SREE VIDYANIKETHAN ENGINEERING COLLEGE
(Autonomous)
DEPARTMENT OF ECE
COURSE STRUCTURE for M.Tech. (CMS)
I – SEMESTER

S. No.	Course Code	Course Title	Periods per week			C	Scheme of Examination Max. Marks		
			L	T	P		Int.	Ext.	Total
1.	14MT15706	Advanced Digital Signal Processing	4	-	-	4	40	60	100
2.	14MT13802	Digital Communication Techniques	4	-	-	4	40	60	100
3.	14MT13805	Computer Networks	4	-	-	4	40	60	100
4.	14MT13809	Linear Algebra	4	-	-	4	40	60	100
5.	14MT23808	Optical Communications and Networks	4	-	-	4	40	60	100
6.		**Elective-I**							
	14MT16101	RF Circuit Design	4	-	-	4	40	60	100
	14MT16102	Satellite Communications							
	14MT16103	Speech Processing							
	14MT13808	Transform Techniques							
7.	14MT10310	Research Methodology	3	-	-	3	40	60	100
8.	14MT16121	Communications Lab. - I	-	-	4	2	25	50	75
		Total:	**27**	**-**	**4**	**29**	**305**	**470**	**775**

II-Semester

S. No.	Course Code	Course Title	Periods per week			C	Scheme of Examination Max. Marks		
			L	T	P		Int.	Ext.	Total
1.	14MT26101	Adaptive Signal Processing	4	-	-	4	40	60	100
2.	14MT23806	Detection and Estimation of Signals	4	-	-	4	40	60	100
3.	14MT23802	Information Theory and Coding Techniques	4	-	-	4	40	60	100
4.	14MT26102	Software Defined Radio	4	-	-	4	40	60	100
5.	14MT23805	Wireless Communications	4	-	-	4	40	60	100
6.		**Elective-II**							
	14MT26103	EMI/ EMC	4	-	-	4	40	60	100
	14MT26104	Radar Signal Processing							
	14MT26105	Telemetry and Telecontrol							
	14MT25709	Wireless Sensor Networks							
7.	14MT26121	Communications Lab. - II	-	-	4	2	25	50	75
8.	14MT26122	Seminar	-	-	-	2	-	50	50
		Total:	**24**	**-**	**4**	**28**	**265**	**460**	**725**

III-Semester

S. No.	Course Code	Course Title	Periods per week			C	Scheme of Examination Max. Marks		
			L	T	P*		Int.	Ext.	Total
1	14MT36121	Project Work – Phase I	-	-	-	4	40	-	40
Total:			**-**	**-**	**-**	4	**40**	**-**	**40**

*Fulltime Project Work

IV-Semester

S. No.	Course Code	Course Title	Periods per week			C	Scheme of Examination Max. Marks		
			L	T	P*		Int.	Ext.	Total
1	14MT46121	Project Work – Phase II	-	-	-	12	40	120	120
Total:			**-**	**-**	**-**	12	**40**	**120**	**160**

*Fulltime Project Work

Total Credits: 73 **Total Marks: 1700**

SREE VIDYANIKETHAN ENGINEERING COLLEGE (Autonomous)

M. Tech. (VLSI) - I Semester (Elective-I)
M. Tech. (CMS) - I Semester
(14MT15706) ADVANCED DIGITAL SIGNAL PROCESSING

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	--	--	4

PRE-REQUISITES: Courses on Digital Signal Processing at UG level.

COURSE DESCRIPTION:
Design of digital filter banks; Power spectral estimation; Digital signal processing algorithms; DSP applications.

COURSE OUTCOMES:
On successful completion of this course the students will be able to
CO1. Demonstrate advanced knowledge in
- Filter banks and Wavelets
- Efficient power Spectral Estimation Techniques.
- Adaptive filters.
- Applications of Multirate signal processing

CO2. Analyze complex engineering problems critically for conducting research in Adaptive filter design.
CO3. Solve engineering problems by designing computationally efficient DSP algorithms for feasible and optimal solutions in digital signal processing field.
CO4. Contribute to scientific research in signal processing and inter disciplinary areas like cellular mobile communications, multirate signal processing and spectral analysis.

DETAILED SYLLABUS:

UNIT I: MULTIRATE FILTER BANKS (Periods:12)
Decimation, Interpolation, Sampling rate conversion by a rational factor I/D, Multistage Implementation of sampling rate conversion. **Digital Filter Banks**: Two-Channel Quadrature-Mirror Filter Bank, Elimination of aliasing, condition for Perfect Reconstruction, Polyphase form of QMF bank, Linear phase FIR QMF bank, IIR QMF bank , Perfect Reconstruction Two-Channel FIR QMF Bank .
UNIT II: POWER SPECTRAL ESTIMATIONS (Periods:11)
Estimation of spectra from finite duration observation of signals, **Non-Parametric Methods**: Bartlett, Welch, Blackmann & Tukey methods. Performance Characteristics of Nonparametric Power Spectrum Estimators, Computational Requirements of Nonparametric Power Spectrum Estimates.
UNIT III: PARAMETRIC METHODS OF POWER SPECTRAL ESTIMATION (Periods:11)
Autocorrelation & Its Properties, Relation between auto correlation & model parameters, Yule-Walker & Burg Methods, MA & ARMA models for power spectrum estimation.

UNIT IV: DSP ALGORITHMS (Periods:10)

Fast DFT algorithms based on Index mapping, Sliding Discrete Fourier Transform, DFT Computation Over a narrow Frequency Band, Split Radix FFT, Linear filtering approach to Computation of DFT using Chirp Z-Transform.

UNITV: APPLICATIONS OF DIGITAL SIGNAL PROCESSING (Periods:11)

Digital cellular mobile telephony, Adaptive telephone echo cancellation, High quality A/D conversion for digital Audio, Efficient D/A conversion in compact hi-fi systems, Acquisition of high quality data, Multirate narrow band digital filtering, High resolution narrowband spectral analysis.

Total periods: 55

TEXT BOOKS:

1. John G. Proakis, Dimitris G. Manolakis, *Digital signal processing, principles, Algorithms and applications,* Prentice Hall, 4th Edition, 2007.
2. Sanjit K Mitra, *"Digital signal processing, A computer base approach",* McGraw-Hill Higher Education, 4th Edition, 2011.

REFERENCE BOOKS:

1. Emmanuel C Ifeacher Barrie. W. Jervis, "*DSP-A Practical Approach*", Pearson Education, 2nd Edition, 2002.
2. A.V. Oppenheim and R.W. Schaffer, *"Discrete Time Signal Processing",* PHI, 2nd Edition, 2006.

M. Tech. (CMS & DECS)-I Semester
(14MT13802) DIGITAL COMMUNICATION TECHNIQUES

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	-	-	4

PRE-REQUISITES: A Course on Digital Communications at UG Level
COURSE DESCRIPTION:
Representation of band pass signals and systems; Digital modulation techniques; Design of optimum receivers; Generation and detection of spread spectrum signals.

COURSE OUTCOMES: On successful completion of this course the students will be able to
CO1: Demonstrate n-depth knowledge in
- Characterization of communication signals and systems.
- Digital modulation techniques
- Communication over AWGN channels
- Optimum receivers
- Spread spectrum techniques

CO2: Analyze numerical and analytical problems critically for conducting research in the field of Digital Communication Systems.
CO3: Solve engineering problems and arrive at optimal solutions pertaining to digital communications.
CO4: Apply appropriate techniques to complex engineering activities in the field of signal processing and communications.

DETAILED SYLLABUS
Review of random Variables and Processes
UNIT–I: CHARACTERIZATION OF COMMUNICATION SIGNALS AND SYSTEMS (Periods:10)
Representation of Band Pass Signals and Systems – Representation of Band-Pass Signals, Representation of Linear Band-Pass System, Response of a Band-Pass System to a Band-Pass Signal. Signal Space Representations – Vector Space Concepts, Signal Space Concepts, Orthogonal Expansion of Signals. Representation of Digitally Modulated Signals – Memory Less Modulation Methods – PAM Signals, Phase Modulated Signals, QAM Signals, Multidimensional Signals, Orthogonal Multidimensional Signals. Spectral Characteristics of Digitally Modulated Signals – Power Spectra of Linearly Modulated Signals.
UNIT–II: DIGITAL MODULATION TECHNIQUES (Periods:11)
Digital Modulation – Factors that Influence the Choice of Digital Modulation, Bandwidth and Power Spectral Density of Digital Signals. Linear Modulation Techniques – BPSK, DPSK, QPSK, OQPSK, ∏/4 QPSK. Constant Envelope Modulation Techniques – MSK, GMSK, Combined Linear and Constant Envelope Modulation Techniques – M-ary PSK, M- ary QAM.

UNIT–III: OPTIMUM RECEIVERS FOR THE ADDITIVE GAUSSIAN NOISE CHANNEL (Periods:10)

Optimum Receiver for Signals Corrupted by AWGN – Correlation Demodulator, Matched Filter Demodulator, the Optimum Detector. Performance of the Optimum Receiver for Memory Less Modulation – Probability of Error for Binary Modulation, M-ary Orthogonal Signals, M-ary PAM, M-ary PSK, QAM. Optimum Receiver for Signals with Random Phase in AWGN Channel – Optimum Receiver for Binary Signals, Optimum Receiver for M-ary Orthogonal Signals.

UNIT–IV: SPREAD SPECTRUM TECHNIQUES (Periods:10)

Introduction, Model of Spread Spectrum Digital Communication System, Direct Sequence Spread Spectrum Signals – Introduction, The Processing Gain and Jamming Margin. Applications of Direct Sequence Spread Spectrum Signals – Anti-jamming Application, Low-Detectability Signal Transmission, Code Division Multiple Access. Generation of PN-Sequences, Frequency-Hopped Spread Spectrum Signals, Other Types of Spread Spectrum Signals.

UNIT–V: DETECTION OF SPREAD SPECTRUM SIGNALS (Periods:09)

Coherent Direct-Sequence Receivers, Coherent Carrier Tracking – Delay-Lock Loop Analysis, Tau-Dither Loop. Non Coherent Carrier Tracking, Non coherent Frequency-Hop Receiver, Acquisition of Spread-Spectrum Signals – Acquisition by Cell-By-Cell Searching. Reduction of Acquisition Time – Acquisition with Matched Filters, Matched filters for PN Sequences, Matched Filters for Frequency-Hopped Signals.

Total periods: 50

TEXT BOOKS:

1. John G. Proakis, "Digital Communications", McGraw Hill, 4th edition, 2001.
2. Theodore S. Rappaport, "Wireless Communications", Pearson Education, 2nd edition, 2002.
3. George R. Cooper & Clare D. McGillem, "Modern Communication and Spread Spectrum", McGraw-Hill Book Company, 1986.

REFERENCE BOOKS:

1. Marvin K. Simon, Jim K Omura, Robert A. Scholtz & Barry K.Levit, "Spread Spectrum Communications", Computer Science Press, 1995.
2. J.Marvin, K.Simon, Sami. M.Hinedi and William C. Lindsey, "Digital Communication Techniques", PHI, 2009.

M. Tech. (CMS) – I Semester
M. Tech. (DECS) – I Semester (Elective-I)
(14MT13805) COMPUTER NETWORKS

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	--	--	4

PRE-REQUISITES:
A Course on Computer Networks at UG Level

COURSE DESCRIPTION:
Protocols & standards of computer and wireless networks; Advanced network architectures; Upper layers protocols; Network security.

COURSE OUTCOMES: After completion of the course, students should be able to:

CO 1. Demonstrate in-depth knowledge on
  a. Architectures and functioning of Advanced Wireless LAN and WAN technologies such as Wi-Fi, Wi-Max, Frame Relay, ATM networks etc.
  b. Protocols like MPLS, RSVP, VOIP associated with modern computer network systems.
  c. Know the security features associated with modern computer network systems.

CO 2. Analyze various design issues for conducting research related to the Internet protocol (IP), Wireless LANs and ATM network technologies prominent in high performance scenario.

CO 3. Formulate solutions for engineering problems pertaining to the advanced networking technologies.

CO 4. Apply appropriate techniques and tools to complex engineering activities in the field of computer networks.

DETAILED SYLLABUS

UNIT- I: INTRODUCTION TO COMPUTER NETWORKS (Periods:11)
Data communications & Networking for Today's Enterprise, Data Communications, Network Edge, Network core, Internet, OSI, TCP/IP models, Data Link Control Protocols - HDLC, Point to Point Protocol (PPP);

UNIT- II: WIRELESS NETWORKS (Periods:12)
Ethernet, Fast Ethernet, Gigabit Ethernet, WLANS – Merits and topologies, IEEE 802.11 WLAN Standard – Physical Layer, MAC Layer, Frame structure, IEEE 802.11 a, b, g, e and n standards, Applications; Bluetooth & WiMax- features, standards, protocols and utility; Virtual LANs

UNIT- III: ADVANCED NETWORK ARCHITECTURES (Periods:13)
Circuit switching network - SONET/SDH; Virtual Circuit Networks – Frame Relay, ATM - Protocol Architecture, Logical Connections, ATM Cells, Transmission of ATM Cells, ATM Service Categories; Signaling Protocols - MPLS,

RSVP; VPN architectures, IP over ATM, Connecting Devices: Repeaters, Bridges, Routers, Gateways.

UNIT- IV: INTERNET TRANSPORT AND APPLICATION PROTOCOLS (Periods:12)

Internet protocol - IPv6, Transport protocols – Connection Oriented protocol TCP, Connectionless protocol UDP; Congestion control in TCP, Socket interface, Domain Name System, Simple Mail Transfer Protocol, WWW and HTTP, Multimedia Applications – RTP, Voice Over IP.

UNIT- V: SECURITY IN COMPUTER NETWORKS (Periods:08)

Simple Network Management Protocol, Network security, Cryptography - Symmetric Key Cryptography, Public Key Cryptography, Firewalls - Packet filtering, Application Gateway, Digital Signature, IP Sec.

Total Periods: 56

TEXT BOOKS:

1. William Stallings, "Data and Computer Communication", 9th edition, Prentice hall, 2010
2. Behrouz A. Forouzan, "Data Communications and Networking", 4th Ed, Tata McGraw-Hill, New Delhi, 2006
3. Jim Kurose, Keith Ross, "Computer Networking: A Top Down Approach", 4th edition, Addison Wesley, July 2007.

REFERENCE BOOKS:

1. Andrew S. Tanenbaum "Computer Networks", 4th Edition, Pearson Education, 2008
2. LEON-GARCIA, INDRA WIDJAJA, "Communication Networks – Fundamental concepts and Key architectures", TMH, 2000

M. Tech. (DECS & CMS) - I Semester
(14MT13809) LINEAR ALGEBRA

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	--	--	4

PRE-REQUISITES: Courses on Mathematics at UG level.

COURSE DESCRIPTION:
Solving linear systems of equations; Abstract structures with underlying mathematics such as vector spaces, linear transforms, inner products, Eigen values and Eigen vectors; Engineering applications of linear algebra.

COURSE OUTCOMES:
On successful completion of course the student will be able to

CO1. Demonstrate advanced knowledge in
- (a) solving Linear equations
- (b) finding the bases and dimensions of Vector Spaces
- (c) determining the Linear Transformation between different Vector Spaces .

CO2. Develop skills in
- (a) designing the Dynamical Systems in electrical circuits
- (b) analyzing Discrete time signals
- (c) applying complex Eigen Values in Decoupling systems
- (d) applying concepts of Inner Product Spaces in Fourier Series Analysis.

CO3. Apply Eigen Values and Eigen Vectors in diagonalisation of matrices related to transformations.

DETAILED SYLLABUS:

UNIT – I : VECTORS AND LINEAR EQUATIONS (Periods:09)
System of linear equations, Vector equations, The matrix and vector equations AX=B and AX=0.Solution sets of linear system, Linear combinations, Linear dependence and independence of vectors. Solutions of equations using LU decomposition.

UNIT–II: VECTOR SPACES AND LINEAR TRANSFORMATIONS (Periods:10)
Vector spaces – subspaces, Null and column Spaces of a matrix ,Bases, Coordinate systems, Dimension of a Vector Space .Linear transformation, Properties of linear transformations Rank and Nullity ,Matrix of linear transformations.

UNIT – III: INNER PRODUCT SPACES (Periods:10)
Inner product, Norm, Inner product space, Othrogonality , Orthogonal sets, Ortho normal basis - Orthogonal projections ,Gram-Schmidt orthogonalisation process.

UNIT – IV: EIGEN VALUES AND EIGEN VECTORS (Periods:12)

Eigen Values and Eigen Vectors of a matrices and linear transformations, Eigen values and Eigen vectors of complex matrices. Diagonalisation, Quadratic forms- Nature , Orthogonality of symmetric matrices. Singular value decomposition (SVD).

UNIT – V: ENGINEERING APPLICATIONS OF LINEAR ALGEBRA (Periods:14)

Applications to Difference equations, Discrete-time signals. Linear Independence in the space signals, Applications to Decoupling a dynamical system , Complex Eigen Values in Decoupling systems, Applications of inner product spaces to Fourier Series Analysis.

Total periods : 55

TEXT BOOKS :

1. David C. Lay, **Linear Algebra and its applications**, Fourth edition, Pearson education, India. (2014).
2. Jim DeFramza and Dan Gagliardi **Introduction to Linear Algebra with applications,** The McGraw. Hill Companies, India. (2012)

REFERENCES:

1. Gilbert Strang, **Introduction to Linear Algebra**, Fourth edition, South Asian edition, Cambridge Press. (2009).
2. Otto Bretscher , **Linear Algebra with applications**, Third edition, Pearson education, India. (2007)

M. Tech. (CMS)-I Semester
M. Tech. (DECS)-II Semester (Elective-II)
(14MT23808) OPTICAL COMMUNICATIONS AND NETWORKS

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	--	--	4

PRE-REQUISITES:
A Course on Optical Communications at UG Level.

COURSE DESCRIPTION:
Characteristics of fiber materials; Optical cables design and connectors; Fiber optic components; Modulation and demodulation of optical signals; Optical networks.

COURSE OUTCOMES:
At the end of the course, the students will be able to

CO1. Demonstrate Knowledge in
- Linear and Non-linear Characteristics of Optical fiber.
- Fiber design considerations.
- Minimization of Losses in Cable design.
- Understanding the operation of advanced fiber optic components
- Modulation and demodulation techniques
- Access networks

CO2. Analyze complex engineering problems critically in the domain of optical communication for conducting research.

CO3. Formulate solutions to problems related to optical communication to meet societal and industrial needs.

CO4. Apply appropriate techniques to complex engineering activities in the field of communication networks.

DETAILED SYLLABUS

UNIT I: INTRODUCTION (Periods:11)
Evolution of fiber types, guiding properties of fibers, cross talk between fibers, coupled modes and mode mixing, dispersion properties of fibers, nonlinear effects of optical fibers- SRS, SBS, intensity dependent refractive index. Characterizations of materials for fibers, fiber preform preparation- Soot deposition, MCVD. Fiber drawing and control, roles of coating and jacketing.

UNIT II: OPTICAL CABLE DESIGN (Periods:10)
Fiber design considerations-Fiber diameter, Cladding thickness, Low and high bit rate systems. Design objectives and cable structures, Fiber splicing- fiber end preparation, single and array splices, measurement of splicing effects. Optical fiber connectors-The role of connectors, Connector alignment techniques.

UNIT-III: FIBER OPTIC COMPONENTS FOR COMMUNICATION AND NETWORKING (Periods:14)

Couplers, Isolators and Circulators, Multiplexers & filters- Bragg Gratings, Fabry-Perot Filters, Mach-Zehnder Interferometers, Arrayed Waveguide Grating, Acousto-Optic Tunable Filter, High Channel Count Multiplexer Architectures. Optical Amplifiers- Erbium Doped Fiber amplifiers, Raman amplifiers, Transmitters- LED, Lasers, Direct and External Modulation, Detectors- Photo detectors. Optical Switches – Large Optical Switches. Wavelength Converters – Optoelectronic Approach, Optical gating.

UNIT-IV: MODULATION AND DEMODULATION (Periods:08)

Signal formats for Modulation, Subcarrier Modulation and Multiplexing, Optical Modulations – Duo binary, Single Side Band and Multilevel Schemes, Demodulation- Ideal and Practical receivers, Bit Error Rates, Coherent Detection, Timing Recovery and Equalization, Reed-Solomon Codes for Error Detection and Correction.

UNIT-V: OPTICAL NETWORKS (Periods:10)

Access Networks - architecture overview, Enhanced HFC, Fiber to the curb (FTTC). Photonic packet switching - OTDM, Synchronization, OTDM test beds. Deployment considerations- Designing the transmission layer using SDM, TDM, WDM, Unidirectional versus Bidirectional WDM systems.

Total Periods: 53

TEXT BOOKS:

1. S.E.Miller, A.G.Chynoweth, "*Optical Fiber Telecommunication",* 1979
2. Rajiv Ramaswamy, Kumar N. Sivaranjan and Galen H.Sasaki,"*Optical Networks* ", Elsevier, 3rd edition,2010.

REFERENCE BOOKS:

1. Govind P.Agarwal "Fiber – Optic Communication Systems", Wiley India, 3rd edition, 2002.
2. Gerd Kaiser, "*Optical Fiber Communication"*, McGraw Hill, 4th edition, 2008.
3. John. M. Senior, "*Optical fiber communications: Principles and Practice",* Pearson, 3rd edition, 2010.

M. Tech. (CMS)-I Semester (Elective-I)
(14MT16101) RF CIRCUIT DESIGN

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	--	--	4

PRE-REQUISITES:
Concept of Basic Electronics and Wave Theory at UG level

COURSE DESCRIPTION:
Radio frequency electronics; Transmission lines; RF passive and active components; RF transistor amplifiers and oscillators.

COURSE OUTCOMES:
On successful completion of this course the students will be able to
CO1. Demonstrate advanced knowledge in

- RF Electronics
- Transmission line analysis
- Matching and biasing networks
- RF Passive and Active components
- RF Transistor amplifier design
- Oscillators and RF Mixers.

CO2. Analyze complex problems critically in the domains of RF field, RF Passive and Active components as well as a smart antenna techniques for better spectrum exploitation for conducting research.
CO3. Solve engineering problems to arrive at optimal solutions in compliance with public health and safety, cultural, societal and environmental factors in the core areas of RF Circuit design.
CO4. Apply appropriate techniques to for the development of scientific knowledge in wireless communication Systems and allied areas.

DETAILED SYLLABUS

UNIT – I: INTRODUCTION TO RF ELECTRONICS (Periods:10)
The Electromagnetic Spectrum, units and Physical Constants, Microwave bands, RF behavior of Passive components: Tuned resonant circuits, Vectors, Inductors and Capacitors. Voltage and Current in capacitor circuits, Tuned RF/IF Transformers.
UNIT – II: TRANSMISSION LINE ANALYSIS (Periods:14)
Examples of transmission lines, Transmission line equations and Biasing: Kirchoffs Voltage and current law representation, Traveling voltage and current waves, General Impedance definition, lossless transmission line model. Micro Strip Transmission Lines, Special Termination Conditions, sourced and Loaded Transmission Lines. **Single and Multiport Networks**: The Smith Chart, Interconnectivity networks, Network properties and Applications, Scattering Parameters.

UNIT -III: MATCHING AND BIASING NETWORKS (Periods:13)
Impedance matching using discrete components, Micro strip line matching networks, Amplifier classes of Operation and Biasing networks.
RF Passive and Active Components: Filter Basics, Lumped filter design, Distributed Filter Design, Diplexer Filters, Crystal and Saw filters, Active Filters, Tunable filters. Power Combiners / Dividers: Directional Couplers, Hybrid Couplers, Isolators. RF Diodes: BJTs, FETs, HEMTs and Models.
UNIT – IV: RF TRANSISTOR AMPLIFIER DESIGN (Periods:09)
Characteristics of Amplifiers, Amplifier Circuit Configurations, Amplifier Matching Basics, Distortion and noise products, Stability Considerations, Small Signal amplifier design, Power amplifier design, MMIC amplifiers, Broadband High Power multistage amplifiers, Low noise amplifiers, VGA Amplifiers.
UNIT – V: OSCILLATORS (Periods:11)
Oscillator basics, Low phase noise oscillator design, High frequency Oscillator configuration, LC Oscillators, VCOs, Crystal Oscillators, PLL Synthesizer, and Direct Digital Synthesizer.
RF Mixers: Basic characteristics of a mixer, Active mixers, Image Reject and Harmonic mixers, Frequency domain considerations.

Total periods: 57

TEXT BOOKS:

1. Reinhold Ludwing, Pavel Bretchko, “RF Circuit design: Theory and applications”, Pearson Education Asia Publication, New Delhi 2001.
2. Devendra K. Misra, "Radio Frequency and Microwave Communication Circuits – Analysis and Design", Wiley Student Edition, John Wiley & Sons, 2nd edition, July 2004.

REFERENCE BOOKS:

1. Mathew M.Radmangh, “Radio frequency and microwave electronics”, PE Asia Publication, 2001.
2. Christopher Bowick, Cheryl Aljuni and John Biyler, “RF Circuit Design”, Elsevier Science, 2008.
3. Joseph Carr, "Secrets of RF Design", Tata McGraw Hill Publications, 3rd Edition, 2004.

M. Tech. (CMS)-I Semester (Elective-I)
(14MT16102) SATELLITE COMMUNICATIONS

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	--	--	4

PREREQUISITES: A course on 'Digital Communications' at UG level.

COURSE DESCRIPTION:
Orbital mechanics and satellite sub-systems; Non-geostationary satellite systems; Demand assignment multiple access techniques and packet communications; Spread spectrum communications; Satellite applications.

COURSE OUTCOMES:
After completion of this course, student will be able to:
CO1. Demonstrate advanced knowledge in
- Satellite Orbits and Sub-Systems
- NGSO Constellation Designs
- DAMA Interfaces
- Satellite Packet Communications and ALOHA systems
- Spread spectrum Communications
- Satellite Applications such as VSAT, MSAT, Direct Broadcast Satellite Television.

CO2. Investigate and analyze complex engineering problems critically for conducting research in satellite systems.
CO3. Solve engineering problems with feasible and economical solutions in satellite communications.
CO4. Apply appropriate techniques to engineering activities in the field of satellite communications.
CO5. Follow ethical code of conduct in the field of satellite communications as per the regulations of International Telecommunications Union (ITU).

DETAILED SYLLABUS
UNIT–I: SATELLITE ORBITS AND SUBSYSTEMS (Periods:11)
Overview of Satellite Communications- Brief history, Orbital Mechanics, Look Angles determination, Orbital perturbations, Apogee- Perigee heights. Geo-stationary orbits- launching orbits, launch vehicles. Satellite Sub-Systems- Attitude and Orbit Control system, TT&C subsystem, Power systems, Communication subsystems, Satellite Antenna Equipment.
UNIT– II: LOW EARTH ORBIT AND NON-GEOSTATIONARY SATELLITE SYSTEMS (Periods:10)
Introduction-Orbit Considerations, Equatorial Orbits, Inclined Orbits, Elliptical Orbits, Molniya Orbit. Coverage and Frequency Considerations- General Aspects, Frequency band, Elevation Angle Considerations, Number of Beams Per Coverage, Off-Axis Scanning, Determination of Optimum Orbital Altitude, Projected NGSO System Customer Service Base. Delay and Throughput Considerations, System considerations- Incremental Growth, Interim

Operations, Replenishment Options. Operational NGSO Constellation Designs-Ellipse, Global star, New ICO, Iridium, Orbcomn, Sky bridge, Teledesic.

UNIT–III:EFFICIENT TECHNIQUES & SATELLITE PACKET COMMUNICATIONS (Periods:11)

Demand Assignment Multiple Access and Digital Speech Interpolation: The ERLANG B Formula, Types of Demand Assignments, DAMA Characteristics, Real-Time Frame Reconfiguration- Frame and Burst Structures for DA-TDMA. DAMA Interfaces, SCPC-DAMA, SPADE, Digital Speech Interpolation.

Satellite Packet Communications: Preliminaries, Message Transmission by FDMA-The M/G/1 Queue, Message Transmission by TDMA, Pure ALOHA-Satellite Packet Switching, Slotted ALOHA, Packet Reservation, Tree Algorithm.

UNIT– IV: SATELLITE SPREAD SPECTRUM COMMUNICATIONS (Periods:12)

Direct Sequence Spread Spectrum Systems- PN Sequence, Error Rate Performance in Uniform Jamming, Error Rate Performance in Pulsed Jamming. Direct Sequence Code Division Multiple Access- Sequence Synchronous DS-CDMA, Sequence Asynchronous DS-CDMA, Random Access DS-CDMA. Frequency HOP Spread Spectrum Systems-Frequency HOP Code Division Multiple Access. DS Acquisition and Synchronization, FH Acquisition and Synchronization, Satellite on Board Processing.

UNIT –V: SATELLITE APPLICATIONS (Periods:11)

Very Small Aperture Terminal Networks: VSAT Technologies, Network Configurations, Multi-access and Networking, Network Error Control.

Mobile Satellite Networks: Operating Environment, MSAT Network Concept, CDMA MSAT Network, Statistics of Mobile Propagation.

Direct Broadcast Satellite Television and Radio

C-Band and Ku-Band Home Satellite TV, Digital DBS TV, DBS-TV System Design, DBS-TV Link Budget, Error Control in Digital DBS-TV, Master Control Station and Uplink, Installation of DBS-TV Antennas, Satellite Radio Broadcasting. **Total periods: 55**

TEXT BOOKS:

1. Timothy Pratt, Charles Bostian, Jeremy Allnutt, *Satellite Communications,* John Wiley & Sons, 2nd Edition, 2003.
2. Tri T. Ha, *Digital Satellite Communications,* McGraw-Hill, 2nd Edition, 1999.

REFERENCE BOOKS:

1. Dennis Roddy, *Satellite Communications,* Tata McGraw-Hill Education Private Limited, 4th Edition, 2009.
2. Wilbur L. Pritchard, H.G. Suyderhoud, Robert A.Nelson, *Satellite Communication Systems Engineering*, 2nd Edition, Pearson Publications, 2008.

M. Tech. (CMS)-I Semester (Elective-I)
(14MT16103) SPEECH PROCESSING

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	--	--	4

PRE-REQUISITES: Courses on Signals & Systems and Digital Signal Processing in UG

COURSE DESCRIPTION:

Acoustic theory of speech production; Models for speech signals and speech processing systems; Mathematical analysis of speech signals - homomorphic and LPC models; Speech and speaker recognition systems.

COURSE OUTCOMES:

On successful completion of this course the students will be able to

CO1. Demonstrate advanced knowledge in
- Digital model representation of speech signal
- LPC analysis
- Homomorphic models.

CO2. Analyze complex engineering problems critically for conducting research in speech signal processing.

CO3. Solve engineering problems using an efficient algorithms for feasible and optimal solutions in Speech signal processing field.

CO4. Apply speech and speaker verification techniques to complex engineering activities in the field of speech processing.

DETAILED SYLLABUS:

UNIT-I: DIGITAL MODEL FOR THE SPEECH SIGNAL (Periods:13)

The process of speech production - the mechanism of speech production, acoustic phonetics. The Acoustic theory of speech production- sound propagation, uniform lossless tubes, Effect of losses in the vocal tract, Effect of radiation at the lips, Vocal tract transfer functions for vowels, the effect of nasal coupling, Excitation of sound in the vocal tract. Digital model for speech signals.

UNIT - II : TIME DOMAIN MODELS FOR SPEECH PROCESSING (Periods:10)

Introduction, Window considerations, Short time energy and average magnitude, Short time average zero crossing rate, Speech vs silence discrimination using Average energy and zero crossing, Pitch period estimation using parallel processing approach, The short time autocorrelation function, The short time average magnitude difference function, Pitch period estimation using the autocorrelation function.

UNIT-III: HOMOMORPHIC SPEECH PROCESSING (Periods:09)

Homomorphic systems for convolution – properties of the complex Cepstrum, computational considerations. The complex Cepstrum of speech, pitch detection, formant estimation, Homomorphic vocoder.

UNIT-IV : LINEAR PREDICTIVE CODING OF SPEECH (Periods:12)
Basic principles of linear predictive analysis – Auto correlation method, The covariance method. Computation of the gain for the model, solution of LPC Equations – Cholesky Decomposition solution for the covariance method. Durbin's Recursive solution for the autocorrelation equations. Comparison between methods of solutions of LPC analysis equations. Applications of LPC parameters – Pitch detection using LPC parameters, Formant analysis using LPC parameters.

UNIT-V: SPEECH AND SPEAKER RECOGNITION SYSTEMS (Periods:08)
Speaker recognition system-speaker verification system, speaker identification systems.

Speech recognition system- isolated digit recognition system, continuous digit recognition system, LPC distance measure.

Total periods: 52

TEXT BOOKS:

1. L R Rabiner and SW Schafer, " *Digital processing of speech signals*", pearson education, 2006.
2. LR Rabiner ,BH Juang, B Yegnanarayana, " *Fundamentals of Speech Recognition*", pearson Education, 1993.

REFERENCE BOOKS:

1. Thomas F Quateri, "*Discrete time speech signal processing*", pearson edition, 2006.
2. Ben Gold & Nelson Morgan, "*Speech & audio signal processing*", wiley, 2006.
3. Douglas o shaughnessy , " *Speech Communications*", 2nd Edition , Oxford university press, 2000.

M. Tech. (DECS & CMS)-I Semester (Elective-I)
(14MT13808) TRANSFORM TECHNIQUES

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	--	--	4

PRE-REQUISITES:
Course on Signal Processing at UG Level.

COURSE DESCRIPTION:
Continuous wavelet transforms; Discrete wavelet transforms; Multi resolution analysis; Wavelet packets; Applications of wavelet transforms.

COURSE OUTCOMES:
On successful completion of this course the students will be able to

CO1. Demonstrate advanced knowledge in
- Multiresolution Analysis
- Continuous wavelets
- Discrete wavelets
- Alternative wavelets & Wavelet packets

CO2. Analyze complex engineering problems critically for conducting research in Signal Processing.

CO3. Solve engineering problems with wide range of solutions in the areas of Biomedical Signal Processing, Image Processing, Radar Signal Processing and Communications.

CO4. Contribute to collaborative multidisciplinary scientific work on Data compression, Noise reduction, Communications, Image and signal Processing.

CO5. Apply appropriate Transform techniques, resources and tools to engineering activities in the fields of Signal Processing and Communications.

DETAILED SYLLABUS

UNIT –I: (Periods:14)

Review of Transforms:
Fourier series and Geometry- Vector space, functions and function spaces. Fourier transform, short-time Fourier transform, Walsh, Hadamard, Haar, Slant, KLT, Hilbert transforms.

Continuous Wavelet Transform:
Introduction, Continuous-Time Wavelets, Definition of the CWT, The CWT as a correlation, Constant Q-Factor Filtering Interpretation and Time-Frequency Resolution, The CWT as an operator, Inverse CWT.

UNIT –II: DISCRETE WAVELET TRANSFORM AND ORTHOGONAL WAVELET DECOMPOSITION (Periods:08)
Introduction, Approximations of vectors in nested linear vector spaces, Example of an MRA-Bases for the Approximation Subspaces and Harr Scaling Function, Bases for the Detail Subspaces and Harr Wavelet, Digital Filter Implementation of the Harr Wavelet Decomposition.

UNIT–III: MRA ORTHONORMAL WAVELETS, AND THEIR RELATIONSHIP TO FILTER BANKS (Periods:12)

Introduction, Formal Definition of an MRA, Construction of a General Orthonormal MRA, A Wavelet basis for MRA, Digital Filtering Interpretation, Examples of Orthogonal Basis Generating Wavelets, Interpreting Orthonormal MRAs for Discrete time signals, Miscellaneous issues Related to PRQMF Filter Banks, Generating Scaling Functions and Wavelets from Filter Coefficients.

UNIT-IV: ALTERNATIVE WAVELET REPRESENTATIONS (Periods:09)

Bi-orthogonal Wavelet Bases, Filtering Relationship for Bi-orthogonal Filters, Examples of Bi-orthogonal Scaling Functions and Wavelets, Two-Dimensional Wavelets, Non-separable Multidimensional Wavelets, Wavelet Packets.

UNIT–V: APPLICATIONS OF WAVELETS (Periods:11)

Wavelet De-noising, Speckle Removal, Edge Detection and Object Isolation, Image Fusion, Object Detection by Wavelet Transforms of Projections, Communication Applications-Scaling Functions as signaling pulses, Discrete Wavelet Multitone Modulation.

Total Periods: 54

TEXT BOOKS:

1. Raghuveer M.Rao and Ajit S.Bopardikar, "*Wavelet Transforms-Introduction to theory and applications*", Pearson edu, 1998.
2. Soman.K.P, Ramachandran.K.I, Resmi.N.G, "*Insight into Wavelets from theory to Practice*", PHI, Third Edition, 2010.

REFERENCE BOOKS:

1. R. C. Gonzalez, R. E. Woods, "*Digital Image Processing*," 2nd Edition, Pearson Education, 1992.
2. Jaideva C Goswami, Andrew K.Chan, "*Fundamentals of Wavelets-Theory, Algorithms and Applications*", John Wiley and sons, 1999.
3. C.Sidney Burrus, Ramesh A Gopinath and Haitao Guo, "*Introduction to Wavelets and Wavelet Transforms*", Prentice Hall, 1998.

M. Tech. – I Semester
(14MT10310) RESEARCH METHODOLOGY
(Common to all M. Tech. Programmes)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	3	--	--	3

PRE-REQUISITES: --

COURSE DESCRIPTION:
Fundamentals of research work - research problem and design; Data collection, Analysis and hypothesis; Statistics in Research; Interpretation and Report Writing.

COURSE OUTCOMES:
On successful completion of course, the student will be able to
CO1. Demonstrate knowledge on research approaches, research process and data collection.
CO2. Identify and analyze research problem.
CO3. Solve the research problems using statistical methods.
CO4. Carryout literature survey and apply good research methodologies for the development of scientific/technological knowledge in one or more domains of engineering.
CO5. Learn, select and apply modern engineering tools to complex engineering activities.
CO6. Write effective research reports.

DETAILED SYLLABUS:
UNIT-I: INTRODUCTION TO RESEARCH METHODOLOGY (Periods:07)
Objectives and Motivation of Research, Types of Research, Research Approaches, Research Process, Criteria of good Research.
UNIT-II: RESEARCH PROBLEM AND DESIGN (Periods:09)
Defining and Formulating the Research Problem, Problem Selection, Necessity of Defining the Problem, Techniques involved in Defining a Problem. Features of Good Design, Research Design Concepts, Different Research Designs.
UNIT-III: DATA COLLECTION, ANALYSIS, AND HYPOTHESIS (Periods:09)
Different Methods of Data Collection, Processing Operations, Types of Analysis, Basic Concepts of Testing of Hypothesis, Hypothesis Testing Procedure.
UNIT-IV: STATISTICS IN RESEARCH (Periods:09)
Review of Statistical Techniques - Mean, Median, Mode, Geometric and Harmonic Mean, Standard Deviation, Measure of Asymmetry. Normal Distribution, Chi-Square Test as a Test of Goodness of Fit.
UNIT-V: INTERPRETATION AND REPORT WRITING (Periods:06)
Interpretation – Techniques and Precautions. Report Writing – Significance, Stages, Layout. Types of reports, Precautions in Writing Reports.

Total Periods: 40

TEXT BOOK:

1) C.R. Kothari, *Research Methodology: Methods and Techniques*, New Age International Publishers, New Delhi, 2nd Revised Edition, 2004.

REFERENCE BOOKS:

1) Ranjit Kumar, *Research Methodology: A step-by-step guide for beginners*, Sage South Asia, 3rd ed., 2011.
2) R. Panneerselvam, Research Methodology, PHI learning Pvt. Ltd., 2009

M. Tech. (CMS) - I SEMESTER
(14MT16121) COMMUNICATIONS LAB - I

Int. Marks	Ext. Marks	Max. Marks	L	T	P	C
25	50	75	-	-	4	2

PRE-REQUISITES: Simulation Lab at UG Level

COURSE DESCRIPTION:
Design and simulation of communication systems - Baseband Communication Systems with Optimum terminal filters, QPSK communication system for AWGN channel, Base Band Direct Sequence Spread Spectrum (DS/SS) System; Generation of different density and distribution functions; Generation of maximal and Gold code sequences.

COURSE OUTCOMES:
At the end of the course, students will be able to
CO1. Demonstrate skills in
- The generation of Maximal and Gold Sequences & verification of their properties.
- Design of Communication system for Band limited Channels: Signal Design for Zero ISI.
- Evaluation of QPSK over AWGN Channel, 16MPSK, 16QAM.
- The Simulation of Code matched filter in Spread Spectrum Communication System.
- Design of Baseband Communication Systems with Optimum terminal filters.
- The Simulation of Base Band Direct Sequence Spread Spectrum (DS/SS) System.

CO2. Analyze complex engineering problems critically for conducting research in the field of Communications.
CO3. Solve engineering problems for feasible and optimal solutions in the core area of Communication.
CO4. Use MATLAB Toolboxes to complex engineering activities in the domain of communication.
CO6. Demonstrate Knowledge and understanding of Engineering Principles to execute the Projects effectively in the field of communications.

List of experiments:

1. Generation of discrete time Independent, Identically Distributed (i.i.d) random processes with different distributions (Bernoulli, Binomial, Geometric, Poisson, Uniform, Gaussian, Exponential, Laplacian, Rayleigh, Rician).(2 time slots)
2. Communication system Design for Band limited Channels: Signal Design for Zero ISI.(2 time slots)
3. Design of Baseband Communication Systems with Optimum terminal filters.(2 time slots)

4. Simulation & performance evaluation of QPSK communication system for AWGN channel.(1 time slot)
5. Simulation of maximal sequences of any length & verification of their properties.(1 time slot)
6. Generation of Gold Codes & verification of auto-correlation & cross correlation properties.(1 time slot)
7. Design and simulation of code matched filter in spread spectrum communication system.(2 time slots)
8. Comparison of 16-MPSK and 16-QAM.(1 time slot)
9. Design and Simulation of Base Band Direct Sequence Spread Spectrum (DS/SS) System.(2 time slots)

Tools:
Numerical Computing Environments – GNU Octave or MATLAB or any other equivalent tool.

REFERENCE BOOKS:

1. W.H. Tranter, K. Sam Shanmugham, T.S. Rappaport, and K.L. Kosbar, *Principles of Communication System Simulation with Wireless Applications,* Pearson, 2004.
2. J.G. Proakis, and M. Salehi, *Contemporary Communication Systems using MATLAB,*Bookware Companion Series, 2006.
3. John G. Proakis, “DIGITAL COMMUNICATIONS”, McGraw Hill, 4th edition, 2001.

M. Tech. (CMS)-II Semester
(14MT26101) ADAPTIVE SIGNAL PROCESSING

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	--	--	4

PRE-REQUISITES:
A Course on Signal Processing at UG Level

COURSE DESCRIPTION:
Adaptive systems; Steepest descent algorithms; Least mean square algorithms; Kalman filtering; Recursive filtering.

COURSE OUTCOMES:
On completion of the course, the student will be able to

CO1. Demonstrate in-depth knowledge in
- Required mathematical frame work
- Characteristics of adaptive systems
- Searching algorithms such as gradient and steepest descent
- Adaptive algorithms like LMS, RLS and Kalman filtering
- Non-linear adaptive filtering, Ordered-recursive adaptive filters

CO2. Analyze complex engineering problems critically in the domain of adaptive filtering for conducting research.

CO3. Solve engineering problems for feasible and optimal solutions in the core area of adaptive signal processing.

CO4. Contribute positively to multidisciplinary scientific research in signal processing with objectivity and rational analysis.

DETAILED SYLLABUS

UNIT - I: INTRODUCTION TO ADAPTIVE SYSTEMS & DEVELOPMENT OF ADAPTIVE FILTER THEORY (Periods:10)

Definitions, Characteristics, Applications, Examples of an Adaptive System. The Adaptive Linear Combiner - Description, Weight Vectors, Desired Response Performance function, Gradient & Mean Square Error. Introduction to Filtering, Smoothing and Prediction, Linear Optimum Filtering, Problem statement, Principle of Orthogonality - Minimum Mean Square Error, Wiener- Hopf equations, Error Performance - Minimum Mean Square Error

UNIT – II: SEARCHING THE PERFORMANCE SURFACE & STEEPEST DESCENT ALGORITHMS: (Periods:08)

Searching the Performance Surface- Methods & Ideas of Gradient Search methods, Gradient Searching Algorithm & its Solution, Stability & Rate of convergence - Learning Curves

Gradient Search by Newton's Method, Method of Steepest Descent, Comparison of Learning Curves

UNIT III: LMS AND RLS ALGORITHMS (Periods:13)

LMS Algorithm-Overview, LMS Adaptation algorithms, Stability & Performance analysis of LMS Algorithms, LMS Gradient & Stochastic algorithms, Convergence of LMS algorithm. Applications-Noise cancellation, Cancellation of

Echoes in long distance telephone circuits, Adaptive Beam forming. RLS Algorithm **-** Matrix Inversion lemma, exponentially weighted recursive least square algorithm, update recursion for the sum of weighted error squares, convergence analysis of RLS Algorithm, Application of RLS algorithm on Adaptive Equalization.

UNIT - IV: KALMAN FILTERING AND NON LINEAR ADAPTIVE FILTERING (Periods:12)

Kalman Filtering**-**Introduction, Recursive Mean Square Estimation Random variables, Statement of Kalman filtering problem, The Innovations Process, estimation of the state using the Innovations Process, Filtering, Initial conditions, Variants of Kalman filtering.

NON LINEAR ADAPTIVE FILTERING

Theoretical and Practical considerations of Blind Deconvolution, Buss Gang Algorithm for blind Equalization.

UNIT V: ORDER-RECURSIVE ADAPTIVE FILTERS (Periods:12)

Gradient-Adaptive Lattice Filter, order-recursive adaptive filters using least square estimation, adaptive forward linear prediction, adaptive backward linear prediction, conversion factor, l east-square lattice predictor, angle normalized estimation errors, first order state space models for lattice filtering, QR-Decomposition-Based Least-Squares Lattice Filters, Recursive Least-Squares lattice Filters Using a Posteriori Estimation Errors.

Total periods: 55

TEXT BOOKS:

1. Bernard Widrow, Samuel D. Strearns, *Adaptive Signal Processing,* PE, 1985.
2. Simon Haykin, *Adaptive Filter Theory,* 4th Edition, PE Asia, 2002.

REFERENCE BOOKS:

1. Alexander D Poularikas & Zayed M Ramadan, CRC, *Adaptive Filtering Primer with MATLAB,* Taylor & Francis group.
2. Sophocles. J. Orfamadis, *Optimum signal processing: An introduction,* 2nd Edition, McGraw-Hill, Newyork, 1988.

M. Tech. (CMS)-II Semester
M. Tech. (DECS)-II Semester (Elective-II)
(14MT23806) DETECTION AND ESTIMATION OF SIGNALS

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	--	--	4

PRE-REQUISITES:
A Course on Probability theory and Stochastic Processes at UG Level

COURSE DESCRIPTION:
Detection criteria for single and multiple observations; Estimation techniques; Properties of estimators; Estimation of parameters.

COURSE OUTCOMES:
On successful completion of this course the students will be able to
CO1. Demonstrate advanced knowledge in
- Different decision criteria
- Estimation techniques and their properties
- Selection of an efficient estimator for the given specifications.
- Design of Kalman and Matched filters
- Statistical estimation of parameters

CO2 Analyze complex engineering problems critically for conducting research in the field of signal detection and estimation.
CO3 Conceptualize and solve engineering problems to obtain solutions for the design of optimum receivers.
CO4 Apply appropriate techniques to engineering activities in the field of Communications.

DETAILED SYLLABUS
UNIT – I: DETECTION THEORY (Periods:12)
Binary Decisions: Single observation – Maximum-likelihood decision criterion, Neyman-Pearson criterion, Receiver operating characteristics, Probability-of-error criterion, Bayes risk criterion, Min-max criterion. Problem solving.
UNIT–II: BINARY DECISIONS: MULTIPLE OBSERVATIONS (Periods:11)
Vector observations, the general Gaussian Problem, Waveform Observation in Additive Gaussian Noise, The Integrating Optimum Receiver, Matched Filter Receiver, Problem solving.
UNIT - III: ESTIMATION THEORY (Periods:12)
Maximum-likelihood estimation, Bayes estimation criterion - Mean Square Error Criterion, Uniform Cost Function, Absolute-Value Cost Function. Linear minimum-Variance and Least Squares Method, Estimation in the presence of Gaussian noise - Linear observation, Non-linear estimation. Problem solving.
UNIT – IV: PROPERTIES OF ESTIMATORS (Periods:08)
Bias, Efficiency, Cramer-Rao bound, Asymptotic properties, Sensitivity and error analysis.

UNIT–V: STATE ESTIMATION AND STATISTICAL ESTIMATION OF PARAMETERS (Periods:11)

State Estimation: Prediction, Kalman filter, Problem solving.

Statistical Estimation of Parameters: Concept of sufficient statistics, Exponential families of Distributions, Exponential families and Maximum likelihood estimation, uniformly minimum-variance unbiased estimation.

Total periods: 54

TEXT BOOKS:

1. James L.Melsa & David L.Cohn, "Decision and Estimation Theory", McGraw Hill, 1978.
2. Steven M. Kay, "Fundamentals of Statistical Signal Processing Vol. 1: Estimation Theory, Prentice Hall, 1993, Vol. 2: Detection Theory", Prentice Hall Inc., 1998.

REFERENCE BOOKS:

1. Harry L. Van Trees, "Detection, Estimation and Modulation Theory", Part 1, John Wiley & Sons Inc. 1968.
2. Jerry M. Mendel, "Lessons in Estimation Theory for Signal Processing, Communication and Control", Prentice Hall Inc., 1995.
3. Sophocles J.Orfanidis, "Optimum Signal Processing", McGraw Hill, 2nd edition, 1988.

M. Tech. (CMS & DECS)-II Semester
(14MT23802) INFORMATION THEORY AND CODING TECHNIQUES

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	--	--	4

PRE-REQUISITES:
A Course on Digital Communications at UG Level

COURSE DESCRIPTION:
Information theory; Channel capacity; Channel coding techniques – Linear block codes, Cyclic codes, Convolutional codes; Reed-Solomon and Turbo codes.

COURSE OUTCOMES:
After completion of the course, students should be able to:
CO1. Demonstrate knowledge in
- Various aspects of source and channel coding techniques
- channel capacity
- Performance evaluation of various source coding techniques

CO2. Analyze complex engineering problems critically in the domain of information, source and line encoding.
CO3. Conceptualize and Solve engineering problems for feasible and optimal solutions in the core area of information theory and coding techniques.
CO4. Apply appropriate techniques to complex engineering activities in the field of information and communications.

DETAILED SYLLABUS
UNIT I: INTRODUCTION (Periods:12)
Entropy: Discrete stationary sources, Markov sources, Entropy of a discrete Random variable- Joint, conditional, relative entropy, Mutual Information and conditional mutual information. Chain rules for entropy, relative entropy and mutual information, Differential Entropy - Joint, relative, conditional differential entropy and Mutual information.
Loss less Source coding: Uniquely decodable codes, Instantaneous codes, Kraft's inequality, optimal codes, Huffman code, Shannon's Source Coding Theorem.
UNIT II: CHANNEL CAPACITY (Periods:10)
Capacity computation for some simple channels, Channel Coding Theorem, Fano's inequality and the converse to the Coding Theorem, Equality in the converse to the coding theorem, The joint source Channel Coding Theorem, The Gaussian channels- Capacity calculation for Band limited Gaussian channels, Parallel Gaussian Channels, Capacity of channels with colored Gaussian noise.
UNIT III: CHANNEL CODING-1 (Periods:08)
Linear Block Codes: Introduction to Linear block codes, Generator Matrix, Systematic Linear Block codes, Encoder Implementation of Linear Block

Codes, Parity Check Matrix, Syndrome testing, Error Detecting and correcting capability of Linear Block codes, Application of Block codes for error control in data storage Systems.

UNIT IV: CHANNEL CODING-2 (Periods:14)

Cyclic Codes: Algebraic Structure of Cyclic Codes, Binary Cyclic Code Properties, Encoding in Systematic Form, Systematic Encoding with an (n - k)-Stage Shift Register, Error Detection with an (n - k)-Stage Shift Register, Well-Known Block Codes-Hamming Codes, Extended Golay Code, BCH Codes.

Convolutional Codes: Convolution Encoding, Convolutional Encoder Representation, Formulation of the Convolutional Decoding Problem, Properties of Convolutional Codes, Sequential Decoding, Feedback Decoding, Application of Viterbi and sequential decoding.

UNIT V: CHANNEL CODING-3 (Periods:12)

Reed-Solomon Codes- Reed-Solomon Error Probability, Finite Fields, Reed-Solomon Encoding, Reed-Solomon Decoding, Interleaving and Concatenated Codes- Block Interleaving, Convolutional Interleaving, Concatenated Codes. Coding and Interleaving Applied to the Compact Disc Digital Audio System-CIRC Encoding, CIRC Decoding. Turbo Codes- Turbo Code Concepts, Encoding with Recursive Systematic Codes, Feedback Decoder, The MAP Decoding Algorithm.

Total Periods: 56

TEXT BOOKS:

1. Thomas M. Cover and Joy A. Thomas, Elements of Information Theory, John Wiley & Sons, 1 st Edition,1999.
2. Bernard sklar, "Digital Communications – Fundamental and Application", Pearson Education, 2 nd Edition, 2009.

REFERENCES:

1. Robert Gallager, Information Theory and Reliable Communication, John Wiley & Sons,1st Edition,1968.
2. John G. Proakis, "Digital Communications", Mc. Graw Hill Publication, 5th Edition, 2008.
3. SHU LIN and Daniel J. Costello, Jr., "Error Control Coding – Fundamentals and Applications", Prentice Hall, 2nd Edition, 2002.

M. Tech. (CMS)-II Semester
(14MT26102) SOFTWARE DEFINED RADIO

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	--	--	4

PRE-REQUISITES:
A Course on Wireless Communications at UG Level

COURSE DESCRIPTION:
Principles of software defined radio; Multirate signal processing; Digital generation of signals; Smart antennas with applications.

COURSE OUTCOMES:
On successful completion of this course the students will be able to

CO1. Demonstrate advanced knowledge in the evolving paradigm of Software defined radio and technologies for its implementation.

CO2. Analyze complex problems critically in the domains of Radio frequency implementation issues, multirate signal processing in SDR, as well as a Smart antenna techniques for better spectrum exploitation for conducting research.

CO3. Apply appropriate techniques for the development of scientific and technological knowledge in designing software defined radios and their usage for cognitive radio.

DETAILED SYLLABUS

UNIT – I: INTRODUCTION TO SOFTWARE RADIO CONCEPTS (Periods:14)
The need for Software radios and its definition, Characteristics and benefits of Software radio, Design principles of a software radio.
Radio Frequency Implementation Issues: Purpose of RF front – end, Dynamic range, RF receiver front – end topologies, Enhanced flexibility of the RF chain with software radios, Importance of the components to overall performance, Transmitter architectures and their issues, Noise and distortion in the RF chain, ADC & DAC distortion, Pre-distortion, Flexible RF systems using micro-electromechanical systems.

UNIT – II: MULTIRATE SIGNAL PROCESSING IN SDR (Periods:08)
Sample rate conversion principles, Polyphase filters, Digital filter banks, Timing recovery in digital receivers using multirate digital filters.

UNIT -III: DIGITAL GENERATION OF SIGNALS (Periods:13)
Introduction, Comparison of direct digital synthesis with analog signal synthesis, Approaches to direct digital synthesis, Analysis of spurious signals, Spurious components due to periodic jitter, Bandpass signal generation, Performance of direct digital synthesis systems, Hybrid DDS – PLL Systems, Applications of direct digital synthesis, Generation of random sequences, ROM compression techniques.

UNIT – IV: SMART ANTENNAS (Periods:13)

Introduction, Vector channel modelling, Benefits of smart antennas, Structures for beamforming systems, Smart antenna algorithms, Diversity and Space time adaptive signal processing, Algorithms for transmit STAP, Hardware implementation of smart antennas, Array calibration, Digital Hardware Choices-Key hardware elements, DSP processors, FPGAs, Power management issues.

UNIT – V: OBJECT ORIENTED REPRESENTATION OF RADIOS AND NETWORK (Periods:10)

Networks, Object –oriented programming, Object brokers, Mobile application environments, Joint Tactical radio system.

Case Studies in Software Radio Design: SPEAKeasy, JTRS, Wireless Information transfer system, SDR-3000 digital transceiver subsystem, Spectrum Ware, Brief introduction to Cognitive Networking.

Total periods: 58

TEXT BOOKS:

1. Jeffrey Hugh Reed, "Software Radio: A Modern Approach to Radio Engineering," Prentice Hall Professional, 2002.
2. Paul Burns, "Software Defined Radio for 3G," Artech House, 2002.

REFERENCE BOOKS:

1. Tony J Rouphael, "RF and DSP for SDR," Elsevier Newnes Press, 2008.
2. P. Kenington, "RF and Baseband Techniques for Software Defined Radio," Artech House, 2005.

M. Tech. (CMS & DECS)-II Semester
(14MT23805) WIRELESS COMMUNICATIONS

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	--	--	4

PRE-REQUISITES:
A Course on Digital Communications at UG Level.

COURSE DESCRIPTION:
Introduction to cellular wireless communication systems; Radio propagation in mobile environment; Equalization and Diversity techniques; Multiple access techniques; Introduction to wireless networking; Multicarrier modulation techniques.

COURSE OUTCOMES:
On successful completion of this course the students will be able to
CO1. Demonstrate advanced knowledge in
- Cellular systems and wireless standards
- Radio wave propagation in wireless environment
- Equalization and diversity techniques
- Multiple access techniques and networking
- Multicarrier modulation

CO2. Analyze complex engineering problems critically for conducting research in wireless systems.
CO3. Solve engineering problems with wide range of solutions in wireless communications.
CO4. Apply appropriate techniques to engineering activities in the field of wireless communications.

DETAILED SYLLABUS
UNIT – I: INTRODUCTION TO WIRELESS COMMUNICATION SYSTEMS AND CELLULAR CONCEPT (Periods:11)
Evolution of Mobile Radio Communication Systems, Examples of Wireless Communication Systems, 1G, 2G, 2.5G, and 3G Wireless Cellular Networks and Standards, Frequency Reuse Concept, Channel Assignment Strategies, Interference and System Capacity, Trunking and Grade of Service, Improving Coverage and Capacity in Cellular Systems-cell splitting and sectoring. Problem solving.
UNIT – II: MOBILE RADIO PROPAGATION (Periods:15)
Large Scale Path Loss: Introduction, Free Space Propagation Model, Relating Power to Electric field, Propagation Mechanisms – Reflection, Diffraction, and Scattering. Practical Budget Design using Path Loss Models, Outdoor and Indoor Propagation Models. Problem solving.
Small Scale Fading and Multipath: Small Scale Multipath Propagation, Impulse Response Model of a Multipath Channel, Small Scale Multipath Measurements, Parameters of Mobile Channels, Types of Small Scale Fading

(all variations), Statistical Models – Clarke's Model for Flat Fading, and Jake's Model. Problem solving.

UNIT -III: EQUALIZATION & DIVERSITY TECHNIQUES (Periods:11)

Equalization: Introduction, Survey of Equalization Techniques, Linear and Non-linear Equalizers – Linear Transversal Equalizer, Decision Feedback Equalizer (DFE). Algorithms for Adaptive Equalization – Zero Forcing, LMS, and RLS. Problem solving.

Diversity Techniques: Realization of Independent Fading Paths, Receiver Diversity – System Model, Selection Combining, Threshold Combining, Maximal Ratio Combining, and Equal Gain Combining, Rake receiver. Transmit Diversity–Channel known at Transmitter, Channel unknown at Transmitter – the Alamouti Scheme, analysis.

UNIT – IV: MULTIPLE ACCESS TECHNIQUES & NETWORKING (Periods:12)

Introduction to Multiple Access: FDMA, TDMA, CDMA, SDMA, Packet Radio - Pure ALOHA, Slotted ALOHA, CSMA, and Reservation protocols. Capacity of Cellular Systems- Cellular CDMA. Problem Solving.

Introduction to Wireless Networking: Introduction to Wireless Networks, Differences between Wireless and Fixed Telephone Networks, Development of Wireless Networks, Traffic Routing in Wireless Networks, Wireless Data Services, Common Channel Signaling.

UNIT – V: MULTICARRIER MODULATION (Periods:08)

Data Transmission using Multiple Carriers, Multicarrier Modulation with Overlapping Subchannels, Discrete Implementation of Multicarrier Modulation – DFT and its properties, The Cyclic Prefix, Orthogonal Frequency Division Multiplexing (OFDM), Matrix Representation of OFDM, Vector Coding. Challenges in Multicarrier Systems. Problem solving.

Total periods: 56

TEXT BOOKS:

1. T. S. Rappaport, "Wireless Communications, Principles and Practice," Prentice Hall, 2nd Edition, 2002.
2. Andrea Goldsmith, "Wireless Communications," Cambridge University Press, 2005.

REFERENCE BOOKS:

1. David Tse, PramodViswanath, "Fundamentals of Wireless Communications," Cambridge University Press, 2006.
2. Dr. Kamilo Feher, "Wireless Digital Communications," Prentice Hall, 1995.

M. Tech. (CMS)-II Semester (Elective-II)
(14MT26103) EMI/EMC

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	--	--	4

PRE-REQUISITES:
Courses on Electromagnetic waves and Transmission lines, Antennas and wave propagation & Microwave engineering at UG Level.

COURSE DESCRIPTION:
Sources of EMI; Standards for EMI/EMC and test sites; Interference measurements; Effects of grounding, shielding and bonding; Components for EMC.

COURSE OUTCOMES:
On successful completion of this course the students will be able to
CO1. Demonstrate knowledge in
- electromagnetic interference effects
- standards of EMC
- Radiated and conducted interference measurements
- Effects of grounding at high frequencies

CO2. Analysis and design of electronic systems for real time applications.
CO3. Apply appropriate research methodologies, techniques to contribute individually and in groups for the development of scientific knowledge in electronic systems.
CO4. Demonstrate knowledge and understanding of effects of electromagnetic interference and apply the same in practice.

DETAILED SYLLABUS
UNIT-I: INTRODUCTION AND SOURCES OF EMI AND NONIDEAL BEHAVIOR OF COMPONENTS (Periods:10)
Concepts and Definition of EMI and EMC, Natural and man-made EMI sources. Non-ideal behavior of components-Wires, printed circuit board (PCB) lands, effect of component leads, resistors, capacitors, inductors.
UNIT-II: EMI/EMC STANDARDS AND OPEN AREA TEST SITES (Periods:10)
Introduction - Standards for EMI/EMC, MIL, STD 461 /462, IEEE/AXSI Standards , CISPR/IEC Standards, FCC regulations. Open area test sites- open area test site measurements, Measurement precautions, open area test site, Terrain Roughness, Normalized Site Attenuation, Measurement of test site imperfections, Antenna factor measurement, Measurement errors.
UNIT-III: RADIATED INTERFERENCE AND CONDUCTED INTERFERENCE MEASUREMENTS (Periods:11)
Radiated Interference measurements-Anechoic chamber, Transverse Electromagnetic Cell, Reverberating chamber, Giga-Hertz TEM Cell, Comparison of test facilities.
Conducted Interference measurements- Characterization of conduction

currents/voltages, Conducted EM noise on power supply lines, Conducted EMI from equipment, Immunity to conducted EMI, Detectors and measurement.

UNIT-IV: GROUNDING, SHIELDING AND BONDING (Periods:13)

Grounding - Principles and Practice of Earthing, Precautions in Earthing, Measurements of ground resistance, System grounding for EMC, Cable shield Grounding. Shielding- Shielding Theory and Effectiveness, Shielding Materials, Shielding Integrity at discontinuities, Conductive coatings, Cable shielding, Shielding Effectiveness measurements. Electrical Bonding.

UNIT-V: EMC FILTERS, CABLES, CONNECTORS AND COMPONENTS (Periods:10)

Characteristics and Types of Filters - Impedance Mismatch Effects, Lumped Element Low Pass Filter, High Pass Filter, Band Pass Filter, Band Reject filter. Power Line filter Design - Common mode filter, Differential mode filter, Combined CM and DM filter. EMI suppression cables. EMC connectors.

EMC Gaskets - Knitted Wire-Mesh Gaskets, Wire Screen Gaskets, Oriented Wire mesh, Conductive Elastomer, Transparent Conductive windows, Conductive Adhesive, Conductive Grease. Conductive Coatings. Isolation transformers. Opto Isolators.

Total Periods: 54

TEXT BOOKS

1. V. Prasad Kodali, "Engineering Electromagnetic Compatibility", S.Chand & company Ltd., 1st edition,2000.
2. Clayton R. Paul, "Introduction to Electromagnetic Compatibility", John Wiley and Sons, 2nd edition, 2008.

REFERENCE BOOKS

1. Christos Christopoulos, "Principles and Techniques of Electromagnetic Compatibility", CRC Press (Taylor & Francis Group) 2nd edition, 2007.

M. Tech. (CMS)-II Semester (Elective-II)
(14MT26104) RADAR SIGNAL PROCESSING

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	--	--	4

PRE-REQUISITE: A course on Communication systems at UG level.

COURSE DESCRIPTION:
Radar range equation and matched filter; Demodulation of radar signals in the presence of noise; Wave form selection and radar clutter; Pulse compression and Phase coding techniques.

COURSE OUTCOMES: After completion of the course, the student will be able to

CO1: Demonstrate knowledge in
- Characteristics of matched filter
- Detection criteria of radar signals in noise environment.
- Radar waveform design requirements.
- Pulse compression techniques
- Different coding techniques.

CO2: Develop skills in designing Radar systems in different noise environments.

CO3: Apply appropriate techniques for radar signal de-noising.

DETAILED SYLLABUS

UNIT - I: RANGE EQUATION AND MATCHED FILTER (Periods:13)

Introduction– Radar Frequencies, Radar Block Diagram, Radar Equation, Information Available from Radar Echo. Review of Radar Range Performance– General Radar Range Equation, Radar Detection with Noise Jamming, Beacon and Repeater Equations, Bistatic Radar.

Matched Filter Receiver – Impulse Response, Frequency Response Characteristic and its Derivation. Matched Filter and Correlation Function, Correlation Detection and Cross-Correlation Receiver. Efficiency of Non-Matched Filters, Matched Filter for Non-White Noise.

UNIT - II: DETECTION OF RADAR SIGNALS IN NOISE (Periods:10)

Detection Criteria – Neyman-Pearson Observer, Likelihood-Ratio Receiver, Inverse Probability Receiver, Sequential Observer, Detectors –Envelope Detector, Logarithmic Detector, I/Q Detector. Automatic Detection – CFAR Receiver, Cell Averaging CFAR Receiver, CFAR Loss, CFAR Uses in Radar. Radar Signal Management –Schematics, Component Parts, Resources and Constraints.

UNIT - III: WAVEFORM SELECTION (Periods:09)

Radar Ambiguity Function and Ambiguity Diagram – Principles and Properties; Specific Cases – Ideal Case, Single Pulse of Sine Wave, Periodic Pulse Train, Single Linear FM Pulse, Noise like Waveforms. Waveform Design Requirements. Radar clutter- Introduction, surface clutter, Land clutter, Detection of targets in Clutter.

UNIT - IV: PULSE COMPRESSION IN RADAR SIGNALS (Periods:08)
Introduction, Significance, Types. Linear FM Pulse Compression – Block Diagram, Characteristics, Reduction of Time Side lobes, Stretch Techniques, Generation and Decoding of FM Waveforms – Block Schematic and Characteristics of Passive System, Digital Compression,
SAW Pulse Compression.

UNIT - V: PHASE CODING TECHNIQUES (Periods:13)
Phase Coding Techniques: Principles, Binary Phase Coding, Barker Codes, Maximal Length Sequences (MLS/LRS/PN), Block Diagram of a Phase Coded CW Radar.

Poly Phase Codes : Frank Codes, Costas Codes, Non-Linear FM Pulse Compression, Doppler Tolerant PC Waveforms – Short Pulse, Linear Period Modulation (LPM/HFM), Side lobe Reduction for Phase Coded PC Signals, Complementary codes, Huffman codes, Limiting in Pulse Compression, Cross-Correlation Properties, compatibility.

Total Periods : 53

TEXT BOOKS:

1. M.I. Skolnik, *"Introduction to Radar Systems",* TMH, 3rd Edition, 2001.
2. Fred E. Nathanson, *"Radar Design Principles – Signal Processing and The Environment",*McGraw Hill,Inc, 2nd Edition,1991.
3. 3 M.I. Skolnik, *Radar Handbook,* McGraw Hill, 2nd Edition, 1991.

REFERENCE BOOKS:

1. Peyton Z. Peebles Jr., *Radar Principles,* Wiley India Pvt. Ltd., 1998.
2. R. Nit berg, *Radar Signal Processing and Adaptive Systems,* Artech House, 1999.
3. F.E. Nathanson, *Radar Design Principles,* 1st Edition, McGraw Hill, 1969

M. Tech. (CMS)- II Semester (Elective-II)
(14MT26105) TELEMETRY AND TELECONTROL

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	--	--	4

PRE-REQUISITES:
Courses on Analog Communications, Digital Communications, Satellite Communications and Optical Communications at UG level.

COURSE DESCRIPTION:
Principles of telemetry; Channel coding; Multiplexing systems; Satellite and optical telemetry; Analog and digital telecontrol techniques.

COURSE OUTCOMES:
On successful completion of this course the students will be able to

CO1. Demonstrate in-depth knowledge in
- Telemetry and Telecontrol systems
- Symbols and Codes
- Different multiplexers in telemetry
- Satellite and optical telemetry systems

CO2. Analyze complex engineering problems critically in the domain of Telemetry and Telecontrol systems for conducting research.

CO3. Solve engineering problems for feasible and optimal solutions in the core area of Telemetry and

CO4. Apply appropriate techniques to complex engineering activities in the field of telemetry and telecontrol systems.

DETAILED SYLLABUS

UNIT–I:TELEMETRY PRINCIPLES (Periods:08)
Introduction, Functional blocks of Telemetry system, Methods of Telemetry – Non Electrical, Electrical, Pneumatic, Frequency, Power Line Carrier Communication .

UNIT – II: SYMBOLS AND CODES (Periods:07)
Bits and Symbols, Time function pulses, Line and Channel Coding, Modulation Codes, Intersymbol Interference.

UNIT – III: FREQUENCY DIVISION AND TIME DIVISION MULTIPLEXED SYSTEMS (Periods:13)
FDM, IRIG Standard, FM and PM Circuits, Receiving end, PLL. TDM-PAM systems, PAM /PM and TDM–PCM Systems. PCM reception. Differential PCM. Modems-Introduction, QAM, Modem Protocols.

UNIT – IV: SATELLITE AND OPTICAL TELEMETRY (Periods:10)
General considerations, TT&C Service, Digital Transmission systems, TT&C Subsystems, satellite Telemetry and Communications.
Optical fibers Cable – dispersion, losses, connectors and splicers, Sources and detectors, Transmitter and Receiving Circuits, Coherent Optical Fiber Communication System, WDM.

UNIT – V: TELECONTROL METHODS **(Periods:12)**

Analog and Digital techniques in Telecontrol, Telecontrol apparatus – Remote adjustment, Guidance and regulation – Telecontrol using information theory – Example of a Telecontrol System.

Total Periods: 50

TEXT BOOKS:

1. D. Patranabis, Telemetry Principles, Tata McGraw-Hill, 1999
2. Swoboda G., Telecontrol Methods and Applications of Telemetry and Remote Control, Reinhold Publishing Corp., London, 1991

REFERENCE BOOKS:

1. Gruenberg L., Handbook of Telemetry and Remote Control, McGraw Hill, New York, 1987.
2. Young R.E., Telemetry Engineering, Little Books Ltd., London, 1988.
3. Housley T.,Data Communication and Teleprocessing System, PH Intl., Englewood Cliffs, New Jersey, 1987.

M. Tech. (CMS & VLSI)-II Semester (Elective-II)
(14MT25709) WIRELESS SENSOR NETWORKS

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	--	--	4

PRE-REQUISITES:
A Course on Wireless Communications at UG Level

COURSE DESCRIPTION:
Concepts of wireless sensor networks; Physical, Network, Transport and Application layers.

COURSE OUTCOMES:
On successful completion of this course the students will be able to

CO1. Demonstrate advanced knowledge in
- Wireless Sensor Networks
- Physical layer
- Data link layer
- Network layer
- Transport layer

CO2. Analyze and design complex problems critically in the domains of Wireless Communications and Wireless sensor Networks for conducting research.

CO3. Apply appropriate techniques to for the development of scientific knowledge in Wireless Sensor Networks.

CO4. Demonstrate knowledge and understanding of wireless sensor networks and apply the same in practice.

DETAILED SYLLABUS

UNIT – I: INTRODUCTION TO WIRELESS SENSOR NETWORKS (Periods:11)

Challenges for wireless sensor networks, Comparison of sensor network with ad hoc network, Single node architecture - Hardware components, energy consumption of sensor nodes. Network architecture: Sensor network scenarios - types of sources and sinks, single hop versus multi-hop networks, multiple sinks and sources. Design principles for wireless sensor networks.

UNIT – II: PHYSICAL LAYER (Periods:11)

Introduction, wireless channel and communication fundamentals – frequency allocation, modulation and demodulation, wave propagation effects and noise, channels models, spread spectrum communication, packet transmission and synchronization, quality of wireless channels and measures for improvement. Physical layer and transceiver design consideration in wireless sensor networks - Energy usage profile, choice of modulation, Power Management .

UNIT -III: DATA LINK LAYER (Periods:16)

MAC protocols: fundamentals of wireless MAC protocols - Requirements and design constraints for wireless MAC protocols, Important classes of MAC protocols, MAC protocols for wireless sensor networks. Low duty cycle protocols and wakeup concepts - Sparse topology and energy management (STEM), S-MAC, Wakeup radio concepts. Contention-based protocols - CSMA protocols, PAMAS. Schedule-based protocols - SMAC, BMAC, Traffic-adaptive medium access protocol (TRAMA). Link Layer protocols – fundamentals task and requirements, error control - Causes and characteristics of transmission errors, ARQ techniques, FEC techniques, Hybrid schemes, Power control,

UNIT – IV: NETWORK LAYER (Periods:10)

Gossiping and agent-based uni-cast forwarding - Basic idea, Randomized forwarding. Energy-efficient unicast, Broadcast and multicast - Source-based tree protocols, Shared, core-based tree protocols, Mesh-based protocols. geographic routing - Basics of position-based routing, Geocasting. Mobile nodes - Mobile sinks, Mobile data collectors, Mobile regions. Data centric and content-based networking - Introduction, Data-centric routing, Data aggregation.

UNIT – V: TRANSPORT LAYER (Periods:09)

The transport layer and QoS in wireless sensor networks - Quality of service/reliability, Transport protocols. Coverage and deployment - Sensing models, Coverage measures, Uniform random deployments: Poisson point processes, Coverage of random deployments: Boolean sensing model, general sensing model, Coverage determination, Coverage of grid deployments. Reliable data transport, Single packet delivery - Using a single path, Multiple paths, Multiple receivers. Congestion control and rate control - Congestion situations in sensor networks, Mechanisms for congestion detection and handling, Protocols with rate control, The CODA congestion-control framework.

Total periods: 57

TEXT BOOKS:

1. Holger Karl, Andreas willig "Protocol and Architecture for Wireless Sensor Networks", John wiley publication, Oct 2007.

REFERENCE BOOKS:

1. Feng zhao, Leonidas guibas, Elsivier , "Wireless Sensor Networks: an information processing approach –publication, 2004.
2. Edgar H .Callaway, First Edition,"Wireless Sensor Networks : Architecture and protocol", CRC press 2003.
3. C.S.Raghavendra Krishna, M.Sivalingam and Tarib znati, "Wireless Sensor Networks", Springer publication, 2006.

M. Tech. (CMS) - II SEMESTER
(14MT26121) COMMUNICATIONS LAB - II

Int. Marks	Ext. Marks	Max. Marks	L	T	P	C
25	50	75	-	-	4	2

PRE- REQUISITES: Simulation lab at UG level

COURSE DESCRIPTION:

Simulation of communication systems over communication channels with and without line coding; Design and simulation of Bussgang Blind channel equalizer; Adaptive equalizers using LMS and RLS algorithms; Image processing techniques; Design and simulation of WDM systems.

COURSE OUTCOMES: At the end of the course, students will be able to

CO1. Demonstrate skills in
- Simulation of Rayleigh fading channel in the mobile environment.
- Design and simulation of an adaptive equalizer using LMS and RLS algorithms.
- Designing communication system over a Gaussian channel and evaluate its performance.
- Simulating communication system using convolutional codes & Viterbi Decoding.
- Developing Color image in various color models.
- Performing image smoothening and sharpening.
- Designing WDM system.

CO2. Solve engineering problems for feasible and optimal solutions in the core area of Communications.

CO3. Use MATLAB Toolboxes to complex engineering activities in the domain of communications.

CO4. Demonstrate Knowledge and understanding of Engineering Principles in the field of communications.

List of experiments:

1. Simulation of Rayleigh fading channel in the mobile environment. (2 time slots)
2. Design and performance evaluation of CDMA communication system over a Gaussian channel.
   (2 time slots)
3. Simulation of communication system using convolutional codes & Viterbi Decoding.
   (2 time slots)
4. Design and simulation of an adaptive equalizer using LMS algorithm. (1 time slot)
5. Design and simulation of an adaptive equalizer using RLS algorithm. (1 time slot)
6. Design and simulation of communication system using Bussgang Blind channel equalizer.
   (2 time slots)

7. Smoothening and Sharpening of a given image.
   (1 time slot)
8. Color image in various color models.
   (1 time slot)
9. Design of WDM system.
   (2 time slots)

Tools required:
MATLAB with communication & image processing tool boxes and OptSim and ModeSYS software.

REFERENCE BOOKS:

1. Advanced communication lab-II manual of the department.
2. W.H. Tranter, K. Sam Shanmugham, T.S. Rappaport, and K.L. Kosbar, *Principles of Communication System Simulation with Wireless Applications,* Pearson, 2004.
3. J.G. Proakis, and M. Salehi, *Contemporary Communication Systems using MATLAB,* cengage learning, *2nd Edition,* 2004.
4. *R. C. Gonzalez, R. E. Woods, Steven L. Eddins, Digital Image Processing using MATLAB, Gatesmark publishing,2nd Edition, 2009.*
5. OptSim and ModeSYS user manual.

M. Tech. (CMS) – II Semester
(14MT26122) SEMINAR

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
--	50	50	--	--	--	2

PRE-REQUISITES: --

COURSE DESCRIPTION:
Identification of seminar topic; Literature survey; Preparation of technical report and Presentation.

COURSE OUTCOMES:
On successful completion of the course, the student will be able to

CO1. Demonstrate capacity to identify an advanced topic for seminar in core and allied areas.

CO2. Extract information pertinent to the topic through literature survey.

CO3. Comprehend extracted information through analysis and synthesis critically.

CO4. Plan, organize, prepare and present effective written and oral technical report on the topic.

CO5. Adapt to independent and reflective learning for sustainable professional growth.

M. Tech. (CMS) – III & IV Semesters
(14MT36121 & 14MT46121) PROJECT WORK

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
80	120	200	--	--	--	16

PRE-REQUISITES: --

COURSE DESCRIPTION:
Identification of topic for the project work; Literature survey; Collection of preliminary data; Identification of implementation tools and methodologies; Performing critical study and analysis of the topic identified; Time and cost analysis; Implementation of the project work; Writing of thesis and presentation.

COURSE OUTCOMES:
On successful completion of the course, the student will be able to

CO1. Demonstrate capacity to identify an advanced topic for project work in core and allied areas.

CO2. Gather information related to the topic through literature survey.

CO3. Comprehend gathered information through critical analysis and synthesis.

CO4. Solve engineering problems pertinent to the chosen topic for feasible solutions.

CO5. Use the techniques, skills and modern engineering tools necessary for project work.

CO6. Do time and cost analysis on the project.

CO7. Plan, prepare and present effective written and oral technical report on the topic.

CO8. Adapt to independent and reflective learning for sustainable professional growth.