pearson Education, 1988..
R. Ludwig and G. Bogdanov, "RF Circuit Design: Theory and Applications", 2nd Edition, Pearson Education India, 2009.
Behzad Razavi, "RF Microelectronics", Second Edition, Pearson Education India, 2012.

EC733 OPTICAL NETWORKS AND SWITCHING (4-0-0) 4

Course Contents

Introduction to basic optical communications and devices. Optical multiplexing techniques. Optical Networks: Conventional optical networks, Multiple access optical networks, Optical amplification in all optical networks. All-optical subscriber access networks. Design issues. Optical switching: Motivation, Spatial light modulator, Relational and non-relational switching devices, Fundamental limits on optical switching elements, Switching architectures, Free-space optical switching. Wavelength routed networks and other special topics. Soliton based networks, Optical networks management issues.

References

Rajiv Ramaswami, Kumar Sivarajan, Galen Sasaki, Morgan Optical Networks: A Practical Perspective, Kauffman Publishers, ELSEVIER, 2010.
Hussein T. Mouftah, Jaafar M. H. Elmirghani, Photonic Switching Technology: Systems and Networks, Wiley, 1999.
Ray T. Chen, Joseph C. WDM and Photonic Switching Devices for Network Applications, Volume 4653, Chon SPIE, 2002 - Technology & Engineering
Martin Maier, Optical Switching Networks, Cambridge University Press, 2008.
A. Selvarajan, Subrat Kar, T. Srinivas, Optical Fibre Communication: principles and systems, TMH, 2002.

EC734 SIGNAL DETECTION AND ESTIMATION (4-0-0) 4

Course Contents

Hypothesis Testing, Neyman Pearson Lemma, UMP test, Decision Theoretic framework, Multiple-Decision Problem. Parameter Estimation - Unbiasedness, Consistency, asymptotic normality, sufficient statistics, minimax estimation, decision theoretic framework, Rao-Blackwell theorem, Cramer – Rao inequality. Estimation: Minimum mean square linear estimation, Wiener filter, Kalman filter, Levinson – Durbin and innovation algorithms.

References

H. L. Van Trees Detection, Estimation and Modulation Theory, Part I, John Wiley, 1968.
Srinath, Rajasekaran and Viswanathan, Introduction to Statistical Signal Processing with applications, PHI, 1995.
Steven M. Kay, Fundaments of Statistical Signal Processing, Vol. I:Estimation Theory, Vol. II: Detection Theory, Prentice Hall International, 1993
Papoulis A., Probability Random Variables and Stochastic Processes, McGraw Hill, 2002
H. Stark and J. W Woods, Probability and Random Processes with applications to signal processing, Pearson Education, 2002.

EC736 COMMUNICATION AND NETWORKING LAB (0-0-3) 2

Course Contents

Design experiments to reflect the contents of core courses in the curriculum. Exposure to hardware design of communication systems and simulation using tools such as MATLAB, ADS, HFSS, SystemVue, Network Simulator and GNU Radio etc.

EC791 LINEAR ALGEBRA AND STOCHASTIC PROCESSES (3-1-0) 4

Course Contents

Vector Spaces, Subspaces, Linear Independence, Span, Basis, Dimension, Linear Transformations, Orthogonal Transformations, Orthogonal projections, Matrix subspaces and orientation, Eigen decomposition, SVD, Least Squares , Pseudo inverse.

Review of Probability theory and Random variables, Random vectors and moments, Stochastic Processes and Examples, stochastic processes and linear systems, Gaussian random process, spectral analysis of stationary processes, Power Spectral Densities, Stationarity and Ergodicity.

References

Gilbert Stran, Linear algebra and its applications, Thomson Brooks, 2006.
P Halmos, Finite Dimensional Vector Spaces, Springer, 1993.
Edgar G. Goodaire, Linear Algebra: Pure & Applied, World Scientific, 2014.
Dimitris P. Bertsekas, John N. Tsitsiklis, Introduction to Probability, 2nd Ed, Athena Scientific, 2008.
Alberto Leon-Garcia, Probability, Statistics, and Random Processes for Electrical Engineering, 3rd Ed, Addison-Wesley, 2008.

EC793 SIGNAL ANALYSIS AND PROCESSING (4-0-0) 4

Course Contents

Review of Time domain analysis of discrete-time signals & systems, Transform domain analysis of discrete time signals & systems: Z transforms, application of Z transforms to discrete-time systems, Frequency domain analysis of discrete-time signals and systems, Sampling in time and frequency domain, linear convolution using DFT, Fast Fourier Transform algorithms.

Digital Filter Design: Filter Structures; FIR filter design, IIR Filter Design, Filter design using Butterworth, Chebyshev and elliptic approximations, Spectral transformation technique for HP, BP and BS filter design. Direct design of IIR filters, Introduction to multirate Signal Processing, Upsampling, Downsampling, Sample rate conversion.

References

D G Manolakis, V K Ingle, Applied Digital Signal Processing, Cambridge University Press, 2012
Oppenheim, Schaffer, Discrete Time Signal Processing, Prentice Hall,
Ashok Ambardar, Digital Signal Processing – A Modern Introduction, Thomson, 2007
Sanjit K. Mitra, Digital Signal Processing: A computer based Approach, TMH, 2006

ELECTIVE COURSES

EC831 SPREAD SPECTRUM COMMUNICATION SYSTEMS (4-0-0) 4

Course Contents

Direct sequence spread spectrum, Frequency hop spread spectrum, Hybrid direct sequence/frequency hop spread spectrum, Complex envelope representation of spread spectrum systems. Binary Shift Register Sequences for Spread Spectrum Systems: Maximum length sequences, Gold Codes, Synchronization of Spread Spectrum Signals: Acquisition, Tracking, Code tracking loops for frequency hop systems, Synchronization using matched filter, Performance of Spread Spectrum Systems in Jamming Environments, CDMA System Design Concepts, Direct Sequence Ultra-wideband Communications, Ultra Low Power, Short Range system optimization and trade-offs.

References

Roger L.Peterson, Rodger E.Ziemer, David E.Borth, "Introduction to Spread Spectrum Communications", Prentice Hall, 1995.

Gordon Stuber, "Principles of Mobile Communication", Fourth Edition, Springer, 2017.

Don Torrieri, "Principles of Spread Spectrum Communications", Springer, Third Edition, 2015.

Marvin Simon, Jim Omura, Robert Scholtz, Barry Levitt "Spread Spectrum Communication Handbook", McGraw - Hill Inc., 2002.

Jack K. Holmes, "Spread Spectrum Systems for GNSS and Wireless Communications", First Edition, Artech House, 2007.

EC832 MIMO COMMUNICATION SYSTEMS (4-0-0) 4

Course Contents

Overview of MIMO communications: Introduction to MIMO, Introduction to Spatial Diversity and Spatial Multiplexing, MIMO capacity formula, MIMO System Model. Application of MIMO Capacity, Phenomenology of multipath channels, Power law propagation, Impulse response of a multipath channel, Intrinsic multipath channel parameters, Classes of multipath channels, Statistics of small-scale fading, MIMO channels in LOS geometry, Antenna spacing and scattering angle,. Alamouti Coding and Space-time Coding: Maximal ratio receive combining (MRRC), Maximum likelihood decoding in MRRC and Alamouti receivers, Performance results, Space-time coding. Spatial Multiplexing: Overview of spatial multiplexing, BLAST architecture, Broadband MIMO, Narrowband and Broadband MIMO channel estimation

References

Jerry R. Hampton, "Introduction to MIMO Communications", Cambridge University Press, 2014.

Bliss and S. Govindasamy, "Adaptive Wireless Communications: MIMO Channels and Networks", Cambridge University Press, 2013.

Simon Haykin, Michael Moher, "Modern Wireless Communications", First Edition, Pearson, 2004.

Andrea Goldsmith, "Wireless Communication", Cambridge University Press 2005.

Jafarkhani, "Space-Time Coding: Theory and Practice", Cambridge University Press, 2005.

EC833 INTERNET OF THINGS (4-0-0) 4

Course Contents

The IoT Networking Core , Technologies involved in IoT Development, Overview of IoT supported Hardware, Network Fundamentals: Overview and working principle of Wired Networking equipment, Linux Network configuration Concepts, IoT Architecture, Applications, Back end Application, Case Study & advanced IoT Applications, IoT applications in home, infrastructures, buildings, security, Industries, Home appliances, other IoT electronic equipment. Use of Big Data and Visualization in IoT, Industry 4.0 concepts. Sensors and sensor Node and interfacing.

References

Ovidiu Vermesan, Peter Friess, Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems, River Publishers, 2013.

Jean-Philippe Vasseur, Adam Dunkels, Interconnecting Smart Objects with IP: The Next Internet, Morgan Kuffmann, 2010.

Lu Yan, Yan Zhang, Laurence T. Yang, Huansheng Ning, The Internet of Things: From RFID to the Next Generation Pervasive Networked, Auerbach Publications, 2008.

Arshdeep Bahga, Vijay Madisetti, Internet of Things (A Hands on Approach), VPT, 2014.

Adrian McEwen, Hakim Cassimally, Designing the Internet of Things, Wiley, 2013.

EC834 ERROR CONTROL CODING (4-0-0) 4

Course Contents

Coding for reliable digital transmission and storage. Groups, Rings, Vector Spaces, Galois Fields, Polynomial rings, Channel models, Linear Block codes, Cyclic codes, BCH codes, Reed Solomon Codes, Berlekamp-Massey and Euclid decoding algorithm, Applications of Reed-Solomon codes, Convolutional codes, Decoding algorithms for Convolutional codes, Viterbi, Trellis coded modulation, Turbo Codes, LDPC codes.

References

Shu Lin and Daniel J. Costello Jr., Error Control Coding: Fundamentals and Applications, Prentice Hall, 2003.
S. B Wicker, Error Control Systems for Digital Communication and Storage, Prentice Hall International, 1995.
Blahut R.E., Algebraic codes for Data transmission, Cambridge University Press, 2003.

EC835 ALGORITHMS FOR PARAMETER AND STATE ESTIMATION (4-0-0) 4

Course Contents

Maximum likelihood (ML) estimation, Maximum a posteriori (MAP) estimation, Least squares (LS) estimation, Minimum mean square error (MMSE) estimation, Linear MMSE (LMMSE) estimation. LS estimation for linear and nonlinear systems, modeling stochastic dynamic systems, the Kalman filter for discrete time linear dynamic systems with Gaussian noise. Steady state filters for noisy dynamic systems, adaptive multiple model estimation techniques. Nonlinear estimation techniques, computational aspects of discrete time estimation.

References

Y. Bar-Shalom, X. Rong Li and T. Kirubarajan, Estimation with Applications to Tracking and Navigation, John Wiley & Sons, 2001.
F. L. Lewis, Optimal Estimation, John Wiley & Sons, 1986.
R. G. Brown and P. Y. C. Hwang, Introduction to Random Signals and Applied Kalman Filtering, John Wiley & Sons, 1992.

EC836 RADAR SIGNAL PROCESSING (4-0-0) 4

Course Contents

Radar and its composite environment, Review of Radar range performance computations, Detection Processes, Sequential and adaptive processes, Atmospheric effects, Sea and land Back scatter, Signal Processing concepts and waveform designs MTI & CW radars, phase coding techniques, FM pulse compression waveforms, Mateorogical radar and system performance analysis.

References

R.J Sullivan, Radar Foundations for imaging and Advanced Concepts, PMI, 2004.
F.E Nathanson, Radar Design Principles, Signal Processing and the Environment, PMI, 2004.
J.C. Toomay, Principles of radar, PMI, 2004.

EC837 ADVANCED RADIATING SYSTEMS (4-0-0) 4

Course Contents

Planar Antennas - Microstrip rectangular and circular patch antennas- Analysis and design, Feeding methods; circularly polarized microstrip antennas, Broadband techniques. Array Theory, Planar array- Array factor, beamwidth, directivity. Electronic scanning,. Broadband Antennas, Yagi array of linear elements and printed version, Log-periodic dipole array. Frequency Independent Antennas Aperture Antennas- Field equivalence principle, Babinet's principle, Antennas for mobile communication - Active and smart microstrip antennas, Design and analysis of microstrip antenna arrays.

Referecnces

C. A. Balanis, Antenna Theory and Design, John Wiley & Sons, 1997.
J.D. Kraus, Antennas, McGraw-Hill, 1988.
R.A. Sainati, CAD of Microstrip Antennas for Wireless Applications, Artech House, 1996.
R. Garg, P. Bharhia, I. Bahl, and A. Ittipiboo, Microstrip Antenna design Handbook, Artech House.
J. R. James, P.S. Hall and C.Wood, Microstrip Antennas: Theory & Design, Peter Peregrinns , UK.

EC838 MULTI TARGET TRACKING AND MULTI-SENSOR INFORMATION FUSION (4-0-0) 4

Course Contents

Target tracking, performance evaluation techniques, data association. Tracking with multiple sensors, out - of - sequence measurement, track initialization, track management. Probabilistic Data Association Filter (PDAF), adaptive gating for PDAF. Maximum Likelihood - PDA (ML - PDA). Joint Probabilistic Data Association Filter (JPDA). Multiple Hypothesis Tracking (MHT). Performance prediction, sensor management, track - to - track fusion. Nonlinear filters.

References

Y. Bar-Shalom, X. Rong Li, Multi Target Multi Sensor Tracking-Principles and Techniques, YBS Publishers, 1995.
Y.Barshalom, P K Willet and X Tin, Tracking and Data Fusion: A Hand book of algorithms, Yaakov Bar-Shalom, 2011.
Y.Barshalom, Multitarget-Multisensor Tracking: Applications and Advances v.2, Yaakov Bar-Shalom, 2000.
Y.Barshalom, Multitarget-Multisensor Tracking: Applications and Advances v.3, Artech House, 2000.
S.Blackman and R.Popoli, Design and Analysis of Modern Tracking systems published by Artech house, 1999.

EC839 NANO-PHOTONICS (4-0-0) 4

Course Contents

Fundamentals, Maxwell's equations, light-matter interaction, dispersion, EM properties of nanostructures, etc. Photonic crystals and photonic crystal fibers, Photonic and plasmonic nanocircuits, Metal optics Manipulating light with plasmonic nanostructures, Plasmonic nano-sensors, Near-field optics, Metamaterials: artificial magnetism and negative refractive index, Metamaterials: superlens and hyperlens, Transformation optics and cloaking, Metasurfaces, Nanolasers, Tunable and active plasmonic materials, Refractory plasmonics, Plasmonics for energy conversion, data storage and biomed applications, Silicon photonics, Diamond photonics, Graphene photonics, Intro to quantum photonics.

References

W. Cai and V. Shalaev, Optical Metamaterials: Fundamentals and Applications, Springer, 2009.
Surface plasmons on smooth and rough surfaces and on gratings," Raether (Springer-Verlag, New York, 1986)
Principles of Nano-Optics," Lukas Novotny and Bert Hecht, Cambridge, 2006.
S. Maier, Plasmonics: Fundamentals and Applications, Springer (2007). Photonic Crystals: Molding the Flow of Light" J. D. Joannopoulos, R. D. Meade, J. N. Winn (Princeton University Press, 1995).

EC840 MILLIMETER WAVE COMMUNICATIONS (4-0-0) 4

Course Contents

Millimeter wave characteristics, Radio wave propagation for mm wave, emerging applications of millimeter wave communications. Millimeter wave generation and amplification, Analog mm wave components, Consumption factor theory, Modulation for millimeter wave communications, Millimeter wave link budget, Transceiver architecture, Millimeter wave calibration, Millimeter wave design considerations. Massive MIMO Communications, Noise coupling in MIMO system, Dynamic spatial, frequency and modulation allocation. Antenna beam width, polarization, advanced beam steering and beam forming, mm wave design consideration, Implementation for mm wave in adaptive antenna arrays, Device to Device communications over 5G systems.

References

K.C. Huang, Z. Wang, "Millimeter Wave Communication Systems", Wiley-IEEE Press, March 2011.
Robert W. Heath, Robert C. Daniel, James N. Theodore S. Rappaport, Murdock, "Millimeter Wave Wireless Communication", Prentice Hall, 2014.
Jonathan Wells, "Multi-Gigabit Microwave and Millimeter-Wave Wireless Communications", Artech House, 2010.
Xiang, W; Zheng, K; Shen, X.S; "5G Mobile Communications: Springer, 2016.

EC841 CRYPTOGRAPHY (4-0-0) 4

Course Contents

Elementary Number Theory, Finite series, Arithmetic and Algebraic Algorithms, Secrete key and Public key Cryptography, Pseudo Random bit generators, Block and Stream Ciphers, Hash functions and Message digests, Public key encryption, Authentication, Digital Signatures, Zero Knowledge Interactive Protocols, Elliptic curve cryptosystems, formal verification, Crypt analysis, Hard Problems.

References

Koblitz N., A Course on Number Theory and Cryptography, Springer Verlag, 1986.
Menezes A. et. all, Handbook of Applied Cryptography, CRC Press, 1996.

EC842 INFORMATION THEORY (4-0-0) 4

Course Contents

Communication systems and Information Theory, Measures of Information, Coding for Discrete sources, Discrete memory-less channels and capacity, Noisy channel coding theorem, Techniques for coding and decoding, Waveform channels, Source coding with Fidelity criterion, Network Information Theory.

References

Thomas M Cover & Joy A Thomas, Elements of Information Theory, Second Edition, John Wiley,2006.
R.G.Gallagher, Information Theory and Reliable Communication, Addison Wesley, 1987.
A.J.Viterbi & J.K. Omura, Principles of Digital Communications and Coding, McGraw Hill, 1979.

EC843 BROADBAND COMMUNICATIONS (4-0-0) 4

Course Contents

Introduction, Internet-based Networks, Networking Technologies, Multiple Access Techniques, Timing Synchronization, Delay Lock Loop, ISDN Physical Layer, ISDN Data Link Layer, Signaling System Number 7, BISDN and SONET, ATM Switch and Protocols, UWB, specialized video (DBS) and wireless networks; CATV architecture; and the role of the Internet in the broadband environment, Access Networks, Cable Modem Systems, PONs, Personal Communication Systems, VPNs, VSATs, CLOS Network Switch, OFDM Concept, OFDMA System, Multi-Carrier CDMA, WiMAX.

References

Introduction to Broadband Communication Systems, Cajetan M. Akujuobi, Matthew N.O. Sadiku, Scitech Publishing Inc, CRC Press, 2007.
Balaji Kumar, Broadband Communications, McGraw-Hill, 1998.
Robert Newman, Broadband Communications, Prentice Hall, 2002.

EC844 ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY (4-0-0)4

Course Contents

Introduction to EMI/EMC to circuit designer, Biological effects of EMI. Sources of EMI/EMC-noise paths Measurement of RE/CE interference. EMI in analog and digital circuits, power circuit case studies, Grounding, Shielding-cut-off frequency, effectiveness calculation, common mode choke design, radiation emission reduction. Power distribution issues in PCB using different converters, filtering techniques. Reflection and cross talk in PCB for high-speed circuits. Signal integrity-propagation on multi-conductor lines and cross talk, PCB design for signal integrity, EMI/EMC standards.

References

Ott. H.W. Noise reduction techniques in Electronic system, 2nd edition, John Wiley Interscience, New York (1988).
Clayton R.Paul, Introduction to electromagnetic compatibility, John Wiley and Sons, Inc. 1991.
Dr.V.P.Kodali, "Engineering EMC", IEEE Publications, S. Chand., New Delhi, 2000.

EC845 PRINCIPLES OF COMMUNICATION SYSTEMS SIMULATION (4-0-0)4

Course Contents

The role of simulation and simulation methodology. Sampling and Quantization. Low pass Simulation models for Band pass Signals and systems, Complex envelope representation of band pass signals, multi carrier signals, nonlinear and time variant systems. Filter Models and Simulation Techniques, Phase Locked Loops and Differential Equation Methods, Generating and Processing random Signals, Stationary and ergodic processes, PN sequence generation and processing. Monte Carlo Simulation of Communication Systems: Fundamental concepts, AWGN channel, Fading channel, examples, Semi analytic techniques.

References

Tranter, Sam Shanmugan, Rappaport and Kosbar, "Principles of Communication Systems Simulation with Wireless Applications", First edition, Prentice Hall, 2004.
Jeruchim, "Simulation of Communication Systems", Second Edition, Springer, 2011.
Won Y Yang, "MATLAB/Simulink for Digital Communication", Second Edition, YesDee Publishers, 2014.

EC846 COMPUTER COMMUNICATION NETWORKS (4-0-0)4

Course Contents

Introduction to common networks such as the Internet, WiFi, Cellular networks, Ad hoc and Sensor networks; Introduction to ISO/OSI Layers; Deterministic and Stochastic Network Calculus, Introduction to Network Simulators, Medium Access Control Layer, ARQ protocols; Random access, Backoff algorithms; WFQ implementations, Introduction to Queueing theory, Routing Layer and algorithms, Buffer management; Transport Layer, Cross-layer Design; Network Monitoring; Performance Measures.

References

Communication Networking: An Analytical Approach, Anurag Kumar, D Manjunath and Joy Kuri, Morgan Kauffmann, 2004.
Data Networks, 2nd Edition, Dimitri P Bertsekas and R Gallager, Pearson, 1992.
Wireless Networking, Anurag Kumar, D Manjunath and Joy Kuri, Morgan Kauffmann, 2004.
Resource Allocation and Cross-Layer Control in Wireless Networks, Leonidas Georgiadis, Michael J. Neely and Leandros Tassiulas, NOW Publishers, 2006.
Computer Networking: A top-down approach, James F Kurose, Pearson Education, 5th Edition, 2012.
Various research publications

EC847 SELECTED TOPICS IN COMMUNICATION ENGINEERING (4-0-0) 4

Course Contents

Current advances in Communication Engineering as defined by the instructor

References

Current literature from IEEE and other quality journals and recent books in the field.

EC851 SMART ANTENNAS FOR MOBILE COMMUNICATION (3-1-0)4

Course Contents

Introduction: Fundamentals of radiating systems. Phased array antenna, optimal antenna, adaptive antennas, Smart antenna, Benefits of smart antenna, Types of smart antennas.

Fixed Beam Smart antenna systems: Sectorization, Broad side End fire arrays, impact of number of elements. Planar arrays, Beam forming, Butler matrix, Spatial filtering, Switched beam systems, multiple fixed beam systems, adaptive cell sectorization

Adaptive array systems: Adaptive Array Concept: Motivation of using Adaptive Arrays, Adaptive Array problem statement, Signal Environment, Array Element Spacing considerations, Array Performance, Nulling Limitations due to miscellaneous array effects. Broadband Processing.

DOA Estimation: Conventional Subspace methods.ML estimation techniques. Estimation of the number of sources using eigen decomposition. Direction finding and true ranging PL systems. Elliptic and hyperbolic PL systems. TDOA estimation techniques. MUSIC algorithms. Smart antenna receivers, MIMO systems.

References

T.S.Rappaport & J.C.Liberti, Smart antennas for wireless Communication, Printice Hall,1999.

R.Janaswamy, Radio wave propagation and Smart antennas for wireless communication, Kluwer,2001.

EC852 SYNCHRONIZATION IN WIRELESS COMMUNICATION SYSTEMS (3-1-0)4

Course Contents

Basic detection process in initial acquisition, Detection performance with pre- and post-detection integration, Theoretical and practical aspects of design and implementation, Initial acquisition in CDMA systems, An overview of PLL techniques, Analog PLLs, Digital PLLs, Mapping between analog PLL and digital PLL, Design and implementation of digital PLLs, Applications of PLL in synchronization and frequency synthesis, Overview of carrier synchronization, Passband synchronization of single carrier systems, Baseband synchronization of single carrier systems, Carrier phase and frequency synchronization of OFDM systems, Carrier synchronization implementations in WCDMA, 802.11a/g, LTE systems, Fundamental aspects of timing synchronization, Timing synchronization with unknown transmitter data symbols, Data/Decision-Assisted timing synchronization, Timing synchronization in CDMA and OFDM systems, Timing control with digital resampling, Polyphase FIR filter bank for rate conversion, Design and properties of interpolation filters, Application of resampling in CDMA and OFDM systems.

References

Fuyun Ling, "Synchronization in Digital Communication Systems", Cambridge University Press, 2017.

Michael Rice, "Digital Communications: A Discrete-Time Approach", Pearson Education India, 2011.

Qasim Chaudhari, "Wireless Communications from the Ground Up: An SDR Perspective", CreateSpace Independent Publishing Platform, 2018.

Umberto Mengali, "Synchronization Techniques for Digital Receivers", Springer International, 1997.

Heinrich Meyr and Gerd Ascheid, "Synchronization in Digital Communications: Volume-1", John Wiley & Sons, 1991.

EC853 CHANNEL MODELLING AND EQUALIZER DESIGN FOR WIRELESS COMMUNICATION (3-1-0)4

Course Contents

Wave propagation in Low- and medium-frequency bands (surface waves), Wave propagation in the HF band (Sky waves), Wave propagation in VHF, UHF, SHF and EHF bands (LOS propagation), Tropospheric refraction, Outdoor path-loss models, Indoor-propagation models, Fading channels, FSO channels, Underwater communication channels, Communication range equation and link budget analysis, Channel sounding and estimation techniques for single carrier, CDMA, OFDM, and MIMO communication, Simulation methods for various channel models (Channel paths to channel taps), Channel resource allocation algorithms, Communication through time invariant and time variant band limited channels, Nyquist criteria for zero ISI, The big picture of equalization, Brute Force equalization: ML sequence estimation using Viterbi algorithm, Zero forcing equalizer design in time and frequency domain, MMSE equalizer, Wiener-Hopf equations, Adaptation algorithms, LMS and RLS equalizer, Kalman equalizer, Decision feedback equalizer, Cyclic equalization, Blind equalization, Single-carrier frequency domain equalization, Performance analysis of equalizers over various channel models.

References

Mehmet Safak, "Digital Communications", John Wiley & Sons, 2017.
Qasim Chaudhari, "Wireless Communications from the Ground Up: An SDR Perspective", CreateSpace Independent Publishing Platform, 2018.
Gordon Stuber, "Principles of Mobile Communication", Fourth Edition, Springer International, 2017.
Behrouz Farhang-Boroujeny, "Adaptive Filters: Theory and Applications", Second Edition, John Wiley & Sons, 2013.
Richard W. Middlestead, "Digital Communications with Emphasis on Data Modems", John Wiley & Sons, 2017.
Heinrich Meyr, Marc Moeneclaey, and Stefan A. Fechtel, "Digital Communication Receivers, Volume-2", 1997.

EC757	**Seminar**	**2**
EC758	**Minor Project**	**2**
EC759	**Major Project – I**	**6**
EC760	**Major Project – II**	**6**

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