



PSN COLLEGE OF ENGINEERING AND TECHNOLOGY (AUTONOMOUS)

Melathediyoor, Tirunelveli

(Approved by AICTE and Recognized by UGC Section 2 (f) and 12 (B))

An ISO 9001:2015 Certified Institution

(Accredited by NAAC, Affiliated to Anna University Chennai)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

M.E (COMMUNICATION SYSTEMS)

REGULATION-2018

CURRICULAM FOR I,II,III& IV SEMESTER (FULL TIME)

SEMESTER I

S.NO	SUB CODE	SUBJECT NAME	L	T	P	C
THEORY						
1	523001	Applied Mathematics for Communication Engineers	3	1	0	4
2	520002	Advanced Signal Processing	3	1	0	4
3	523002	Satellite Communication	3	0	0	3
4	523003	Advanced Digital Communication Techniques	3	0	0	3
5	523004	Optical Communication Systems	3	0	0	3
6		Professional Elective I	3	0	0	3
PRACTICAL						
7	523101	Communication Systems Laboratory – I	0	0	4	2
TOTAL			18	2	4	22

SEMESTER II

S.NO	SUB CODE	SUBJECT NAME	L	T	P	C
THEORY						
1	523006	Wireless Communications and Networks	3	0	0	3
2	523007	Multimedia Compression Techniques	3	0	0	3
3	523008	MIC and RF System Design	3	0	0	3
4	523009	Electromagnetic Interference and Compatibility in System Design	3	0	0	3
5	523010	Broadband Wireless Technologies	3	0	0	3
6		Professional Elective II	3	0	0	3
PRACTICAL						
7	523102	Communication Systems Laboratory – II	0	0	4	2
8	520501	Technical Seminar	0	0	2	1
TOTAL			18	0	6	21

LIST OF ELECTIVES
ELECTIVE-I

S.NO	SUB CODE	SUBJECT NAME	L	T	P	C
1.	523201	Speech and Audio Signal Processing	3	0	0	3
2.	523203	VLSI for Wireless Communication	3	0	0	3
3.	523204	Radar Signal Processing	3	0	0	3
4.	523205	Sensor and Signals Conditioning	3	0	0	3
5.	523206	Signal Processing Techniques for Biological Systems	3	0	0	3
6.	523207	System on a chip	3	0	0	3

ELECTIVE-II

S.NO	SUB CODE	SUBJECT NAME	L	T	P	C
1.	523202	Wireless Sensor Networks	3	0	0	3
2.	523208	Wireless Security	3	0	0	3
3.	523209	Mobile Adhoc Networks	3	0	0	3
4.	523210	Wireless ADHOC and Sensor Networks	3	0	0	3
5.	523211	Advanced wireless networks	3	0	0	3
6.	523212	Cognitive Radio Networks	3	0	0	3

SEMESTER III

S.NO	SUB CODE	SUBJECT NAME	L	T	P	C
THEORY						
1		Professional Elective III	3	0	0	3
2		Professional Elective IV	3	0	0	3
3		Professional Elective V	3	0	0	3
PRACTICAL						
4	523301	Project Work (Phase – I)	0	0	12	6
TOTAL			9	0	12	15

SEMESTER IV

S.NO	SUB CODE	SUBJECT NAME	L	T	P	C
PRACTICAL						
1	523302	Project Work (Phase – II)	0	0	24	12
TOTAL			0	0	24	12

Total No. of credits to be earned for the award of Degree 22+21+15+12=70

ELECTIVE-III

S.NO	SUB CODE	SUBJECT NAME	L	T	P	C
1.	523214	Communication Network Security	3	0	0	3
2.	523215	Microwave Remote Sensing	3	0	0	3
3.	523216	Pattern Recognition & Artificial Intelligence	3	0	0	3
4.	523217	<i>Software Defined Radio</i>	3	0	0	3
5.	523218	Satellite remote sensing and data analysis	3	0	0	3
6.	523219	High Performance Communication Networks	3	0	0	3

ELECTIVE-IV

S.NO	SUB CODE	SUBJECT NAME	L	T	P	C
1.	523220	Ultra Wide Band Communication	3	0	0	3
2.	523221	Millimetre Wave Communication	3	0	0	3
3.	523222	Advanced Satellite Communication and Navigation Systems	3	0	0	3
4.	523223	Photonics	3	0	0	3
5.	523224	RF IC Design	3	0	0	3
6.	523225	RF System Design for Wireless Communication	3	0	0	3

ELECTIVE-V

S.NO	SUB CODE	SUBJECT NAME	L	T	P	C
1.	523226	Advanced Digital Image Processing	3	0	0	3
2.	523227	Research Methodologies	3	0	0	3
3.	523228	Application of MEMS Technology	3	0	0	3
4.	523229	Detection & Estimation Theory	3	0	0	3
5.	523230	Internet of Things	3	0	0	3
6.	523231	Medical Image Processing	3	0	0	3

523001	APPLIED MATHEMATICS FOR COMMUNICATION ENGINEERS	L T P C 3 1 0 4
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AIM:

To provide the basic mathematical knowledge to enhance the exposure of technical knowhow essential for communication engineers

LEARNING OUTCOMES:

Having successfully completed this course, the students should be able to:

- Students can know about the uses of the fundamental concepts of Bessel functions, random variables and Queuing models in day to day life.

UNIT I SPECIAL FUNCTIONS 12

Bessel's equations –Bessel functions – Recurrence relations –Generating functions and orthogonal property for Bessel functions of first kind – Fourier Bessel expansion.

UNIT II MATRIX THEORY 12

Some important matrix factorizations – The Cholesky decomposition – QR factorization– Least squares method – Singular value decomposition - Toeplitz matrices and some applications.

UNIT III ONE DIMENSIONAL RANDOM VARIABLES 12

Random variables - Probability function – moments – moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Function of a Random Variable

UNIT IV TWO DIMENSIONAL RANDOM VARIABLES 12

Joint distributions – Marginal and Conditional distributions – Functions of two dimensional random variables – Regression Curve – Correlation.

UNIT V QUEUEING MODELS 12

Poisson Process – Markovian queues – Chapman Kolmogrov equation – Single and Multi-server Models – Little's formula- Machine Interference Model – Steady State analysis – Self Service queue, Assignment using appropriate software system.

L=60 TOTAL: 60 PERIODS

REFERENCES:

- 1.Richard Johnson, Miller & Freund, Probability and Statistics for Engineers, 7th Edition, Prentice – Hall of India, Private Ltd., New Delhi , 2007.
- 2.Taha, H.A., Operations Research, An introduction, 7th edition, Pearson education editions, Asia, New Delhi, 2002

TEXT BOOK :

1. Elsgolts L, “Differential Equation and Calculus of variation”, MIR Publishers, 2005.(For unit 1)
2. Bronson.R. Matrix Operations, “Schaum’s outline series”, Mc Graw Hill, New York,New Edition. (For unit 2)
- 3.Trivedi K.S, “Probability and Statistics with Reliability, Queuing and Computer Science Applications, Prentice Hall, 2003. (For units 3,4,5)

520002	ADVANCED SIGNAL PROCESSING	L	T	P	C
COURSE OBJECTIVE:		3	1	0	4

To familiarize the student with compute designing digital filters and able to understand the multi rate signal processing.

COURSE OUTCOMES:

Having successfully completed this course, the students should be able to:

- Learn fundamental concepts on signal processing in power spectrum estimation.
- Study the adaptive filters and its applications.
- Explore the concepts of multi rate signal processing and multi rate filters.

UNIT I DISCRETE RANDOM SIGNAL PROCESSING 9

Discrete Random Processes, Ensemble Averages, Stationary processes, Bias and Estimation, Auto covariance, Autocorrelation, Parseval's theorem, Wiener-Khintchine relation, White noise, Power Spectral Density, Spectral factorization, Filtering Random Processes, Special types of Random Processes, ARMA, AR, MA, Yule-Walker equations.

Unit- II SPECTRAL ESTIMATION 9

Estimation of spectra from finite duration signals, Nonparametric methods, Periodogram, Modified periodogram, Bartlett, Welch and Blackman-Tukey methods, Parametric methods, ARMA, AR and MA model based spectral estimation.

Unit- III LINEAR ESTIMATION AND PREDICTION 9

Linear prediction, Forward and Backward prediction, Solution of Prony's normal equations, Least mean-squared error criterion, Wiener filter for filtering and prediction, FIR and IIR Wiener filters.

UNIT IV ADAPTIVE FILTERS 9

FIR adaptive filters, adaptive filter based on steepest descent method- Widrow-Hoff LMS algorithm, Normalized LMS algorithm, Adaptive channel equalization, Adaptive echo cancellation, Adaptive noise cancellation, RLS adaptive algorithm.

UNIT 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, Polyphase filter structures, Multistage implementation of multirate system, Application to subband coding, Wavelet transform, Assignment using MATLAB Tools.

L=45 T= 45 TOTAL: 60 PERIODS

REFERENCES:

1. Monson H. Hayes, "Statistical Digital Signal Processing and Modeling", John Wiley and Sons, Inc, Singapore, 2009.
2. Saeed V. Vaseghi, "Advanced Digital Signal Processing and Noise Reduction", 4th Edition, Wiley, 2009.
3. John G. Proakis and Dimitris K Manolakis "Digital Signal Processing", Pearson Education, 4th Edition, 2009.
4. Richard G. Lyons "Understanding Digital Signal Processing", PHI, 3rd Edition, 2010.

5. Alan V. Oppenheim and Ronald W. Schaffer “Discrete-Time Signal Processing”, 3rd Edition PHI.

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COURSE OUTCOMES	PROGRAMS OUTCOMES	PROGRAMS OUTCOMES														PROGRAM SPECIFIC OUTCOMES	
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2		
CO-1	Learn fundamental concepts on signal processing in power spectrum estimation	3	3	3	3	3								2	2	2	
CO-2	To learn the various method for spectral estimation	3	3	3	3	3								2	2	2	
CO-3	Able to understand the filter concept and linear estimation	3	3	3	3	3								2	2	2	
CO-4	To Study the adaptive filters and its applications	3	3	2	2	2								2	2		
CO-5	Explore the concepts of multi rate signal processing and multi rate filters	3	3	2	3	3								2	2	2	

523002

SATELLITE COMMUNICATION

L T P C
3 0 0 3

COURSE OBJECTIVE:

The purpose of this course is to develop a strong foundation in the field of Satellite communication. The subject gives the students an opportunity to know the communication principles involved in the satellite communications.

COURSE OUTCOMES:

Having successfully completed this course, the students should be able to:

- Identify the fundamentals of orbital mechanics and the characteristics of common orbits used by communications and other satellites
- Develop launching methods and technologies, Overview of Spacecraft subsystem
- evaluate accurate link budget for a satellite or other wireless communications link & Calculate the reliability of the satellite
- To understand about the FDMA/TDMA/CDMA
- To understand about the satellite services

UNIT I ORBITAL MECHANICS 9

Kepler laws – Orbital elements – Orbital perturbations – Apogee perigee heights – Inclines orbits – Sun synchronous orbits – Geo stationary orbits – Limits of visibility – Sun transit outage – polar Mount antenna – Antenna Look angles – launching orbits – Low earth orbits – medium orbits – constellation.

UNIT II SPACECRAFT SUB SYSTEMS AND EARTH STATION 9

Space segment – space subsystems payload – Bus – power supply – attitude control – station keeping – thermal control – TT & C Subsystem – Transponders – Antenna subsystem – Earth segment – cassegrain antenna – Noise temperature – Low Noise Amplifiers – Earth station subsystems.

UNIT III SPACE LINKS 9

EIRP – transmission losses – power budget equation – system Noise carrier to Noise ration – Uplink and downlink equations – Input and Output back Off - TWTA – Inter modulation Noise – C/No – G/T measurement.

UNIT IV MULTIPLEXING AND MULTIPLE ACCESS TECHNIQUES 9

Frequency Division multiplexing FDM/FM/FDMA – Single channel per carrier – MCPC – Combanded FDM/FM/FDMA – Time division multiplexing – T1 carrier – Time Division multiple Access – Frame Burst structure, Frame efficiency, frame Acquisition and synchronization – SS TDMA – SPADE – Spread spectrum – direct sequence – CDMA.

UNIT V SERVICES AND APPLICATIONS 9

INTELSAT – INSAT Series – VSAT – Weather forecasting – Remote sensing – LANDSAT – Satellite Navigation – Mobile satellite Service – Direct to Home.

L=45 TOTAL: 45 PERIODS

REFERENCES:

1. Dennis Roddy, "Satellite Communications", Third Edition, McGraw Hill International Editions, 2001.
2. Bruce R.Elbert, "The Satellite Communication Applications Hand Book", ArtechHouse Boston, 1997.
3. Wilbur L.Pritchard, HendriG.Snyderhood, Robert A.Nelson,"Satellite Communication Systems Engineering", II Edition, Prentice Hall, New Jersey, 1993.
4. Tri T.Ha, "Digital satellite communication", 2nd Edition, McGraw Hill, New York.

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COURSE OUTCOMES	Statement's	PROGRAMS OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	
CO-1	Identify the fundamentals of orbital mechanics and the characteristics of common orbits used by communications and other satellites	3	3	2	2									2		2
CO-2	Develop launching methods and technologies, Overview of Spacecraft subsystem	3	3	3	3	1			2					2	3	2
CO-3	valuate accurate link budget for a satellite or other wireless communications link& Calculate the reliability of the satellite	3	3	3	2									2	2	
CO-4	To understand about the FDMA/TDMA/CDMA	3	3	3	3	3	2		2				2	2	2	2
CO-5	To understand about the satellite services	3	2	2	2	2							2			2

**523003 ADVANCED DIGITAL COMMUNICATION
TECHNIQUES**

L T P C
3 0 0 3

COURSE OBJECTIVE:

2. John G. Proakis and MasoudSalehi, "Digital Communications", 5th edition, Mc Graw-Hill International Editions, 2008.
3. R. G. Gallager, "Principles of Digital Communication", Cambridge University Press, 2008.
4. A. Lapidoth, "A Foundation in Digital Communication", Cambridge, 2009.
5. Stephen G. Wilson., "Digital Modulation and Coding", First Indian Reprint Pearson Education, 2003
6. Richard Van Nee & Ramjee Prasad., "OFDM for Multimedia Communications" Artech House Publications, 2001.

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COURSE OUTCOMES	Statement's	PROGRAMS OUTCOMES												PROGRAM SPECIFIC OUTCOMES	
		P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12	PSO 1	PSO 2
CO-1	Understand the basics of signal-space analysis and digital transmission	3	3	3	2	2							2	2	2
CO-2	To know the coherent and noncoherent receivers and its impact on different channel characteristics	3	3	2	3	2							2	2	2
CO-3	Realize Orthogonal Frequency Division Multiplexing	3	3	3	2	2							2	2	
CO-4	To understand the convolutional coded digital communication module	3	3	3	2	2	2						2		2

CO-5	Be aware of the different block coded and convolutional coded digital communication systems	3	2	2	2	3	2	1					2			2
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523004

OPTICAL COMMUNICATION SYSTEMS

L T P C
3 0 0 3

COURSE OBJECTIVE:

To learn the basic knowledge of optical system components and its networks and provide concepts to design network and its management.

COURSE OUTCOMES:

Having successfully completed this course, the students should be able to:

- Elaborate about the basic elements of optical fiber transmission link, Fiber modes Configurations and structures
- Examine the Optical networks and the various kind of architectures
- Design of network and its management.
- Analyze the basic OTDM concepts in optical networks
- To design the overall network elements and management function

UNIT I OPTICAL SYSTEM COMPONENTS 9

Light propagation in optical fibers, Loss & bandwidth, System limitations, Non-Linear effects, Solitons, Optical Network Components, Couplers, Isolators & Circulators, Multiplexers & Filters, Optical Amplifiers, Switches, Wavelength Converters.

UNIT II OPTICAL NETWORK ARCHITECTURES 9

Introduction to Optical Networks; SONET / SDH, Metropolitan Area Networks, Layered Architecture ; Broadcast and Select Networks , Topologies for Broadcast Networks, Media-Access Control Protocols, Test beds for Broadcast & Select WDM; Wavelength Routing Architecture.

UNIT III WAVELENGTH ROUTING NETWORKS 9

The optical layer, Node Designs, Optical layer cost tradeoff, Routing and wavelength assignment, Virtual topology design, Wavelength Routing Test beds, Architectural variations.

UNIT IV PACKET SWITCHING AND ACCESS NETWORKS 9

Photonic Packet Switching, OTDM, Multiplexing and Demultiplexing, Synchronization, Broadcast OTDM networks, Switch-based networks; Access Networks, Network Architecture overview, Future Access Networks, Optical Access Network Architectures; and OTDM networks. Assignment using optical Simulation Software.

UNIT V NETWORK DESIGN AND MANAGEMENT 9

Transmission System Engineering , System model, Power penalty, transmitter, receiver, Optical amplifiers, crosstalk, dispersion, Wavelength stabilization, Overall design considerations, Control and Management, Network management functions, Configuration management, Performance management, Fault management, Optical safety, Service interface.

L=45 TOTAL: 45 PERIODS

REFERENCES:

1. John M. Senior, “Optical Fiber Communications: Principles and Practice”, Prentice Hall, 4thEdition 2009

2. Rajiv Ramaswami, Kumar Sivarajan and Galen Sasaki “Optical Networks: A Practical Perspective”, Morgan Kaufmann, 3rdEdition, 2009.
3. William Shieh and Ivan Djordjevic, “OFDM for Optical Communications”, Academic Press,2009
4. Gerd Keiser, “Optical Fiber Communications”, McGraw Hill, 4th Edition, 2010
5. Leonid G. Kazovsky, Ning Cheng, Wei-Tao Shaw and David Gutierrez, “Broadband Optical Access Networks”, Wiley Interscience, 2011
6. C. Siva Ram Moorthy and Mohan Gurusamy, “WDM Optical Networks: Concept, Design and Algorithms”, Prentice Hall of India, 1stEdition, 2002.

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COURSE OUTCOMES	PROGRAMS OUTCOMES	PROGRAM SPECIFIC OUTCOMES	
		PSO 1	PSO 2
CO-1	Elaborate about the basic elements of optical fiber transmission link, Fiber modes Configurations and structures	3	2
CO-2	Examine the Optical networks and the various kind of architectures	3	2
CO-3	Design of network and its management	3	2

COURSE OUTCOMES:

Having successfully completed this course, the students should be able to:

- To acquire knowledge on Transmission line and S- parameter estimation of microwave devices.
- To introduce the basics of Microstrip Patch Antenna and its analysis .
- To study & measure the performance of digital communication systems.
- To provide a comprehensive knowledge of Wireless Communication.
- To learn about the design of digital filter and its adaptive filtering algorithms.

LIST OF EXPERIMENTS

1. Channel equalizer design using MATLAB (LMS, RLS)
2. Transform based compression techniques.
3. Antenna Radiation Pattern measurement.
4. Performance Evaluation of digital modulation schemes
5. Implementation of Linear and Cyclic Codes
6. OFDM transceiver design using MATLAB
7. Performance evaluation of Digital Data Transmission through Fiber Optic Link
8. Fiber optic characterization using OTDR

TOTAL: 45 PERIODS

List of Requirements:

S.NO.	DESCRIPTION OF EQUIPMENT	QUANTITY REQUIRED
1.	MATLAB	10 User License
2.	MICROWAVE OSCILLATOR	1
3.	MICROWAVE SET UP	1
4.	FIBER OPTIC ANALOG / DIGITAL KIT	1

COURSE OUTCOMES	PROGRAMS OUTCOMES	PROGRAM SPECIFIC OUTCOMES

CO's	Statement's	P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12	PSO 1	PSO 2
CO-1	To acquire knowledge on Transmission line and S- parameter estimation of microwave devices	3	3	3	2	2				3	1	2	2		2
CO-2	To introduce the basics of Microstrip Patch Antenna and its analysis	3	3	2	2	2	1			3	1	2	2	2	
CO-3	To study & measure the performance of digital communication systems	3	3	2	2	2				3	1	1	2	2	2
CO-4	To provide a comprehensive knowledge of Wireless Communication	3	2	2	2	2					3	2		2	2
CO-5	To learn about the design of digital filter and its adaptive filtering algorithms	3	3	2	2					1	2	2			2

SEMESTER: II

523006

WIRELESS COMMUNICATIONS AND NETWORKS

L	T	P	C
3	0	0	3

COURSE OBJECTIVE:

To provide the basic knowledge about wireless networks and protocols used in transport and application layer.

COURSE OUTCOMES:

Having successfully completed this course, the students should be able to:

- Build the idea about modern wireless network.
- Elaborate the cellular concepts such as frequency reuse, handoff, interference and problems in frequency reuse.
- Analyze the Large scale path loss in Propagation mechanisms and idea about Wireless Standards
- To understand the concept of Routing protocol
- Justify how the WAP architecture work for the WWW

UNIT I INTRODUCTION 9

Wireless Transmission – signal propagation – spread spectrum – Satellite Networks – Evolution of mobile communications -Capacity Allocation – FAMA – DAMA – MAC

UNIT II MOBILE NETWORKS 9

Cellular Wireless Networks – GSM – Architecture – Protocols – Connection Establishment – Frequency Allocation – Routing – Handover – Security – GPRS

UNIT III WIRELESS NETWORKS 9

Introduction to wireless LANs - IEEE 802.11 WLANs - Physical Layer- MAC sublayer- MAC Management Sublayer- Wireless ATM - HIPERLAN- HIPERLAN-2

UNIT IV ROUTING 9

Self organized network layer security in MANETs - mechanism to improve authentication and integrity in AODV using hash chain and digital signatures - on demand secure routing protocol resilient to Byzantine failures - ARIADNE, SEAD, SAR, and ARAN.

UNIT V TRANSPORT AND APPLICATION LAYERS 9

TCP over Adhoc Networks – WAP – Architecture – WWW Programming Model – WDP – WTLS – WTP – WSP – WAE – WTA Architecture – WML – WML scripts, Assignment using appropriate software system/s.

L=45 TOTAL: 45 PERIODS

REFERENCES:

1. Rappaport.T.S, “Wireless Communications: Principles & Practice”, 2nd Edition, PHI, 2002.
2. Kaveh Pahlavan, Prasanth Krishnamoorthy, “Principles of Wireless NetworksPHI/Pearson Education, 2003.
3. Vijay Garg, Morgan Kaufmann,”Wireless Communication and Networking”,2010.
4. Subir Kumar Sarkar, T.G.Basavaraju,”Adhoc Mobile Wireless Networks:Principles Protocols, Applications”,2nd edition,2013.
5. Charles E. Perkins, “ Adhoc Networking”, Addison-Wesley, 2001.
6. Jochen Schiller, “Mobile communications”, PHI/Pearson Education, 2nd Edition, 2003.

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COURSE OUTCOMES	Statement's	PROGRAMS OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	
CO-1	Build the idea about modern wireless network	3	2	3	2	2	1								2	
CO-2	Elaborate the cellular concepts such as frequency reuse, handoff, interference and problems in frequency reuse	3	2	3	2	3	2						2	2		2
CO-3	Analyze the Large scale path loss in Propagation mechanisms and idea about Wireless Standards	3	2	3	2	2	2							2		2
CO-4	To understand the concept of Routing protocol	3	3	3	2	2								2	2	
CO-5	Justify how the WAP architecture work for the WWW	3	2	2	2	2		1						2	2	2

523007

MULTIMEDIA COMPRESSION TECHNIQUES

L T P C

3 0 0 3

COURSE OBJECTIVE:

To introduce the concepts for realizing compression in text, audio, image and video.

COURSE OUTCOMES:

Having successfully completed this course, the students should be able to:

- To provide in-depth knowledge about
- Data Compression.
- Text Compression and Audio Compression
- Image and Video Compression

UNIT I INTRODUCTION 9

Special features of Multimedia – Graphics and Image Data Representations – Fundamental Concepts in Text, Images, Graphics, Video and Digital Audio – Storage requirements for multimedia applications -Need for Compression – Lossy & Lossless compression techniques – Overview of source coding, Information theory & source models- Kraft McMillan Inequality – scalar quantization-Uniform and non-uniform quantization -vector quantization –LZ algorithm – Evaluation techniques

UNIT II TEXT COMPRESSION 9

Compression techniques – Huffman coding – Adaptive Huffman Coding – Arithmetic coding – Shannon-Fano coding – Dictionary techniques –LZ77,LZ78, LZW family algorithms.

UNIT III AUDIO COMPRESSION 9

Audio compression techniques - μ - Law and A- Law companding. Frequency domain and filtering – Basic sub-band coding – ADPCM-LPC-CELP -Application to speech coding – G.722 – Application to audio coding– MPEG audio, progressive encoding for audio – Silence compression, speech compression techniques, Assignment using relevant software systems.

UNIT IV IMAGE COMPRESSION 9

Predictive techniques – DM, PCM, and DPCM: Optimal Predictors and Optimal Quantization – Contour based compression – Transform Coding – JPEG Standard – Sub-band coding algorithms: Design of Filter banks – Wavelet based compression: Implementation using filters – EZW, SPIHT coders – JPEG 2000 standards - JBIG, JBIG2 standards- Runlength coding, Assignment using relevant software systems.

UNIT V VIDEO COMPRESSION 9

Video compression techniques and standards – MPEG Video Coding I: MPEG – 1 and 2 – MPEG Video Coding II: MPEG – 4 and 7 – Motion estimation and compensation techniques – H.261 Standard – DVI technology – DVI real time compression – Packet Video, Video Compression Algorithm Based on Frame Difference Approaches.

L=45 TOTAL: 45 PERIODS

REFERENCES:

1. Khalid Sayood: Introduction to Data Compression, Morgan Kaufman Harcourt India, 3rd Edition, 2012.(Unit-I,II,III)
2. YunQ.Shi, Huifang Sun : “Image and Video Compression for Multimedia Engineering –Fundamentals, Algorithms & Standards, CRC press, 2003.(Unit-,IV,V)
3. David Salomon: Data Compression – The Complete Reference, Springer Verlag New York Inc., 2nd Edition, 2001.
4. Peter Symes : “ Digital Video Compression”, McGraw Hill Pub., 2004.
5. Mark Nelson : “Data compression”, BPB Publishers, New Delhi,1998.
6. Mark S.Drew, Ze-NianLi : “Fundamentals of Multimedia”, PHI, 1st Edition, 2003.

7. Watkinson,J : “Compression in Video and Audio”, Focal press,London.1995.

CO-PO MAPPING

COURSE OUTCOMES	PROGRAMS OUTCOMES	PROGRAMS OUTCOMES														PROGRAM SPECIFIC OUTCOMES	
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2		
CO-1	To Complete Understanding Of Error-Control Coding	3					3		3		2		2	2			
CO-2	To Understand Encoding and Decoding Of Digital Data Streams	3	2	2		2	2		2					3			
CO-3	To Introduce Methods for The Generation Of These Codes And Their Decoding Techniques	3	2	2									2	2			
CO-4	To understand the Detailed Knowledge Of Compression And Decompression Techniques	3	2	2							2		2	2			
CO-5	To Introduce the Concepts Of Multimedia Communication	2	2				1			2		2		2			

523008

MIC AND RF SYSTEM DESIGN

L	T	P	C
3	0	0	3

COURSE OBJECTIVE:

The aim of this course is to familiarize the student with the monolithic integrated circuit and RF systems.

COURSE OUTCOMES:

Having successfully completed this course, the students should be able to:

- Extend knowledge about RF radio system design.
- Elaborate the basic concept of matching networks
- To understand the various concept about the power amplifiers
- Understand the various components that constitute an RF radio system for wireless Communications.
- Basic analysis techniques needed for evaluating the performance of an RF radio system for Wireless applications.

UNIT I CMOS PHYSICS, TRANSCIEVER ECIFICATION ARCHITECTURES 9

CMOS: Introduction to MOSFET Physics – Noise: Thermal, shot, flicker, popcorn noise
transceiver Specifications: Two port Noise theory, Noise Figure, THD, IP2, IP3, Sensitivity, SFDR,
Phase noise - Specification distribution over a communication link Transceiver Architectures:
Receiver: Homodyne, Heterodyne, Image reject, Low IF Architectures – Transmitter: Direct up
conversion, Two step up conversion

UNIT 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.

UNIT 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 –Linearization Techniques – Efficiency boosting
techniques – ACPR metric – Design considerations

UNIT IV RF FILTER DESIGN, OSILLATOR, MIXER 9

Overview-basic resonator and filter configuration-special filter realizations-filter implementation.
Basic oscillator model-high frequency oscillator configuration-basic characteristics of mixers-phase
locked loops-RF directional couplers hybrid couplers-detector and demodulator circuits.

UNIT V 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.

REFERENCES:

1. T. Lee, "Design of CMOS RF Integrated Circuits", Cambridge, 2004.
2. B.Razavi, "RF Microelectronics", Pearson Education, 2011.
3. JanCrols, MichielSteyaert, "CMOS Wireless Transceiver Design", Kluwer Academic Publications, 1997.
4. B. Razavi, Design of analog CMOS Integrated Circuits", McGraw Hill,2001.
5. I.D. Robertson &S. Lucyszyn, "RFIC and MMIC Design and Technology", IEE Circuits, Devices and Systems series 13, London, UK, 2001.

CO-PO MAPPING

COURSE OUTCOMES	Statement's	PROGRAMS OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
CO-1	Extend knowledge about RF radio system design	3	2	3	3									3	2	2
CO-2	Elaborate the basic concept of matching networks	3	2	2	2	3								2	2	
CO-3	To understand the various concept about the power amplifiers	3	3	2	2									2	2	2
CO-4	Understand the various components that constitute an RF radio system for wireless Communications	3	3	2										2	2	2
CO-5	Basic analysis techniques needed for evaluating the performance of an RF radio system for Wireless applications	3	2	2	2									2	2	2

523009	ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY IN SYSTEMDESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

The aim of this course is to familiarize the student with the EMI/EMC concepts , principles, techniques and measurement standards.

COURSE OUTCOMES:

Having successfully completed this course, the students should be able to:

- understand the basics of EMI
- study EMI Sources
- Analysis EMI problems in EMI control Techniques
- understand Solution methods in PCB
- be aware of Measurement technique for emission and immunity

UNIT I EMI/EMC CONCEPTS 9

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

UNIT 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, EMI as combination of radiation and conduction.

UNIT III EMI CONTROL TECHNIQUES 9

Shielding- Shielding Material-Shielding integrity at discontinuities, 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.

UNIT 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.

UNIT V EMI/EMC STANDARDS AND MEASUREMENTS 9

Civilian standards - FCC, CISPR, IEC, EN, Military standards - MIL STD 461D/462, Frequency assignment - spectrum conversation, British VDE standards, EMI Shielded Chamber, Open area test sides: OATS measurements, measurement precautions, TEM cell; EMI test shielded chamber and shielded ferrite lined anechoic chamber; Tx /Rx Antennas, Sensors, Injectors / Couplers, and coupling factors.

L=45 TOTAL: 45 PERIODS

REFERENCES:

1. Henry W.Ott, "Noise Reduction Techniques in Electronic Systems", John Wiley and Sons New York. 2011 (Unit - I, II, III)
2. Paul.C.R , "Introduction to Electromagnetic Compatibility" , John Wiley and Sons, Inc, 2006 (Unit - IV, V)
3. Kodali. V.P, "Engineering EMC Principles, Measurements and Technologies", Wiley- IEEE Press, 2001.
4. Bernhard Keiser, "Principles of Electromagnetic Compatibility", Artech house, 3rd Ed, 1987.

5. Don R.J.White Consultant Incorporate, “Handbook of EMI/EMC” ,Vol I-V, 1988

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COURSE OUTCOMES	Statement's	PROGRAMS OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	
CO-1	To Understand the basics of EMI	3	2		2		1							2	2	2
CO-2	To analysis the EMI Sources	3	2	2		2	1							2	2	2
CO-3	To Recognize EMI problems	3	2	2		1								2	2	2
CO-4	To Understand Solution methods in PCB	3	2	2		2								3	2	
CO-5	Be aware of Measurement technique for emission and immunity	2	3	3		2						2		2		2

523010

BROAD BAND WIRELESS TECHNOLOGIES

L T P C
3 0 0 3

COURSE OBJECTIVE:

To learn the current technology trends and system standards as well as emerging technologies for next generation broadband access networks.

COURSE OUTCOMES:

Having successfully completed this course, the students should be able to:

- To understand about the wired access technologies include: ADSL, Gigabit Ethernet, and optical access networks (PONs) which include APON, BPON, GPON, GE-PON, and WDM-PON.
- To understand about fundamental device technology, operation system requirements, physical layer interface, link protocols and network architectures.
- Compare recent international standards efforts on Optical PON architecture and performance and requirement of Fiber-Optic Services (FiOS) .

UNIT I INTRODUCTION TO BROADBAND ACCESS TECHNOLOGIES

9

History, Overview, Applications requirements ,Introductory comparisons of access technologies: Legacy systems, Limitations of Twisted Pair wires, XDSL systems, HFC systems, Wireless Access, Fiber Access/FTTP/FTTH, Gigabit, 10 Gigabit Ethernet, and 100Gbit Ethernet, Economic considerations ,Layered view of the system

UNIT II FUNDAMENTALS OF BROADBAND DISTRIBUTION SYSTEMS

9

Coaxial Cable- Types, Impedance, Attenuation, Return Loss, and Shielding, Amplifiers, Passive Coaxial Components, Power Supplies, System Design: CNR, BER vs. System Design ,Distortion, Signal level stability and management.

Linear Fiber Optic Signal Transport-Optical basics ,Multimode and Single Mode Fibers ,Network Passive Components ,Linear Optical Transmitters, Optical Amps and Receivers, Subcarrier, Multiplexing Techniques ,Interactions and End to End Link Performance.

UNIT III BROADBAND WIRELESS SYSTEMS

9

DMA- Principle, Network design, Link capacity, Power control, WCDMA-Network planning, MC-CDMA, OFDM, Cellular mobile communication beyond 3G,Ultra Wideband communications, 4G and beyond 4G, Direct broadcast satellite, MMDS, LMDS,WIDIS.

UNIT IV DIGITAL CABLE TELEVISION SYSTEMS

9

Cable TV frequency plans (HRC, IRC, and STD),Digitization of Video, Digital Compression, Packetized multi program Data stream ,Modulation ,Error Correction ,Signal Quality ,Legacy(analog) Cable TV: Head end Signal Reception and processing ,Program Denial Technologies, Open Cable and other Digital Video Standards ,Cable Digital Data Transport :Modulation Methods, Spectrum Sharing and Capacity Issues ,Advanced PHY Specification: FA-TDMA/S-CDMA combination ,Receiver Design Examples ,Performance Evaluation.

UNIT V ALTERNATE BROADBAND ACCESS NETWORKS

9

Comparison to Alternate Broadband Access Networks, ADSL/xDSL Access Networks. Wireless Access Networks- Fixed wireless media characteristics, Different physical layer options for wireless, WiFi, WiMax, LTE and WiMedia,60GHz wireless over Fiber networks .

L=45 TOTAL: 45 PERIODS

REFERENCES:

1. W. Ciccora, J. Farmer, and D. Large. Modern Cable Television Technology, Video, Voice and Data Communications, Elsevier 2nd edition,2004.
2. Glen Kramer, Ethernet Passive Optical Networks, McGraw Hill Professional,2005.
3. HoudaLabiod, HossamAfifi, Costantino de Santis, WiFi, Bluetooth, Zigbee,andWimax,Springer,2010.
4. Jochen Schiller, “Mobile communications”, PHI/Pearson Education, 2nd Edition, 2003.

5. Rappaport.T.S, “Wireless Communications: Principles & Practice”, 2nd Edition, PHI, 2002.

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COURSE OUTCOMES	Statement's	PROGRAMS OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	
CO-1	To learn the technical, economic and service advantages of next generation networks	3	3	3	3	2								2	2	3
CO-2	To learn the fundamentals of distribution system and cables	3	3	2	2	3							3	2	2	3
CO-3	To understand about fundamental device technology, operation system requirements, physical layer interface, link protocols and network architectures	3	3	2	2	2							2	2	3	
CO-4	Compare recent international standards efforts on Optical PON architecture and performance and requirement of Fiber-Optic Services (FiOS)	3	3	2	2	2							3	2	3	

CO-5	To understand the wireless broadband access network and channel medium	3	3	2	2		2				2		2	2	2
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523102 COMMUNICATION SYSTEMS LABORATORY II L T P C
0 0 4 2

COURSE OBJECTIVE:

COURSE OUTCOMES:

- Having successfully completed this course, the students should be able to:
- To acquire knowledge on Transmission line and S- parameter estimation of microwave devices.

- To introduce the basics of Microstrip Patch Antenna and its analysis .
- To study & measure the performance of digital communication systems.
- To provide a comprehensive knowledge of Wireless Communication.
- To learn about the design of digital filter and its adaptive filtering algorithms.

. Experiments Using MATLAB

- Simulation of Audio compression algorithms.
- Simulation of speech compression algorithms.
- Implementation of image compression algorithms.

. Experiments Using IE3D

- Simulation of Microstrip Antennas
 - a circular/rectangular microstrip patch antenna
 - a 2X 2-element planar array antenna
- S-parameter estimation of Microwave devices.
- Design and testing of a Microstrip coupler.
- Characteristics of N/4 and N/2 transmission lines.
- Design and testing of multiple conductors microwave filter (Compline filter)

TOTAL: 45 PERIODS

List of Requirements:

S.NO.	DESCRIPTION OF EQUIPMENT	QUANTITY REQUIRED
1.	MATLAB	10 User License
2.	MICROWAVE OSCILLATOR	1
3.	MICROWAVE SET UP	1
4.	FIBER OPTIC ANALOG / DIGITAL KIT	1

COURSE OUTCOMES	PROGRAMS OUTCOMES	PROGRAM SPECIFIC OUTCOMES													
		PSO 1	PSO 2												
CO's	Statement's	P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12		

CO-1	To acquire knowledge on Transmission line and S- parameter estimation of microwave devices	3	3	3	2	2				3	1	2	2		2
CO-2	To introduce the basics of Microstrip Patch Antenna and its analysis	3	3	2	2	2	1			3	1	2	2	2	
CO-3	To study & measure the performance of digital communication systems	3	3	2	2	2				3	1	1	2	2	2
CO-4	To provide a comprehensive knowledge of Wireless Communication	3	2	2	2	2					3	2		2	2
CO-5	To learn about the design of digital filter and its adaptive filtering algorithms	3	3	2	2					1	2	2			2

LIST OF ELECTIVES

ELECTIVES I

523201 SPEECH AND AUDIO SIGNAL PROCESSING

L T P C
3 0 0 3

COURSE OBJECTIVE:

To introduce the basic concepts and methodologies for analysis, modelling, synthesis and coding of speech and music and to provide a foundation for developing applications and for further study in the field of digital audio standards and its techniques

COURSE OUTCOMES:

Having successfully completed this course, the students should be able to:

- Describe concepts of speech signal processing
- Analyse the speech production and perception model
- Explain the speech parameters for speech processing
- Explain analysis by synthesis speech coding
- Explain the speech detection, speech recognition and synthesis

UNIT I Mechanics of Speech 9

Speech production mechanism – Nature of Speech signal – Discrete time modelling of Speech production – Representation of Speech signals – Classification of Speech sounds – Phones –Phonemes – Phonetic and Phonemic alphabets – Articulatory features. Music production – Auditory perception – Anatomical pathways from the ear to the perception of sound – Peripheral auditory system – Psycho acoustics.

UNIT 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 Autocorrelation Function – Pitch period estimation using Auto Correlation Function.

UNIT III Frequency Domain Method for Speech Processing 9

Short Time Fourier analysis – Filter bank analysis – Formant extraction – Pitch Extraction – Analysis by Synthesis-Analysis synthesis systems- Phase vocoder—Channel vocoder. Homomorphic speechnalysis: Cepstral analysis of Speech – Formant and Pitch Estimation Speech enhancement techniques in time domain

UNIT IV Linear Predictive Analysis of Speech 9

Formulation of Linear Prediction problem in Time Domain – Basic Principle – Auto correlation method – Covariance method – Solution of LPC equations – Cholesky method – Durbin’s Recursive algorithm – lattice formation and solutions – Comparison of different methods – Application of LPC parameters – Pitch detection using LPC parameters – Formant analysis – VELP – CELP.

UNIT V Application of Speech & Audio Signal Processing 9

Algorithms: Spectral Estimation, dynamic time warping – Hidden Markov model – Music analysis –Pitch Detection– Feature analysis for recognition – Music synthesis – Automatic Speech Recognition– ASR systems – Speaker identification and verification –Speech Synthesis: Text to speech - voice over IP-Enhancement of speech using spectral subtraction,wiener filter-Voice activity detection for speech coding-simulation of audio coding techniques – Pitchdetection using LPC.

L=45 TOTAL: 45 PERIODS

REFERENCES:

1. Andreas Spanias, Ted Painter, Venkatraman Atti, “ Audio Signal Processing and Coding” wiley publications, 3rd edition, 2010.

2. Ben Gold, Nelson Morgan, Dan Ellis - Speech, and Audio Signal Processing: Processing and Perception of Speech and Music - Wiley, India – 2011(2nd Edition)
3. Ben Gold and Nelson Morgan, Speech and Audio Signal Processing, John Wiley and Sons Inc., 2004.
4. Paul Hill, “Audio and Speech Processing with MATLAB” CRC Press, 3rd edition, 2010.
5. Vijay Madiseti – The Digital Signal Processing Handbook: Video, Speech, and Audio Signal Processing and Associated Standards - CRC Press, U.K./India – 2009(2nd Edition)

COURSE OUTCOMES	STATEMENTS	PROGRAMS OUTCOMES												PROGRAM SPECIFIC OUTCOMES	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO-1	Describe concepts of speech signal processing	3	2	2	2	1							2	3	
CO-2	Analyse the speech production and perception model	3	2	2	2								2	3	
CO-3	Explain the speech parameters for speech processing	3	3	2	2	2							2	2	
CO-4	Explain analysis by synthesis speech coding	3	3	2	2	2							2	2	
CO-5	Explain the speech detection, speech recognition and synthesis	3	2	3	2	2							2	3	

523203

VLSI FOR WIRELESS COMMUNICATION

L T P C
3 0 0 3

COURSE OBJECTIVE:

To Introduce the concepts for Understanding of application of VLSI circuits in wireless communication.

COURSE OUTCOMES:

Having successfully completed this course, the students should be able to:

- To introduce to the low power design techniques of VLSI circuits.
- To understand the transceiver architecture and Parameters
- To understand the low power design techniques and power dissipation function
- To learn the design and implementation of various VLSI circuits for wireless communication
- To understand about the VLSI design of synthesizers.

UNIT I WIRELESS COMMUNICATION BASICS: 9

Digital communication systems- minimum bandwidth requirement, the Shanon limit- overview of modulation schemes- classical channel- wireless channel description- path loss- multipath fading basics of spread spectrum and spread spectrum techniques- PN sequence.

UNIT II TRANSCEIVER ARCHITECTURE: 9

Transceiver design constraints- baseband subsystem design- RF subsystem design- Super heterodyne receiver and direct conversion receiver- Receiver front-end- filter design- non-idealities and design parameters- derivation of noise figure and IP3 of receiver front end.

UNIT III LOW POWER DESIGN TECHNIQUES 9

Source of power dissipation- estimation of power dissipation- reducing power dissipation at device and circuit levels- low voltage and low power operation- reducing power dissipation at architecture and algorithm levels.

UNIT IV WIRELESS CIRCUITS 9

VLSI Design of LNA-wideband and narrow band-impedance matching. Automatic Gain Control(AGC) amplifier-power amplifier- Active mixer- analysis, conversion gain, distortion analysis- low frequency and high frequency case, noise. Passive mixer- sampling mixer and switching mixer analysis of distortion, conversion gain and noise in these mixers.

UNIT V VLSI DESIGN OF SYNTHESIZERS 9

VLSI design of Frequency Synthesizers (FS) – Parameters of FS - PLL based frequency synthesizer, phase detector/charge pump- dividers- VCO- VLSI architecture for Multitier Wireless System - Hardware Design Issues for a Next generation CDMA System - Efficient VLSI Architecture for Base Band Signal processing.- Phase Noise

L=45 TOTAL: 45 PERIODS

REFERENCES:

1. Bosco Leung, VLSI for Wireless Communication, Springer, 2011.
2. Elmad N Farag and Mohamed I Elmasry, Mixed Signal VLSI Wireless Design-Circuits and Systems, Kluwer Academic Publishers, 2002
3. Systems, Kluwer Academic Publishers, 2002
4. Emad N Farag and Mohamed I Elmasry, “Mixed Signal VLSI Wireless Design - Circuits and Systems”, Kluwer Academic Publishers, 2000.
5. Bosco Leung, VLSI for Wireless Communication, Springer, 2011.

COURSE OUTCOMES	Statement's	PROGRAMS OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	
CO-1	To introduce to the low power design techniques of VLSI circuits	3	3	3	2	2	2					2	2	2		2
CO-2	To understand the transceiver architecture and Parameters	3	3	2			2							2	2	2
CO-3	To understand the low power design techniques and power dissipation function	3	3	2	2	2								2	2	
CO-4	To learn the design and implementation of various VLSI circuits for wireless communication	3	3	2	2	2				2	2			2		2
CO-5	To understand about the VLSI design of synthesizers	3	2	3	2	2								2	3	

COURSE OBJECTIVE:

To study and analyze about Radar Signals

COURSE OUTCOMES:

Having successfully completed this course, the students should be able to:

- Understand the Radar Signal acquisition and sampling in multiple domains
- Provide clear instruction in radar DSP basics
- Equip the skills needed in both design and analysis of common radar algorithms
- Understand the basics of synthetic aperture imaging and adaptive array processing
- Illustrate how theoretical results are derived and applied in practice

UNIT I INTRODUCTION TO RADAR SYSTEMS 9

History and application of radar, basic radar function, elements of pulsed radar, review of signal processing concepts and operations, A preview of basic radar signal processing, radar system components, advanced radar signal processing, Current radar research.

UNIT II SIGNAL MODELS 9

Components of a radar signal, amplitude models: simple point target radar range equation, radar cross section, radar cross section for meteorological targets. types of clutters, noise model and signal-to-noise ratio, jamming, frequency models: the Doppler shift, spatial models, spectral model

UNIT III SAMPLING AND QUANTIZATION OF PULSED RADAR SIGNALS 9

Domains and criteria for sampling radar signals, Sampling in the fast time dimension, Sampling in slow time: selecting the pulse repetition interval, sampling the Doppler spectrum: the Nyquist rate in Doppler, Sampling in the spatial and angle dimension, Quantization, I/Q Imbalance and Digital I/Q

UNIT IV RADAR WAVEFORMS 9

Introduction, The waveform matched filter, Matched filtering of moving targets, The ambiguity function, The pulse burst waveform, frequency-modulated pulse compression waveforms, Range side lobe control for FM waveforms, Phase-modulated pulse compression waveforms: Biphase codes, poly phase codes, COSTAS Frequency Codes

UNIT V DOPPLER PROCESSING 9

Alternate forms of the Doppler spectrum, Moving target indication (MTI): pulse cancellers, vectors formulation of the matched filters. Pulse Doppler processing, dwell-to-dwell stagger, Pulse pair processing, clutter mapping and the moving target detector, MTI for moving platforms: adaptive displaced phase center antenna processing

L=45 TOTAL: 45 PERIODS

REFERENCES:

1. "Fundamentals of Radar Signal Processing", Mark A. Richards McGraw-Hill, New York, 2005
2. "Principles of Radar and Sonar Signal Processing", Francois Le Chevalier, Artech House, 2002
3. "Radar systems, Peak Detection and Tracking", Michael O Kolawole, 2010, Elseveir

4. "Introduction to Radar Systems" 3/E, Skolnik, McGraw Hill,2001.
5. "Radar Principles", Peyton Z. Peebles, 2009 Wiley India
6. "Radar Design Principles-Signal Processing and the environment", Fred E Nathanson, PHI,2006.

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COURSE OUTCOMES	PROGRAMS OUTCOMES	PROGRAM SPECIFIC OUTCOMES													
		PSO 1	PSO 2												
CO's	Statement's	P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12	PSO 1	PSO 2
CO-1	Understand the Radar Signal acquisition and sampling in multiple domains	3	3	2	2								2	2	2
CO-2	Provide clear instruction in radar DSP basics	2	3	2	2	2							2	1	2
CO-3	Equip the skills needed in both design and analysis of common radar algorithms	3	2	2	2	1	2						2	2	2
CO-4	Understand the basics of synthetic aperture imaging and adaptive array processing	3	2	2	2	2	1						2		2
CO-5	Illustrate how theoretical results are derived and applied in practice	3	2	2	2	2	2						2	2	2

523205

SENSORS AND SIGNAL CONDITIONING

L T P C
3 0 0 3

COURSE OBJECTIVE:

To introduce study various types of sensors, basic measurement systems and its components and applications.

COURSE OUTCOMES:

Having successfully completed this course, the students should be able to:

- Study about static and dynamic characteristic of systems.
- Get knowledge of various measurement devices.
- Know about application of the sensor devices.
- Evaluate digital sensors and semiconductor device sensors
- Discuss Self-generating sensors

UNIT I INTRODUCTION TO MEASUREMENT SYSTEMS 9

Introduction to measurement systems: general concepts and terminology, measurement systems, sensor classification, general input-output configuration, methods of correction performance characteristics: static characteristics of measurement systems, accuracy, precision, sensitivity, other characteristics: linearity, resolution, systematic errors , random errors, dynamic characteristics of measurement systems: zero-order, first-order, and second-order measurement systems and response

UNIT II RESISTIVE AND REACTIVE SENSORS 9

Resistive sensors: potentiometers, strain gages, resistive temperature detectors, magneto resistors, light-dependent resistors, Signal conditioning for resistive sensors: Wheatstone bridge, sensor bridge calibration and compensation, Instrumentation amplifiers, sources of interference and interference reduction, Reactance variation and electromagnetic sensors, capacitive sensors, differential, inductive sensors, linear variable differential transformers (LVDT), magneto elastic sensors, hall effect sensors, Signal conditioning for reactance-based sensors & application to the LVDT.

UNIT III DIGITAL SENSORS AND SEMICONDUCTOR DEVICE SENSORS 9

Digital sensors: position encoders, variable frequency sensors – quartz digital thermometer, vibrating wire strain gages, vibrating cylinder sensors, saw sensors, digital flow meters, Sensors based on semiconductor junctions: thermometers based on semiconductor junctions, magneto diodes and magneto transistors, photodiodes and phototransistors, sensors based on MOSFET transistors, CCD imaging sensors , ultrasonic sensors, fiber-optic sensors.

UNIT IV SELF-GENERATING SENSORS 9

Self-generating sensors: thermoelectric sensors, piezoelectric sensors, pyroelectric sensors, photovoltaic sensors , electrochemical sensors, Signal conditioning for self-generating sensors: chopper and low-drift amplifiers, offset and drifts amplifiers , electrometer amplifiers, charge amplifiers, noise in amplifiers

UNIT V SENSORS- THEIR APPLICATIONS 9

Smart sensors- primary sensors-excitation-amplification-filters-converters-compensation-data communication, On-board Automobile sensors-Flow rate sensors- Pressure sensors-temperature sensors-oxygen sensors, Home appliance sensors, Aerospace sensors-Sensors for environmental pollution.

L=45 TOTAL: 45 PERIODS

REFERENCES:

1. Andrzej M. Pawlak Sensors and Actuators in Mechatronics Design and Applications, 2006.
2. D. Johnson, “Process Control Instrumentation Technology”, John Wiley and Sons. 2010
3. E.O. Doebelin, “Measurement System : Applications and Design”, McGraw Hill publications,2009
4. Ian Sinclair, Sensors and Transducers, Elsevier, 3rd Edition, 2011.
5. Kevin James, PC Interfacing and Data acquisition, Elsevier, 2011.

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COURSE OUTCOMES	Statement's	PROGRAMS OUTCOMES												PROGRAM SPECIFIC OUTCOMES	
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO-1	Study about static and dynamic characteristic of systems	3	2	2	2	2					2		2	2	2
CO-2	Get knowledge of various measurement devices	3	2	2	3	2					2		2		2
CO-3	Know about application of the sensor devices	3	2	2	2	2	2						2		2
CO-4	Evaluate digital sensors and semiconductor device sensors	3	3	2	2						2		2	2	2

CO-5	Discuss Self-generating sensors	3	3	2	2		2						2	2	2
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523206	SIGNAL PROCESSING TECHNIQUES FOR BIOLOGICAL SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

To learn fundamental concepts on Image processing and its applications

COURSE OUTCOMES:

Having successfully completed this course, the students should be able to:

- Acquiring knowledge of Signals and systems
- Ability to compute FFT
- Ability to design and implement filter
- Understanding basics of image processing
- Apply above knowledge and skills to analysis of biological systems

UNIT I SIGNALS AND SYSTEMS 9

Introduction to signals and its classification-Sinusoids, complex exponentials, impulse and step signals, -LTI Systems and properties: impulse response, convolution, Eigen functions of LTI systems , Biological time series signals from gene expression microarrays

UNIT II TRANSFORMS 9

Discrete time Fourier transform Fast Fourier transform -sampling theorems-Biological example: Fourier transform of DNA sequences reveal inherent periodicities. 1D DFT, 2D transforms - DFT, DCT, Discrete Sine, Walsh, Hadamard, Slant, Haar, KLT, SVD, Wavelet transform

UNIT III BAYESIAN DETECTION AND ESTIMATION 9

Bayesian Detection and Estimation-Bayesian statistics: Incorporating prior knowledge-Minimum mean square error -Linear MMSE estimator-Maximum Aposteriori Probability detection

UNIT IV IMAGE FUNDAMENTALS 9

Fundamental studies related to visual perception, sampling and quantization of visual data, Elements of Image Processing-Fundamental steps in image processing- Image Acquisition- Image restoration and enhancement, Image compression, watermarking, authentication. Image preprocessing –Image enhancement, Image restoration, Image compression

UNIT V IMAGE ANALYSIS AND OTHER APPLICATIONS 9

Image segmentation, Image representation and analysis, Neural Network approaches. Image visualization, virtual reality based Interactive visualization. Applications – Spectral Imaging- Tele radiology. Abnormality detection in medical images, Medial Image formats cell classification using supervised learning methods. .

L=45 TOTAL: 45 PERIODS

REFERENCES:

1. Anil K. Jain ,Fundamentals of Digital Image Processing: PHI, India 2005
2. Monson .H.Hayes, Statistical Digital Signal Processing and Modeling , New York , USA , Wiley ,1996.
3. Rafael C. Gonzalez, Richard E .Woods, stevenL. Eddins, Digital Image Processing using Matlab, TMH, India Second Edition ,2010

4. SterenM.Kay , Fundamentals of Statistical signal processing : Estimation theory upper , New Jersey , USA : Prentics Hall , 1993

COURSE OUTCOMES	PROGRAMS OUTCOMES	PROGRAMS OUTCOMES												PROGRAM SPECIFIC OUTCOMES	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO-1	Acquiring knowledge of Signals and systems	3	2	2									1	2	2
CO-2	Ability to compute FFT	2	3	2	1								1	2	
CO-3	Ability to design and implement filter	3	3	2	2		1						1	2	
CO-4	Understanding basics of image processing	3	2	3	2								2		2
CO-5	Apply above knowledge and skills to analysis of biological systems	2	3	2	1		1						2		2

523207

SYSTEM ON CHIP DESIGN

L	T	P	C
3	0	0	3

COURSE OBJECTIVE:

- To understand the concepts of System on Chip Design methodology for Logic and Analog Cores and the concepts of System on Chip Design Validation

COURSE OUTCOMES:

Having successfully completed this course, the students should be able to:

- Able to understand about SoC Design Methodology.
- Ability to understand the design of different embedded memories.
- Able to understand the simulation models and design methodology.
- Able to understand the concept of SoC Design Validation
- To study about the Testing Concepts of system on chip.

UNIT I INTRODUCTION 9

System tradeoffs and evolution of ASIC Technology- System on chip concepts and methodology – SoC design issues -SoC challenges and components

UNIT II DESIGN METHODOLOGICAL FOR LOGIC CORES 9

SoC Design Flow – On-chip buses –Design process for hard cores –Soft and firm cores –Designing with hard cores, soft cores- Core and SoC design examples

UNIT III DESIGN METHODOLOGY FOR MEMORY AND ANALOG CORES 9

Embedded memories –Simulation modes Specification of analog circuits – A to D converter –Phase located loops –High I/O.

UNIT IV DESIGN VALIDATION 9

Core level validation –Test benches –SoC design validation – Co simulation –hardware/ Software co verification. Case Study: Validation and test of systems on chip

UNIT V SOC TESTING 9

SoC Test Issues – Testing of digital logic cores –Cores with boundary scan –Test methodology for design reuse– Testing of microprocessor cores – Built in self method –testing of embedded memories. Case Study: Integrating BIST techniques for on-line SoC testing. Designing BIST techniques for SOC testing- soft core models for different logic circuits

L=45 TOTAL: 45 PERIODS

REFERENCES:

1. M.Keating, D.Flynn, R.Aitken, A, GibbonsShi, Low Power Methodology Manual for Systemon-ChipDesign Series: Integrated Circuits and Systems, Springer, 2007.
2. Prakash Raslinkar, Peter Paterson &Leena Singh, System-on-a-chip verification: Methodology and Techniques, Kluwer Academic Publishers, 2000
3. RochitRajsunah, System-on-a-chip: Design and Test, Artech House, 2007.

COURSE OUTCOMES	Statement's	PROGRAMS OUTCOMES												PROGRAM SPECIFIC OUTCOMES	
		P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12	PSO 1	PSO 2
CO-1	Able to understand about SoC Design Methodology	3	3	3	2	2				2		2	3	3	
CO-2	Ability to understand the design of different embedded memories	3	2	1	2		2						2	2	
CO-3	Able to understand the simulation models and design methodology	3	3	2	3	1				2			1	2	
CO-4	Able to understand the concept of SoC Design Validation	2		1		2				2		2	2	2	1
CO-5	To analysis about the Testing Concepts of system on chip	2	3	2	3							2	2		2

ELECTIVE-II

523202

WIRELESS SENSOR NETWORKS

L T P C

3 0 0 3

COURSE OBJECTIVE:

- 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.

COURSE OUTCOMES:

- Able to learn the basics of wireless sensor networks and its applications in enabling technologies.
- Able to understand the architecture and elements of wireless sensor networks.
- Able to get an idea on MAC protocols for wireless sensor networks.
- Able to get the knowledge on infrastructure establishment
- Able to study the tools and platforms needed to establish sensor networks.

UNIT 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- Wireless Sensor Networks-Classification .Enabling Technologies for Wireless Sensor Networks

UNIT 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.

UNIT 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 , Wakeup Radio Concepts, Address and Name Management, Hybrid Routing, Routing Protocols- Energy Efficient Routing, Geographic Routing.

UNIT IV INFRASTRUCTURE ESTABLISHMENT

9

Topology Control – Motivation and Clustering, Time Synchronization - LTS, RBS, Localization and positioning – Possible approaches, single hop localization. Multi hop localization

UNIT 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. The Mediation Device Protocol, TRAMA, Ad hoc Network Design Algorithm (ANDA). .

L=45 TOTAL: 45 PERIODS

REFERENCES:

1. Anna Hac, Wireless Sensor Network Designs, John Wiley, 2003
2. Feng Zhao and Leonidas J. Guibas, Wireless Sensor Networks - An Information Processing Approach, Elsevier, 2007
3. Holger Karl and Andreas Willig, Protocols And Architectures for Wireless Sensor Networks, John Wiley, 2005.
4. KazemSohraby, Daniel Minoli and TaiebZnati, Wireless Sensor Networks-Technology, Protocols, AndApplications, John Wiley, 2007 .
5. Mohammad Ilyas and ImadMahgaob, Handbook of Sensor Networks: Compact Wireless and Wired Sensing Systems, CRC Press, 2005.
6. Wayne Tomasi, Introduction To Data Communication And Networking, Pearson Education,

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COURSE OUTCOMES	PROGRAMS OUTCOMES	PROGRAM SPECIFIC OUTCOMES													
		PSO 1	PSO 2												
CO's	Statement's	P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12	PSO 1	PSO 2
CO-1	Able to learn the basics of wireless sensor networks and its applications in enabling technologies	3	2	2	2		2					2	2	2	2
CO-2	Able to understand the architecture and elements of wireless sensor networks	3	2	2	2		2		2				2	2	
CO-3	Able to get an idea on MAC protocols for wireless sensor networks	3	2	2	2				2				2	2	2
CO-4	Able to get the knowledge on infrastructure establishment	3	3	2	2		2		2					2	2

CO-5	Able to study the tools and platforms needed to establish sensor networks	2	3	2	3							2	2		2
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REFERENCES:

1. Amitabh Mishra, Intrusion Detection in Wireless Ad Hoc Networks, IEEE Wireless Communication, February 2004. .
2. Hongmei Deng, Wei Li and Dharma P. Agrawal, Routing Security in Wireless Ad Hoc Networks, IEEE Communication Magazine, Oct 2002.
3. Ivan Stojmenović, Handbook of Wireless Networks and Mobile Computing, Wiley, 2002
4. June Peng Ning, Kun Sun, How To Misuse AODV: A Case Study of Insider Attacks Again Mobile AdHoc Routing Protocols in proceeding of the 4th annual IEEE information assurance workshop, page 60 – 67 west point2003.
5. Ram Murthy and B.S.Manoj, AdHoc Wireless Networks: Architectures and Protocols, Prentice Hall PTR, 2004.

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COURSE OUTCOMES	Statement's	PROGRAMS OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
		P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12	PSO 1	PSO 2	
CO-1	Ability to identify the various attacks and threads of wireless Networks	3	2	2	2	2	2							2	2	2
CO-2	Understand and recognize the architectures, vulnerabilities and challenges of mobile protocols	3	2	3	2	2							2		2	2
CO-3	Analyze the solutions for covering the security principles of wireless networks	3	2	3	2	3							2		2	2

CO-4	Analyze and design security systems for wireless networks	3	2	2	2	3					2		2	2	
CO-5	Apply in-depth knowledge of wireless communications principles, systems, and networks to the solution of wireless engineering problems	3	2	3	2	3					2		2	2	2

523209

MOBILE ADHOC NETWORKS

L T P C
3 0 0 3

COURSE OBJECTIVE:

- To study characteristics, vulnerabilities and challenges of ad hoc networks
- 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

COURSE OUTCOMES:

- Ability to identify the various challenges and vulnerabilities in MANET
- Obtain an awareness cyber attacks and threads in mobile networks.
- Understand and recognize the architectures, designing MAC,TCP,IP and security protocols
- Analyze the solutions for covering the security principles of wireless networks.
- Apply in-depth knowledge of wireless communications principles, systems, and networks to the solution of wireless engineering problems.

UNIT I WIRELESS LAN, PAN, WAN AND MAN 9

Characteristics of wireless channel - Fundamentals of WLANs - IEEE 802.11 standard - HIPERLAN – Wireless ATM - IEEE 802.16 standard – GSM-IS 95-UMTS-Bluetooth

UNIT II MAC AND ROUTING PROTOCOLS 9

MAC: Design issues - Goals and classification - Contention-based MAC protocols: MACAW,DPRMA, DPSMA.MAC protocols using directional antenna- Hybrid Protocols-Routing protocols: AODV,DSR,ZRP,LAR,CHGSR,FSR and power-aware routing protocols

UNIT III TRANSPORT LAYER AND SECURITY PROTOCOLS 9

Transport layer Protocol: Design issues - Goals and classification - TCP over AdHoc wireless Networks – Security - Security requirements - Issues and challenges in security provisioning - Network security attacks - Security routing.

UNIT IV ENERGY MANAGEMENT 9

Need - Classification of battery management schemes - Transmission power management schemes - System power management schemes. Wireless Sensor Networks: Architecture - Data dissemination - Data gathering - MAC protocols - Location discovery - Quality of a sensor network.

UNIT V PERFORMANCE ANALYSIS 9

ABR beaconing - Performance parameters - Route-discovery time - End-to-end delay performance - Communication throughput performance - Packet loss performance - Route reconfiguration/repair time - TCP/IP based applications.VANET-architecture, challenges-wireless technologies for VANET-wireless body area network communication domains-Energy-efficient multicasting- wireless recharging techniques- QoS frame works in MANET- Network layer solutions.

L=45 TOTAL: 45 PERIODS

REFERENCES:

1. Charles E. Perkins, AdHoc Networking, Addison – Wesley, 2008
2. Mohammad Ilyas, The Handbook of AdHoc Wireless Networks, CRC press, 2002
3. C.Siva Ram Murthy and B.S.Manoj, AdHoc Wireless Networks: Architectures and protocols, Prentice Hall PTR, 2007
4. Stefano Basagni, Marco Conti, Silvia Giordano and Ivan Stojmenovic, Mobile AdHoc Networking, Wiley – IEEE press, 2004
5. C.K.Toh. ,AdHoc Mobile Wireless Networks: Protocols and Systems, Prentice Hall PTR, 2008 .

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COURSE OUTCOMES	PROGRAMS OUTCOMES	PROGRAM SPECIFIC OUTCOMES															
		CO's	Statement's	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO-1	Ability to identify the various challenges and vulnerabilities in MANET			3	3	3	2	2							2	2	2
CO-2	Obtain an awareness cyber attacks and threads in mobile networks			3	3	3	2	2							2	2	3
CO-3	Understand and recognize the architectures, designing MAC,TCP,IP and security protocols			3	3	2	3	2							2	2	2
CO-4	Analyze the solutions for covering the security principles of wireless networks			2	3	2	3	3							3	2	2
CO-5	Apply in-depth knowledge of wireless communications principles, systems, and networks to the			2	3	2	2	2							2	3	2

Introduction – Sensor Networks parameters- Architecture – Mobile Sensor Networks Deployment-Directed Diffusion- Aggregation in Wireless Sensor Networks – Boundary Estimation – Back off Phenomenon- Data Funneling- Equivalent Transport Control Protocols in Sensor Networks – Security –Authentication – Security Architecture- Key management – Security management in GSM, UMTS –Security in AdHoc and Sensor Networks.

L=45 TOTAL: 45 PERIODS

REFERENCES:

1. Adrian Perrig, J. D. Tygar, "Secure Broadcast Communication: In Wired and Wireless Networks", Springer, 2006.
2. Carlos De MoraesCordeiro, Dharma Prakash Agrawal “Ad Hoc and Sensor Networks: Theory and Applications (2nd Edition), World Scientific Publishing, 2011
3. C.Siva Ram Murthy and B.S.Manoj, “Ad Hoc Wireless Networks – Architectures and Protocols”, Pearson Education, 2004.
4. Holger Karl, Andreaswillig, Protocols and Architectures for Wireless Sensor Networks, John Wiley & Sons, Inc .2005.
5. Subir Kumar Sarkar, T G Basavaraju, C Puttamadappa, “Ad Hoc Mobile Wireless Networks”, Auerbach Publications, 2008.

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COURSE OUTCOMES	PROGRAMS OUTCOMES	PROGRAM SPECIFIC OUTCOMES													
		PSO 1	PSO 2												
CO's	Statement's	P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12	PSO 1	PSO 2
CO-1	Identify different issues in wireless ad hoc and sensor network	3	3	3	2	2							2	2	2
CO-2	To analyze protocols developed for ad hoc and sensor networks	3	3	3	2	2							2	2	3

523208

ADVANCED WIRELESS SECURITY

L	T	P	C
3	0	0	3

COURSE OBJECTIVE:

- To explore variety of attacks and threats and its impact on MAC layer and Network layer
- To study characteristics, vulnerabilities and challenges of ad hoc networks
- To provide solution for covering the security principles and flaws of popular wireless technologies

COURSE OUTCOMES:

- Ability to identify the various attacks and threads of wireless Networks.
- Understand and recognize the architectures, vulnerabilities and challenges of mobile protocols.
- Analyze the solutions for covering the security principles of wireless networks.
- Analyze and design security systems for wireless networks.
- Apply in-depth knowledge of wireless communications principles, systems, and networks to the solution of wireless engineering problems.

UNIT I ATTACKS ON ROUTING PROTOCOLS 9

Vulnerability of MANET to attack - review of AODV and DSR - type of attack - active and passive - internal and external - behaviour of malicious node - black hole, DoS, Routing table overflow, Impersonation, Energy consumption, Information Disclosure - Misuse type – Misuse goals – Security flaw in AODV -attack on AODV - wormhole and rushing attack -Performance analysis of AODV in the presence of malicious node

UNIT II INTRUSION DETECTION IN WIRELESS AD HOC NETWORKS 9

Problem in current IDS techniques - requirements of IDS - classification of IDS – Network and host based - anomaly detection, misuse detection, specification based - intrusion detection in MANETs using distributed IDS and mobile agents - AODV protocol based IDS - Intrusion resistant routing algorithms - Comparison of IDS. .

UNIT III SECURE ROUTING PROTOCOLS 9

Self organized network layer security in MANETs - mechanism to improve authentication and integrity in AODV using hash chain and digital signatures - on demand secure routing protocol resilient to Byzantine failures - ARIADNE, SEAD, SAR, and ARAN

UNIT IV CHALLENGES IN ROUTING SECURITY 9

Security - Challenges and solutions - Providing Robust and Ubiquitous security support - Adaptive security for multilevel Ad Hoc Network - Denial of service Attack at the MAC layer

UNIT V SECURITY PRACTICE & SYSTEM SECURITY 9

Electronic Mail Security – PGP, S/MIME, IPSec, Secure Electronic Transaction, web security considerations – SSL, TLS, IDS-password management, viruses and related threats, viruses counter measures, firewalls design principles, types of firewalls, configurations, trusted systems.

L=45 TOTAL: 45 PERIODS

REFERENCES:

1. Amitabh Mishra, Intrusion Detection in Wireless Ad Hoc Networks, IEEE Wireless Communication, February 2004. .
2. Hongmei Deng, Wei Li and Dharma P. Agrawal, Routing Security in Wireless Ad Hoc Networks, IEEE Communication Magazine, Oct 2002.
3. Ivan Stojmenović, Handbook of Wireless Networks and Mobile Computing, Wiley, 2002
4. June Peng Ning, Kun Sun, How To Misuse AODV: A Case Study of Insider Attacks Again Mobile AdHoc Routing Protocols in proceeding of the 4th annaul IEEE information assurance workshop, page 60 – 67 west point2003.
5. Ram Murthy and B.S.Manoj, AdHoc Wireless Networks: Architectures and Protocols, Prentice Hall PTR, 2004.

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COURSE OUTCOMES	Statement's	PROGRAMS OUTCOMES											PROGRAM SPECIFIC OUTCOMES			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	
CO-1	Ability to identify the various attacks and threads of wireless Networks.	2	1	3	2			2				2		1	2	2
CO-2	Understand and recognize the architectures, vulnerabilities and challenges of mobile protocols.	2	1	3	3						2	2		2	1	1

CO-3	Analyze the solutions covering the security principles of wireless networks. Analyze and design security systems for wireless networks.	2	1	3	2				2			2		1	2	2
CO-4	Apply in-depth knowledge of wireless communications principles, systems, and networks to the solution of wireless engineering problems.	2		3	3					2	2			2	1	2

523212

COGNITIVE RADIO NETWORKS

L	T	P	C
3	0	0	3

COURSE OBJECTIVE:

To understand the evolving paradigm of cognitive radio communication and the enabling technologies for its implementation and the essential functionalities and requirements in designing software defined radios and their usage for cognitive communication.

COURSE OBJECTIVE:

Having successfully completed this course, the students should be able to:

- Appreciate the motivation and the necessity for cognitive radio communication strategies.
- Evolve new techniques and demonstrate their feasibility using mathematical validations and simulation tools.
- Understand the function of the spectrum sensing and its identification level.
- Demonstrate the impact of the evolved solutions in future wireless network design.
- Study about the information theoretical and CR network functions.

UNIT I SOFTWARE DEFINED RADIO AND ITS ARCHITECTURE 9

Definitions and potential benefits, software radio architecture evolution, technology tradeoffs and architecture implications. Essential functions of the software radio, basic SDR, hardware architecture, Computational processing resources, software architecture, top level component interfaces, interface topologies among plug and play modules.

UNIT II COGNITIVE RADIOS AND ITS ARCHITECTURE 9

Marking radio self-aware, cognitive techniques – position awareness, environment awareness in cognitive radios, optimization of radio resources, Artificial Intelligence Techniques, Cognitive Radio – functions, components and design rules, Cognition cycle – orient, plan, decide and act phases, Inference Hierarchy, Architecture maps, Building the Cognitive Radio Architecture on Software defined Radio Architecture- DRC.

UNIT III SPECTRUM SENSING AND IDENTIFICATION 9

Primary Signal Detection: Energy Detector, Cyclostationary Feature Detector, Matched Filter, Cooperative Sensing, Definition and Implications of Spectrum Opportunity, Spectrum Opportunity Detection, Fundamental Trade-offs: Performance versus Constraint, MAC Layer Performance Measures, Global Interference Model, Local Interference Model, Fundamental Trade-offs: Sensing Accuracy versus Sensing Overhead.

UNIT IV USER COOPERATIVE COMMUNICATIONS 9

User Cooperation and Cognitive Systems, Relay Channels: General Three-Node Relay Channel, Wireless Relay Channel, User Cooperation in Wireless Networks: Two-User Cooperative Network, Cooperative Wireless Network, Multihop Relay Channel

UNIT V INFORMATION THEORETICAL LIMITS ON CR NETWORKS 9

Types of Cognitive Behavior, Interference-Avoiding Behavior: Spectrum Interweave, Interference-Controlled Behavior: Spectrum Underlay, Underlay in Small Networks: Achievable Rates, Underlay in Large Networks: Scaling Laws, Interference-Mitigating Behavior: Spectrum Overlay, Opportunistic Interference Cancellation, Asymmetrically Cooperating Cognitive Radio Channel

L=45 TOTAL: 45 PERIODS

REFERENCES:

1. Alexander M. Wyglinski, Maziar Nekovee, And Y. Thomas Hou, — Cognitive Radio Communications And Networks - Principles And Practice, Elsevier Inc. , 2010
2. Hattab, Ahmed, Perkins, Dmitri, Bayoumi, Magdy, —Cognitive Radio Networks – From Theory to Practice, Springer Series: Analog Circuits and Signal Processing, 2009
3. 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
4. Kwang-Cheng Chen and Ramjee Prasad, “Cognitive Radio Networks”, John Wiley & Sons, Ltd, 2009.
5. Mitola, — Cognitive Radio: An Integrated Agent Architecture for software defined radio, Doctor of Technology thesis, Royal Inst. Technology, Sweden 2000

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COURSE OUTCOMES	PROGRAMS OUTCOMES	PROGRAM SPECIFIC OUTCOMES													
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO-1	Appreciate the motivation and the necessity for cognitive radio communication strategies	3	3	2	2	1							2	2	2
CO-2	Evolve new techniques and demonstrate their feasibility using mathematical validations and simulation tool	3	3	2	2	2	1						2	2	2

ELECTIVE-III

523214	COMMUNICATION NETWORK SECURITY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

To study about Network security.

COURSE OUTCOMES:

Having successfully completed this course, the students should be able to:

- The student would be able to demonstrate an understanding of the ways in which communication network security may get compromised and the basic principles of security algorithm design.
- The student would be able to implement and analyse the different algorithms and compare their Performances.
- The student would be in a position to apply his knowledge for designing or modifying existing algorithms and implementing them atleast by simulation.
- The student would be able to understand the concept of password authentication system.
- The student would be able to understand the security system with the layers

UNIT I INTRODUCTION AND NUMBER THEORY 9

Introduction to Information Security, Computer Security & Network Security. Need For Security. Security – Goals, Attacks, Security Services and Mechanisms, and Techniques. Number Theory and Mathematics for Symmetric Cryptography- Mathematics for Asymmetric-Key Cryptography: Classical Symmetric-Key Ciphers –Substitution Ciphers, Transposition Ciphers.

UNIT II SYMMETRIC AND ASYMMETRIC CRYPTOSYSTEMS 9

Modern Symmetric-Key Cipher - Block Ciphers (DES, 3DES, AES and its mode of operations), Stream Ciphers, Asymmetric-Key Cryptosystem- RSA, ElGamal, ECC, Key Management - DiffieHellman (DH) Mechanism, Kerberos – Needham Schroeder Protocol.

UNIT III AUTHENTICATION, DIGITAL SIGNATURES AND CERTIFICATES 9

Message Integrity & Message Authentication - Message Authentication Code (MAC), Cryptographic Hash Functions – Birthday Attacks, Digital Signatures - Digital Signature Standards (FIPS 186-2), DSA (ANSI X9.30), RSA (ANSI X9.31) – Public Key Distribution – RSA schemes, Digital Certificates - PKI Certificates, PKI Life Cycle Management .

UNIT IV TRUSTED IDENTITY 9

Entity Authentication: Password System- Fixed and One time Passwords (S/Key) RFC 2289 – Callback Systems, Zero Knowledge, Challenge and Response Systems – RADIUS — ITU-T X.509. 60

UNIT V SECURITY AT LAYERS 9

Network Layer Security - IPSec, Transport Layer Security- SSL/TLS, SSH, Application Layer Security –PGP, S/MIME, Firewall - Concepts, Architecture, Packet Filtering, Proxy Services and Bastion Hosts.

L=45 TOTAL: 45 PERIODS

REFERENCES:

1. AtulKahate ,” Cryptography and Network security”, 2nd Edition, Tata McGraw-Hill, 2013.
2. BehrouzA.Forouzan, “Cryptography and Network Security”, Special Edition, Tata McGraw Hill, 2008.
3. Bruce Schneier, “Applied Cryptography”, 20th edition, John Wiley & Sons, 2017.
4. Charlie Kaufmann, Radia Perlman, Mike Speciner, "Network Security", Second Edition, Prentice Hall, 2016.
5. Joseph Migga Kizza, “Guide to Computer Network Security” , springer, 4th edition, 2017.

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COURSE OUTCOMES	PROGRAMS OUTCOMES	PROGRAM SPECIFIC OUTCOMES													
		PSO 1	PSO 2												
CO's	Statement's	P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12	PSO 1	PSO 2
CO-1	The student would be able to demonstrate an understanding of the ways in which communication network security may get compromised and the basic principles of security algorithm design	3	2	3	2	2							3	3	3
CO-2	The student would be able to implement and analyse the different algorithms and compare their Performances	3	2	3	3	3							2	2	2

CO-3	The student would be in a position to apply his knowledge for designing or modifying existing algorithms and implementing them atleast by simulation	3	2	2	2	2							1			2
CO-4	The student would be able to understand the concept of password authentication system	2	3	2	3	3							2			2
CO-5	The student would be able to understand the security system with the layers	2	2	3	3	3							2	1		

523215

MICROWAVE REMOTE SENSING

L T P C
3 0 0 3

COURSE OBJECTIVE:

To learn the concepts of Radio telemetry, knowledge of the basics of radar remote sensing, airborne and space borne radar systems, knowledge of Microwave Remote sensing and its applications.

COURSE OUTCOMES:

Having successfully completed this course, the students should be able to:

- Understanding of applications Radar systems
- Knowledge of various techniques and aspects of Radar for remote sensing.
- Learn the problems in remote sensing
- To study about the radar remote sensing
- Able to understand the concept of interferometry and the applications of remote sensing

UNIT I FUNDAMENTALS AND RADIOMETRY 9

Introduction and early history, Basic concepts, plane waves, antenna systems, radiometry, microwave interactions with atmospheric constituents, Earth's surface and vegetation, Radiometric systems, Sensors, Data products and its applications.

UNIT II RADAR REMOTE SENSING 9

Radar Basics, Radar interaction with Earth surface and vegetation, Surface scattering theory. Radar equation, fading concept, Measurement and discrimination, Physical mechanisms and empirical models for scattering and emission, Geometry of Radar images, Radar return and image signature, Resolution concepts, SAR, Speckle in radar imagery, concept of roughness, geometry of targets, resonance, dielectric constant, surface and volume scattering, signal penetration and enhancement.

UNIT III MODERN RADAR 9

Ballistic Missile Defense radar- requirements, design, performance. Air traffic control (ATC) radar – task of ATC, design issues. Weather Radar – hardware, range equation, hydrological measurements, meteorological phenomena, Sun echoes and Roost Rings, advance processing and systems. Foliage - Penetrating radar – battle field surveillance, FOPEN clutter characteristics, image formation, target detection and characterisation. Space -based SAR for remote sensing – design considerations, special modes and capabilities, design example.

UNIT IV APPLICATION OF RADAR REMOTE SENSING 9

Applications in Agriculture, Forestry, Geology, Hydrology, ice studies, land use mapping and ocean related studies, military and surveillance applications, search and rescue operations, ground and air target detection and tracking.

UNIT V SPECIAL TOPICS IN RADAR REMOTE SENSING 9

SAR interferometry-Basics- differential SAR interferometry, Radar polarimetry-Radargrammetry and applications-Altimeter and its applications, scatter meter and its applications.

L=45 TOTAL: 45 PERIODS

REFERENCES:

1. Floyd.M.Handerson and Anthony, J.Lewis ,Principles and applications of Imaging RADAR,
2. Manual of Remote sensing, Third edition, vol.2, ASPRS, Jhumurley and sons, Inc,1998.
3. Wiliam L Melvin, James A Scheer, “Principles of Modern Radar”, vol.III : Radar Applications, Scitech publishing, 2014.
4. Philippe Lacomme, Jeancl and eMarchais, Jean-Philippe Hardarge and Eric Normant, Air andspaceborneradar systems-An introduction, Elsevier publications 2001.
5. IainH.woodhouse, Introduction to microwave remote sensing, 2004.
6. Roger J Sullivan, Knovel, Radar foundations for Imaging and Advanced Concepts, SciTech
7. Pub, 2004.Ian Faulcon bridge, Radar Fundamentals, Published by Argos Press, 2002.

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COURSE OUTCOMES	Statement's	PROGRAMS OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
		P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12	PSO 1	PSO 2	
CO-1	Understanding of applications Radar systems	3	2	2	2	2	1							1	2	2
CO-2	Knowledge of various techniques and aspects of Radar for remote sensing	3	2	3	2	2	1							1	2	2
CO-3	Learn the problems in remote sensing	3	3	2	2	2								2		2

CO-4	To study about the radar remote sensing	3	3	2	2								2	2	
CO-5	Able to understand the concept of interferometry and the applications of remote sensing	3	3	2	2	2							2	2	1

523216

PATTERN RECOGNITION & ARTIFICIAL INTELLIGENCE

L T P C
3 0 0 3

COURSE OBJECTIVE:

- To understand different supervised and unsupervised learning techniques
- To obtain sound knowledge on recent advancement on pattern recognition techniques .

COURSE OUTCOMES:

- Analysis the procedure for various pattern recognition principles in real world problem.
- Analysis feature enhancement and optimization methods
- Analysis the windowing of better solution in rough surface searching algorithms both using association and non association rules.
- Identification of new developments in object recognition systems
- To study about the neural networks and neural pattern recognition.

UNIT I PATTERN CLASSIFIER

9

Overview of pattern recognition - Discriminant functions - Supervised learning - Parametric estimation -Maximum likelihood estimation - Bayesian parameter estimation - Perceptron algorithm - LMSE algorithm-Problems with Bayes approach - Pattern classification by distance functions - Minimum distance patternclassifier.

UNIT II UNSUPERVISED CLASSIFICATION

9

Clustering for unsupervised learning and classification - Clustering concept - C-means algorithm -Hierarchical clustering procedures - Graph theoretic approach to pattern clustering - Validity of clusteringsolutions

UNIT III STRUCTURAL PATTERN RECOGNITION

9

Elements of formal grammars - String generation as pattern description - Recognition of syntacticdescription -Parsing - Stochastic grammars and applications - Graph based structural representation

UNIT IV FEATURE EXTRACTION AND SELECTION

9

Entropy minimization - Karhunen - Loeve transformation - Feature selection through functionsapproximation -Binary feature selection .

UNIT V RECENT ADVANCES

9

Neural network structures for Pattern Recognition - Neural network based Pattern associators
 –Unsupervised learning in neural Pattern Recognition - Self organizing networks - Fuzzy logic –
 Fuzzypattern classifiers -Pattern classification using Genetic Algorithms.

L=45 TOTAL: 45 PERIODS

REFERENCES:

1. Duda R.O., Hart.P.E., and Strok, *Pattern Classification*, second Edition Wiley, New York, 2008..
2. Robert J.Schalkoff, *Pattern Recognition: Statistical, Structural and Neural Approaches*, JohnWiley&Sons Inc., New York, 2007..
3. IEEE Transaction on Pattern Recognition Techniques 2006
4. IEEE Engineering Medicine and Biology Magazine 2006

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COURSE OUTCOMES	PROGRAMS OUTCOMES	PROGRAM SPECIFIC OUTCOMES													
		PSO 1	PSO 2												
CO's	Statement's	P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12	PSO 1	PSO 2
CO-1	Analysis the procedure for various pattern recognition principles in real world problem	3	3	3	2								2	2	3
CO-2	Analysis feature enhancement and	3	2	3	2								2	2	2

	optimization methods														
CO-3	Analysis the windowing of better solution in rough surface searching algorithms both using association and non association rules	3	3	3	3	2	2						2	2	2
CO-4	Identification of new developments in object recognition systems	2	3	3	2	2	2						2	2	
CO-5	To study about the neural networks and neural pattern recognition	3	3	3	2	3					2		3		2

523217

SOFTWARE DEFINED RADIO

L T P C

3 0 0 3

OBJECTIVES:

The students should be made to:

- Understand radio frequency implementation
- Learn multi rate signal processing and digital generation of signals

OUTCOMES:

At the end of this course, the students should be able to:

- Design data converters
- Evaluate smart antennas
- Discuss digital hardware and software choices

UNIT I INTRODUCTION & CASE STUDIES 9

Introduction to software Radio concepts: Need for software Radios, Definition of software Radio, Characteristics and Benefits. Design Principles. Case studies: SPEAK easy, JTRS, SDR-3000.

UNIT II RADIO FREQUENCY IMPLEMENTATION 9

The purpose of the RF Front End, Dynamic Range, RF receivers front end Topologies, Importance of the components to Overall performance, Transmitter Architecture, Noise and Distortion in the RF Chain, ADC and DAC Distortion, Flexible RF systems using MEMS.

UNIT III MULTI RATE SIGNALS PROCESSING AND DIGITAL GENERATION OF SIGNALS 9

Sample rate conversion principles. Digital filter Banks. Timing recovery in Digital Receivers using Multi rate Digital filters. Approaches to Direct Digital Synthesis. Analysis of spurious signal Band pass signal generation, Generation of Random sequences.

UNIT IV DATA CONVERTERS AND SMART ANTENNAS 9

Parameters of Ideal and practical Data Converters, Techniques to Improve Data Converter performance, Common ADC and DAC Architectures. Smart Antennas- Hardware implementation of Smart Antennas.

UNIT V DIGITAL HARDWARE AND SOFTWARE CHOICES 9

DSP Processors, FPGA, ASIC s. Trade offs, Object oriented programming, Object Brokers, GNU Radio-USRP.

TOTAL : 45 PERIODS

REFERENCES:

1. Jeffrey H.Reed, "Software Radio: A Modern Approach to Radio Engineering, Prentice Hall,2002.
2. Joseph Mitola, "Software Radio Architecture: Object Oriented Approaches to Wireless System Engineering", Wiley-Inter science; I Edition 2000,ISBN:0471384925
3. Radio, G. N. U. "The software radio." Available from World Wide Web: <https://gnuradio.org> (2007).
4. S.Shanmugavel, M.A.Bhagyaveni, R.Kalidoss, “Cognitive Radio-An Enabler for Internet of things”, River Publishers, 2017. CU5095 SPACE TIME WIRELESS COMMUNICATION.

COURS E OUTCO MES	PROGRAMS OUTCOMES	PROGRAMS OUTCOMES												PROGRA M SPECIFIC OUTCOM ES		
		P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O1 0	P O1 1	P O1 2	PSO 1`	PSO 2	
CO's	Statement's															
CO-1	Design data converters	2	2	2	2	3	2	-	-	-	-	-	2	3	1	
CO-2	Evaluate smart antennas	3	1	2	3	3	-	-	-	-	-	-	2	3	3	
CO-3	Discuss digital hardware and software choices	3	1	2	3	3	2	2	-	-	-	-	2	3	3	

1. Thomas M.Lillesand,RalphW.Kiefer, "Remote Sensing And Image Interpretation", Fifth Edition,2004
2. Robert A.Schowengerdt, 'Remote Sensing Models & Methods For Image Processing', III Edition, 2004
3. A.Richards "Remote Sensing Digital Image Analysis: An Introduction", Second Revised Edition, 1993. .
4. JohnR.Jensen,"Remote Sensing Of The Environment-An Earth Resource Perspective", Pearson Education Series,2003.
5. Rafael C.Gonzalez,RichardE.Woods,"Digital Image Processing" Third edition, Prentice .

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COURSE OUTCOMES	Statement's	PROGRAMS OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	
CO-1	Understanding of remote sensing process and spectral reflectance curve	3	3	2	2									2	3	
CO-2	Knowledge of preprocessing techniques	3	3	3	3	3								2	2	2
CO-3	discussion of satellite image enhancement techniques	3	3	2	3	2								2	2	
CO-4	Learn the various data fusion and data compression techniques	3	3	2	2	2								2		2
CO-5	To understand about the data transformation	3	3	3	2	3						2		3		2

523219

**HIGH PERFORMANCE COMMUNICATION
NETWORKS**

L T P C

3 0 0 3

COURSE OBJECTIVE:

To introduce the basic networking concepts and its application along with get awareness about network security.

COURSE OUTCOMES:

Having successfully completed this course, the students should be able to:

- Realize principles of high speed communication networking.
- Analyze the performance of various networks, and to sharpen one's conceptual and intuitive understanding of the field.
- Evaluate the architectures of ISDN, Frame Relay, and ATM.
- Compare the various methods of providing connection-oriented services.
- Create Skills in a balance between the description of existing networks and tools.

UNIT I INTRODUCTION

9

Review of OSI, TCP/IP; Multiplexing, Modes of Communication, Switching, Routing. SONET – DWDM – DSL – ISDN – BISDN, ATM.

UNIT II MULTIMEDIA NETWORKING APPLICATIONS

9

Streaming stored Audio and Video – Best effort service – protocols for real time interactive applications – Beyond best effort – scheduling and policing mechanism – integrated services – RSVP- differentiated services.

UNIT III ADVANCED NETWORKS CONCEPTS

9

VPN-Remote-Access VPN, site-to-site VPN, Tunneling to PPP, Security in VPN. MPLS Soperation, Routing, Tunneling and use of FEC, Traffic Engineering and MPLS based VPN, overlay networks-P2P connections.

UNIT IV TRAFFIC MODELLING

9

Little's theorem, Need for modeling, Poisson modeling and its failure, Non- Poisson models, Network performance evaluation, Assignment using relevant software systems.

UNIT V NETWORK SECURITY AND MANAGEMENT

9

Principles of cryptography – Authentication – integrity – key distribution and certification – Access control and: fire walls – attacks and counter measures – security in many layers. Infrastructure for network management – The internet standard management framework – SMI, MIB, SNMP, Security and administration – ASN.1

L=45 TOTAL: 45 PERIODS

REFERENCES:

1. Aunurag Kumar, D. MAnjunath, Joy kuri, “Communication Networking”, Morgan Kaufmann Publishers, 1st edition 2004.
2. J.F. Kurose & K.W. Ross, “Computer Networking- A top down approach featuring the Internet”, Pearson, 5th edition, 2008.
3. LEOM-GarCIA, WIDJAJA, “Communication networks”, TMH seventh reprint 2002.
4. Walrand .J. Varatya, High performance communication network, Morgan Kauffman – Harcourt Asia Pvt. Ltd. 2nd Edition, 2000.
5. William Stallings, ISDN and Broadband ISDN with Frame Relay and ATM, 6th edition, Pearson education Asia, 2010.

COURSE OUTCOMES	PROGRAMS OUTCOMES	PROGRAM SPECIFIC OUTCOMES														
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
CO-1	Realize principles of high speed communication networking	3	2	3	2	2								3		3
CO-2	Analyze the performance of various networks, and to sharpen one's conceptual and intuitive understanding of the field	3	2	3	3	3								2		3
CO-3	Evaluate the architectures of ISDN, Frame Relay, and ATM	3	2	2	2	2								1		3
CO-4	Compare the various methods of providing connection-oriented services	2	3	2	3	3								3		2

CO-5	Create Skills in a balance between the description of existing networks and tools	2	2	3	3	3							3		1
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ELECTIVE-IV

523220

ULTRA WIDE BAND COMMUNICATION

L T P C
3 0 0 3

COURSE OBJECTIVE:

The purpose of this subject is to develop a strong foundation in the ultra wide band communication.

COURSE OUTCOMES:

Having successfully completed this course, the students should be able to:

- To know about UWB Technologies
- To know about the function of UWB techniques and channel Models
- To understand the concepts of UWB signal processing.
- To study about UWB antennas and its applications
- To understand the concepts of UWB applications and regulations

UNIT I INTRODUCTION TO UWB 9

History, Definition, FCC Mask, UWB features, UWB Interference: IEEE 802.11.a Interference, Signal to Interference ratio calculation, Interference with other wireless services

UNIT II UWB TECHNOLOGIES AND CHANNEL MODELS 9

Impulse Radio, Pulsed Multiband, Multiband OFDM, features : Complexity, Power Consumption, Security and achievable data rate. MIMO Multiband OFDM, Differential multiband ofdm, Ultra-Wideband Channel Characteristics: Channel Bandwidth, Frequency Dependence, Bandwidth Effect on Fading Statistics, Signal Processing for UWB, Channel Models for Wireless Communications, Parameter Estimation and Model Selection

UNIT III UWB SIGNAL PROCESSING 9

Data Modulation schemes, UWB Multiple Access Modulation, BER, Rake Receiver, Transmit-Reference (T-R) Technique, UWB Range- Data Rate Performance, UWB Channel Capacity UWB Wireless Locationing: Position Locationing Methods, Time of Arrival Estimation, NLOS Location Error , Locationing with OFDM

UNIT IV UWB ANTENNAS 9

Antenna Requirements, Radiation Mechanism of the UWB Antennas, Types of Broad band antennas, Parameters, Analysis of UWB Antennas, Link Budget for UWB System. Design examples of broad band UWB antennas.

UNIT V UWB APPLICATIONS AND REGULATIONS 9

Wireless Ad hoc Networking, UWB Wireless Sensor, RFID , Consumer Electronics and Personal ,Asset Location, Medical applications UWB Regulation and standards in various countries , UWB Regulation in ITU, IEEE Standardization

L=45 TOTAL: 45 PERIODS

REFERENCES:

1. Homayoun Nikookar and Ramjee Prasad, "Introduction to Ultra Wideband for Wireless Communications" 1st Edition, Springer Science & Business Media B.V. 2009.
2. W. Pam Siriwongpairat and K. J. Ray Liu, "Ultra-Wideband Communications Systems: Multiband OFDM approach" John Wiley and IEEE press, Newyork 2008
3. Thomas Kaiser, Feng Zheng "Ultra Wideband Systems with MIMO", 1st Edition, John Wiley & Sons Ltd, Newyork, 2010

COURSE OUTCOMES	PROGRAMS OUTCOMES	PROGRAM SPECIFIC OUTCOMES													
		PSO 1	PSO 2												
CO's	Statement's	P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12	PSO 1	PSO 2
CO-1	To know about UWB Technologies	3	2	2	2	3					2		2		2
CO-2	To know about the function of UWB techniques and channel Models	3	2	2	3	2					2		2	2	2
CO-3	To understand the concepts of UWB signal processing	3	2	2	3	2							2	2	
CO-4	To study about UWB antennas and its applications	3	2	3	2	3							2	2	
CO-5	To understand the concepts of UWB applications and regulations	3	2	3	2								2		2

523221

MILLIMETRE WAVE COMMUNICATION

L T P C
3 0 0 3

COURSE OBJECTIVE:

- To understand the fundamentals of Millimeter wave devices and circuits.
- To understand the various components of Millimeter wave Communications system.
- To know the antenna design at Millimeter wave frequencies.

COURSE OUTCOMES:

- Ability to understand Millimeter devices and circuits
- Ability to design antenna for Millimeter wave frequencies
- Knowledge of Millimeter wave technology
- Understand the concept of multiple antennas techniques.
- Knowledge of antenna wave systems.

UNIT I INTRODUCTION

9

Millimeter wave characteristics- millimeter wave wireless, implementation challenges, Radio wave propagation for mm wave: Large scale propagation channel effects, small scale channel effects, Outdoor and Indoor channel models, Emerging applications of millimeter wave communications.

UNIT II MM WAVE DEVICES AND CIRCUITS

9

Millimeter wave generation and amplification: Peniotrons, Ubitrons, Gyrotrons and Free electron lasers. HEMT, models for mm wave Transistors, transistor configurations, Analog mm wave components: Amplifiers, Mixers, VCO, PLL. Metrics for analog mm wave devices, Consumption factor theory, Trends and architectures for mm wave wireless, ADC's and DAC's.

UNIT III MM WAVE COMMUNICATION SYSTEMS

9

Modulations for millimeter wave communications: OOK, PSK, FSK, QAM, OFDM, Millimeter wave link budget, Transceiver architecture, Transceiver without mixer, Receiver without Oscillator, Millimeter wave calibration, production and manufacture, Millimeter wave design considerations.

UNIT IV MM WAVE MIMO SYSTEMS

9

Massive MIMO Communications, Spatial diversity of Antenna Arrays, Multiple Antennas, Multiple Transceivers, Noise coupling in MIMO system, Potential benefits for mm wave systems, Spatial, Temporal and Frequency diversity, Dynamic spatial, frequency and modulation allocation.

UNIT V ANTENNAS FOR MM WAVE SYSTEMS

9

Antenna beam width, polarization, advanced beam steering and beam forming, mm wave design consideration, On-chip and In package mm wave antennas, Techniques to improve gain of on-chip antennas, Implementation for mm wave in adaptive antenna arrays, Device to Device communications over 5G systems, Design techniques of 5G mobile.

L=45 TOTAL: 45 PERIODS

REFERENCES:

1. Robert W. Heath, James N. Murdock, Robert C. Daniels, Theodore S. Rappaport, “
2. Millimeter Wave Wireless Communications” Publisher: Prentice Hall *Release Date: September 2014* ISBN: 9780132173636.
3. K.C. Huang, Z. Wang, "Millimeter Wave Communication Systems", Wiley-IEEE Press, March ISBN: 978-0-470-40462-1 April 2011
4. Xiang, W; Zheng, K; Shen, X.S; "5G Mobile Communications: Springer, 2016
5. Robert W. Heath, Robert C. Daniel, James N. Theodore S. Rappaport, Murdock, "Millimeter Wave Wireless Communication", Prentice Hall, 2014.

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COURSE OUTCOMES	Statement's	PROGRAMS OUTCOMES												PROGRAM SPECIFIC OUTCOMES	
		P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12	PSO 1	PSO 2
CO-1	Ability to understand Millimeter devices and circuits	3	3	2	2	2	2						2	2	2
CO-2	Ability to design antenna for Millimeter wave frequencies	2	3	2	2	2	2						2	2	2
CO-3	Knowledge of Millimeter wave technology	3	2	3	2	2	2						2		2
CO-4	Understand the concept of multiple antennas techniques	3	2	3	2	2	3						2	2	2

CO-5	Knowledge of antenna wave systems	3	2	3	1	1	2						1	2	2

523222 ADVANCED SATELLITE COMMUNICATION AND NAVIGATION SYSTEMS L T P C
3 0 0 3

COURSE OBJECTIVE:

- Learn M2M developments and satellite applications
- Understand Satellite Communication In Ipv6 Environment

COURSE OUTCOMES:

- Discuss satellite navigation and global positioning system
- Outline deep space networks and inter planetary missions
- Understand Satellite Communication In Ipv6 Environment
- Able to understand the satellite navigation and methods of GPS.
- Able to understand the concept on inter planetary missions.

UNIT I OVERVIEW OF SATELLITE COMMUNICATION 9

Overview of satellite communication and orbital mechanics Link budget Parameters, Link budget calculations, Auxiliary Equations, Performance Calculations.

UNIT II M2M DEVELOPMENTS AND SATELLITE APPLICATIONS 9

Overview of the Internet of Things and M2M- M2M Applications Examples and Satellite Support Satellite Roles Context and Applications- Antennas for Satellite M2M Applications- M2M Market Opportunities for Satellite Operators- Ultra HD Video/TV and Satellite Implications- High Throughput Satellites (HTS) and Ka/Ku Spot Beam Technologies- Aeronautical, Maritime and other Mobility Services.

UNIT III SATELLITE COMMUNICATION IN IPV6 ENVIRONMENT 9

Overview of IPv6 and its benefits for Satellite Networks - Migration and Coexistence--Implementation scenarios and support- Preparations for IPv6 in Satellite communication- Satellite specific Protocol issues in IPv6 – Impact of IPv6 on Satellite Network architecture and services-Detailed transitional plan- IPv6 demonstration over satellites - Key results and recommendations.

UNIT IV SATELLITE NAVIGATION AND GLOBAL POSITIONING SYSTEM 9

Over view of Radio and Satellite Navigation, GPS Principles, Signal model and Codes, Satellite Signal Acquisition, Mathematical model of GPS observables, Methods of processing GPS data , GPS Receiver Operation and Differential GPS. IRNSS, GAGAN, GLONASS and Galileo.

UNIT V DEEP SPACE NETWORKS AND INTER PLANETARY MISSIONS 9

Introduction – Functional description - Design procedure and performance criterion-Mars exploration Rover- Mission and space craft summary-Telecommunication subsystem overview-Ground Subsystem-Telecom subsystem and Link performance Telecom subsystem Hardware and software Chandrayaan-1 Mission - Mission and space craft summary-Telecommunication subsystem overviewGround Subsystem-Telecom subsystem and

Link performance. Mangalyaan Mission - Mission and space craft summary-Telecommunication subsystem overview- Ground Subsystem-Telecom subsystem and Link performance.

L=45 TOTAL: 45 PERIODS

Text Books :

1. Adimurthy.V,” Concept design and planning of India”s first interplanetary mission” Current Science, VOL. 109, NO. 6, 1054 25 SEPTEMBER 2015.
2. Anil K. Maini, Varsha Agrawal, „Satellite Technology: Principles and Applications”, Third Edition, Wiley, 2014.

Reference:

1. Daniel Minoli” “Innovations in Satellite Communication and Satellite Technology” Wiley, 2015
2. Daniel Minoli, “Satellite Systems Engineering in an IPv6 Environment”, CRC Press, First Edition, 2009.
3. Hofmann-Wellenhof B., Lichtenegger H., and ElmarWasle, “Global Navigational Satellite Systems” Springer-Verlag, 2008.
4. Jim Taylor, “ Deep Space Communications” John Wiley & Sons, 2016.
5. Louis J. Ippolito, Jr. “Satellite Communications Systems Engineering: Atmospheric Effects, Satellite Link Design and System Performance”, Second Edition, 2017
6. <http://www.isro.gov.in/pslv-c25-mars-orbiter-mission>
7. https://en.wikipedia.org/wiki/Mars_Orbiter_Mission
8. <https://en.wikipedia.org/wiki/Chandrayaan-1>

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COURSE OUTCOMES	Statement's	PROGRAMS OUTCOMES												PROGRAM SPECIFIC OUTCOMES	
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO-1	Discuss satellite navigation and global positioning system	3	3	2	2								2	3	3
CO-2	Outline deep space networks and inter planetary missions	3	3	3	3	1				2			2	2	2
CO-3	Understand Satellite Communication In Ipv6 Environment	3	3	3	3	2				2			2		2
CO-4	Able to understand the satellite navigation and methods of GPS	3	3	3	2	2							2	2	2
CO-5	Able to understand the concept on inter planetary missions	3	2	3	2	2	2			2			2	2	2

523225

**RF SYSTEM DESIGN FOR WIRELESS
COMMUNICATION**

L T P C

3 0 0 3

COURSE OBJECTIVES:

To introduce to the students the transmitter and receiver system design techniques and Analysis, learn the applications of RF systems in wireless communication.

COURSE OUTCOMES:

Having successfully completed this course, the students should be able to:

- Understanding of application of RF system parameters.
- Knowledge of various RF architectures.
- Design for transmitter system and various kinds of wireless systems.
- Discussion about design and simulation of transmitter and receivers using software
- Learn the application of RF system design.

UNIT I FUNDAMENTALS OF SYSTEM DESIGN

9

Linear systems and transformation- linear system, Fourier series and transformation, frequency response of LTI system, Band-pass to Low-pass equivalent mapping and Hilbert transform- nonlinear system representation and analysis approaches- representation of memory less nonlinear systems, multiple input effects in nonlinear systems, memory less band-pass nonlinearities and their low-pass equivalents. Noise and Random Process -Noise Power and Spectral Representation, Noise and Random Process Through Linear Systems, Narrow-Band Noise Representation ,Noise Figure and Noise Temperature-Elements of Digital Base-Band System

UNIT II RADIO ARCHITECTURE AND DESIGN CONSIDERATIONS

9

Super heterodyne Architecture- configuration, frequency planning and design consideration- Direct conversion(Zero IF) architecture- configuration, technical challenges, design considerations- Low IF architecture- configuration, approaches to achieve high image rejection, design considerations- Band pass sampling radio architecture- basics of band-pass sampling, configuration and design considerations.

UNIT III RECEIVER SYSTEM DESIGN

9

Introduction- sensitivity and noise figure of receiver- inter modulation characteristics- single tone desensitization-adjacent/alternate channel selectivity and blocking characteristics- receiver dynamic range and AGC system- system design and performance evaluation- compression points, minimum detectable signal, dynamic range, spurious components, SFDR, blocking, cross-modulation, reciprocal mixing, IF notch rejection.

UNIT IV TRANSMITTER SYSTEM DESIGN AND ANALYSIS

9

Transmitter power and spectrum- modulation accuracy- adjacent and alternate channel power- noise emission calculation- important considerations in system design- transmitter noise,

frequency stability and spurious signals, frequency tuning, output power and efficiency, inter modulation

UNIT V APPLICATIONS OF SYSTEM DESIGN 9

Multimode and Multiband Super heterodyne Transceiver -Selection of a Frequency Plan, Receiver System Design, Transmitter System Design- Direct Conversion Transceiver- Receiver System Design, and Transmitter System Design.

L=45 TOTAL: 45 PERIODS

REFERENCES:

1. Bosco Leung, VLSI for Wireless Communication ,Springer, 2011.
2. Elmad N Farag and Mohamed I Elmasry, Mixed Signal VLSI Wireless Design-Circuits and Systems, Kluwer Academic Publishers, 2002.
3. Gabriele Manganaro, Domine M W Leenaerts, “Advances in Analog and RF IC Design for Wireless Communication System”, Elsevier, 3rd edition, 2008.
4. Qizheng Gu, “RF System Design of Transceivers for Wireless Communications” , Springer publications, 3rd edition, 2009.
5. William F. Egan, “Practical RF System Design”, willy publications, 4th edition, 2012.
6. Zhipei Chi, High Performance, High Speed VLSI Architectures for Wireless Communication Applications University of Minnesota, 2009
- 7.

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COURSE OUTCOMES	PROGRAMS OUTCOMES	PROGRAM SPECIFIC OUTCOMES													
		PSO 1	PSO 2												
CO's	Statement's	P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12	PSO 1	PSO 2
CO-1	Discuss satellite navigation and global positioning system	3	3	2	2								2	3	3
CO-2	Outline deep space networks and inter planetary missions	3	3	3	3	1				2			2	2	2

CO-3	Understand Satellite Communication In Ipv6 Environment	3	3	3	3	2				2			2		2
CO-4	Able to understand the satellite navigation and methods of GPS	3	3	3	2	2							2	2	2
CO-5	Able to understand the concept on inter planetary missions	3	2	3	2	2	2			2			2	2	2

523223

PHOTONICS

L T P C
3 0 0 3

COURSE OBJECTIVE:

To introduce the concepts of photonics and various wave generating components.

COURSE OUTCOMES::

Having successfully completed this course, the students should be able to:

- Gain knowledge about light and its propagation.
- Study the different types of Interfaces.
- To study about the function of various kind of networks for the data transmission
- Learn about holography
- Study the non-linear optic devices.

UNIT I INTRODUCTION TO PHOTONICS 9

Nature of Light – Wave and light terminology, Maxwell equation, light spectra and sources, absorption and emission, black body radiation. Dielectric Media, Constitutive Relations, Anisotropic Media. Geometric Optics – law of reflection including plane mirrors, prisms and thin lenses including ensmaker’s equation, Lens problems and optical instruments using the thin lens equation.

UNIT II WAVE OPTICS 9

Wave descriptive terminology, wave superposition (interference) including double – slit interference, diffraction and diffraction gratings, interference applications, eg. Michelson, Mach Zender and Fabry Perot interferometers, Thin film interference and Fibre Bragg Gratings. Diffraction Effects including: airy disk, near far field effects. Polarization principles including scattering, reflection and birefringence.

UNIT III DATA TRANSMISSION INTERFACES AND DISPLAYS 9

Photonic Networks – Microwave Communication System – Liquid Crystal Displays – Organic Light emitting diodes.

UNIT IV HOLOGRAPHY 9

Holography – Theory and basic principles, Requirement to record and reconstruct holograms –Amplitude and phase holograms - Experimental techniques- Recording Materials-Reflection holography- Holographic Interferometry-Nondestructive testing, optical memory, Applications of holography.

UNIT V NON-LINEAR OPTICS 9

Non-linear optics – Harmonic Generation, sum and difference frequency generation, wave mixing, Optical Parametric Oscillator. Non-linear optic materials – inorganic and organic. Phase matching, efficiency of harmonic generation- powder and single crystal methods. Second-order nonlinear phenomena (electro- optic effect, second harmonic generation and frequency conversion), Third-order nonlinear phenomena (Z-scan and four-wave mixing), Phase conjugation Silicon Photonics-Silicon on Insulator Photonics-Fabrication of Silicon Waveguides"

L=45 TOTAL: 45 PERIODS

REFERENCES:

1. Bahaa E. A. Saleh, Malvin Carl Teich, "Fundamentals of Photonics", John Wiley & Sons 2011, 2nd Edition

COURSE OUTCOME S	PROGRAMS OUTCOMES	PROGRAMS OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	
CO-1	Gain knowledge about light and its propagation	3	2	2	2	2					2	2		2	2	
CO-2	Study the different types of Interfaces	3	2	2	2						2		2	2		
CO-3	To study about the function of various kind of networks for the data transmission	3	3		2						2	2			2	
CO-4	Learn about holography	3	2	2		2	2						1		2	
CO-5	Study the non-linear optic devices	3	2		2		2					2		2	2	

ELECTIVE-V

523226	ADVANCED DIGITAL IMAGE PROCESSING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

To explore the concepts of digital image processing and design image analysis techniques in the form of image segmentation and to evaluate the methodologies for segmentation.

COURSE OUTCOMES:

Having successfully completed this course, the students should be able to:

- Understand the image fundamentals and mathematical transforms
- Know the image segmentation and representation techniques.
- Introduce the concepts of image registration and image fusion.
- Analyze the constraints in image processing when dealing with 3D data sets

UNIT I FUNDAMENTALS OF DIGITAL IMAGE PROCESSING 9

Elements of visual perception, brightness, contrast, hue, saturation, mach band effect, 2D image transforms-DFT, DCT, KLT, and SVD. Image enhancement in spatial and frequency domain, Review of morphological image processing

UNIT II SEGMENTATION 9

Image Segmentation: Edge Detection - Line Detection - Curve Detection - Edge Linking And Boundary Extraction, Boundary Representation, Region Representation And Segmentation, Morphology-Dilation, Erosion, Opening And Closing. Hit And Miss Algorithms Feature Analysis

UNIT 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- Autocorrelation, Co-occurrence features, Runlength features, Fractal model based features, Gabor filter, wavelet features.

UNIT IV REGISTRATION AND IMAGE FUSION 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-Overview of image fusion, pixel fusion, Multiresolution based fusion discrete wavelet transform, Curvelet transform. Region based fusion.

UNIT 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, Measurements on 3D images.

Total: 45 periods

REFERENCES:

1. John C.Russ, “The Image Processing Handbook”, CRC Press,2007, 6th Edition.
2. . Mark Nixon, Alberto Aguado, “Feature Extraction and Image Processing”, Academic Press, 2th Edition 2008.
3. Ardeshir Goshtasby, “ 2D and 3D Image registration for Medical, Remote Sensing and Industrial Applications”,John Wiley and Sons,2005.
4. Rafael C. Gonzalez, Richard E. Woods, , Digital Image Processing', Pearson,Education, Inc.,Second Edition, 2004.
5. Anil K. Jain, , Fundamentals of Digital Image Processing', Pearson Education,Inc., 2002.

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COURSE OUTCOMES	Statement's	PROGRAMS OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	
CO-1	To Understand the image fundamentals and mathematical transforms	3	2	2		2						2	2		2	
CO-2	To understand the image segmentation and representation techniques	3	2		2		2					2	2		2	
CO-3	Identify the image restoration model and different noise models	2	2		1	1						1	1		2	

CO-4	To Introduce the concepts of image registration and image fusion	3	2		2	2					2	2	2		2
CO-5	To Analyze the constraints in image processing when dealing with 3D data sets	3	2		2					2	2			2	2

523227

RESEARCH METHODOLOGIES

L T P C
3 0 0 3

COURSE OBJECTIVE:

To familiarize the student with the basic need of research for their evolution using various methods and techniques.

COURSE OUTCOMES:

Having successfully completed this course, the students should be able to:

- Introduce about research and its importance.
- Gain knowledge about design and data collection techniques evolve in research.
- Get idea about prepare research report and its execution.

UNIT I INTRODUCTION TO RESEARCH

The hallmarks of scientific research – the building blocks of science in research – the research process for applied and basic research – the need for theoretical frame work – hypothesis development – hypothesis testing with quantitative data. The research design. The purpose of the study: Exploratory, Descriptive, Hypothesis testing (Analytical and Predictive) – cross sectional and longitudinal studies.

UNIT II EXPERIMENTAL DESIGN 9

The laboratory and the field experiment – Simulation--internal and external validity – factors affecting internal validity. Measurement of variables – scales and measurement of variables – development scales - rating scale and concept in scales being developed. Stability measures. Meaning & Role of hypothesis

UNIT III DATA COLLECTION METHOD 9

Interviewing, questionnaires etc. Secondary sources of data collection. Guidelines for questionnaire design – electronic questionnaire design and surveys. Special data source: Focus groups, Static and dynamic data-collection methods and when to use each. Sampling techniques and confidence in determining sample size. Hypothesis testing determination of optimal sample size.

UNIT IV A REFRESHER ON SOME MULTIVARIATE STATISTICAL TECHNIQUES 9

Factor analysis – cluster analysis – discriminate analysis –multiple regression & Correlation – canonical correlation – application of SPSS package.

UNIT V THE RESEARCH REPORT 9

The purpose of the written report – concept of audience – Basics of written reports. The integral parts of a report – the title of a report. The table of content, the synopsis, the introductory section, method of sections of a report, result section – discussion section – recommendation and implementation section

TOTAL : 45 PERIODS

REFERENCES:

1. Donald R.Cooper and Ramcis S.Schindler, Business Research Methods, TataMcGraw Hill Publishing CompanyLimited, New Delhi, 2000
2. C.R.Kothari Research Methodology, Wishva Prakashan, New Delhi, 2001
3. Uma Sekaran, Research Methods for Business, John Wiley and Sons Inc., New York, 2000.
4. Donald H.Mc.Burney, Research Methods, Thomson Asia Pvt. ltd. Singapore 2002
5. G.W.Ticehurst and A.J.Veal, Business Research Methods, Longman, 1999
6. Ranjit Kumar, Research Methodology, Sage Publication, London, New Delhi, 1999.
7. Raymond-Alain Thie'tart, ET, al., doing management research, sage publication, London, 1999.

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COURSE OUTCOMES	PROGRAMS OUTCOMES	PROGRAMS OUTCOMES														PROGRAM SPECIFIC OUTCOMES	
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2		
CO-1	To Introduce about research and its importance	3	2	2	2	2					2	2	2		2		
CO-2	To understand the experimental design	3	2	2	2						2	2		2			
CO-3	To understand about design and data collection techniques evolve in research	3	2	2		1				2		2	2		2		

CO-4	To understand the multivariate statistical techniques	3	2		2	2				2		2	2	2	
CO-5	Get idea about prepare research report and its execution	3	2	2		2					2	2			2

523228

APPLICATION OF MEMS

L	T	P	C
3	0	0	3

COURSE OBJECTIVE:

To introduce the concepts of micro electro mechanical devices and to know the fabrication process of Microsystems.

COURSE OUTCOMES:

Having successfully completed this course, the students should be able to:

- Understanding the concepts of MEMS
- Design of different type of micro sensors
- Understanding the concepts of MEMS transducers
- To study about the MEMS and thermal transducers
- Design a different type of sensors and MEMS sensors

UNIT I INTRODUCTION TO MEMS 9

MEMS, Use of MEMS, Fabrication process. The Substrate and adding material to it: Introduction, The silicon substrate, Additive technique Oxidation, Additive technique- Physical vapor deposition, other additive techniques.

UNIT II MEMS FABRICATION TECHNOLOGIES 9

Microsystem fabrication processes: Photolithography, Ion Implantation, Diffusion, Oxidation. Thin film depositions: LPCVD, Sputtering, Evaporation, Electroplating; Etching techniques: Dry and wet etching, electrochemical etching; Micromachining: Bulk Micromachining, Surface Micromachining, High Aspect- Ratio (LIGA and LIGA-like) Technology; Packaging: Microsystems packaging, Essential packaging technologies, Selection of packaging materials

UNIT III MEMS TRANSDUCERS-I 9

Modelling: Units, The input-output concept, Physical variables and notation, Preface to the modeling chapters. MEMS Transducers: An overview-Transducer, Distinguishing between sensors and actuators, Response characteristics of transducers, MEMS Sensors- Principles of operation, MEMS Actuators Principles of operation, Signal conditioning, RF applications and Optical applications. Piezoresistive Transducers: Introduction, Modeling Piezoresistive transducers, Piezoresistive pressure sensor.

UNIT IV MEMS TRANSDUCERS – II 9

Capacitive Transducers: Introduction, Capacitor fundamentals, Modeling a capacitor sensor, Capacitive accelerometer, Thermal Transducers: Introduction, Basic heat transfer, Hot-arm actuator.

UNIT V MICRO SENSORS 9

MEMS Sensors: Design of Acoustic wave sensors, resonant sensor, Vibratory gyroscope, Capacitive and Piezo Resistive Pressure sensors

L=45 TOTAL: 45 PERIODS

REFERENCES:

1. Adams, Thomas M., Layton, Richard A., “Introductory MEMS Fabrication and Applications”, Springer.2010
2. Chang Liu, “Foundations of MEMS”, Pearson education India limited, 2006.
3. Mohamed Gad-el-Hak, “MEMS-Applications”, CRC Press, 29-Nov-2005.
4. Michael Kraft, Neil M White, “Mems for Automotive and Aerospace Applications” , WP Publication 4th edition, 2013.
5. Tai-Ran Hsu, “MEMS and Microsystems- Design and Manufacture”, McGraw-Hill, 2002.
6. Vikas Choudhary, Krzysztof Iniewski, “MEMS: Fundamental Technology and Applications” CRC Press, 4th edition, 2013.

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COURSE OUTCOMES	Statement's	PROGRAMS OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
		P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12	PSO 1	PSO 2	
CO-1	To Understanding the concepts of MEMS	3	3	3	3	1								2		3
CO-2	Design of different type of micro sensors	3	3	3	2	1								2	1	1
CO-3	Understanding the concepts of MEMS transducers	3	3	3	3	2	2							2		2
CO-4	To study about the MEMS and thermal transducers	3	3	2	3	2	2							2	1	1
CO-5	Design a different type of sensors and MEMS sensors	3	3	3	2	2	2							2	2	2

523229

DETECTION & ESTIMATION THEORY

L T P C
3 0 0 3

COURSE OBJECTIVE:

To understand the concepts of detection and estimation.

- To learn the basics of multi-user detection theory
- To understand the theory behind various estimation techniques.
- To understand Wiener filter and Kalman filter in detail.

COURSE OUTCOMES:

- To be able to apply detection and estimation theory to solve communication problems.
- To apply probability and stochastic process concepts in detection and estimation
- To design Wiener and Kalman filters to solve linear estimation problems.
- To be able to apply detection and estimation theory to solve communication problems.
- To apply probability and stochastic process concepts in detection and estimation.
- To design Wiener and Kalman filters to solve linear estimation problems.

UNIT I REVEIW OF PROBABILITY AND STOCHASTIC PROCESS 9

Conditional Probability, Bayes' Theorem , Random Variables, Conditional Distributions and Densities, moments and distribution of random variables., Stationary Processes Cyclostationary Processes Averages and Ergodicity Autocorrelation Function Power Spectral Density Discrete Time Stochastic Processes, Spatial Stochastic Processes, Random Signals, Relationship of Power Spectral Density and Autocorrelation Function.

UNIT II SINGLE AND MULTIPLE SAMPLE DETECTION 9

Hypothesis Testing and the MAP Criterion, Bayes Criterion, Minimax Criterion, Neyman-Pearson Criterion, Sequential Detection, The Optimum Digital Detector in Additive Gaussian Noise , Performance of Binary Receivers in AWGN.

UNIT III FUNDAMENTALS OF ESTIMATION THEORY 9

Formulation of the General Parameter Estimation Problem, Relationship between Detection and Estimation Theory, Types of Estimation Problems, Properties of Estimators, Bayes estimation, Minimax Estimation, Maximum-Likelihood Estimation, Comparison of Estimators of Parameters.

UNIT IV WIENER AND KALMAN FILTERS 9

Orthogonality Principle, Autoregressive Techniques, Discrete Wiener Filter, Continuous Wiener Filter, Generalization of Discrete and Continuous Filter Representations , Linear Least-Squares Methods, Minimum-Variance Weighted Least-Squares Methods, Minimum-Variance, LeastSquares, Kalman Algorithm - Computational Considerations, Signal Estimation, Continuous Kalman Filter, Extended Kalman Filter.

UNIT V APPLICATIONS 9

in Non-Gaussian Noise , Examples of Noise Models, Receiver Structures, and Error-Rate Performance, Estimation of Non-Gaussian Noise Parameters Fading Multipath Channel Models, Receiver Structures with Known Channel Parameters, Receiver Structures without Knowledge of

Phase, Receiver Structures without Knowledge of Amplitude or Phase, Receiver Structures and Performance with No Channel Knowledge.

L=45 TOTAL: 45 PERIODS

TEXTBOOKS:

1. Steven M. Kay, "Fundamentals of Statistical Processing, Volume V: Estimation Theory", Prentice Hall Signal Processing Series, Prentice Hall, PTR, New Jersey, 2010.

REFERENCES:

1. Harry L. Van Trees, "Detection, Estimation and Modulation Theory", Part I John Wiley and Sons, New York, 2013.
2. Ludeman, Lonnie C. Random processes: filtering, estimation, and detection. John Wiley & Sons, Inc., 2011.
3. Sergio Verdu "Multi User Detection" Cambridge University Press, 2002.
4. Thomas Schonhoff, "Detection and Estimation Theory", Prentice Hall, New Jersey, 2007.

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COURSE OUTCOMES	Statement's	PROGRAMS OUTCOMES												PROGRAM SPECIFIC OUTCOMES	
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO-1	To be able to apply detection and estimation theory to solve communication problems.	3	2	2			2				2		2	2	
CO-2	To design Wiener and Kalman filters to solve linear estimation problems	3		2	2						2		2	2	
CO-3	To be able to apply detection and estimation theory to solve	3	2	2		2					2			2	2

	communication problems														
CO-4	To apply probability and stochastic process concepts in detection and estimation	3	2		2					2	2		2	2	2
CO-5	To design Wiener and Kalman filters to solve linear estimation problems	3	2	2	2		2					2	2	2	

523230

INTERNET OF THINGS

L T P C

3 0 0 3

COURSE OBJECTIVES:

The purpose of this course is to impart knowledge on IoT Architecture and various protocols

COURSE OUTCOMES:

- To introduce the terminology, technology and its applications
- To introduce the concept of M2M (machine to machine) with necessary protocols
- To introduce the Python Scripting Language which is used in many IoT devices
- To introduce the Raspberry PI platform, that is widely used in IoT applications
- To introduce the implementation of web based services on IoT devices

UNIT I INTRODUCTION TO INTERNET OF THINGS

9

Definition and Characteristics of IoT, Physical Design of IoT – IoT Protocols, IoT communication models, Iot Communication APIs IoT enabled Technologies – Wireless Sensor Networks, Cloud Computing, Big data analytics, Communication protocols, Embedded Systems, IoT Levels and Templates Domain Specific IoTs – Home, City, Environment, Energy, Retail, Logistics, Agriculture, Industry, health and Lifestyle

UNIT II IoT AND M2M

9

Software defined networks, network function virtualization, difference between SDN and NFV for IoT Basics of IoT System Management with NETCOZF, YANG- NETCONF, YANG, SNMP NETOPEER

UNIT III INTRODUCTION TO PYTHON

9

Language features of Python, Data types, data structures, Control of flow, functions, modules, packaging, file handling, data/time operations, classes, Exception handling Python packages – JSON, XML, HTTPLib, URLLib, SMTPLib

UNIT IV IoT PHYSICAL DEVICES AND ENDPOINTS

9

Introduction to Raspberry PI-Interfaces (serial, SPI, I2C) Programming – Python program with Raspberry PI with focus of interfacing external gadgets, controlling output, reading input from pins.

UNIT V IoT PHYSICAL SERVERS AND CLOUD OFFERINGS

9

Introduction to Cloud Storage models and communication APIs Webserver – Web server for IoT, Cloud for IoT, Python web application framework Designing a RESTful web API

L=45 TOTAL: 45 PERIODS

REFERENCES:

1. A Hands-on Approach, Arshdeep Bahga and Vijay Madiseti, Universities Press, 2015, ISBN: 9788173719547
2. Bernd Scholz-Reiter, Florian Michahelles, “Architecting the Internet of Things”, ISBN 978-3-642-19156-5 e-ISBN 978-3-642-19157-2, Springer
3. Daniel Minoli, “Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications”, ISBN: 978-1-118- 47347-4, Willy Publications
4. Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O’Reilly (SPD), 2014, ISBN: 9789350239759
5. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, StamatisKarnouskos, David Boyle, “From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence”, 1 st Edition, Academic Press, 2014
6. Vijay Madiseti and ArshdeepBahga, “Internet of Things (A Hands-onApproach)”, 2nd Edition, VPT, 2014.

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COURSE OUTCOMES	PROGRAMS OUTCOMES	PROGRAM SPECIFIC OUTCOMES													
		PSO 1	PSO 2												
CO's	Statement's	P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12	PSO 1	PSO 2
CO-1	To introduce the terminology, technology and its applications	2	2		2	2					2	2		2	
CO-2	To introduce the concept of M2M (machine to machine) with necessary protocols	3	2		2							2		2	2
CO-3	To introduce the Python Scripting Language which is used in many IoT devices	3	2		2						2		2	2	2

CO-4	To introduce the Raspberry PI platform, that is widely used in IoT application	2	2		2					2			2	2	2
CO-5	To introduce the implementation of web based services on IoT devices	2	2	1		2				1			2	2	

523231

MEDICAL IMAGE PROCESSING

L T P C
3 0 0 3

COURSE OBJECTIVE:

To study about fundamentals of medical image processing techniques.

COURSE OUTCOMES:

Having successfully completed this course, the students should be able to:

- To understand the fundamentals of medical image processing techniques.
- To develop computational methods and algorithms to analyze and quantify biomedical data
- Students will be able to apply image processing concepts for medical images.
- Will be able to analyze Morphology, Segmentation techniques and implement these in images.
- Enables quantitative analysis and visualization of medical images of numerous modalities such as PET, MRI, CT, or microscopy

UNIT I IMAGE FUNDAMENTALS AND PRE-PROCESSING 9

Image perception, MTF of the visual system, Image fidelity criteria, Image model, Image sampling and quantization – two dimensional sampling theory, Image quantization, Optimum mean square quantizer, Image transforms – 2D-DFT and other transforms. Image enhancement – point operation, Histogram modeling, spatial operations, Transform operations,

UNIT II BASICS OF MEDICAL IMAGE SOURCES 9

Radiology- The electromagnetic spectrum-Computed Tomography-Magnetic Resonance Tomography –ultrasound-nuclear medicine and molecular imaging-other imaging techniques-radiation protection and dosimetry.

UNIT III MEDICAL IMAGE REPRESENTATION 9

Pixels and voxels – algebraic image operations - gray scale and color representation- depth-color and look up tables - image file formats- DICOM- other formats- Analyze 7.5, NifTI and Interfile, Image quality and the signal to noise ratio- MATLAB based simple operations.

UNIT IV MEDICAL IMAGE ANALYSIS AND CLASSIFICATION 9

Image segmentation- pixel based, edge based, region based segmentation. Image representation and analysis, Feature extraction and representation, Statistical, Shape, Texture, feature and image classification – Statistical, Rule based, Neural Network approaches

UNIT V IMAGE REGISTRATIONS AND VISUALIZATION 9

Rigid body visualization, Principal axis registration, Interactive principal axis registration, Feature based registration, Elastic deformation based registration, Image visualization – 2D display methods, 3D display methods, virtual reality based interactive visualization.

L=45 TOTAL: 45 PERIODS

REFERENCES:

1. AtamP.Dhawan, „Medical Image Analysis“, Wiley Interscience Publication, NJ, USA 2007.
2. G.R. SINHA, BHAGWATI CHARAN PATEL, “Medical Image Processing”, PHI publications, 3rd edition, 2010.
3. R.C.Gonzalez and R.E.Woods, „Digital Image Processing“, 3rd edition, Pearson Education, 2008.
4. Thomas Martin Deserno, “Biomedical Image Processing”, Springer, 4th edition, 2012.
5. Wolfgang Birkfellner, „Applied Medical Image Processing – A Basic course“, CRC P.

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COURSE OUTCOMES	Statement's	PROGRAMS OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	
CO-1	To understand the fundamentals of medical image processing techniques	3	2	2	2	2	1					1		2	1	2
CO-2	To develop computational methods and algorithms to analyze and quantify biomedical data	3	2	2	2	3						1		2	2	
CO-3	To apply image processing concepts for medical images	3	2	2	2	1						2		3		2

CO-4	To analyze Morphology, Segmentation techniques and implement these in images	3	3	2	2	2							3	2		
CO-5	Enables quantitative analysis and visualization of medical images of numerous modalities such as PET, MRI, CT, or microscopy	3	3	3	2	2					1		2	2		