SRI KRISHNA COLLEGE OF ENGINEERING AND TECHNOLOGY COIMBATORE-8

(An Autonomous Institution Affiliated to Anna University Chennai)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

M.E (COMMUNICATION SYSTEMS)

AUTONOMOUS CURRICULUM AND SYLLABUS

REGULATIONS 2015

(For students admitted during 2015-16 and onwards)

From the academic year 2016 - 2017

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VISION

To be a center of excellence for technological education, training & Research and to produce world class Engineers who can be placed in top core companies to serve the nation and the society.

MISSION

- To provide intensive training in the fundamentals as well as the current trends in the field of Electronics and Communication Engineering.
- To continuously update the various facilities in the department and facilitate R&D and Consulting activities.
- To provide placement assistance to the students.
- To disseminate the knowledge by organizing seminars, Faculty Development Programs and Workshops.

SRI KRISHNA COLLEGE OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
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CURRICULUM FOR M.E (COMMUNICATION SYSTEMS)

SEMESTER I							
S No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs/week**	**Credit**	**Ext/Int**	**Category**
1	15PH203	Applied Mathematics for Electronic Engineers	3/2/0	4	4	60/40	FCBS
2	15PL401	Statistical Signal Processing	3/2/0	4	4	60/40	PC
3	15PK401	Advanced Radiation Systems	3/2/0	4	4	60/40	PC
4	15PK402	Mobile Communication Networks	3/0/0	3	3	60/40	PC
5		PE – 1	3/0/0	3	3	60/40	PE
6		PE – 2	3/0/0	3	3	60/40	PE
7	15PK451	Advanced Communication Systems Laboratory – I	0/0/3	2	2	40/60	PC Lab
			Total	**23**	**23**	**700**	

SEMESTER II							
S No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs/week**	**Credit**	**Ext/Int**	**Category**
1	15PK403	Digital Communication Receivers	3/2/0	4	4	60/40	PC
2	15PK404	RF System Design	3/2/0	4	4	60/40	PC
3	15PK405	High Performance Communication Networks	3/2/0	4	4	60/40	PC
4		PE - 3	3/0/0	3	3	60/40	PE
5		PE – 4	3/0/0	3	3	60/40	PE
6		PSC – 1	3/0/0	3	3	60/40	PSC
7	15PK452	Advanced Communication Systems Laboratory – II	0/0/3	2	2	40/60	PC Lab
8	15PK801	Technical Seminar	0/0/2	2	1	40/60	
			Total	**25**	**24**	**800**	

FCBS - Foundation Compulsory Basic Science PC - Programme Core

PE - Programme Elective PSC - Programme Soft Core

SEMESTER III							
S No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs/week**	**Credit**	**Ext/Int**	**Category**
1		PSC – 2	3/0/0	3	3	60/40	PSC
2		PE – 5	3/0/0	3	3	60/40	PE
3		PE – 6	3/0/0	3	3	60/40	PE
4	15PK901	Project Work & Viva-voce – Phase I	0/0/12	12	6	40/60	Project
5	15PK802	Comprehensive Viva – Voce	0/0/2	4	1	40/60	
			Total	**25**	**16**	**500**	

SEMESTER IV							
S No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs/week**	**Credit**	**Ext/Int**	**Category**
1	15PK902	Project Work & Viva-voce - Phase II/Internship	0/0/24	24	12	40/60	Project
			Total	**24**	**12**	**100**	

PE – Programme Elective PSC – Programme Soft Core

Program Elective (PE) Groups:

S.No	SUBJECT CODE	Group Name	List of subjects
1	15PK601	RF	RF MEMS
	15PK602		Design of Microwave Integrated Circuits
	15PK603		Electromagnetic Interference and Compatibility
2	15PK604	Communication	Information Theory and Coding
	15PK605		Multicarrier Modulation
	15PK606		Energy Management for Wireless Communication
3	15PK607	Networking	Network Security
	15PK608		Algorithms for Network Routing
	15PK609		Communication Protocol Engineering
4	15PK610	Wireless Communication	Advanced Wireless Communication
	15PK611		Cognitive Radio Network
	15PK612		Wireless Sensor Network Architecture and Security
5	15PK613	Signal Processing	Speech Signal Processing
	15PK614		DSP Processor Architecture
	15PK615		VLSI for Wireless Communication

Program Soft Core (PSC) Group

S.No	SUBJECT CODE	Subject Name
1	15PK501	Digital Image Processing and Applications
2	15PK502	MANET Protocols
3	15PK503	Space Time wireless Communication
4	15PK504	Embedded Architecture
5	15PK505	Neural Networks and its Applications

Note :

1. **Programme Electives (PE) must be framed by having 5 domains, each possessing 3 subjects. Students should get specialized in any two domains.**
2. **List of subjects must be given in Programme Soft Core (PSC), so that students can choose any 2 subjects.**
3. **Students can earn extra credits by doing certification courses.**

Curriculum Structure

S.No	Category Name	Credits Break Up
1	Foundation Compulsory Basic Science (FCBS)	4
2	Programme Core(PC)	23
3	Programme Elective(PE)	18
4	Programme Core(PC) Lab	4
5	Programme Soft Core(PSC)	6
6	Project	18
7	Technical Seminar	1
8	Comprehensive Viva – Voce	1
	Total	**75 credits**

Course Code	Course Name	Contact Hours			
		L	T	P	C
15PH216	**APPLIED MATHEMATICS FOR ELECTRONIC ENGINEERS** *(Common to M.E. Communication Systems and M.E. Applied Electronics)*	**3**	**2**	**0**	**4**

Course Objectives :

- *To provide strong foundation to the students to expose various emerging new areas of applied mathematics and appraise them with their relevance in Engineering and Technological field.*
- *To develop the ability to use the concepts of Linear algebra and Special functions for solving problems related to Networks.*
- *To formulate and construct a mathematical model for a linear programming problem in real life situation*
- *To expose the students to solve ordinary differential equations by various techniques.*

Course pre-requisites: *Mathematics – III, Probability Theory and Random Process*

Module- I VECTOR SPACES AND CHARACTERISTIC EQUATION (9)

Set Theory (Concept only)- Abelian Group- Examples- Rings and Fields – Properties (statement only) – N-dimensional vectors – Vector spaces and sub spaces – Null spaces and Column spaces – Linear transformations – Matrix of linear transformation – Linear Dependent and Independent set of vectors – Basis and Dimensions – Rank – Real symmetric matrix – Characteristic equation- Eigen values and Eigen vectors of real symmetric matrix

Module – II INNER PRODUCT SPACES AND SPECIAL FUNCTIONS (9)

Inner product spaces – Properties – Examples- Length and Orthogonality- Orthogonal sets- Orthogonal projections- Gram-Schmidt Orthogonalization Process.

Bessel's equation – Bessel Functions – Recurrence relations – generating functions and orthogonal property for Bessel functions.

Module - III OPTIMIZATION TECHNIQUES (9)

Linear Programming Problem- Simplex Method- Variants of Simplex method- Transportation problem- Maximization and Minimization types- Initial basic feasible solution by NWC,LCM and VAM methods – Assignment problem- Hungarian Algorithm for Optimum solution- Travelling Salesman problem – Maxima and Minima of functions of two variables – Constraint Maxima and Minima – Lagrangian multiplier method.

Module IV - NUMERICAL SOLUTION OF DIFFERENTIAL EQUATIONS (9)
Boundary value problems for ODE – Finite difference methods – Numerical solution of PDE – Solution of Laplace and Poisson equations – Liebmann's iteration process – Solution of heat conduction equation by Schmidt explicit formula and Crank-Nicolson implicit scheme – Solution of wave equation.

Module -V STOCHASTIC MODELS (9)
Random variables (concept only)- Stochastic Process – Introduction – Markov Process and Markov chain – Birth and Death Queuing models – Steady state results: Single and multiple server Queuing models – Queues with finite waiting rooms – Little's Formula – M/G/1 queue (steady state solutions only)

TOTAL HOURS: 45 + 15=60

1. Course Outcomes:

- *Understand the basic concepts of vector space and characteristic equation.*
- *Familiarize the students with special functions and solve problems associated with engineering applications.*
- *Demonstrate and solve various optimization techniques*
- *Apply numerical analysis techniques to solve differential equations.*
- *Understand the notion of Markov chain and be familiar with some simple infinite state space cases such as birth and death chains.*

REFERENCES:

1. David C Lay, "Linear Algebra and its Applications", Pearson Education Asia, NewDelhi,2003
2. Greweal B.S. "Higher Engineering Mathematics", Khanna Publishers, 2005
3. Sankara Rao.K. "Introduction to Partial Differential Equation ", PHI, 1995.
4. D.Gross and C.M. Harris, "Fundamentals of Queueing Theory", Wiley Student edition, 2004.
5. Kanti Swarup, P.K.Gupta, Man Mohan, "Operations research", Ninth edition, S.Chand, Delhi 2001.

Course Code	Course Name	Contact Hours			
		L	T	P	C
15PL401	**STATISTICAL SIGNAL PROCESSING** *(Common to M.E. Communication Systems and M.E. Applied Electronics)*	**3**	**2**	**0**	**4**

Course Objectives :

- *To establish fundamental concepts on signal processing in modern spectral estimation.*
- *To study the adaptive filters and its applications.*
- *To explore the concepts of multirate signal processing by study of DFT, computation and design of Multi rate filters*

Course pre-requisites : *Engineering Mathematics III, Digital Signal Processing*

Module - I DISCRETE RANDOM SIGNAL PROCESSING (9)

Discrete Random Processes- Ensemble averages, stationary processes, Autocorrelation and Autocovariance matrices. Parseval's Theorem, Wiener-Khintchine Relation- Power Spectral Density Periodogram, Spectral Factorization, Filtering random processes. Low Pass Filtering of White Noise. Parameter estimation: Bias and consistency.

Module - II SPECTRUM ESTIMATION (9)

Estimation of spectra from finite duration signals, Non-Parametric Methods-Correlation Method, Periodogram Estimator, Performance Analysis of Estimators -Unbiased, Consistent Estimators- Modified periodogram, Bartlett and Welch methods, Blackman –Tukey method. Minimum variance spectrum estimation. Parametric Methods - AR, MA, ARMA model based spectral estimation. Parameter Estimation -Yule-Walker equations, solutions using Durbin's algorithm

Module - III LINEAR ESTIMATION AND PREDICTION (9)

Linear prediction- Forward and backward predictions, Solutions of the Normal equations- Levinson- Durbin algorithms. Maximum likelihood criterion -Least mean squared error criterion -Wiener filter for filtering and prediction , FIR Wiener filter and Wiener IIR filters ,Discrete Kalman filter.

Module - IV ADAPTIVE FILTERS (9)

FIR adaptive filters -adaptive filter based on steepest descent method-Widrow-Hoff LMS adaptive algorithm, Normalized LMS. Adaptive channel equalization-Adaptive echo cancellation-Adaptive noise cancellation- Adaptive recursive filters (IIR). RLS adaptive filters- exponentially weighted RLS-sliding window RLS.

Module - V MULTIRATE DIGITAL SIGNAL PROCESSING (9)

Mathematical description of change of sampling rate - Interpolation and Decimation, Decimation by an integer factor - Interpolation by an integer factor, Sampling rate conversion by a rational factor, Filter implementation for sampling rate conversion- Direct form FIR structures, Polyphase filter structures, time-variant structures. Multistage implementation of multirate system. Application to sub band coding - Wavelet transform and filter bank implementation of wavelet expansion of signals.

TOTAL HOURS=45+15=60

Course Outcomes:

- *Understand the importance of discrete random processing in DSP and its applications on statistical measures, prediction and estimation.*
- *Understand the basic theories behind parametric and non-parametric methods of spectrum estimation.*
- *Understand the concept of linear prediction and estimation and various filter techniques.*
- *Design LMS and RLS adaptive filters for different applications like signal enhancement, channel equalization.*
- *Acquire knowledge about concept of multi rate signal processing and sample rate conversion.*

REFERENCES:

1. Monson H.Hayes, "Statistical Digital Signal Processing and Modeling", John Wiley and Sons,
1. Inc.,Singapore,Reprint 2008.
2. John G. Proakis, Dimitris G. Manolakis, "Digital Signal Processing", Prentice Hall of India,
2. New Delhi, 2009.
3. Dimitris G.Manolakis et.al.,"Statistical and adaptive signal Processing", McGraw Hill, Newyork,2005.
4. Sophoncles J. Orfanidis, "Optimum Signal Processing", McGraw-Hill, 2007.
5. Simon Haykin, "Adaptive signal processing, next generation solutions", John Wiley and Sons, Inc. ,2010
6. P. Vaidyanathan, "Multirate Systems and Filter Banks", Prentice Hall, 1993.

WEB URLs:

1. http://www.engr.wisc.edu/ece/courses/ece732.html
2. http://www.courses.ece.illinois.edu/ECE551/
3. http://www.et.byu.edu/groups/ece777web/
4. http://www.ee.lamar.edu/gleb/adsp/Lecture%2007%20%20Adaptive%20filtering.pdf
5. http://www.users.abo.fi/htoivone/courses/sbappl/asp_chapter2.pdf

Course Code	Course Name	Contact Hours			
		L	T	P	C
15PK401	ADVANCED RADIATION SYSTEMS	3	2	0	4

Course Objectives:

- *To understand the relation between the fields and to be familiar with antenna arrays.*
- *To understand signal propagation at Radio frequencies & to study aperture and Reflector antennas.*
- *To introduce the basics of Microstrip Patch Antennas and its analysis*
- *To learn antenna arrays.*

Course pre-requisites: *Antenna and Wave Propagation*

Module- I ANTENNA FUNDAMENTALS (9)

Antenna fundamental parameters, Radiation integrals ,Radiation from surface and line current distributions – dipole, monopole, loop antenna; Mobile phone antenna- base station, hand set antenna; Image; Induction ,reciprocity theorem, Broadband antennas and matching techniques, Balance to unbalance transformer, Introduction to numerical techniques.

Module- II RADIATION FROM APERTURES (9)

Field equivalence principle, Radiation from Rectangular and Circular apertures,
Uniform aperture distribution on an infinite ground plane; Slot antenna; Horn antenna;
Reflector antenna, aperture blockage, and design consideration.

Module- III ARRAYS (9)

Introduction-General structure of phased array, linear array theory, variation of gain as a function of pointing direction, effects of phase quantization, frequency scanned arrays, analog beam forming matrices-Active modules, digital beam forming, MEMS technology in phased arrays-Retro directive and self phased arrays.

Module- IV MICRO STRIP ANTENNA (9)

Introduction to Microstrip antenna, Radiation Mechanism from patch; Excitation techniques; Microstrip dipole; Rectangular patch, Circular patch, and Ring antenna – radiation analysis from transmission line model, cavity model; input impedance of rectangular and circular patch antenna; Microstrip array and feed network; Application of microstrip array antenna.

Module- V EMC ANTENNA AND ANTENNA MEASUREMENTS (9)

Concept of EMC measuring antenna; Receiver and Transmitter antenna factors; Log periodic dipole, Biconical, Ridge guide, Multi turn loop; Antenna measurement and instrumentation – Gain, Impedance and antenna factor measurement; Antenna test range Design.

TOTAL HOURS=45+15=60

1. Course Outcomes:

- *Understand the fundamentals of antennas and various antenna parameters.*
- *Acquire knowledge of aperture antennas and the fields associated with it.*
- *Learn the applications of array antennas.*
- *Describe about Microstrip patch antennas and their applications.*
- *Learn the concept behind measurement of antenna parameters and special array antennas design.*

REFERENCES:

1. Hubregt.J.Visser "Antenna Theory and Applications", John Wiley & Sons Ltd, NewYork, 1st Edition, 2012.
2. Zhijun Zhang" Antenna Design for Mobile Devices", , John Wiley & Sons (Asia) Ltd, NewYork, 1st Edition 2011.
3. Xavier Begaud, "Ultra Wide Band Antennas" , ISTE Ltd and John Wiley & Sons Ltd, NewYork, 1st Edition, 2013.
4. Balanis.A, "Antenna Theory Analysis and Design", John Wiley and Sons, New York, 1982.
5. Krauss.J.D, "Antennas", John Wiley and sons, New York, II edition, 1997.
6. I.J. Bahl and P. Bhartia," Microstrip Antennas", Artech House, Inc., 1980.

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2. http://www.ece.rutgers.edu/~orfanidi/ewa/ch18.pdf
3. https://electrondevices.grc.nasa.gov/files/S-71-2005WAMICON.pdf
4. http://www.slideshare.net/totitarek/microstrip-antenna-15491076
5. http://www.ewerksinc.com/refdocs/EMC%20Antenna%20Fundamentals.pdf

Course Code	Course Name	Contact Hours			
		L	T	P	C
15PK402	MOBILE COMMUNICATION NETWORKS	3	0	0	3

Course Objectives:

- *To study various aspects of Network Security Attacks, Services and Mechanisms.*
- *To understand the Cellular Mobile Networks*
- *To provide a comprehensive background knowledge of Wireless Communication*
- *To study the various broadband technologies*

Course pre-requisites: *Digital Communication*

Module-I OPERATION OF MOBILE COMMUNICATION NETWORKS (9)

Operation of first, second, and third generation wireless networks: cellular systems, medium access techniques, Mobile networks Elementary Principles of cellular Telephony Channel Division Techniques (TDMA, FDMA, CDMA) Cellular Coverage Methods Network Planning and Resource Allocation, Network Dimensioning ,Mobility Management Procedures

Module -II PROPAGATION MODELS AND AIR PROTOCOLS (9)

Radio propagation models, error control techniques, handoff, power control, Soft handover, Forward link, Reverse link, common air protocols (AMPS,IS-95,IS-136,GSM,GPRS,EDGE, WCDMA, CDMA2000)

Module -III MOBILE NETWORK ARCHITECTURE (9)

General Architecture definition, Mobile Terminals (MT, SIM) Radio Section (BTS, BSC) Core Network (MSC, G-MSC, VLR, HLR, AuC) User and Control Plane Protocol Stack, MAP & SS#7, the Key Role of Signaling Interfaces and Network Entities Relation The Physical Channel, The Logical Channels Terminal, Call and Network Management Procedures, Network Planning.

Module -IV WIRELESS LOCAL AREA NETWORKS (9)

Wireless Local Area Networks , General Characteristics of the Hyper LAN System, 802.11 Standard, Basic DCF access & DCF Access Scheme with Handshaking, PCF Access Scheme, 802.11a Standard, Mobile Ad Hoc Networks, Wireless Sensor Networks, Routing Energy Efficiency, Localization, Clustering. IEEE 802.16 Standard Architecture

Module -V SECURITY ISSUES IN WIRELESS NETWORKS (9)

Security in Wireless Networks, Secure routing, Key Pre-distribution and Management, Encryption and Authentication, Security in Group Communication, Trust Establishment and

Management, Denial of Service Attacks, Energy-aware security mechanisms, Location verification, Security on Data fusion.

TOTAL HOURS=45

Course Outcomes:

- *Understand about cellular mobile communication technologies and the characteristics of different multiple access techniques in wireless communication networks*
- *Review about propagation models and protocols.*
- *Understand the basic concepts of mobile network architecture and network management.*
- *Acquire basic knowledge behind wireless local area networks and standards.*
- *Learn security issues in wireless networks.*

REFERENCES:

1. W. Stallings, "Wireless Communications and Networks", Prentice Hall, Second Edition ,2007.
2. W.C.Y.Lee, “Mobile communications Engineering: Theory And Applications”, Tata McGraw Hill, NewDelhi, Second Edition,2008
3. T.S.Rappaport, "Wireless Communications: Principles & Practice", Prentice Hall, Second Edition, 2002.
4. Leon-Garcia and I. Widjaja, "Communication Networks, Fundamental Concepts and Key Architectures", McGraw-Hill, 2000.
5. J.Schiller, ”Mobile Communications", Addison Wesley, 2000.
6. Iti Saha Misra, “Wireless Communication and Networks 3G and Beyond”, Tata McGraw Hill, 2009.

WEB URLs:

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2. http://www.ip.eap.gr/pdf/Experimental%20Work%20Papoutsis-2_Patras.pdf
3. http://www.iet.ntnu.no/projects/beats/documents/mimo.pdf
4. http://www.ece.rice.edu/~ashu/publications/encylopedia.pdf
5. http://www.technet.microsoft.com/en-us/library/bb457019.aspx

Course Code	Course Name	Contact Hours			
		L	T	P	C
15PK451	ADVANCED COMMUNICATION SYSTEMS LABORATORY – I	0	0	3	2

Course Objectives:

- To understand underlying concepts in signal processing, modulation and coding.
- To provide a comprehensive analysis of power spectral estimation.
- To learn about the adaptive filtering algorithms.
- To learn about OFDM, CDMA systems.
- To provide the knowledge about radiation mechanism of various antennas.

Course pre-requisites: *Digital Communication, DSP*

LIST OF EXPERIMENTS

1. Design and performance analysis of error control encoder and decoder
2. Study Power Spectral density of various line codes
3. Design of Channel equalizers (LMS, RLS)
4. Design and Analysis of Spectrum Estimators (Borlett , Welch)
5. Simulation of Turbo coding
6. Performance evaluation of various digital modulation schemes and spread spectrum
7. Measurement of Radiation Pattern of different Antennas
8. Simulation of OFDM transceivers
9. Simulation and performance evaluation of CDMA System.
10. Study of GPS.

TOTAL HOURS=30

Course Outcomes:

- Analyze signal processing concepts, modulation and coding.
- Implement the adaptive filtering algorithms.
- Design and implement OFDM, CDMA systems.
- Analyze and estimate spectrum of various ranges, necessity of coding for error detection and correction.
- Knowledge about radiation mechanism of various antennas.

Course Code	Course Name	Contact Hours			
		L	T	P	C
15PK403	DIGITAL COMMUNICATION RECEIVERS	3	2	0	4

Course Objectives:

- *To study various aspects of digital communication techniques like modulation, spectral characteristics etc.*
- *To understand the design of receiver for AWGN and fading channel*
- *To provide a comprehensive background knowledge on various synchronization techniques*
- *To study the various equalization techniques.*

Course pre-requisites: *Digital Communication*

Module-I REVIEW OF DIGITAL COMMUNICATION TECHNIQUES (9)

Base band communication; signal space representation, linear and nonlinear modulation techniques, Error tracking and Spectral characteristics of digital modulation.

Module-II OPTIMUM RECEIVERS FOR AWGN CHANNEL (9)

Correlation demodulator, matched filter, maximum likelihood sequence detector, optimum receiver for CPM signals, M-ary orthogonal signals, envelope detectors for Mary and correlated binary signals.

Module-III RECEIVERS FOR FADING CHANNELS (9)

Characterization of fading multiple channels, statistical models, flat and frequency selective

fading, diversity technique, Optimal receivers for data detection and synchronization parameter estimation, coded waveform for fading channel.

Module-IV SYNCHRONIZATION TECHNIQUES (9)

Carrier and signal synchronization, carrier phase estimation-PLL, Decision directed loops, symbol timing estimation, maximum likelihood and non-decision directed timing estimation, joint estimation.

Module-V ADAPTIVE EQUALIZATION (9)

Zero forcing algorithm, LMS algorithm, adaptive decision-feedback equalizer and Equalization of Trellis-coded signals. Kalman algorithm, blind equalizers and stochastic gradient algorithm.

TOTAL HOURS=45+15=60

Course Outcomes:

- *Understand about digital modulation techniques and the characteristics signal*
- *Design the optimum receiver in AWGN channel.*
- *Design the optimum receiver in fading channel.*
  Acquire knowledge on synchronization techniques like PLL, ML criteria, loops
- *Learn about various adaptive equalization techniques.*

REFERENCES:

1. Heinrich Meyer, Mare Moeneclacy, Stefan.A.Fechtel, " Digital communication receivers ", Vol I & Vol II, John Wiley, New York, 1997.
2. U.Mengali & A.N.D'Andrea, Synchronization Techniques for Digital Receivers, Kluwer, 1997.
3. John.G.Proakis, "Digital communication "4th Edition, McGraw - Hill, NewYork, 2001.
4. E.A.Lee and D.G. Messerschmitt, "Digital communication ", 2nd Edition, Allied Publishers, New Delhi, 1994.
5. Simon Marvin, "Digital communication over fading channel; An unified approach to performance Analysis ", John Wiley, New York, 2000.

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2. http://www.win.ce.ncu.edu.tw/winlab_tw/modules/course/DigitalComm/Slide/ch4_v1.pdf
3. http://www.dspace.cc.tut.fi/dpub/bitstream/handle/123456789/107/hamila.pdf?sequence=1.
4. http://www.alcatel-lucent.com/bstj/vol45-1966/articles/bstj45-2-255.pdf
5. http://www.eecs.berkeley.edu/~dtse/mud_fading.pdf

Course Code	Course Name	Contact Hours			
		L	T	P	C
15PK404	RF SYSTEM DESIGN	3	2	0	4

Course objectives:

- *To give sufficient background for CMOS based design*
- *To understand the various components that constitute an RF system*
- *To know the basic analysis techniques needed for evaluating the performance of an RFsystem for various applications*

Course Pre-requisites : *Solid State Circuits-I, Solid State Circuits-II*

Module – I CMOS PHYSICS, TRANSCEIVER SPECIFICATIONS AND ARCHITECTURES (9)

CMOS: Introduction to MOSFET Physics – Noise: Thermal, shot, flicker, popcorn noise Transceiver Specifications: Two port Noise theory, Noise Figure, Sensitivity, SFDR, Phase noise Transceiver Architectures: Receiver: Homodyne, Heterodyne, Image reject, Low IF Architectures – Transmitter: Direct upconversion, Two step upconversion.

Module – II IMPEDANCE MATCHING AND AMPLIFIERS (9)

S-parameters with Smith chart – Passive IC components - Impedance matching networks Amplifiers: Common Gate, Common Source Amplifiers – OC Time constants in bandwidth estimation and enhancement – High frequency amplifier design Low Noise Amplifiers: Power match and Noise match – Single ended and Differential LNAs – Terminated with Resistors and Source Degeneration LNAs.

Module - III FEEDBACK SYSTEMS AND POWER AMPLIFIERS (9)

Feedback Systems: Stability of feedback systems: Gain and phase margin, Root-locus techniques –Time and Frequency domain considerations–Compensation Power Amplifiers: General model –Class A, AB, B, C, D, E and F amplifiers–Linearisation Techniques – Efficiency boosting techniques – ACPR metric.

Module-IV PLL AND FREQUENCY SYNTHESIZERS (9)

PLL: Linearised Model – Noise properties – Phase detectors – Loop filters and Charge pumps Frequency Synthesizers: Integer-N frequency synthesizers – Direct Digital Frequency synthesizers.

Module–V MIXERS AND OSCILLATORS (9)

Mixer: characteristics–Non-linear based mixers: Quadratic mixers–Multiplier based mixers: Single balanced and double balanced mixers–subsampling mixers Oscillators: Describing Functions, Colpitts oscillators–Resonators–Tuned Oscillators–Negative resistance oscillators– Phase noise

TOTAL HOURS: 45 + 15=60

Course Outcomes:

- *Understand the fundamentals of CMOS architecture and specification*
- *Analyze the performance of RF circuits and design RF circuits*
- *Understand the working concepts of RF active components and amplifiers*
- *Understand the frequency synthesizers and linearised PLL model*
- *Study the operation of mixers and oscillators.*

REFERENCES:

1. T.Lee, "Design of CMOS RF Integrated Circuits", Cambridge, 2004.
2. B.Razavi, "RF Microelectronics", Pearson Education, 1997.
3. Jan Crols, Michiel Steyaert, "CMOS Wireless Transceiver Design", Kluwer Academic Publishers, 1997.
4. B.Razavi, "Design of Analog CMOS Integrated Circuits", McGraw Hill, 2001.
5. Thomas H Lee, J.L. Dawson , "Feedback linearization of RF Power Amplifiers" , Kluwer Publishers 2004.

WEB URL's :

1. http://www.qsl.net/va3iul/Files/RF_courses_lectures.htm
2. http://www.seas.ucla.edu/brweb/teaching.html
3. http://nptel.ac.in/courses/117102012/

Course Code	Course Name	Contact Hours			
		L	T	P	C
15PK405	**HIGH PERFORMANCE COMMUNICATION NETWORKS**	**3**	**2**	**0**	**4**

Course Objectives:

- *To understand and analyze modern data communications networks.*
- *To understand the architecture of packet networks and the protocols used to enable transmission of packets through the network.*
- *To understand the concepts of ISDN.*

Course pre-requisites: *Computer Networks*

Module- I PACKET SWITCHED NETWORKS (9)

OSI and IP models, Ethernet (IEEE 802.3), Token ring (IEEE 802.5), Wireless LAN (IEEE 802.11) FDDI, DQDB, SMDS: Internetworking with SMDS.

Module- II ISDN AND BROADBAND ISDN (9)

ISDN - overview, interfaces and functions, Layers and services - Signaling System 7 (SS7)- Broadband ISDN architecture and Protocols.

Module- III ATM AND FRAME RELAY (9)

ATM: Main features-addressing, signaling and routing, ATM header structure-adaptation layer, management and control, ATM switching and transmission. Frame Relay: Protocols and services, Congestion control, Internetworking with ATM, Internet and ATM, Frame relay via ATM.

Module- IV ADVANCED NETWORK ARCHITECTURE (9)

IP forwarding architectures overlay model, Multi Protocol Label Switching (MPLS), integrated services in the Internet, Resource Reservation Protocol (RSVP), Differentiated services

Module –V RECENT WIRELESS TECHNOLOGIES (9)

Blue tooth Technology -Protocol stack, Zig bee Technology – Radio Hardware – Software,WiMAX Technology – protocol stack, Near field communications.

TOTAL HOURS=45+15= 60

Course Outcomes:

- *Understand the basic mechanism of packet switched communication networks.*
- *Learn ISDN and broadband ISDN architecture and protocols.*
- *Understand the main features of ATM and frame relay protocols and services.*
- *Describe IP forwarding architectures, MPLS and RSVP.*

- *Learn various recent trends in wireless technologies.*

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1. William Stallings,"ISDN and Broadband ISDN with Frame Relay and ATM", Pearson education Asia, 7th edition, 2003.
2. Leon Gracia, Widjaja, "Communication networks ", Tata McGraw-Hill, New Delhi, 2004.
3. Jennifer Bray and Charles F.Sturman,"Blue Tooth", Pearson education Asia, 2001.
4. Rainer Handel, Manfred N.Huber and Stefan Schroder ,"ATM Networks", Pearson education Asia, 3rd edition, 2002.
5. Jean Walrand and Pravin varaiya ,"High Performance Communication networks", Harcourt and Morgan Kauffman, London, 2nd edition,2000.
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4. http://www.sprint.com/business/resources/SPR6859c.pdf
5. http://www.infosys.com/infosys- labs/.../new-service-discovery-protocol.pdf

Course Code	Course Name	Contact Hours			
		L	T	P	C
15PK452	**ADVANCED COMMUNICATION SYSTEMS LABORATORY - II**	**0**	**0**	**3**	**2**

Course Objectives:

- *To provide experience in Simulation and Implementation of the Microstrip antenna and couplers.*
- *To provide the knowledge about audio signal and image processing.*
- *To analyze about various routing algorithms*

Course pre-requisites: *ARS, DIP, NRA*

LIST OF EXPERIMENTS:

1. Simulation of Audio compression algorithms
2. Simulation of EZW / SPIHT Image coding algorithm.
3. Programming Arithmetic coding, Huffman coding
4. Transform based compression techniques
5. Noise Removal and Deblurring of image by using wiener filters.
6. Implementation of an edge detection algorithm
7. Implementation of image segmentation by median filters
8. Design and testing of a Microstrip Antennas and coupler.
9. S-parameter estimation of Microwave devices.
10. Implementation of Shortest Path Routing/ Sliding Window Protocol Algorithm/ Distance Vector routing/ Link State routing Algorithms using Network Simulation Software.
11. RTOS – Simple task creation, Round Robin Scheduling, Preemptive scheduling, Semaphores, Mailboxes.

TOTAL HOURS=30

Course Outcomes:

- *Implement various compression algorithms for audio, speech and image.*
- *Analyze about microstrip antennas and their parameters.*
- *Analyze about various routing algorithms*

Course Code	Course Name	Contact Hours			
		L	T	P	C
15PK601	RF MEMS	3	0	0	3

Course Objectives:

- *To understand the concepts in RF MEMS relays and switches.*
- *To learn design of practical RF MEMS devices.*
- *To study high performance circuits and sub-systems using RF MEMS components.*
- *To learn RF MEMS technology for wireless applications.*
- *To study the design of micro machined RF filters.*

Course pre-requisites: *RF system Design*

Module-I SWITCHING (9)

RF MEMS relays and switches: Switch parameters – Actuation mechanisms– Bistable relays and micro actuators – Dynamics of switching operation.

Module- II COMPONENTS – I (9)

MEMS inductors and capacitors: Micromachined inductor – Effect of inductor layout – Modeling and design issues of planar inductor – Gap tuning and area tuning capacitors – Dielectric tunable capacitors.

Module- III COMPONENTS – II (9)

MEMS phase shifters: Types – Limitations – Switched delay lines – Micromachined transmission lines – Coplanar lines – Micromachined directional coupler and mixer.

Module- IV FILTERS (9)

Micromachined RF filters: Modeling of mechanical filters – Electrostatic comb drive – Micromechanical filters using comb drives – Electrostatic coupled beam structures.

Module- V ANTENNAS (9)

Micromachined antennas: Microstrip antennas – Design parameters – Micromachining to improve performance – Reconfigurable antennas.

TOTAL HOURS: 45

1. Course Outcomes:

- *Understand the operation of RF MEMS relays and switches.*
- *Learn the modeling and designing of MEMS inductors and capacitors.*
- *Describe MEMS phase shifters and micromachined transmission lines.*
- *Design micromachined RF filters.*
- *Design micromachined antennas.*

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1. Vijay K.Varadan, k.A.Jose and K.J Vinoy, “RFMEMS and their Applications”, John Wiley and Sons, New York, 2003.
2. Matthew M Radmanesh, “Radio Frequency and Microelectronic Illustrated”, Pearson Education Asia Publication, 2002.
3. Leon H J Delos, Santos Gracia and Widjaja “RF MEMS circuit Design for Wireless Communications”, Artech House Publication, 2002.
4. Ulrich L, Rohde David P Razavi and NewKirk,” RF / Microwave Circuit Design”, John Wiley and Sons USA, 2000.
5. Rebeiz G.M,” RF MEMS: THEORY, Design and Technology”, John Wiley and Sons Inc., 2003

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Course Code	Course Name	Contact Hours			
		L	T	P	C
15PK602	DESIGN OF MICROWAVE INTEGRATED CIRCUITS	3	0	0	3

Course Objectives

- *To study about the technology of IC's and propagation of signals through Microstrip Transmission lines*
- *To understand how analyzes of fields and microwave circuit design are performed*
- *To learn coplanar MICs and design of microwave circuits like amplifiers, mixers etc.*

Course pre-requisites: *Microwave Systems*

Module- I TECHNOLOGY OF HYBRID MICS & MONOLITHIC MICS (9)

Hybrid MICs: Dielectric substrates - thick film technology and materials - thin film technology and materials – methods of testing – encapsulation of devices for MICs – mounting of active devices. MMICs: Processes involved in fabrication – epitaxial growth of semiconductor layer – growth of dielectric layer – diffusion-ion implantation –electron beam technology.

Module - II MICROSTRIP TRANSMISSION LINES (9)

Strip lines- formulas for propagation constant, characteristic impedance and attenuation, an approximate electrostatic solution, Slot Lines, and Coplanar waveguides -Static TEM parameters and design of microstrips- High frequency dispersion effects in microstrips.

Module - III ANALYSIS OF PASSIVE RECIPROCAL AND NON-RECIPROCAL MICROWAVE DEVICES (9)

Passive reciprocal devices: Methods of analysis of passive reciprocal microwave devices, the Even and Odd mode method and the Eigen value method. Applications to Microstrip directional couplers – parallel coupled lines, coupled microstrips design, branch line couplers, Lange couplers, hybrid ring couplers and the Wilkinson power dividers/combiners. Passive Non-Reciprocal Components: Ferromagnetic substrates for non-reciprocal devices – Design of microstrip circulators – latching circulators – isolators – phase shifters.

Module- IV COPLANAR MICS (9)

Coplanar waveguides- transmission properties, discontinuities. Introduction to Coplanar MICs, Coplanar transistors and coplanar switches, coplanar microwave active filters, coplanar microwave active amplifiers, Coplanar Electronic circulators and Coplanar frequency doublers.

Module- V MICROWAVE CIRCUIT DESIGN (9)

Microwave amplifier Design – Two port power gain, stability single stage transistor amplifier design, low noise amplifier design, broad band amplifier design, balanced and distributed amplifiers, design of class A amplifiers. Microwave Oscillator Design, negative resistance oscillator, transistor oscillators design, dielectric resonator oscillator design, oscillator phase noise, microwave mixer, single ended diode mixer, FET mixer, balanced mixer, image reject mixer, double balanced mixer.

TOTAL HOURS=45

Course Outcomes

- *Understand various MIC technologies.*
- *Acquire knowledge of microstrip transmission lines and their parameters.*
- *Analyse passive and non-passive reciprocal microwave devices.*
- *Learn the various coplanar MICs and their applications.*
- *Design various microwave circuits like amplifiers, oscillators and mixers.*

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1. K.C.Gupta,, and Amarjit singh , "Microwave Integrated Circuits" , John Wiley and sons – Wiley Eastern Reprint, 2004.
2. Reinmut K. Hoffmann, "Handbook of Microwave Integrated Circuits", Artech House, 1987.
3. Ingo Wolff, "Coplanar Microwave Integrated Circuits", John Wiley and Sons, 2006.
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Course Code	Course Name	Contact Hours			
		L	T	P	C
15PK603	**ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY** *(Common to M.E. Communication Systems and M.E. Applied Electronics)*	**3**	**0**	**0**	**3**

1. Course Objectives:

- *To understand the basics of EMI*
- *To study EMI Sources*
- *To understand EMI problems*
- *To understand Solution methods in PCB*
- *To understand Measurement technique for emission*
- *To understand Measurement technique for immunity*

***2. Course Pre-requisites**: EMF*

Module - I EMI/EMC CONCEPTS (9)

EMI-EMC definitions and Units of parameters; Sources and victim of EMI; Conducted and Radiated EMI Emission and Susceptibility; Transient EMI, ESD; Radiation Hazards.

Module - II EMI COUPLING PRINCIPLES (9)

Conducted, radiated and transient coupling; Common ground impedance coupling ; Common mode and ground loop coupling ; Differential mode coupling ; Near field cable to cable coupling,cross talk ; Field to cable coupling ; Power mains and Power supply coupling.

Module - III EMI CONTROL TECHNIQUES (9)

Shielding- Shielding Material-Shielding integrity at discontinuties, Filtering-Characteristics of Filters-Impedance and Lumped element filters-Telephone line filter, Power line filter design, Filter installation and Evaluation, Grounding- Measurement of Ground resistance-system grounding for EMI/EMC-Cable shielded grounding, Bonding, Isolation transformer, Transient suppressors, Cable routing, Signal control. EMI gaskets.

Module - IV EMC DESIGN OF PCBS (9)

EMI Suppression Cables-Absorptive, ribbon cables-Devices-Transient protection hybrid circuits, Component selection and mounting; PCB trace impedance; Routing; Cross talk control- Electromagnetic Pulse-Noise from relays and switches, Power distribution decoupling; Zoning;Grounding; VIAs connection; Terminations.

Module - V EMI MEASUREMENTS AND STANDARDS (9)

Open area test site; TEM cell; EMI test shielded chamber and shielded ferrite lined anechoic chamber; Transmitter /Receiver Antennas, Sensors, Injectors / Couplers, and coupling factors; EMI Receiver and spectrum analyzer; Civilian standards-CISPR, FCC, IEC, EN; Military standards-MIL461E/462. Frequency assignment - spectrum conversation. British VDE standards, Euro norms standards in Japan - comparisons. EN Emission and Susceptibility standards and Specifications.

TOTAL HOURS=45

3. Course Outcomes:

- *Learn the basic concepts of EMI/EMC.*
- *Understand the principles of various EMI coupling methods.*
- *Design and study EMI control techniques.*
- *Design high speed Printed Circuit board with minimum interference*
- *Learn EMI measurements, standards and specifications.*

REFERENCES:

1. V.P.Kodali, "Engineering EMC Principles, Measurements and Technologies", IEEE Press, Newyork, 1996.

2. Clayton R.Paul," Introduction to Electromagnetic Compatibility", John Wiley Publications, 2008
3. Henry W.Ott.,"Noise Reduction Techniques in Electronic Systems", A Wiley InterScience Publications, John Wiley and Sons, Newyork, 1988.
4. Bemhard Keiser, "Principles of Electromagnetic Compatibility", Artech house, Norwood, 3rd Ed, 1986.
5. Don R.J.White Consultant Incorporate, "Handbook of EMI/EMC", Vol I-V, 1988.

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PE GROUP 2- COMMUNICATION

Course Code	Course Name	Contact Hours			
		L	T	P	C
15PK604	INFORMATION THEORY AND CODING	3	0	0	3

1. Course Objectives :

- *To understand the concepts of Information theory and Coding.*
- *To understand the fundamental limits prescribed by the information theory.*
- *To learn the various coding schemes in detail.*

2. Course Pre-requisites: *Probability Theory and Random Process , Digital Communication*

Module- I INFORMATION THEORY (9)

Information – Entropy, Information rate, classification of codes, Kraft McMillan inequality, Source coding theorem, Shannon-Fano coding, Huffman coding, Extended Huffman coding - Joint and conditional entropies, Mutual information.

Module-II CHANNEL CAPACITY (9)

Discrete memoryless channels – Channel capacity, Shannon limit- Properties of channel capacity- Jointly typical sequences, Channel Coding Theorem, converse to channel coding theorem, Joint source channel coding theorem-Differential entropy and mutual information for continuous ensembles.

Module- III SOURCE CODING: TEXT,AUDIO AND SPEECH (9)

Text: Adaptive Huffman Coding, Arithmetic Coding, LZW algorithm – Audio: Perceptual coding, Masking techniques, Psychoacoustic model, MEG Audio layers I,II,III, Dolby AC3 - Speech: Channel Vocoder, Linear Predictive Coding

Module- IV SOURCE CODING: IMAGE AND VIDEO (9)

Image and Video Formats – GIF, TIFF, SIF, CIF, QCIF – Image compression: READ, JPEG – Video Compression: Principles-I,B,P frames, Motion estimation, Motion compensation, H.261, MPEG standard

Module- V ERROR CONTROL CODING (9)

Definitions and Principles: Hamming weight, Hamming distance, Minimum distance decoding - Single parity codes, Hamming codes, Repetition codes - Linear block codes- Cyclic codes - Syndrome calculation, Encoder and decoder – CRC- Convolutional codes – code tree, trellis, state diagram-Encoding-Decoding: Sequential search and Viterbi

algorithm – Principle of Turbo coding.

TOTALHOURS=45

3.Course Outcomes:

- *Understand and apply fundamental concepts in information theory such as probability, entropy, information content and their inter-relationships.*
- *Understand the properties of channel capacity and different channel coding theorems.*
- *Study the different source coding for text, audio and speech.*
- *Study different image and video formats.*
- *Describe various error control codes*

REFERENCES:

1. R Bose, "Information Theory, Coding and Crptography", TMH 2007
2. Fred Halsall, "Multidedia Communications: Applications, Networks, Protocols and Standards",Pearson Education Asia, 2002
3. K Sayood, "Introduction to Data Compression" 3/e, Elsevier 2006
4. S Gravano, "Introduction to Error Control Codes", Oxford University Press 2007
5. Amitabha Bhattacharya, "Digital Communication", TMH 2006

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Course Code	Course Name	Contact Hours			
		L	T	P	C
15PK605	MULTICARRIER MODULATION	3	0	0	3

1 Course Objectives

- *To understand the underlying principles of multicarrier modulation.*
- *To understand and apply the elementary ideas regarding the design of advanced communication systems introduced in the course.*

2 Course pre-requisites: Digital Communication

Module- I FUNDAMENTALS (9)

Radio Channel Characteristics, Multi-Carrier Transmission, Spread Spectrum Techniques, Multi-Carrier Spread Spectrum.

Module- II OFDM (9)

Channel model for OFDM Systems: Characteristics, FD Channel Modeling, channel simulation, Application to millimeter-wave radio channels, OFDM System model, Performance of uncoded OFDM System.

Module- III MC-CDMA and MC-DS-CDMA (9)

Signal Structure, uplink, downlink, spreading and detection techniques, pre-equalization, soft channel decoding, flexibility and performance analysis, Hybrid Multiple Access Schemes.

Module – IV IMPLEMENTATION ISSUES (9)

Multi-Carrier Modulation and Demodulation, Synchronization, Channel Estimation, Channel Coding and Decoding, Signal Constellation, Mapping, Demapping, and Equalization, Adaptive Techniques in Multi-Carrier Transmission, RF Issues.

Module- V MULTI CARRIER TECHNIQUES FOR 4G MOBILE COMMUNICATIONS (9)

Multicarrier Techniques for 4G systems, Coded OFDM Scheme, Applications of OFDM, Combination of OFDM and CDMA, OFCDM System, OFDM Adaptive Array antennas, MIMO-OFDM.

TOTAL HOURS=45

3. Course Outcomes

- *Understand the fundamentals of multicarrier modulation..*
- *Study the concepts of OFDM and system model.*
- *Understand MC-CDMA and MC-DS-CDMA.*

• *Learn the various implementation issues in multicarrier modulation.*
• *Understand multicarrier techniques for 4G mobile communications.*

REFERENCES :

1. Ramjee Prasad, "OFDM for Wireless Communications Systems", Artech House, Inc. 2004
2. K. Fazel, S. Kaiser, "Multi-Carrier and Spread Spectrum Systems", John Wiley & Sons Ltd., 2003
3. Shinsuke Hara, Ramjee Prasad , "Multicarrier Techniques for 4G Mobile Communication", Artech House 2003

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5. http://www.wseas.us/e-library/transactions/communications/2009/31-558.pdf

Course Code	Course Name	Contact Hours			
		L	T	P	C
15PK606	ENERGY MANAGEMENT FOR WIRELESS COMMUNICATION	3	0	0	3

1. Course Objectives:

- *To enable the student to understand the evolving paradigm of green communication and the enabling technologies for its implementation.*
- *To enable the student to understand the necessities and requirements in designing green communication.*
- *To expose the student to the evolving energy harvesting strategies for green communication and their associated challenges.*

2. Course Pre-requisites: *Wireless and Mobile Communication Networks*

Module -I GREEN COMMUNICATION ENERGY MANAGEMENT AND MODULATION (9)

Energy Management for Location –Based Services on mobile Devices, Energy Efficient Supply of Mobile Devices, Green Radio network-PHY and MAC layer optimization for energy-harvesting wireless networks-Green modulation and coding schemes in energy – constrained wireless networks.

Module–II ENERGY CONSERVATION ON VARIOUS APPLICATIONS (9)

QoE-Based Energy Conservation for VoIP Applications in WLAN, Minimum Energy Multi-criteria Relay Selection in Mobile Ad Hoc Networks; Energy optimization Techniques for Wireless Sensor Networks.

Module-III ENERGY HARVESTING SYSTEMS (9)

Design Issues in EM Energy Harvesting Systems, Energy Scavenging for magnetically Coupled Communication Devices-Case study.

Module–IV TECHNIQUES ON ENERGY HARVESTING SYSTEMS (9)

Mixed –Signal, Low-power Techniques in Energy Harvesting Systems, Toward Modeling Support for Low-power and Harvesting Wireless Sensors for Realistic Simulation of Intelligent Energy-Aware Middleware.

Module -V ENERGY HARVESTING AND MANAGEMENT ON WSN (9)

Energy Consumption Profile for Energy Harvested WSNs, Radio Frequency Energy harvesting and Management for Wireless Sensor Networks.

TOTAL HOURS= 45

3. Course Outcomes:

- *Learn about green communication, energy management and modulation.*
- *Understand the mechanism for minimizing energy consumption of wireless networks without compromising QoS.*
- *Analyze the design issues in EM Energy Harvesting Systems.*
- *Understand new energy harvesting algorithms and tools for that.*
- *Describe the energy efficient harvesting and management on wireless sensor networks.*

REFERENCES:

1. H.Venkataraman, Gabriel-miro Muntean ,"Green Mobile Devices and Networks: Energy optimization and Scavenging Techniques", -CRC Press, 2012.
2. Vijay K. Bhargava ,Gerhard P.Fettweis and Ekram Hossian," Green Radio Communication Networks, Cambridge University press,2012
3. Jinsong Wu, Sundeep Rangan, Honggang Zhang ,"Green Communication: Theoretical Fundamentals, Algorithms and Applications", CRC Press,2012
4. F.Richard Yu,Xi Zhang ,Victor C.M.leung ,"Green Communication and Networking" , - CRC Press, 2012
5. Bhuvan Unhelkar ,"Green IT Strategies and Applications: Using Environmental Intelligence" , CRC Press, 2011.

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PE GROUP 3 – NETWORKING

Course Code	Course Name	Contact Hours			
		L	T	P	C
15PK607	NETWORK SECURITY	3	0	0	3

1. Course objectives:

- *To study various aspects of Network Security Attacks, Services and Mechanisms.*
- *To deal with various Encryption, Authentication and Digital Signature Algorithms*.
- *To deal with different general purpose and application specific Security Protocols and Techniques.*

2. Course pre-requisites : *Computer Networks*

Module - I SYMMETRIC CIPHERS (9)

Introduction, Classical Encryption Techniques-Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Block Ciphers and Data Encryption Standard– Simplified DES, Block Cipher Principles, Data Encryption Standard, Strength of DES, Differential and Linear Crypt Analysis, Block Cipher Design Principles, Block Cipher Modes of operation.

Module -II AES AND CONFIDENTIALITY (9)

Advanced Encryption Standard-Evaluation Criteria for AES, AES Cipher; Contemporary Symmetric Ciphers-Triple DES, Confidentiality using Symmetric Encryption-Placement of Encryption Function, Traffic Confidentiality, Key Distribution, and Random Number Generation.

Module - III PUBLIC-KEY ENCRYPTION AND HASH FUNCTIONS (9)

Public Key Cryptography and RSA- Principles of Public Key Cryptosystems, RSA Algorithm; Key Management, Diffie-Hellman Key Exchange, Elliptic Curve Cryptography; Message Authentication and Hash Functions- Authentication Requirements, Authentication Functions, Message Authentication Codes, Hash Functions and MACs; Hash Algorithms- MD5 Message Digest Algorithm; Secure Hash Algorithm, Digital Signatures and Authentication Protocols, Digital Signature Standards.

Module - IV NETWORK SECURITY PRACTICE (9)

Authentication Applications- Kerberos, X.509 Authentication Service; Electronic Mail Security-Pretty Good Privacy, S/MIME; IP Security- IP Security Overview, IP Security Architecture,Authentication Header, Encapsulating Security Payload, Combining Security

Associations; WebSecurity- Web Security Considerations, Secure Sockets Layer and Transport Layer Security,Secure Electronic Transaction

Module - V SYSTEM SECURITY (9)

Intruders- Intruder Detection, Password Management; Malicious Software- Virus and Related Threats, Virus Counter Measures; Firewalls- Firewall Design Principles, Trusted Systems.

TOTAL HOURS: 45

3. Course outcomes:

- *Study the classical encryption techniques, data encryption standards and block ciphers.*
- *Understand the advanced encryption standard and traffic confidentiality.*
- *Understand the concepts of Public Key Cryptography, RSA and Hash algorithms.*
- *Understand the various authentication applications, IP and web security.*
- *Study the concepts of intruder detection, malicious software and firewalls.*

REFERENCES :

1. William Stallings, "Cryptography and Network Security", 3rd Edition. Prentice Hall of India, New Delhi, 2004.
2. Behrouz A. Foruzan, "Cryptography and Network Security", Tata McGraw-Hill, 2007
3. William Stallings, "Network Security Essentials", Prentice Hall of India, New Delhi, 2nd Edition, 2004
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Course Code	Course Name	Contact Hours			
		L	T	P	C
15PK608	**ALGORITHMS FOR NETWORK ROUTING**	**3**	**0**	**0**	**3**

1. ***Course Objectives****:*

- *To learn about routing algorithms in Circuit switching network & Packet switching networks.*
- *To understand routing algorithms in Routing in High speed and mobile networks.*
- *To learn routing algorithms in Mobile Ad-hoc networks.*

2. ***Course Pre-requisites :*** *Computer Networks*

Module - I CIRCUIT SWITCHING NETWORKS (9)

AT & T's Dynamic Routing Network, Routing in Telephone Network-Dynamic Non Hierarchical Routing- Trunk Status Map Routing-Real Time Network Routing, Dynamic Alternative Routing-Distributed Adaptive Dynamic Routing-Optimized Dynamic Routing

Module - II PACKET SWITCHING NETWORKS (9)

Distance vector Routing, Link State Routing, Inter domain Routing-Classless Inter domain routing (CIDR), Interior Gateway routing protocols (IGRP) - Routing Information Protocol (RIP), Open Shortest Path First (OSPF), Exterior Gateway Routing Protocol (EGRP) - Border Gateway Protocol (BGP), Apple Talk Routing and SNA Routing

Module - III HIGH SPEED NETWORKS (9)

Routing in optical networks-The optical layer, Node Designs, Network design and operation, Optical layer cost tradeoffs, Routing and wavelength assignment, Architectural variations, Routing in ATM networks- ATM address structure, ATM Routing, PNNI protocol, PNNI signaling protocol, Routing in the PLANET network and Deflection Routing.

Module -IV MOBILE NETWORKS (9)

Routing in Cellular Mobile Radio Communication networks-Mobile Network Architecture, Mobility management in cellular systems, Connectionless Data service for cellular systems, Mobility and Routing in Cellular Digital Packet Data (CDPD) network, Packet Radio Routing-DARPA packet radio network, Routing algorithms for small, medium and large sized packet radio networks.

Module - V MOBILE AD-HOC NETWORKS (MANET) (9)

Internet based mobile ad-hoc networking, communication strategies, routing algorithms – Table-driven routing - Destination Sequenced Distance Vector (DSDV), Source initiated on-demand routing- Dynamic Source Routing (DSR), Ad-hoc On- demand Distance

Vector (AODV), Hierarchical based routing- Cluster head Gateway Switch Routing (CGSR) and Temporally-Ordered Routing Algorithm (TORA), Quality of Service.

TOTAL HOURS=45

3. ***Course Outcomes:***

- *Familiarize with various dynamic routing networks.*
- *Understand various packet switching network protocols.*
- *Learn routing in optical and ATM networks.*
- *Describe routing in cellular radio mobile communication networks and familiarize with computer network architecture.*
- *Study various routing algorithms.*

REFERENCES:

1. M. Steen Strub, “Routing in Communication networks”, Prentice Hall International, NewYork, 1995.
2. William Stallings, “ISDN and Broadband ISDN with Frame Relay and ATM”, PHI, New Delhi, 2004.
3. Behrouz A Forouzan, “Data Communications and Networking”, TMH, 3rd edition,2007
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Course Code	Course Name	Contact Hours			
		L	T	P	C
15PK609	COMMUNICATION PROTOCOL ENGINEERING	3	0	0	3

1. ***Course objectives:***

- *To study the network reference model for the communication Protocol engineering process.*
- *To study the Protocol specifications, verification and Validation process.*
- *To study the performance testing, synthesis and implementation of the Protocols.*

2. ***Course pre-requisites:*** *Computer Networks*

Module- I NETWORK REFERENCE MODEL (9)

Communication model, software, subsystems, protocol, protocol development methods, Protocol engineering process, Layered architecture, Network services and Interfaces, Protocol functions, OSI model,TCP/IP protocol suite.

Module - II PROTOCOL SPECIFICATIONS (9)

Components of protocol, Specifications of Communication service, Protocol entity, Interface, Interactions, Multimedia protocol, Internet protocol, SDL, SDL based protocol, other protocol specification languages.

Module- III PROTOCOL VERIFICATION/VALIDATION (9)

Protocol verification, Verification of a protocol using finite state machines, Protocol validation, protocol design errors, Protocol validation approaches, SDL based protocol verification and validation.

Module- IV PROTOCOL CONFORMANCE/PERFORMANCE TESTING (9)

Conformance testing methodology and frame work, Conformance test architectures, Test sequence generation methods, Distributed architecture by local methods, Conformance testing with TTCN, systems with semi controllable interfaces - RIP,SDL based tools for conformance testing, SDL based conformance testing of MPLS Performance testing, SDL based performance testing of TCP and OSPF, Interoperability testing, SDL based interoperability testing of CSMA/CD and CSMA/CA protocol using Bridge, Scalability testing.

Module- V PROTOCOL SYNTHESIS AND IMPLEMENTATION (9)

Protocol synthesis, Interactive synthesis algorithm, Automatic synthesis algorithm, Automatic synthesis of SDL from MSC, Protocol Re-synthesis; Requirements of protocol implementation, Object based approach to protocol implementation, Protocol compilers, Tool for protocol engineering.

TOTAL HOURS: 45

3. Course outcomes:

- *Understand the network reference model and various communication protocols*
- *Learn various protocol specifications and SDL language overview*
- *Understand protocol verification using finite state machines and protocol validation approaches*
- *Know protocol conformance testing and performance testing.*
- *Describe and study protocol synthesis and implementation algorithms and tools*

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1. Pallapa Venkataram and Sunilkumar S.Manvi, "Communication protocol Engineering", PHI, 2012
2. Richard Lai and Jirachiefpattana, "Communication Protocol Specification and Verification", Springer Science & Business Media,2012.
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PE GROUP 4 – WIRELESS COMMUNICATION

Course Code	Course Name	Contact Hours			
		L	T	P	C
15PK610	**ADVANCED WIRELESS COMMUNICATION**	**3**	**0**	**0**	**3**

1. Course objectives:

- *To introduce the concepts of wireless communication.*
- *To make the students to know about the various propagation methods, Channel models, capacity calculations multiple antennas and multiple user techniques used in the mobile communication.*
- *To enhance the understanding of Wi-fi, 3G systems and 4G networks*

2. Course pre-requisites: *Digital Communication*

MODULE-I OVERVIEW OF WIRELESS COMMUNICATIONS (9)

History of Wireless Communications, Wireless Vision, Technical Issues, Current Wireless Systems, Cellular Telephone Systems, Cordless Phones, Wireless LANs, Wide Area Wireless Data, Fixed Wireless Access, Paging Systems, Satellite Networks, Bluetooth, Other Wireless Systems and Applications, The Wireless Spectrum, Methods for Spectrum Allocation, Spectrum Allocations for Existing Systems, The cellular concept system design fundamentals.

MODULE-II CELLULAR SYSTEMS AND INFRASTRUCTURE-BASED WIRELESSNETWORKS (9)

Cellular System Design, Frequency Reuse in Cellular Systems, Frequency Reuse in Code-Division Systems, Frequency Reuse in Time and Frequency Division Systems, Dynamic Resource Allocation in Cellular Systems, Area Spectral Efficiency.

MODULE-III PATH LOSS, SHADOWING AND CAPACITY OF WIRELESS CHANNELS (9)

Free-Space Path Loss, Two-Ray Model, Simplified Path Loss, Shadow Fading, Path Loss and Shadowing, Outage Probability under Path Loss and Shadowing, Cell Coverage Area. Statistical Multipath Channel Models: Time-Varying Channel Impulse, Narrowband fading models, Autocorrelation, Cross Correlation, and Power Spectral Density, Envelope and Power Distributions, Level Crossing Rate and Average Fade Duration, Wideband Fading Models, Power Delay Profile, Coherence Bandwidth, Doppler Power Spectrum and Channel Coherence, Capacity of Wireless Channels-Selective Fading Channels.

MODULE-IV DIGITALMODULATIONANDDETECTION (9)

Signal Space Analysis- Phase Shift Keying (MPSK), Quadrature Amplitude Modulation (MQAM) Differential Modulation, Constellation, Quadrature Offset, Frequency Shift Keying (FSK) and Minimum Shift Keying (MSK), Spread Spectrum and Multiuser Systems.

MODULE-V MULTIPLE ACCESS TECHNIQUES FOR WIRELESS COMMUNICATION (9)

Introduction to Multiple Access, FDMA, TDMA, Spread Spectrum multiple Access, space division multiple access, packet ratio, capacity of a cellular systems.

TOTAL HOURS: 45

REFERENCES:

1. Andrea Goldsmith, "Wireless Communications", Cambridge University Press, 2007.
2. William C Y Lee, "Mobile Communications Engineering, Theory and Applications", Second Edition, McGraw Hill International editions, 1998.
3. Theodore S Rappaport, "Wireless Communications", Pearson Education, Asia , New Delhi, Second Edition, 2002
4. David Tse and Pramod Viswanath, "Fundamentals of Wireless Communication", Prentice Hall, 2003.

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Course Code	Course Name	Contact Hours			
		L	T	P	C
15PK611	COGNITIVE RADIO NETWORK	3	0	0	3

1. Course Objectives:

- *To enable the student to understand the evolving paradigm of cognitive radio communication and the enabling technologies for its implementation.*
- *To enable the student to understand the essential functionalities and requirements in designing software defined radios and their usage for cognitive communication.*
- *To expose the student to the evolving next generation wireless networks and their associated challenges.*

2. Course Pre-requisites :*Wireless and mobile Communication Networks*

Module - I INTRODUCTION TO SDR (9)

Software Defined Radio, Evolution of software defined radio, Software radio architecture evolution - foundations, technology tradeoffs and architecture implications, Radio frequency spectrum and regulation.

Module -II SDR ARCHITECTURE (9)

Ideal Software Radio, Software Radio Functional Architecture, Basic Signal Processing Streams, Acquisition of Software Radio, Broader Implications of the Software Radio, Architecture Evolution, Systems-Level Architecture Analysis.

Module -III INTRODUCTION TO COGNITIVE RADIOS (9)

Motivation, Cognitive radio, Spectrum policy, Data explosion, Applications, Cognitive radio network design, Hardware and system design considerations, Spectrum coexistence, Prototyping and Standardization, Cognitive radio network paradigms, Spectrum sensing.

Module - IV COGNITIVE RADIO ARCHITECTURE (9)

Cognitive Radio Network Architectures, Topology-Aware CRN Architectures, Publish-Subscribe CRN Architecture, Cognitive radio network security.

Module -V NEXT GENERATION WIRELESS NETWORKS (9)

The XG Network architecture, spectrum sensing, spectrum management, spectrum mobility, spectrum sharing, upper layer issues, cross – layer design.

TOTAL HOURS=45

3. Course Outcomes:

- *Understand the basic concepts of software defined radio.*
- *Study about the SDR architecture and analysis.*
- *Understand the concepts and design of cognitive radios.*

- *Analyse the various cognitive radio network architectures*
- *Demonstrate the impact of the evolved solutions in future wireless network design.*

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REFERENCES:

1. Alexander M. Wyglinski, Maziar Nekovee, And Y. Thomas Hou, " Cognitive Radio Communications And Networks - Principles And Practice", Elsevier Inc., 2010.
2. Joseph Mitola III, "Software Radio Architecture: Object-Oriented Approaches to Wireless Systems Engineering", Wiley-Interscience Publication, John Wiley & Sons, Inc, October 2000, ISBN: 978-0-471-38492-2.
3. E. Biglieri, A.J. Goldsmith., L.J. Greenstein, N.B. Mandayam, H.V. Poor, "Principles of Cognitive Radio", Cambridge University Press, 2013.
4. Ian F. Akyildiz, Won – Yeol Lee, Mehmet C. Vuran, Shantidev Mohanty, " Next generation/dynamic spectrum access / cognitive radio wireless networks: A Survey Elsevier Computer Networks, May 2006.
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6.http://www.wirelessinnovation.org/assets/documents/SoftwareDefinedRadio.pdf

Course Code	Course Name	Contact Hours			
		L	T	P	C
15PK612	**WIRELESS SENSOR NETWORK ARCHITECTURE AND SECURITY**	**3**	**0**	**0**	**3**

1. Course Objectives:

- *To obtain a broad understanding of the technologies and applications for the emerging and exciting domain of wireless sensor networks.*
- *To study the challenges and latest research results related to the design and management of wireless sensor networks.*
- *To focus on network architectures and security.*

2. Course Pre-requisites: *Wireless and mobile Communication Networks*

Module - I OVERVIEW OF WIRELESS SENSOR NETWORKS (9)

Challenges for Wireless Sensor Networks-Characteristics requirements-required mechanisms, Difference between mobile ad-hoc and sensor networks, Applications of sensor networks- Enabling Technologies for Wireless Sensor Networks

Module - II ARCHITECTURES (9)

Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes , Operating Systems and Execution Environments, Network Architecture - Sensor Network Scenarios, Optimization Goals and Figures of Merit, Gateway Concepts.

Module - III NETWORKING OF SENSORS (9)

Physical Layer and Transceiver Design Considerations, MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts - S-MAC , The Mediation Device Protocol, Wakeup Radio Concepts, Address and Name Management, Assignment of MAC Addresses, Routing Protocols- Energy-Efficient Routing, Geographic Routing.

Module - IV INFRASTRUCTURE ESTABLISHMENT (9)

Topology Control, Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control.

Module - V SENSOR NETWORK PLATFORMS AND TOOLS (9)

Operating Systems for Wireless Sensor Networks, Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms, Node-level Simulators, State-centric programming.

TOTAL HOURS= 45

3. Course Outcomes:

- *Learn the basics of wireless sensor networks and its applications in enabling technologies.*

- *Understand the architecture and elements of wireless sensor networks.*
- *Study MAC protocols for wireless sensor networks.*
- *Know the tools and platforms needed to establish sensor networks*.
- *Learn about various sensor network platforms and tools.*

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1. Holger Karl and Andreas Willig, "Protocols And Architectures for Wireless Sensor Networks", John Wiley,2005.
2. Feng Zhao and Leonidas J. Guibas, "Wireless Sensor Networks - An Information ProcessingApproach", Elsevier, 2007.
3. Kazem Sohraby, Daniel Minoli and Taieb Znati, "Wireless Sensor Networks-Technology, Protocols, And Applications", John Wiley, 2007
4. Anna Hac, Wireless Sensor Network Designs, John Wiley, 2003.
5. Bhaskar Krishnamachari," Networking Wireless Sensors", Cambridge Press, 2005.

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4. https://people.mpi-inf.mpg.de/~nikolam/downloads/fm-ieswahn-05.pdf
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PE GROUP 5 – SIGNAL PROCESSING

Course Code	Course Name	Contact Hours			
		L	T	P	C
15PK613	SPEECH SIGNAL PROCESSING	3	0	0	3

1. ***Course objectives:***

- *To study the basic concepts of speech.*
- *To study the analysis and synthesis of filter banks.*
- *To learn various transform coders for speech.*
- *To study the speech processing methods in time and frequency domain*
- *To understand the speech recognition and feature extraction process.*

2. ***Course Pre-requisites:*** *Digital Communication*

Module – I MECHANICS OF SPEECH (9)

Speech production: Mechanism of speech production, Acoustic phonetics - Digital models for speech signals - Representations of speech waveform: Sampling speech signals, basics of quantization, delta modulation, and Differential PCM - Auditory perception: psycho acoustics.

Module - II TIME DOMAIN METHODS FOR SPEECH PROCESSING (9)

Time domain parameters of Speech signal – Methods for extracting the parameters Energy, Average Magnitude, Zero crossing Rate – Silence Discrimination using ZCR and energy – Short Time Auto Correlation Function – Pitch period estimation using Auto Correlation Function.

Module- III FREQUENCY DOMAIN METHOD FOR SPEECH PROCESSING (9)

Short Time Fourier analysis: Fourier transform and linear filtering interpretations, Sampling rates Spectrographic displays - Pitch and formant extraction - Analysis by Synthesis - Analysis synthesis systems: Phase vocoder, Channel Vocoder - Homomorphic speech analysis: Cepstral analysis of Speech, Formant and Pitch Estimation, Homomorphic Vocoders.

Module - IV LINEAR PREDICTIVE ANALYSIS OF SPEECH (9)

Basic Principles of linear predictive analysis – Auto correlation method – Covariance method – Solution of LPC equations – Cholesky method – Durbin's Recursive algorithm – Application of LPC parameters – Pitch detection using LPC parameters – Formant analysis – VELP – CELP.

Module – V APPLICATION OF SPEECH AND AUDIO SIGNAL PROCESSING (9)

Algorithms: Dynamic time warping, K-means clustering and Vector quantization, Gaussian mixture modeling, hidden Markov modeling - Automatic Speech Recognition: Feature Extraction for ASR, Deterministic sequence recognition, Statistical Sequence recognition, Language models - Speaker identification and verification – Voice response system – Speech synthesis: basics of articulatory, source-filter, and concatenative synthesis – VOIP

TOTAL HOURS=45

3. Course Outcomes :

- *Understand the mechanism of speech production and speech perception.*
- *Understand time domain parameters.*
- *Understand the mechanisms involved in speech extraction and vocoders.*
- *Understand the various prediction analysis of speech.*
- *Apply the above knowledge in speaker identification and verification.*

REFERENCES:

1. L.R.Rabiner and R.W.Schaffer, " Digital Processing of Speech signals", Prentice Hall 2003.
2. Thomas.F.Quatieri,"Discrete-time Speech Signal Processing",Prentice Hall, Pearson education, 2001.
3. Ben Gold and Nelson Morgan,"Speech and Audio Signal Processing",John Wiley and Sons Inc., Singapore, 2004.
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3. https://www.crcpress.com/product/isbn/9781420046083
4. http://freevideolectures.com/Course/2504/ELEC9344-Speech-and-Audio-Processing
5. http://nptel.ac.in/syllabus/117104023/

Course Code	Course Name	Contact Hours			
		L	T	P	C
15PK614	DSP PROCESSOR ARCHITECTURE	3	0	0	3

1. ***Course Objectives:***

- *To understand the basics of Digital Signal Processor.*
- *To study the third generation DSP Architecture and programming skills.*
- *To understand advanced DSP architectures and some application*

2. ***Course Pre-requisites :*** *DSP, Microprocessor and Microcontroller*

Module - I FUNDAMENTALS OF PROGRAMMABLE DSPs (9)

Multiplier and Multiplier accumulator – Modified Bus Structures and Memory access in PDSPs –Multiple access memory – Multi-port memory – VLIW architecture- Pipelining – Special Addressing modes in P-DSPs – On chip Peripherals.

Module - II TMS320C5X PROCESSOR (9)

Architecture – Assembly language syntax - Addressing modes – Assembly language Instructions - Pipeline structure, Operation – Block Diagram of DSP starter kit – Application Programs for processing real time signals.

Module - III TMS320C6X PROCESSOR (9)

Architecture of the C6x Processor - Instruction Set - DSP Development System: Introduction – DSP Starter Kit Support Tools- Code Composer Studio - Support Files - Programming Examples to Test the DSK Tools – Application Programs for processing real time signals.

Module - IV ADSP PROCESSORS (9)

Architecture of ADSP-21XX and ADSP-210XX series of DSP processors- Addressing modes and assembly language instructions – Application programs –Filter design, FFT calculation.

Module - V ADVANCED PROCESSORS (9)

Architecture of TMS320C54X: Pipe line operation, Code Composer studio – Architecture of TMS320C6X-Architecture of Motorola DSP563XX – Comparison of the features of DSP family processors.

TOTAL HOURS: 45

3. Course Outcomes:

- *Understand the fundamentals of programmable DSPs.*
- *Study the architecture of TMS320C5X PROCESSOR in detail.*
- *Study the architecture of TMS320C6X PROCESSOR in detail.*
- *Study the architecture of ADSP PROCESSORS in detail.*
- *Study the architecture of ADVANCED PROCESSORS in detail.*

REFERENCES:

1. B.Venkataramani and M.Bhaskar, "Digital Signal Processors – Architecture, Programming and Applications" Tata McGraw – Hill Publishing Company Limited, New Delhi, 2008.
2. Avtar Singh and S. Srinivasan, "Digital Signal Processing – Implementations using DSP Microprocessors with Examples from TMS320C54xx", Cengage Learning India Private Limited,Delhi 2012
3. User guides Texas Instrumentation, Analog Devices, Motorola.
4. Rulph Chassaing, "Digital Signal Processing and Applications with the C6713 And C6416 DSK", John Wiley & Sons, inc., Publication, 2012

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Course Code	Course Name	Contact Hours			
		L	T	P	C
15PK615	VLSI FOR WIRELESS COMMUNICATION	3	0	0	3

1. Course Objectives:

- *To study the design concepts of low noise amplifiers.*
- *To study the various types of mixers designed for wireless communication.*
- *To study and design PLL and VCO.*
- *To understand the concepts of CDMA in wireless communication*

2. Course Pre-requisites: *VLSI Design, Digital Communication*

Module - I COMPONENTS AND DEVICES (9)

Integrated inductors, resistors, MOSFET and BJT AMPLIFIER DESIGN: Low Noise Amplifier Design - Wideband LNA - Design Narrowband LNA - Impedance Matching - Automatic Gain Control Amplifiers – Power Amplifiers

Module - II MIXERS (9)

Balancing Mixer - Qualitative Description of the Gilbert Mixer - Conversion Gain – Distortion – Low Frequency Case: Analysis of Gilbert Mixer – Distortion - High-Frequency Case – Noise - A Complete Active Mixer. Switching Mixer - Distortion in Unbalanced Switching Mixer – Conversion Gain in Unbalanced Switching Mixer - Noise in Unbalanced Switching Mixer - A Practical Unbalanced Switching Mixer. Sampling Mixer - Conversion Gain in Single Ended Sampling Mixer - Distortion in Single Ended Sampling Mixer - Intrinsic Noise in Single Ended Sampling Mixer - Extrinsic Noise in Single Ended Sampling Mixer.

Module - III FREQUENCY SYNTHESIZERS (9)

Phase Locked Loops - Voltage Controlled Oscillators - Phase Detector – Analog Phase Detectors– Digital Phase Detectors - Frequency Dividers - LC Oscillators - Ring Oscillators - Phase Noise- A Complete Synthesizer Design Example (DECT Application).

Module - IV SUB SYSTEMS (9)

Data converters in communications, adaptive Filters, equalizers and transceivers

Module - V IMPLEMENTATIONS (9)

VLSI architecture for Multitier Wireless System - Hardware Design Issues for a Next generation CDMA System.

TOTAL HOURS=45

3. Course Outcomes:

- *Understand the basic components and devices and their design.*
- *Study about the different types of mixers.*
- *Design phase detectors and oscillators.*
- *Design and implementation of FIR and IIR filters in subsystems.*
- *Implement CDMA in Multitier Wireless System*

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1. B.Razavi ,"RF Microelectronics" , Prentice-Hall ,1998.
2. Bosco H Leung "VLSI for Wireless Communication", Pearson Education, 2002.
3. Thomas H.Lee, "The Design of CMOS Radio –Frequency Integrated Circuits', Cambridge University Press ,2003.
4. Emad N Farag and Mohamed I Elmasry, "Mixed Signal VLSI Wireless Design -Circuits and Systems", Kluwer Academic Publishers, 2000..
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PROGRAM SOFT CORE

Course Code	Course Name	Contact Hours			
		L	T	P	C
15PK501	DIGITAL IMAGE PROCESSING AND APPLICATIONS	3	0	0	3

1. ***Course Objectives:***

- *To understand the image fundamentals and mathematical transforms necessary for image processing and to study the image enhancement techniques.*
- *To understand the image segmentation and representation techniques.*
- *To understand how image are analyzed to extract features of interest.*
- *To introduce the concepts of image registration and image fusion.*
- *To analyze the constraints in image processing when dealing with 3D data sets.*

2. ***Course Pre-requisites:***

Module -I DIGITAL IMAGE FUNDAMENTALS (9)

Elements of visual perception – Brightness – Contrast – Hue – Saturation – Mach band effect – 2D image transforms – DFT – DCT – KLT – SVD – Image enhancement in spatial and frequency domain – Review of morphological image processing.

Module -II RESTORATION AND SEGMENTATION (9)

Image restoration- degradation model , constrained restoration, Inverse filtering, Weiner filtering, Geometrical transforms. Edge detection – Thresholding – Region growing – Fuzzy clustering – Watershed algorithm – Active contour .

Module -III FEATURE EXTRACTION (9)

First and second order edge detection operators – Phase congruency – Localized feature extraction detecting image curvature – Shape features Hough transform – Shape skeletonization – Boundary descriptors – Moments – Texture descriptors .

Module -IV REGISTRATION (9)

Registration – Preprocessing – Feature selection – Points – Lines – Regions and templates Feature correspondence – Point pattern matching – Line matching – Region matching Template matching – Transformation functions – Similarity transformation and Affine Transformation – Resampling – Nearest Neighbour and Cubic Splines Image Fusion .

Module -V 3D IMAGE VISUALIZATION (9)

Sources of 3D Data sets – Slicing the Data set – Arbitrary section planes – The use of color – Volumetric display – Stereo Viewing – Ray tracing – Reflection – Surfaces – Multiply connected surfaces – Image processing in 3D.

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TOTAL HOURS=45

3. Course Outcomes:

- *Apply image processing techniques in both the spatial and frequency (Fourier) domains.*
- *Design image analysis techniques in the form of image segmentation and to evaluate the methodologies for segmentation.*
- *Analyze feature extraction techniques.*
- *Implement the concepts of image registration and image fusion.*
- *Analyze the constraints in image processing when dealing with 3D data sets and to apply image processing algorithms in practical applications.*

REFERENCES:

1. Rafael C. Gonzalez and Richard E. Woods, "*Digital Image Processing*", Pearson education, 2nd Edition,2004.
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3. John C.Russ, "The Image Processing Handbook", CRC Press, 2007.
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Course Code	Course Name	Contact Hours			
		L	T	P	C
15PK502	**MANET PROTOCOLS**	**3**	**0**	**0**	**3**

1. ***Course Objectives:***

- *To explore issues and challenges in designing MAC and TCP Protocols in the context of adhoc networks*
- *To understand adaptation of the routing protocols in mobile networks*
- *To explore issues and challenges variety of attacks and threats over different layer*
- *To evaluate the performance of MAC, routing protocols in MANETs.*

2. ***Course Pre-requisites:*** *Wireless and Mobile Communication Networks*

Module - I INTRODUCTION (9)

Introduction to Adhoc networks - definition, characteristics features, applications, Characteristics of Wireless channel. Adhoc Mobility Models: - entity and group models.

Module - II MEDIUM ACCESS PROTOCOLS (9)

MAC Protocols: design issues, goals and classification. Contention based protocols, reservation based protocols, scheduling algorithms, protocols using directional antennas.

Module - III NETWORK PROTOCOLS (9)

Routing Protocols: Design issues, goals and classification Proactive Vs reactive routing, Unicast routing algorithms, Multicast routing algorithms, hybrid routing algorithm, Power/ Energy aware routing algorithm, Hierarchical Routing, QoS aware routing.

Module - IV END -TO - END DELIVERY AND SECURITY (9)

Transport layer: Issues in designing- Transport layer classification, adhoc transport protocols. Security issues in adhoc networks: issues and challenges, network security attacks, secure routing protocols.

Module - V CROSS LAYER DESIGN AND INTEGRATION OF ADHOC FOR 4G (9)

Cross layer Design: Need for cross layer design, cross layer optimization, Cross layer cautionary perspective, Co-operative networks;- Architecture, methods of co-operation, Integration of ad hoc network with other wired and wireless networks.

TOTAL HOURS=45

3. ***Course Outcomes:***

- *Study the characteristic features and applications of adhoc networks.*
- *Understand the various MAC protocols and design issues.*

- *Learn the different types of routing protocols.*
- *Analyze and design security systems for wireless networks.*
- *Study about cross layer design and integration of adhoc for 4G*

REFERENCES:

1. C.Siva Ram Murthy and B.S.Manoj, 'Ad hoc Wireless Networks Architectures and protocols", 2nd edition, Pearson Education. 2007.
2. Charles E. Perkins, "Ad hoc Networking", Addison - Wesley, 2000.
3. Stefano Basagni, Marco Conti, Silvia Giordano and Ivan Stojmenovic, "Mobile adhoc networking", Wiley-IEEE press, 2004.
4. Mohammad llyas, "The handbook of adhoc wireless networks", CRC press, 2002.

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4. http://www.ijmer.com/papers/Vol3_Issue2/CZ3210711074.pdf
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Course Code	Course Name	Contact Hours			
		L	T	P	C
15PK503	SPACE TIME WIRELESS COMMUNICATION	3	0	0	3

1. ***Course Objectives:***

- *To acquire the knowledge on various modulation and coding schemes for space-time wireless communications.*
- *To understand transmission and decoding techniques associated with wireless communications.*
- *To understand multiple-antenna systems such as multiple-input multiple-output (MIMO) and space-time codes.*

2. ***Course Pre-requisites:*** *Wireless and Mobile Communication Networks*

Module-I MULTIPLE ANTENNA PROPAGATION AND ST CHANNEL CHARACTERIZATION (9)

Wireless channel, Scattering model in macrocells, Channel as a ST random field, Scattering functions, Polarization and field diverse channels, Antenna array topology, Degenerate channels, reciprocity and its implications, Channel definitions, Physical scattering model, Extended channel models, Channel measurements, sampled signal model, ST multiuser and ST interference channels, ST channel estimation.

Module -II CAPACITY OF MULTIPLE ANTENNA CHANNELS AND SPATIAL DIVERSITY (9)

Capacity of frequency flat deterministic MIMO channel: Channel unknown to the transmitter, Channel known to the transmitter, capacity of random MIMO channels, Influence of Ricean fading, fading correlation, XPD and degeneracy on MIMO capacity, Capacity of frequency selective MIMO channels, Diversity gain, Receive antenna diversity, Transmit antenna diversity, Diversity order and channel variability, Diversity performance in extended channels, Combined space and path diversity ,Indirect transmit diversity, Diversity of a space-time-frequency selective fading channel.

Module -III MULTIPLE ANTENNA CODING AND RECEIVERS (9)

Coding and interleaving architecture, ST coding for frequency flat channels, ST coding for frequency selective channels, Receivers(SISO,SIMO,MIMO),Iterative MIMO receivers, Exploiting channel knowledge at the transmitter: linear pre-filtering, optimal pre-filtering for maximum rate, optimal pre-filtering for error rate minimization, selection at the transmitter, Exploiting imperfect channel knowledge.

Module -IV ST OFDM, SPREAD SPECTRUM AND MIMO MULTIUSER DETECTION (9)

SISO-OFDM modulation, MIMO-OFDM modulation, Signaling and receivers for MIMO-OFDM,SISO-SS modulation, MIMO-SS modulation, Signaling and receivers for MIMO-SS.MIMO-MAC,MIMO-BC, Outage performance for MIMO-MU,MIMO-MU with OFDM,CDMA and multiple antennas

Module-V ST CO-CHANNEL INTERFERENCE MITIGATION AND PERFORMANCE LIMITS IN MIMO CHANNELS (9)

CCI characteristics, Signal models, CCI mitigation on receive for SIMO,CCI mitigating receivers for MIMO,CCI mitigation on transmit for MISO, Joint encoding and decoding, SS modulation, OFDM modulation, Interference diversity and multiple antennas, Error performance in fading channels, Signaling rate vs PER vs SNR, Spectral efficiency of ST doing/receiver techniques, System Design, Comments on capacity.

TOTAL HOURS=45

3. Course Outcomes:

- *Understand the concepts of multiple antenna propagation and ST channel characterization.*
- *Estimate the capacity of multiple antenna channels.*
- *Study the coding and interleaving architectures of multiple antennas.*
- *Design and develop OFDM based MIMO systems.*
- *Study ST co-channel interference mitigation and performance limits in MIMO channels*

REFERENCES:

1. A. Paulraj, Rohit Nabar, Dhananjay Gore., "Introduction to Space Time Wireless Communication Systems", Cambridge University Press, 2003

2. Sergio Verdu, " Multi User Detection", Cambridge University Press, 1998

3. Andre Viterbi, " Principles of Spread Spectrum Techniques", Addison Wesley 1995

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3. http://www.utdallas.edu/~aria/papers/sp03.pdf

Course Code	Course Name	Contact Hours			
		L	T	P	C
15PK504	**EMBEDDED ARCHITECTURE**	**3**	**0**	**0**	**3**

1. Course Objectives:

- *To give sufficient background for understanding embedded systems design.*
- *To introduce the concepts of embedded systems, its hardware and software.*
- *To introduce devices and buses used for embedded networking.*
- *To learn the real time Characteristics and System design techniques.*

2. Course pre-requisites: *Microprocessor and Microcontroller*

Module – I EMBEDDED ARCHITECTURE (9)

Embedded Computers, Characteristics of Embedded Computing Applications, Challenges in Embedded Computing system design, Embedded system design process- Requirements, Specification, Architectural Design, Designing Hardware and Software Components, System Integration, Formalism for System Design- Structural Description, Behavioral Description, Design Example: Model Train Controller.

Module – II EMBEDDED PROCESSOR AND COMPUTING PLATFORM (9)

ARM processor- processor and memory organization, Data operations, Flow of Control, SHARC processor- Memory organization, Data operations, Flow of Control, parallelism with instructions, CPU Bus configuration, ARM Bus, SHARC Bus, Memory devices, Input/output devices, Component interfacing, designing with microprocessor development and debugging, Design Example : Alarm Clock.

Module – III NETWORKS (9)

Distributed Embedded Architecture- Hardware and Software Architectures, Networks for embedded systems- I2C, CAN Bus, SHARC link ports, Ethernet, Myrinet, Internet, Network-Based design- Communication Analysis, system performance Analysis, Hardware platform design, Allocation and scheduling, Design Example: Elevator Controller.

Module – IV REAL-TIME CHARACTERISTICS (9)

Clock driven Approach, weighted round robin Approach, Priority driven Approach, Dynamic Versus Static systems, effective release times and deadlines, Optimality of the Earliest deadline first (EDF) algorithm, challenges in validating timing constraints in priority driven systems, Off-line Versus On-line scheduling.

Module – V SYSTEM DESIGN TECHNIQUES (9)

Design Methodologies, Requirement Analysis, Specification, System Analysis and Architecture Design, Quality Assurance, Design Example: Telephone PBX- System Architecture, Ink jet printer- Hardware Design and Software Design, Personal Digital Assistants, Set-top Boxes.

TOTAL HOURS=45

3. Course Outcomes:

- *Understand the architecture and design involved in design of embedded systems*
- *Program ARM processor*
- *Understand the embedded system network architecture*
- *Analyze the problems in real time implementation of embedded systems and its solutions*
- *Understand the concepts of system design technologies*

REFERENCES:

1. Wayne Wolf, "Computers as Components: Principles of Embedded Computing System Design", Morgan Kaufman Publishers, 2008.
2. Jane.W.S. Liu," Real-Time Systems", Pearson Education Asia, 2000.
3. C. M. Krishna and K. G. Shin, "Real-Time Systems", McGraw-Hill, 1997.
4. Frank Vahid and Tony Givargi," Embedded System Design: An unified Hardware/Software Introduction", John Wiley & Sons, 2000.

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Course Code	Course Name	Contact Hours			
		L	T	P	C
15PK505	NEURAL NETWORKS AND ITS APPLICATIONS	3	0	0	3

1. Course Objectives:

- *To introduce the techniques of adaptive neuro-fuzzy inferencing systems which differ from conventional AI and computing in terms of its tolerance to imprecision and uncertainty.*
- *To become familiar with neural networks that can learn from available examples and generalize to form appropriate rules for inferencing systems*

2. Course Pre-requisites:

Module – I INTRODUCTION TO ARTIFICIAL NEURAL NETWORKS (9)

Neuro-physiology - General Processing Element - ADALINE - LMS learning rule - MADALINE - MR2 training algorithm.

Module - II BPN AND BAM (9)

Back Propagation Network - updating of output and hidden layer weights -application of BPN – associative memory - Bi-directional Associative Memory - Hopfield memory - traveling sales man problem.

Module - III SIMULATED ANNEALING AND CPN (9)

Annealing, Boltzmann machine - learning - application - Counter Propagation network - architecture -training - Applications.

Module - IV SOM AND ART (9)

Self organizing map - learning algorithm - feature map classifier - applications - architecture of Adaptive Resonance Theory - pattern matching in ART network.

Module - V NEOCOGNITRON (9)

Architecture of Neocognitron - Data processing and performance of architecture of spacio - temporal networks for speech recognition.

TOTAL HOURS: 45

3. Course Outcomes:

- *Acquire knowledge about the basics of neural network concepts.*
- *Study about BPN and BAM.*

- *Familiarize on the learning concepts of neural networks.*
- *Learn SOM and ART architectures.*
- *Study the architecture of neocognitron..*

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1. J.A. Freeman and B.M.Skapura , "Neural Networks, Algorithms Applications and Programming Techniques", Addison-Wesely,2003.
2. Laurene Fausett, "Fundamentals of Neural Networks: Architecture, Algorithms and Applications", Prentice Hall, 1994

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