SIR CHHOTU RAM INSTITUTE OF ENGINEERING AND TECHNOLOGY
CH. CHARAN SINGH UNIVERSITY, MEERUT

Syllabus

For

M.Tech.

Electronics & Communication Engineering
(w.e.f. 2022-23)

Study and Evaluation Scheme M. Tech. in Electronics & Communication Engineering

First Year, Semester-I

S.No.	Course Code	Subject	Periods			Credit	Evaluation Scheme					SUBJECT TOTAL
			L	T	P		Theory			Practical		
							CT	TA	ESE	TA	ESE	
1	MTEC101	Advanced Engineering Mathematics	3	0	0	3	20	10	70	-	-	100
2	MTEC102	Advanced Digital Communication	3	0	0	3	20	10	70	-	-	100
3	MTEC103	Departmental Elective I	3	0	0	3	20	10	70	-	-	100
4	MTEC104	Departmental Elective II	3	0	0	3	20	10	70	-	-	100
5	MTEC105	Research Process & Methodology	3	0	0	3	20	10	70	-	-	100
6	MTEC151	Lab I: Optical Fibre Communication Lab	0	0	4	2	-	-	-	20	30	50
7	MTEC152	Lab II: Communication Engineering Lab	0	0	2	1	-	-	-	20	30	50
		Total	15	0	6	18						600

First Year, Semester-II

S.No.	Course Code	Subject	Periods			Credit	Evaluation Scheme					SUBJECT TOTAL
			L	T	P		Theory			Practical		
							CT	TA	ESE	TA	ESE	
1	MTEC201	Discrete Time Signal Processing	3	0	0	3	20	10	70	-	-	100
2	MTEC202	Detection and Estimation Theory	3	0	0	3	20	10	70	-	-	100
3	MTEC203	Departmental Elective III	3	0	0	3	20	10	70	-	-	100
4	MTEC204	Departmental Elective IV	3	0	0	3	20	10	70	-	-	100
5	MTEC205	Departmental Elective V	3	0	0	3	20	10	70	-	-	100
6	MTEC251	Lab III: Modeling and Simulation of Communication System Lab	0	0	4	2	-	-	-	20	30	50
7	MTEC252	Seminar I	0	0	2	1	-	-	-	50	-	50
		Total	15	0	6	18						600

Second Year, Semester-III

S.No.	Course Code	Subject	Periods			Credit	Evaluation Scheme					SUBJECT TOTAL
			L	T	P		Theory			Practical		
							CT	TA	ESE	TA	ESE	
1	MTEC351	Seminar II	0	0	6	3	-	-	-	100	-	100
2	MTEC352	Dissertation	3	0	30	15	-	-	-	200	300	500
		Total				18						600

Second Year, Semester-IV

S.No.	Course Code	Subject	Periods			Credit	Evaluation Scheme					SUBJECT TOTAL
			L	T	P		Theory			Practical		
							CT	TA	ESE	TA	ESE	
1	MTEC451	Dissertation	0	0	36	18	-	-	-	200	400	600
		Total				18						600

Departmental Elective I
MTEC 011: RF Circuit Design
MTEC 012: Information Theory
MTEC 013: Antenna Theory and Design

Departmental Elective II
MTEC 021: Optical Communication
MTEC 022: MIMO Communication Systems
MTEC 023: Next Generation Networks

Departmental Elective III
MTEC 031: Internet of Things
MTEC 032: Error Control & Coding
MTEC 033: Microwave Communication Engineering & Systems

Departmental Elective IV
MTEC 041: Advanced Optical Networks
MTEC 042: Advanced Satellite Communication
MTEC 043: Cognitive Radio

Departmental Elective V
MTEC 051: Advanced Wireless Networks
MTEC 052: Optoelectronics Devices and Systems
MTEC 053: Monolithic Microwave Integrated Circuits

MTEC101 – Advanced Engineering Mathematics

Linear Algebra

Vector spaces: Vector Spaces, Subspaces, Bases and Dimensions and related theorems.

Linear Transforms: Isomorphism, Homomorphism, Matrix representations, Linear Functionals, The Double Dual.

Concept of Random Variables

Introduction, Distribution and Density faction, Specific Random Variables, Conditional Distributions, asymptotic approximations for binomial random variable, The Distributions, Mean and Variance, Moments generating functions.

Two Dimensional Random Variables

Bivariate Distributions, One function of two random variables, Two function of two random variables, Joint Moments, Joint Characteristic Functions, Conditional Distributions, Conditional Expected Values, Sequence of Random Variables.

Concept of Stochastic Process

System with Stochastic Inputs, The Power Spectrum, Discrete time Processes, Continuity, Differentiations and Integration, Shift Operators and Stationary Processes, Random Walks PoissionPoints and Shot Noise, Modulation, Bandlimited Processes and Sampling Theory.

Markov Process and Queuing Theory

Introduction, Higher-Transition Probability and the Chapman-Kolmogorov Equation, Classification of States, Stationary Distributions and Limiting Probabilities, Transient States and Absorption Probabilities, Markov Process, Queuing Theory, Networks of Queues.

Reference Books:

1. A. Papoulis, S.U. Pillai, “Probability, Random Variables and Stochastic Processes”, Tata McGraw Hill Latest Edition, New Delhi.

2. K. Hoffmann and R. Kunze, “Linear Algebra”, Pearson Prentice Hall Latest Edition, New Delhi.

3. Ibe.O.C., “Fundamentals of Applied Probability and Random Processes", Elsevier.

4. Peebles. P.Z., "Probability, Random Variables and Random Signal Principles", Tata Mc Graw Hill,Latest Edition, New Delhi.

MTEC102 –Advanced Digital Communication

Baseband data transmission- Nyquist criterion for zero ISI, Correlative level coding, Optimum design of transmit and receive filters, Equalization.

Passband Digital transmission- Digital modulation schemes, Carrier synchronization methods, Symbol timing estimation methods.

Error control coding - Linear block codes, cyclic codes-encoding and decoding, Non-binary codes, Convolutional codes, Decoding of convolutional codes, Trellis coded modulation, Interleaver, Turbo coding, Performance measures.

Spread spectrum communication- D S and F H spread spectrum, CDMA system based on FH and DS spread spectrum signals, Applications, Synchronization of spread spectrum signals.

Multichannel and Multicarrier communication Systems, Multi user communication systems.

Reference Books:

1. J.G.Proakis, Digital Communication, McGraw- Hill
2. S. Haykin, Communication systems,John Wiley
3. B.P. Lathi, Zhi Ding, Modern Digital and Analog Communication Systems,Oxford University Press
4. S.Lin&D.J.Costello, Error Control Coding, Pearson

MTEC201 –DISCRETE TIME SIGNAL PROCESSING

INTRODUCTION

Introduction and Review: Basic concepts of Digital Signal Processing, Basic digital signal processing examples in block diagram, Overview of typical Digital Signal Processing in real-world

applications. Sampling and Reconstruction of Signals: Sampling band-pass signals, Analog-to-digital and digitaltoanalog conversions.

Multirate Digital Signal Processing:

Introduction, Decimation by a factor D, Interpolation by a factor I, Sampling rate conversion by a

rational factor I/D, Filter design and implementation for sampling rate conversion, Multistage implementation of sampling rate conversion, Sampling rate conversion of band-pass signals, Sampling rate conversion by an arbitrary factor, Applications of multirate signal processing.

Multirate Filter Banks:

Maximally decimated filter banks: Errors created in the QMF bank, alias-free QMF system, power

symmetric QMF banks, M-channel filter banks, poly-phase representation, perfect reconstruction systems, alias-free filter banks, tree structured filter banks, trans-multiplexers. Para-unitary Perfect

Reconstruction Filter Banks: Lossless transfer matrices, filter bank properties induced by paraunitariness, two channel Para-unitary lattices, M-channel FIR Para-unitary QMF banks, transform coding. Linear Phase Perfect Reconstruction QMF Banks: Necessary conditions, lattice

structures for linear phase FIR PR QMF banks, formal synthesis of linear phase FIR PR QMF lattice.

Discrete Fourier Transform & Computation

Discrete Fourier Transform properties, magnitude and phase representation Computation of DFT using FFT algorithm – DIT &DIF using radix 2 FFT – Butterfly structure.

Digital Signal Processors

Introduction – Architecture – Features – Addressing Formats – Functional modes Introduction to Commercial DS Processors.

Reference Books:

1. John G. Proakis and Dimitris G. Manolakis, Digital Signal Processing, Pearson.
2. Li Tan, Digital Signal Processing – Fundamentals and applications, Elsevier.
3. P.P. Vaidyanathan, Multirate Systems and Filter Banks, Pearson Education (Asia) Pte. Ltd.
4. Gilbert Strang and Truong Nguyen, Wavelets and Filter Banks, Wellesley-Cambridge Press.
5. N. J. Fliege, Multirate Digital Signal Processing, John Wiley & Sons, USA.
6. S. Salivahanan, “Digital Signal Processing”, McGraw Hill Education (India) Private Ltd.

MTEC202 – Detection and Estimation Theory

Binary hypothesis testing; Bayes, minimax and Neyman-Pearson tests. Composite hypothesis testing.

Signal detection in discrete time: Models and detector structures. Coherent detection in independent noise. Detection in Gaussian noise. Detection of signals with random parameters. Detection of stochastic signals. Performance evaluation of signal detection procedures.

Bayesian parameter estimation; MMSE, MMAE and MAP estimates. Nonrandom parameter estimation. Exponential families. Completeness theorem.ML estimation. Information inequality. Asymptotic properties of MLEs.

Discrete time Kalman- Bucy filter. Linear estimation. Orthogonality principle and its application in Communication Engineering. Wiener- Kolmogorov filtering – causal and noncausal filters.

Signal detection in continuous time: Detection of deterministic signals in Gaussian noise. Coherent detection in White Gaussian noise.

Reference Books:

1. H.V.Poor, An Introduction to Signal Detection and Estimation, Springer.
2. B.C.Levy, Principles of Signal Detection and Parameter Estimation, Springer.
3. H.L.Vantrees, Detection, Estimation and Modulation theory, Part I, Wiley.
4. M.D.Srinath&P.K.Rajasekaran, Statistical Signal Processing with Applications, Wiley.
5. J.C.Hancock& P.A. Wintz, Signal Detection Theory, Mc-Graw Hill.

MTEC151 – Optical and Fiber Communication Lab

1. Measurement of Numerical Aperture
2. Measurement of Attenuation and Bending Loss
3. Study of Analog Link
4. Study of BER and Q-factor estimation in the optical system simulation
5. EDFA design for DWDM link
6. Study the Characteristics of a Communication channels AWGN BSC
7. Analog and Digital Modulation

Frequency Modulation and Demodulation

QPSK Modulation and Demodulation

8. Conventional Encoder and Decoder

MTEC152 – Communication Engineering Lab

PART I : PCM AND LINK ANALYSIS

Link establishment, Noise on PCM link, Error detection, BER calculation, Error correction, TDM.

PART II : DIGITAL MODULATION & KEYING

ASK, FSK, PSK, QPSK Modulation and Demodulation.

PART III : CDMA - DSSS

Modulation, Demodulation & BER measurement.

PART IV : SIMULATION IN MATLAB ENVIRONMENT

BPSK, QPSK, FSK Modulation & Demodulation. BER calculation.

MTEC251 – Modeling and Simulation of Communication System Lab

1. Study and Analysis of different types of Analog Communication Circuit using Simulation Software (any two circuits)
2. Study and Analysis of different of Digital Communication Systems using Simulation Software (any three)
3. Study and Analysis of Frequency hopped Spread Spectrum System
4. Study and Analysis of Direct Sequence Spread Spectrum System
5. Study and Designing of Equalizers for Digital Communication
6. Study of Eye Pattern using Simulation
7. Study and Implementation of Convolution Codes using Simulation
8. Study and Implementation of Cyclic Codes using Simulation Method
9. Study and Implementation of Linear Block Codes using Simulation
10. Study and Implementation of Optimum Receiver used for Digital Communication
11. Study and Implementation of Lempel Algorithm using Simulation
12. Study and Design of Band Limited Signals with controlled ISI

At least 8 modules have to be performed.

MTEC011 – RF CIRCUIT DESIGN

UNIT-I INTRODUCTION:

Reasons for using RF, Applications, RF Spectrum, Microwave bands–RF behavior of Passive components: Tuned resonant circuits, Vectors, Inductors and Capacitors-Voltage and Current in capacitor circuits–Tuned RF / IF Transformers. Micro Strip Transmission Lines-Special Termination Conditions-sourced and Loaded Transmission Lines.

UNIT-IIRF/MICROWAVE AMPLIFIERS:

Types of amplifiers-small signal amplifier design-design of different types of amplifiers - narrow band, high gain, maximum gain, low noise broad band amplifier design -

Multistage small signal amplifier design, Minimum Noise Multi stage amplifier design, Large signal design, High power amplifiers, Microwave power combining/dividing techniques, signal distortion due to intermodulation products, Multistage amplifiers large signal amplifiers design

UNIT-IIIRF OSCILLATORS:

RF/Microwave oscillator design-Oscillator versus amplifier design-oscillations conditions, design of transistor oscillators, fixed frequency, Frequency tunable oscillators.

UNIT-IVRF CONVERTERS AND MIXERS:

Rectifier design-detector design Formulation,

Properties of S Parameters, Smith charts, applications on distributed circuit applications, lumped element circuit applications. Mixer design-UP conversion, down conversion, Conversion loss for SSB Mixers, SSB verses DSB Mixers conversion loss, one diode mixers, two diode mixer

UNIT-VRF MATCHING NETWORKS:

Design of matching networks using lumped elements, design rules for matching networks, Using distributed elements -using single stub matching Short or Open circuited stubs.

Reference Books:

1. Matthew M Radmanesh, Radio Frequency and Microwave Electronics, Pearson Education Asia.

2. Vendalin, Microwave Circuit Design using Linear and Nonlinear Techniques, Wiley.

3. Cotter W. Sawyer, Complete Wireless Design, McGraw Hill.

4. Less Besser and Rowan Gilmore, " Practical RF Circuit Design for Modem Wireless Systems",
Vol.2.

5. Reinhold Ludwing, Pavel Bretchko, " RF circuit design: Theory and applications ", Pearson Education Asia Publication.

MTEC012 – Information Theory

Unit 1

Entropy, Relative Entropy, and Mutual Information: Entropy, Joint Entropy and Conditional Entropy, Relative Entropy and Mutual Information, Relationship Between Entropy and Mutual Information, Chain Rules for Entropy, Relative Entropy, and Mutual Information, Jensen's Inequality and Its Consequences, Log Sum Inequality and Its Applications, Data-Processing Inequality, Sufficient Statistics, Fano's Inequality

Unit 2

Asymptotic Equipartition Property: Asymptotic Equipartition Property Theorem , Consequences of the AEP: Data Compression, High-Probability Sets and the Typical Set

Unit 3

Entropy Rates of a Stochastic Process: Markov Chains, Entropy Rate, Example: Entropy Rate of a Random Walk on a Weighted Graph, Second Law of Thermodynamics, Functions of Markov Chains

Unit 4

Data Compression: Examples of Codes, Kraft Inequality, Optimal Codes, Bounds on the Optimal Code Length, Kraft Inequality for Uniquely Decodable Codes, Huffman Codes, Some Comments on Huffman Codes, Optimality of Huffman Codes, Shannon–Fano–Elias Coding, Competitive Optimality of the Shannon Code, Generation of Discrete Distributions from Fair Coins

Unit 5

Channel Capacity: Examples of Channel Capacity, Symmetric Channels, Properties of Channel Capacity, Preview of the Channel Coding Theorem, Definitions, Jointly Typical Sequences, Channel Coding Theorem

Reference Books:

1. Thomas M. Cover and Joy A. Thomas,"Elements of Information Theory", Wiley Series in Telecommunications and Signal Processing). Wiley-Interscience 2006.
2. Robert B Ash. "Information Theory". Dover Publishing

MTEC013 – Antenna Theory and Design

Antenna fundamental and definitions: Radiation mechanism - overview, EM fundamentals, Solution of Maxwell's equations for radiation problems, Ideal dipole, Radiation patterns, Directivity and gain, Antenna impedance, Radiation efficiency, Antenna polarization.

Resonant Antennas: Wires and patches, Dipole antenna, Yagi-Uda antennas, Microstrip antenna.

Arrays: Array factor for linear arrays, Uniformly excited equally spaced linear arrays, Pattern multiplication, Directivity of linear arrays, Nonuniformly excited equally spaced linear arrays, Mutual coupling, Multidimensional arrays, Phased arrays, Feeding techniques, Perspectives on Arrays.

Broadband antennas: Travelling wave antennas Helical antennas, Biconical antennas Sleeve antennas, and Principles of frequency independent antennas, Spiral antennas, and Log – periodic antennas.

Aperture antennas: Techniques for evaluating gain, Reflector antennas - Parabolic reflector antenna principles, Axi-symmetric parabolic reflector antenna, Offset parabolic reflectors, Dual reflector antennas, Gain calculations for reflector antennas, Feed antennas for reflectors, FiECSrepresentations, Matching the feed to the reflector, General feed model, Feed antennas used in practice.

Antenna Synthesis: Formulation of the synthesis problem, Synthesis principles, Line sources shaped beam synthesis, Linear array shaped beam synthesis, Fourier series, Woodward - Lawson sampling method, Comparison of shaped beam synthesis methods, low sidelobe narrow main beam synthesis methods, DolphChebyshev linear array, Taylor line source method.

Method of moments: Introduction of the methods moments, Pocklington's integral equation, Integral equation and Kirchhoff's networking equations, Source modeling weighted residual formulationsand computational consideration, Calculation of antenna and scatter characteristics.

Computational EM: FTTD methods, Geometrical optics, Wedge diffraction theory, Ray fixed coordinate system, Uniform theory of wedge diffraction, E--plane analysis of horn antennas. Cylindrical parabolic antennas, Radiation by a slot on a finite ground plane, Radiation by a monopole on a finite ground plane, Equivalent current concepts, Multiple diffraction formulation by a curved surfaces, Physical optics, Methods of stationary phase, physical theory of diffraction, Cylindrical parabolic reflector antennas.

Reference Books:

1. C. A. Balanis, "Antenna Theory Analysis and Design", John Wiley.
2. J. D. Kraus, "Antennas", McGraw Hill TMH.
3. Stutman and Thiele, Antenna theory and design, John Wiley and sons Inc.
4. Sachidnanda et al, "Antennas and propagation", Pearson Education

MTEC021 – Optical Communication

Fundamentals of Coherent Systems: Basic concepts. Modulation and demodulation schemes. System performance

Semiconductor optical amplifiers: EDFA and Raman amplifiers – modeling and analysis.Analysis
and digital transmission with high power fiber amplifiers.
Multichannel systems: WDM lightwave systems. TDM and code division multiplexing.Advances
in wavelength division multiplexing / demultiplexing technologies. Multiple Access Schemes in Optical Communication Systems.
SONET/SDH, ATM, IP, storage area networks. Wavelength routed networks. Next generation optical Internets.
Soliton systems: Nonlinear effects. Soliton – based communication. High speed and WDM Soliton
systems

Reference Books:

1. G.P.Agrawal, Fiber Optic Communication Systems, Wiley
2. B.P.Pal , Guided Wave Optical Components and Devices, Elsevier
3. C.S.Murthy&M.Gurusamy, WDM Optical Networks, PHI
4. R.Ramaswami, K.N. Sivarajan, Optical Networks, Elsevier
5. G.P.Agrawal, Non linear Fiber Optics, (4/e), Elsevier

MTEC022 – MIMO Communication Systems

Concept of diversity, introduction to MIMO systems, space-time coding, MIMO Channels, capacity of MIMO channels, ergodic capacity, Space diversity and system based on space diversity, Smart antenna systems and MIMO, MIMO based system architecture; MIMO exploits multipath, Space time processing, Antenna considerations for MIMO.
Error Probability Analysis for SISO Channels, Error Probability Analysis for MIMO Channels: Pairwise Error Probability, Coherent Maximum-Likelihood Detection, Detection with Imperfect Channel Knowledge, Joint ML Estimation/Detection
Cooperative communication, amplify forward and decode forward protocols, performance evaluation of cooperative communication systems, full duplex communication, optical wireless communication, Introduction to Massive MIMO systems.
MIMO channel modeling, MIMO channel measurements, MIMO channel capacity, CDD, Space

time coding, advantages and applications of MIMO, MIMO application in 3G, MIMO-1, Spatial multiplexing channel modeling: Multiplexing capability of MIMO channels, Physical modeling of

MIMO channels. Modeling MIMO fading channels,

Multi antenna systems, Smart antennas, Multiple Input and Multiple Output systems with various multiple access schemes.

Reference Books:

1. Ke-Lin Du, ad M.N.S. Swamy, "Wireless communication systems-From RF subsystems to 4G enabling Technologies", Cambridge University Press Publication, South Asian 2010 edition.
2. C. Y. William, Lee, "Mobile communication engineering theory and applications", TMH, Publication.
3. U. Dalal& M. Shukla, "Wireless & Mobile Communication", Oxford University Press.
4. S .Haykins, “Communication Systems”, John Wiley and Sons
5. R Bose , “Information Theory Coding and Cryptography” TMH Publication.

MTEC023 – Next Generation Networks

UNIT I

Introduction to next generation networks: Communicating in the new Era, New Era of Networking,

Technologies influencing change, IP Everywhere, Optical fiber anywhere, wireless access, building blocks for NGN, IP Networks, VOIP, Multi service Flexible Networks architecture. VPNs, Optical Networks, Wire line and Wireless Networks, NGN Services, Network Infrastructure convergence, services convergence, from technology push to service pull.

UNIT II

IP Networks: IP past, present and future, IP influence and confluence, IP version 4, I. P. Version 6, IP Network convergence, LAN Technologies, IP Routing, LAN Switching, WAN’s, WAN Technologies and Topologies. Wireless IP LANS, Mobility Networks, Global IP Networks, Global capacity, Globally Resilient IP, Internet – A Network of Networks. Beyond IP, Technology Brief –IP Networks, Business Drivers, Success factors, Applications and Service Value.

UNIT III

Muti service Networks: Origin of multi service ATM, Next Generation Multi service Networks, Next Generation Multi service ATM switching, Multi-protocol Label switching, Networks, Frame

Based MPLS, Cell based MPLS, MPLS services and their benefits, multi service provisioning platforms (MSPP) and Multi service switching platform (MSSP)

UNIT IV

NGN Applications: Internet connectivity, e-commerce, call center, third party application service provision, UMTS, WAP, WiMAX, integrated billing, security and directory enable networks.

Reference Books:

1. Next Generation Network Services, Robet Wood, Pearson

2. Next Generation Networks Services, Technologies and Strategies, Neill Wilkinson, Wiley.

3. Next Generation Telecommunications Network, Parliament office of Science and Technology (Postnote). Dec 2007, No. 296 Ref. www.parliament.uk

4. Mobile Next Generation Networks Huber, JF IEEE Multimedia Vol. 11, Issue I Jan- March 2004.

5. Next Generation Network (NGN) Service, J.C. Crimi, A Telecoolia Technologies white paper refer www.telecodia.com

MTEC032 – Error Control Coding

Unit 1

Context for Error Correction Coding: Introduction: Where Are Codes? , The Communications System, Basic Digital Communications, Signal Detection, MemorylessChannels , Simulation and Energy Considerations for Coded Signals, Hamming Codes

Unit 2

Linear Block Codes: Basic Definitions, The Generator Matrix Description of Linear Block Codes,

The Parity Check Matrix and Dual Codes, Some Simple Bounds on Block Codes, Error Detection

and Correction over Hard-Input Channels, Weight Distributions of Codes and Their Duals, Hamming Codes and Their Duals, Performance of Linear Codes

Unit 3

Cyclic Codes, Rings, and Polynomials: Introduction, Basic Definitions, rings, Quotient Rings, Ideals in Rings, Algebraic Description of Cyclic Codes, Nonsystematic Encoding and Parity Check, Systematic Encoding, Cyclic Encoding, Syndrome Decoding, Binary CRC Codes

Unit 4

Convolutional Codes: Definition of Codes and Equivalent Code, Decoding Convolutional Codes, Some Performance Results, Error Analysis for Convolutional Codes, Puncturing, Suboptimal Decoding Algorithms forConvolutionalCodes, Convolutional Codes as Block Codes, Trellis Representations of Block and Cyclic Codes.

Reference Books:

1. Todd K. Moon. Error Correction Coding: Mathematical Methods and Algorithms. Wiley
2. Shu Lin, Daniel J. Costello, Error Control Coding, Pearson

MTEC031 – Internet of Things

Unit 1

Introduction to the Internet of Things (IoT) : What is the Internet of Things (IoT)? , Technology drivers , Business drivers, Typical IoT applications, Trends and implications

Unit 2

IoT Architectures: Architectures for IoT, Elements of an IoT Architecture, Architectural design considerations

Unit 3

IoT Network protocols (MAC layer): Wireless sensor networks (WSNs) and power consumption, CSMA/CA and slotting, Centralized vs. distributed, State-of-the-art MAC-layer protocols for WSNs

Unit 4

Wireless technologies for IoT (Layer 1 & 2): WiFi (IEEE 802.11), Bluetooth/Bluetooth Smart, ZigBee/ZigBee Smart, UWB (IEEE 802.15.4), 6LoWPAN, Proprietary systems

Unit 5

IoT application programming: Introduction to IoT device programming, IoT application development.

Unit 6

Data analytics for IoT: A framework for data-driven decision making, Descriptive, Predictive and

Prescriptive Analytics, Business Intelligence and Artificial Intelligence, Importance of impact and

open innovation in data-driven decision making

Reference Books:

1. McKinsey Global Institute report: "Unlocking the potential of the Internet of Things". Available from :
http://www.mckinsey.com/insights/business_technology/the_internet_of_things_the_value_of_digitizing_the_physical_world
2. Zhao, Feng, and Leonidas J. Guibas. Wireless sensor networks: an information processing approach. Morgan Kaufmann.
3. Karl, Holger, and Andreas Willig. Protocols and architectures for wireless sensor networks. John Wiley & Sons.
4. Dargie, Waltenegus W., and Christian Poellabauer. Fundamentals of wireless sensor networks: theory and practice. John Wiley & Sons.

MTEC033 – Microwave Communication Engineering & Systems

Microwave and millimeter wave devices:

Overview of microwave and millimeter wave vacuum tu be devices, limitations of microwave vacuum tubes, Gyratron vacuum tube devices.

Advances in microwave and millimeter wave solid state devices, Gunn devices, oscillator using Gunn diode, and injection locked oscillators, IMPATT devices, and microwave and mm wave performance of IMPATT.

Other solid state devices like Tunnel diode, BARITT and TRAPAT.

Microwave and mm wave circuits:

Review of scattering matrix concept in the light of vector network analyzer, impedance matching network k, couplers, power dividers, resonators and filters.

Detectors, mixers, attenuators, phase shifters, amplifier and oscillator

Ferrite based circuits.

Antennas:

Hertzian dipole, loop antenna, helical antenna, frequency independent antenna: Du0Hamel principle, log spiral and log periodic dipole antenna array.

Babinet principle, waveguide slot antenna, microstrip antenna, horn antenna, parabolic reflector. Antenna arrays and phased array antenna. Antenna measurement.

Microwave and mm wave propagation.

Overview of basic radio wave propagation mechanisms, Friis transmission formula, plane earth propagation model, troposcatter systems, ionosphere propagation, duct propagation,microwaveradio link and calculation of link budget.

Effect on radio wave propagation due to rain, fog, snow, ice, atmospheric gases, Earth's magnetic

field.

Reference Books:

1. P Bhartia& I J Bahl, "Millimeter wave engineering and Applications", John Wiley & Sons
2. David M Pozar, "Microwave Engineering", John Wiley & Sons
3. R E Collin, "Antenna & Radio wave Propagation", McGraw Hill Book Co.
4. Jordan &Balmian, "Electromagnetic waves & Radiating System", PHI.
5. R E Collin, "Microwave Engineering", McGraw Hill.

MTEC042 – Advanced Satellite Communication

UNIT -I

Orbital Mechanics: Orbit Equations, Orbit Description, Locating the Satellite in the Orbit and with

Respect to Earth, Orbital Elements. Look Angle Determination and Visibility. Orbital Perturbations, Orbit Determination, Launch Vehicles, Orbital Effects in Communication System Performance.

UNIT –II

Spacecraft: Communication Subsystems, Transponders, Antennas, Equipment Reliability. Earth Stations. The Space Link, Satellite Link Design. Basic Transmission Theory. System Noise Temp.,

G/T Ratio, Noise Figure, Downlink Design, Design of Satellite Links for Specified C/N.

UNIT -III

Multiple Access. FDMA, FDM/FM/FDMA. Calculating the Overall Carrier to Noise Ratio on a FDM/FM/FDMA Link. Backoff. Measuring & Calculating the Effects of Intermodulation Noise. Over deviation and Companding. Companded Single Side Band. Pre-assigned and Demand Assigned FDMA.

UNIT –IV

Time Division Multiple Access. Frame Structure and Design. Reference Burst, Preamble, Network

Synchronization, Unique Word Detection. TDMA. Channel Capacity, Pre-assigned and Demand Assigned TDMA, Speech Interpolation and Prediction, Downlink Analysis for Digital Transmission.

UNIT –V

Satellite Services: Satellite mobile communication, VSAT technology, Direct Broadcast by satellite (DBS).Global Positioning System. Radarsat.

Reference Books:

1. T. Pratt and C. W. Bostian. “Satellite Communications”, John Wiley & Sons.
2. R. M. Gagliardi, “Satellite Communications”, Lifetime Learning Publications, Belmont, CA.
3. W.L. Pritchard, H. G. Suyderhoud, and R. A. Nelson, “Satellite Communication System Engineering”, Prentice Hall.
4. J.J. Spilker , “Digital Communication by satellite” , PHI Publication
5. J. Martin, “Communication satellite systems”, PHI publication

MTEC043 – Cognitive Radio

Filter banks-uniform filter bank. direct and DFT approaches. Introduction to ADSL Modem. Discrete multitone modulation and its realization using DFT. QMF.STFT.Computation of DWT

using filter banks.

DDFS- ROM LUT approach. Spurious signals, jitter. Computation of special functions using CORDIC.Vector and rotation mode of CORDIC.CORDIC architectures.

Block diagram of a software radio. Digital down converters and demodulators Universal modulator

and demodulator using CORDIC. Incoherent demodulation - digital approach for I and Q generation, special sampling schemes. CIC filters. Residue number system and high speed filters using RNS. Down conversion using discrete Hilbert transform. Under sampling receivers, Coherent demodulation schemes.

Concept of Cognitive Radio, Software Defined Radio (SDR), Problems Faced by SDR, Cognitive Networks,

Cognitive Radio Architecture. Cognitive Radio Design, Cognitive Engine Design,

A Basic OFDM System Model, OFDM based cognitive radio, Cognitive OFDM Systems, MIMO

channel estimation, Multi-band OFDM, MIMO-OFDM synchronization and frequency offset estimation. Spectrum Sensing to detect Specific Primary System, Spectrum Sensing for Cognitive

OFDMA, IDMA SC-FDMA and hybrid Systems.

Reference Books:

1. J. H. Reed, “Software Radio”, Pearson.

2. U. Meyer – Baese , “Digital Signal Processing with FPGAs”, Springer.

3. H. Arslan “Cognitive Radio, Software Defined Radio and Adaptive Wireless Systems”, University ofSouth Florida, USA, Springer.

4. T. W. Rondeau, C.W.Bostian, “Artificial Intelligence in Wireless Communications”.

5. U.Dalal, M. Shukla, “Wireless and Mobile Communication”, Oxford University Press.

6. Tusi, “Digital Techniques for Wideband receivers”, Artech House.

7. T. DarcChiueh, P. Yun Tsai,” OFDM baseband receiver design for wireless communications”, Wiley.

MTEC041 – Advanced Optical Networks

SONET & SDH:

Brief history of SONET& SDH, Multiplexing hierarchy, Multiplexing structure – Functional components, Problem detection, Virtual tributaries & containers, Concatenation.

Architecture of OTN:

Digital wrapper, control planes, Control signaling, Multiplexing, hierarchies, Current digital hierarchy, revised hierarchies, Optical & Digital Transport hierarchies, Functionality stacks, Encapsulation &Decapsulation, GFP.

WDM, DWDM Topologies:

Relationship with SONET / SDH, EDF, WDM Amplifiers, Multiplexers, WADM I/P & O/P ports,

span loss & chromatic, dispersion, Tunable DWDM lasers

Network Topologies & Protection schemes:

Non-negotiable requirements of robust networks, Line& Path protection switching, Type of Topologies, Optical Channel Concatenation, Meshed topologies, PON's, Optical Ethernets, Wide area Backbones, Metro optical networking

MPLS & Optical networks:

Label switching, FEC, Scalability &granuility: labels & wavelength, MPLS nodes, Distribution &Binding methods, MPLS support of virtual private networks, Traffic Engineering, MPLS, Relationships of OXC, MPLS operation, MPLS & optical Traffic Engineering, Similarities. Control & Data planes interworking

Architecture of IP & MPLS based optical transport Networks:

IP, MPLS & Optical control planes Interworking, The three control planes, Framework for IP Vs.

Optical networks, Generalized MPLS use in optical networks, Bidirectional LSP's in optical network, Next horizon of GMPLS, ODVK General communication channels, Traffic parameters

Link Management protocol (LMP):

What is managed, Data Bearing links, Basic function of LMP, LMP messages, LMP message header, TLW's control channelManagement, LPC, LCV, Fault management, Extending LMP operations to optical links.

Optical compilers:

Building blocks, Serial Binary adder with carry delay, Fiber delay line memory loop, Bit serial, optical counter design, Lumped delay design, Distributed delay design, Time multiplex multiprocessor, Time slot interchange with 2 log 2 (N-1) switch, Hatch design support system

Reference Books:

1. R.Ramaswami,K.N.Sivarajan, “Optical Networks”,Elsevier.
2. P.E Green, “Optical Networks” Prentice Hall.
3. Uyless Black “Optical Networks Third Generation Transport Systems” Prentice Hall
4. C.S.Murthy& M. Gurusamy, “WDM Optical Networks”, Prentice Hall (India).
5. Tanenbaum Andrew S “Computer Networks” Prentice Hall(India).

MTEC051 – Advanced Wireless Networks

GSM services and features – GSM system architecture – GSM radio subsystem – Frame structure
for GSM– Signal processing in GSM – GPRS network architecture – GPRS services and features –3G UMTSnetwork architecture – UMTS services and features.

WiMAX Genesis and framework: 802.16 standard, WiMAX forum, Other 802.16 standards, Protocol layer topologies - Layers of WiMAX, CS, MAC CPS, Security layer, Physical layer, Reference model, topology.

Frequency utilization and system profiles: Cellular concept, Licensed and unlicensed frequencies,
Fixed WiMAX system profiles, Mobile WiMAX profiles.

WiMAX physical layer: OFDM transmission, SOFDMA, subcarrier permutation, 802.16 transmission chains, Channel coding, Turbo coding, Burst profile.

WiMAX MAC and QoS: CS layer, MAC function and frames, Multiple access and burst profile, Uplink bandwidth allocation and request mechanisms, Network entry and QoS management.

Radio engineering considerations: Radio resource management, Advance antenna technology in WiMAX, MBS. WiMAX architecture, Mobility handover and power save modes, Security.

Reference Books:

1. LoutfiNuyami, "WiMAX - Technology for broadband access", John Wiley, 2007.
2. Yan Zhang, Hsia-Hwa Chen, "Mobile WiMAX", Aurobech Publications, 2008

3. William Stallings, “Wireless Communication and Networking”, Pearson Education, 2002.
4. Siegmund M. Redl, Mathias K. Weber, Malcolm W. Oliphant, “An Introduction to GSM”, ArtechHouse Publishers, 1995.

MTEC052 – Optoelectronics Devices and Systems

Unit-I: Waveguide and Optical Fiber

Dielectric Slab Waveguide (Modes in symmetric slab waveguide, Mode condition, TE & TM polarization, Higher Order modes, Mode Pattern, Modes in Asymmetric slab waveguide), Description of Modes (Types of modes, Guided, Radiation and Leaky modes on ω-β plane, Parameters of single-mode and multi-mode fibers), Multipath dispersion in Step-index and Graded-index fiber, Material dispersion and Pulse distortion, Solitons, Information rate, Signal Degradation (Attenuation loss, Absorption, Rayleigh Scattering, Non-linear Scattering in Fibers), Loss mechanism in Fiber (Losses - Insertion, Return, Intrinsic, Reflection, etc.)

Unit-II: Optical Sources - I (Light Emitting Diode)

Light Emitting Diode: Power & Efficiency; LED structures: Planar LED, Dome LED, Burrus-type
LED, Surface emitting LED, Edge emitting LED, Super-luminescent LED, Resonant cavity and quantum dot LEDs; LED-Analog and Digital Transmissions, LED characteristics (optical output power and spectrum, modulation capability, Transient Response, Power-Bandwidth product).

Unit-III: Optical Sources - I (LASER)

Introduction to LASERs, Black-body radiation, Einstein Coefficients for Absorption and Emission, Population Inversion, Laser Oscillation & its threshold condition, Direct &Indirect bandgap semiconductors, Semiconductor materials for optical sources, Semiconductor Injection Laser: Structures & characteristics, Modulation of Laser diodes, Temperature effects, Noise in Laser (Modal noise, Mode-partition noise, and Reflectionnoise), Non-semiconductor Lasers (Nd-YAG Laser & Glass fiber Lasers).

Unit IV: Optical Detectors

Optical detection theory, Quantum efficiency &Responsivity, Photo detectors without internal gain (p-n photodiode, PIN photodiode), Photo detectors with internal gain (Avalanche photodiode,
Silicon reach through avalanche photodiodes, Germanium avalanche photodiodes, III-V alloy

avalanche photodiodes), Photo-detector noise (noise source, Signal-to-Noise ratio), Detector Response time, Avalanche Multiplication Noise, Temperature effect on Avalanche Gain.

Unit V:Electro-Optic Devices

Electro-Optic effects (Kerr, Pockels, and Faraday effects); Q-switching; Modulation of Laser output; Electo-Optic Modulators, Kerr Modulators; Magneto-Optic Devices; Electro-Optic amplitude modulation; Acousto-Optic effect and devices; Switching & logic devices.

Unit VI: Other Optical and Optoelectronic devices

Overview of Optical sensors and its advantage over conventional sensors, Intensitymodulated optical fiber sensors, Interferometric optical fiber sensors; Optical fiber couplers, Directional couplers; Optical isolators, Wavelength Multiplexers & De-multiplexers, Mach–Zehnder interferometer, Optical A/D, and D/A converters, Semiconductor quantum well structures, Quantum wires and dots.

Unit VII: Optoelectronic Materials

Growth and characterization of III-V and II-VI semiconductor materials required for optoelectronic devices for visible and IR range. Ternary and quaternary semiconductors.

Reference Books:

1. John M. Senior, "Optical Fiber Communications" 3rd Edition, Prentice Hall, 2009.
2. P. Bhattacharya “Semiconductor Opto-Electronic Devices”, Prentice Hall, 2006.
3. Sadao Adachi, "Properties of Semiconductor Alloys: Group-IV, III–V and II–VI Semiconductors Heterostructure super-lattice, photon switching and multiplexing", John Wiley & Sons Ltd, 2009.
4. Gerd Keiser, "Optical Fiber Communications", Fourth Edition, McGraw Hill, 2008.
5. S. C. Gupta, "OPTOELECTRONIC DEVICES AND SYSTEMS", Prentice-Hall, 2005.
6. J. Wilson and J.Haukes, “Opto Electronics – An Introduction”, Prentice Hall, 1995.

MTEC053 – MONOLITHIC MICROWAVE INTEGRATED CIRCUITS

UNIT I

MIC Technology – Thick film and Thin film technology, Testing methods, Encapsulation and mounting of Devices, Hybrid MIC’s, Monolithic MIC technology (MMIC).

UNIT II

Analysis of stripline and microstripline, Method of conformal Transformation, Characteristic

parameters of strip, Microstrip lines, Microstrip Circuit Design, Impedance transformers, Filters, Lumped constant Microstrip circuits.

UNIT III

Coupled Microstrips and Directional couplers, Even and odd mode analysis, Theory of coupled microstrip Directional couplers, Calculations for a coupled pair of Microstrips, Branch line couplers.

UNIT IV

Lumped Elements for MIC's, Impedance transformers, Directional couplers, branch line couplers,
filters, resonators, Design and fabrication of lumped elements, circuits using lumped elements, Comparison with distributed circuits.

UNIT V

Non reciprocal components for MIC's, Microstrip on Ferrimagnetic substrates, Microstrip circulators. Isolators and phase shifters, Design of microstrip circuits – high power and low power
circuits.

TEXT BOOKS:

1. Gupta KC and AmarjitSingh,"Microwave Integrated Circuits", Wiley Eastern.
2. Leo Young," Advances in Microwaves", Academic Press.
3. BharathiBhat,and S.K. Koul, "Stripline-like Transmission Lines for Microwave Integrated Circuits", New Age International.
4. Hoffman R.K "Hand Book of Microwave Integrated Circuits", Artech House, Boston.