Kerala Technological University

Cluster 4: Kottayam

M. Tech Program in Electronics & Communication Engineering

(Wireless Technology)

Scheme of Instruction & Syllabus: 2015 Admissions

Compiled By

Rajiv Gandhi Institute of Technology, Kottayam

July 2015

Kerala Technological University

(Kottayam Cluster)

M. Tech in Electronics and Communication Engineering (Wireless Technology)

Scheme

Credit requirements **:** 65 credits (21+18+14+12)
Normal Duration : Regular: 4 semesters; External Registration: 6 semesters;
Maximum duration : Regular: 6 semesters; External Registration: 7 semesters.
Courses: Core Courses: Either 4 or 3 credit courses; Elective courses: All of 3 credits

ELIGIBILITY: B. Tech/B.E in Electronics and Communication, B. Tech/B.E in Electronics and Instrumentation, B. Tech/B.E in Electrical and Electronics

Allotment of credits and examination scheme:-

Semester 1

Exam Slot	Course No:	Name	L- T - P	Internal Marks	End Semester Exam		Credits
					Marks	(hrs)	
A	04 EC 6601	Probability & Stochastic process	4-0-0	40	60	3	4
B	04 EC 6603	Wireless Communications	3-0-0	40	60	3	3
C	04 EC 6605	Antenna systems	3-0-0	40	60	3	3
D	04 EC6607	Advanced Digital Signal Processing	3-0-0	40	60	3	3
E	04 EC 66XX	Elective - I	3-0-0	40	60	3	3
	04 GN 6001	Research Methodology	0-2-0	100	0	0	2
	04 EC 6691	Seminar - I	0-0-2	100	0	0	2
	04 EC 6693	Communication simulation lab	0-0-2	100	0	0	1
		Total	22				21

**See List of Electives-I for slot E*

List of Elective - I Courses

Exam Slot	Course No.	Course Name
E	04 EC 6609	Digital Communications
E	04 EC 6611	Network Routing Algorithms
E	04 EC6613	Embedded System Design and Application
E	04 EC6615	Microwave Integrated Circuits

Semester 2

Exam Slot	Course No:	Name	L- T - P	Internal Marks	End Semester Exam		Credits
					Marks	(hrs)	
A	04 EC6602	Adhoc And Wireless Sensor Networks	3-0-0	40	60	3	3
B	04 EC6604	Advanced Wireless Mobile Communications	3-0-0	40	60	3	3
C	04 EC6606	MIMO & OFDMA for wireless communication	3-0-0	40	60	3	3
D	04 EC66XX	Elective-2	3-0-0	40	60	3	3
E	04 EC66XX	Elective-3	3-0-0	40	60	3	3
	04 EC6692	Mini Project	0-0-4	100	0	0	2
	04 EC6694	Communication lab with core course	0-0-2	100	0	0	1
		Total	22				18

**See List of Electives -II for slot D* *^See List of Electives -III for slot E*

List of Elective - II Courses

Exam Slot	Course Code	Course Name
D	04 EC6608	Analytical and Computational Techniques in Electromagnetics
D	04 EC6612	Electromagnetic Interference/Electromagnetic Compatibility in System
D	04 EC6614	Speech and Audio Processing System
D	04 EC6616	RF System Design for Wireless Communication

List of Elective - III Courses

Exam Slot	Course Code	Course Name
E	04 EC6618	Image & Video signal processing
E	04 EC6620	RF MEMS for wireless communication
E	04 EC6622	Advanced Techniques For Wireless Reception
E	04 EC6624	Cooperative Wireless Communication System

Summer Break

Exam Slot	Course No:	Name	L- T - P	Internal Marks	End Semester Exam		Credits
					Marks	(hrs)	
NA	04 EC7690	Industrial Training	0-0-4	NA	NA	NA	Pass /Fail
		Total	4				0

Semester 3 (Credits: 14)

Exam Slot	Course No:	Name	L- T - P	Internal Marks	End Semester Exam		Credits
					Marks	Duration (hrs)	
A	04 EC76XX	Elective - IV	3-0-0	40	60	3	3
B	04 EC76XX	Elective - V	3-0-0	40	60	3	3
	04EC7691	Seminar - II	0-0-2	100	0	0	2
	04EC7693	Project (Phase - I)	0-0-12	50	0	0	6
		Total	20				14

**See List of Electives-IV for slot A* *^See List of Electives-V for slot B*

List of Elective - IV Courses

Exam Slot	Course Code	Course Name
A	04 EC 7601	Smart Antennas
A	04 EC 7603	Optical Wireline Technology
A	04 EC 7605	Detection and estimation of signals
A	04 EC 7607	Multimedia Compression techniques

List of Elective - V Courses

Exam Slot	Course Code	Course Name
B	04 EC 7609	Global Positioning Systems
B	04 EC 7611	Broad Band Wireless Technologies
B	04 EC 7613	Advanced information theory and coding techniques
B	04 EC 7615	Soft Computing Techniques

Semester 4 (Credits: 12)

Exam Slot	Course No:	Name	L- T - P	Internal Marks	External Evaluation Marks		Credits
NA	04 EC 7694	Project (Phase -II)	0-0-21	70	30	NA	12
		Total	21				12

Total: 65

SEMESTER 1

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 EC 6601	PROBABILITY &STOCHASTIC PROCESS	4-0-0:4	2015

Pre-requisites:
Nil

Course Objectives:
This course is intended to

- Identify and apply the concepts of probability spaces, Convergence and Stationary processes.
- Devise various methods to estimate the Spectrum of a given Signal
- Analyze the Prediction and estimation techniques using various algorithms

Syllabus:

Probability spaces, Convergence concepts, Stationary in the strict and wide senses, Spectrum Estimation

Course Outcome:

The student will be able to

• Evaluate the different aspects of various probability distributions and the Convergence Concepts.

• Define, Describe and enumerate the concepts of Stationary Processes.

• Estimate the Spectrum of a given Signal using suitable Spectrum Estimation technique.

• Enumerate the Prediction and estimation techniques using various algorithms

Text Books:

1. Monson H. Hayes, Statistical Digital Signal Processing and Modelling, John Wiley and Sons, Inc., New York, 1996

2. Stark and Woods, “Probability and Random Processes with Application to Signal Processing”, Pearson Education 3/e, 2002.

References:

1. A. Papoulis, S. U. Pillai, “Proabability, Random variables and Stochastic processes” 4th edition Tata-Mc Hill (4/e) ,2001

2. R. B. Ash & C. Doleans-Dade, Probability and Measure Theory (2/e), Elsevier, 2005

3. S. Palaniammal, Probability and Random Process PHI, New Delhi, 2008

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 EC 6601	PROBABILITY &STOCHASTIC PROCESS	4-0-0:4	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE 1: Probability spaces. Random variables and random vectors. Distributions and densities. Statistical independence. Expectations, moments and characteristic functions. Infinite sequences of random variables.		9	15
MODULE 2: Convergence concepts. Laws of large numbers. Stochastic processes. Continuity concepts. Gaussian processes and Wiener processes Second order processes. Covariance functions and their properties. Linear operations Orthogonal expansions		10	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3: Stationary in the strict and wide senses. Auto correlation- Cross correlation –Properties Ergodicity in the q.m.sense- L2 – stochastic integrals. Spectral decomposition theorem. Low-pass and band-pass processes.		9	15
MODULE 4: Spectrum Estimation - Non-Parametric Methods- Correlation Method –Co-Variance Estimator – Performance Analysis of Estimators – Unbiased, Consistent Estimators – Periodogram Estimator –Barlett Spectrum Estimation – Welch Estimation Model based Approach – AR, MA, ARMA Signal Modeling – Parameter Estimation using Yule-Walker Method.		12	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5: Linear Estimation and Prediction - Maximum likelihood criterion-efficiency estimator Least mean squared error criterion, Wiener filter Discrete Wiener Hoff equations - LMS algorithm		9	20
MODULE 6: Linear Prediction, prediction error-whitening filter, inverse filter Recursive estimators-Kalman filter .Levinson recursion- Lattice realization- Levinson recursion algorithm for solving Teoplitz system of equations.		7	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 EC6603	WIRELESS COMMUNICATIONS	3-0-0:3	2015

Pre-requisites:

Nil

Course Objectives:

1. To understand the basics of radio propagation
2. To describe cellular concepts and access techniques
3. To have a knowledge of PCS communications
4. To understand algorithms used for signal reception

Syllabus :

Free space propagation-reflection-diffraction-scattering-fading-diversity-frequency reuse-access techniques-LEO,GEO,MEO-SDR-MIMO-CDMA-Blind multiuser detection

Course Outcome:

After Learning this course, the student will be able to:-

- Describe and Enumerate the various methods of Radio Propagation
- Explain and illustrate the various concepts used in diversity techniques
- Describe the concept of Personal Mobile Communication
- Explain the various concepts associated with CDMA systems

Text Books:

1. Theodore S. Rappaport, “Wireless Communications: Principles and Practice”, 2nd edition, Prentice Hall of India, 2005.
2. KamiloFeher, "Wireless Digital Communications: Modulation and Spread Spectrum Techniques”, Prentice Hall of India, 2004.
3. XiaodongWang and Vincent Poor, “Wireless Communication Systems: Advanced Techniques for Signal Reception”, Pearson Education (Asia) Pte. Ltd, 2004

References:

1. V K Garg and J E Wilkes, “Wireless and Personal Communication Systems”, Prentice Hall, 1996.
2. S Haykin and M Moher, “Modern Wireless Communication”, Pearson Education, 2005.
3. Jeffrey H Reed, “ Software Radio: A Modern Approach to Radio Engineering”, Prentice Hall, May 2002.
4. C Oestges and B Clerckx, “MIMO Wireless Communications”, 1st Edition 2007.
5. A J Viterbi, “CDMA: Principles of Spread Spectrum Communications”, Addison Wisley, New York, 1995.

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 EC 6603	WIRELESS COMMUNICATIONS	3-0-0:3	
MODULES		Contact Hours	Sem. Exam Marks (%)
MODULE 1: Radio propagation: Free space propagation modelreflection, ground reflection diffraction, scattering ,indoor and outdoor propagation models,signal penetration into buildings, ray tracking and site specific modeling, small scale multi-path propagation,impulse response model of a multi-path channel, small scale multi-path measurements, parameters of mobile multi-path channels, types of small scale fading, Rayleigh and Ricean distributions, statistical models for multi-path fading channels.		10	15
MODULE 2: Diversity techniques: Concepts of Diversity branch and signal paths, Combining and switching methods, C/N, C/I performance improvements , Average Pe, Performance improvement, RAKE receiver.		10	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3: Basics of Cellular Concepts Cellular Concept: Frequency reuse, channel assignment strategies, handoff strategies; interference and system capacity, trunking and grade of service - improving coverage and capacity in cellular systems. FDMA, TDMA, spread spectrum multiple access, SDMA, Packet Radio, capacity of cellular systems.		9	15
MODULE 4: Personal Mobile Satellite Communications: Integration of GEO, LEO, and MEO Satellite and Terrestrial mobile systems, Personal Mobile Satellite Communications: personal satellite Communications programs. Software Defined Radio (SDR). Characteristics and benefits of a Software Radio, Design Principles of Software Radio. Multiple Input Multiple Output (MIMO) Wireless communications		9	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5: CDMA Systems: Introduction to CDMA, Walsh codes, Variable tree OVSF PN Sequences, Multipath diversity, RAKE Receiver, CDMA Receiver, synchronization, WCDMA		9	20
MODULE 6: Signal Reception Wireless signaling environment, basic receiver signal processing for wireless Blind multi-user detection methods: Direct and subspace methods Performance of blind multi-user detector		9	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 EC 6605	ANTENNA SYSTEMS	3-0-0:3	2015

Pre-requisites:

Nil

Course Objectives:

1. To understand the basic concepts of antenna fundamentals
2. To learn about radiations from various structures
3. To learn about radiations from aperture antenna
4. To get clear insight of array antennas
5. To get a clear insight into microstrip antenna

Syllabus :

Antenna Fundamentals, Types of Antennas, Radiation from Apertures, Antenna Arrays, Microstrip Antennas, Antennas for Terrestrial Mobile Communication Systems

Course Outcome:

After Learning this course, the student will be able to:-

- Define and Describe the fundamentals concepts associated of Antenna
- Distinguish between different types of antennas and enumerate their properties
- Describe different types of antenna arrays
- Enumerate the working of an Antenna in the context of Terrestrial Communication

Text Books:

1. Constantine A. Balanis. “Antenna Theory Analysis and Design”, John Wiley and Sons, New York, 3rd Edition 2010.

2. J.D. Kraus, R. J Marhefka and Ahmed S Khan, “Antennas and wave propagation”, Tata McGraw Hill, Special Indian Edition, 4th ed., 2010.

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 EC 6605	ANTENNA SYSTEMS	3-0-0:3	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE 1: Antenna Fundamentals: Radiation mechanism; Fundamental Parameters of Antennas, Friis Transmission Equation, Radiation integrals		7	15
MODULE 2: Types of Antennas: Linear Wire Antennas - Dipole, Radiation Fields Loop Antennas, Broadband Dipoles, Travelling Wave and Broadband Antennas, Frequency independent Antennas, Fractal antennas,		7	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3: Radiation from Apertures Aperture Antennas, Babinet's Principle, Horn Antennas, Reflector Antennas, Dielectric Resonator Antennas		7	15
MODULE 4: Antenna Arrays Linear array –Uniform array, Radiation pattern of two element and N-element array, Principle of pattern multiplication, end fire and broad side array, Phased Array, Array Factor, beam width, side lobe level, Directivity; Non uniform array –Binomial array, Dolph-Tschebyscheff array, Design Procedure, Planar array.		7	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5: Microstrip Antennas Microstrip Antennas – Radiation Mechanism, Excitation Techniques, Applications,		5	20
MODULE 6: Antennas for Terrestrial Mobile Communication Systems: Base Station Antennas - Non Adaptive Base Station Antennas, Antenna Diversity Adaptive Base Station Antennas,Smart Antennas – Systems, Benefits, Drawbacks, Mobile Station Antennas, Radiation Hazards, Specific Absorption Rate.		9	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 EC 6607	ADVANCED DIGITAL SIGNAL PROCESSING	3-0-0:3	2015

Pre-requisites:

Signals and Systems, DSP

Course Objectives: This course is intended to impart to the students the principles of

- Wavelet theory,
- Construction of wavelets and their applications in signal analysis
- Fundamentals of Multirate Theory and Digital Filter Banks
- Adaptive signal processing,
- Different algorithms used for design of Adaptive Filters

Syllabus:

Wavelets & Applications, The multiresolution analysis, Adaptive System Concepts, Adaptive Filters, Multi-rate Digital Signal Processing

Course Outcome:

After Learning this course, the student will be able to:-

• Define and Describe Wavelet theory
• Explain different techniques involved in wavelet processing
• Illustrate and enumerate the concept of adaptive filters
• Explain the different techniques involved in Multi-rate Digital Signal Processing

Text Books:

1. Monson H.Hayes, “Statistical Digital Signal Processing and Modeling,” Wiley India, 2008.
2. John G. Proakis and DimitrisG.Manolakis, “Digital Signal Processing,” Fourth Edition, Prentice Hall of India, New Delhi, 2007.

References:

1. John G. Proakiset.al., “Algorithms for Statistical Signal Processing,” Pearson Education, 2002.

2. DimitrisG.Manolakiset.al., “Statistical and Adaptive Signal Processing,” McGraw Hill, Newyork, 2000.

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 EC 6607	ADVANCED DIGITAL SIGNAL PROCESSING	**3-0-0:3**	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE 1: Wavelets & Applications: Fourier and Sampling Theory - Generalized Fourier theory, Fourier transform, Short-time(windowed) Fourier transform, Time-frequency analysis, Wavelets - The basic functions, Specifications, Admissibility conditions, Continuous wavelet transform (CWT), Discrete wavelet transform (DWT).		10	15
MODULE 2: The multiresolution analysis (MRA) of L2(R) - Wavelet decomposition and reconstruction of functions in L2(R). Fast wavelet transform algorithms - Relation to filter banks, Wavelet packets. Wavelet Transform Applications: Image processing - Compression, Denoising, Edge detection and Object detection.		10	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3: Adaptive System Concepts Adaptive systems - definitions and characteristics - applications - properties-examples- adaptive linear combiner-input signal and weight vectors ,Performance function-gradient and minimum mean square error - introduction to filtering-smoothing ,and prediction - linear optimum filtering-orthogonality - Wiener - Hopf equation-performance		5	15
MODULE 4: Adaptive Filters: FIR adaptive filters -adaptive filter based on steepest descent method-Normalized LMS. Applications. Adaptive channel equalization etc.		5	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5: Multi-rate Digital Signal Processing: Fundamentals of Multirate Theory: The sampling theorem - sampling at sub-Nyquist rate - Basic Formulations and schemes Basic Multirate operations-Decimation and Interpolation, Decimation by an integer factor - Digital Filter Banks		6	20
MODULE 6: Digital Filter Banks DFT Filter Bank- Identities- Polyphase representation, Maximally decimated filter banks: Polyphase representation Filter implementation for sampling rate conversion, Sub band coding		6	20

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 EC 6609	DIGITAL COMMUNICATION	3-0-0:3	2015

Pre-requisites: Nil

Course Objectives:
After Learning this course, the student will be able to:-

- To understand communications with a focus on modern digital communications theory and systems.
- Explain how communication happens in a band limited channel.
- Explain and enumerate the Basic and Advanced Coding Techniques in Communications.
- Design digital communication systems andapply the underlying methods for up-to-date examples of real world systems
- Emphasis is on modern digital data transmission concepts.

Syllabus:
Elements of a digital communication system., Communication through band limited linear filter channels, Block Coded Digital Communication, Convolutional Coded Digital Communications, Concepts of Spread spectrum communication.

Course Outcome:
After Learning this course, the student will be able to:-

- Identify and describe different techniques in modern digital communications, in particular in source coding, modulation and detection, carrier modulation, and channel coding.
- Compare different techniques and judge the applicability of different techniques in different situations.

TEXT BOOKS:

1. Robert. Gallager“ Principles of Digital communication”, Cambridge University Press, 2008.

2.John G. Proakis, “Digital Communications”," 4th edition, McGraw Hill, 2006.

REFERENCES:

1. Stephen G. Wilson, “Digital Modulation and Coding”, Pearson Education (Asia) Pte. Ltd, 2003.
2. KamiloFeher,” Wireless Digital Communications: Modulation and Spread Spectrum Applications” Prentice-Hall of India, 2004.

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 EC 6609	DIGITAL COMMUNICATION	3-0-0:3	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE 1: **Elements of a digital communication system.** Signal & Vector space concept, Gram Schmidt method - Representation of digitally modulated signals – Performance of memory less modulation methods – signaling schemes with memory.		7	15
MODULE 2: **Communication through band limited linear filter channels:** Optimum Receiver for Signals Corrupted by AWGN, Performance of the Optimum Receiver for Memory-less Modulation, Optimum Receiver for CPM Signals Optimum receiver for channels with ISI and AWGN, Linear equalization.		7	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3: **Block Coded Digital Communication:** Introduction to linear block codes, Cyclic and hamming code. ; Hamming; Golay; Cyclic; BCH ; Reed – Solomon codes. Shannon‟s channel coding theorem; Channel capacity; Matched filter. Decoding of convolutional codes - maximum likelihood decoding.		7	15
MODULE 4: **Convolutional Coded Digital Communications:** Representation of codes using Polynomial, State diagram, Tree diagram, and Trellis diagram – Decoding of convolutional codes - maximum likelihood decoding		7	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5: **Digital Communication through fading multi-path channels:** Characterization of fading multi-path channels,the effect of signal characteristics on the choice of a channel model, frequency - Non-selective, slowly fading channel, diversity techniques for fading multi-path channels. Digital signal over a frequency-selective, slowly fading channel.		7	20
MODULE 6: Concepts of Spread spectrum communication – D S and F H spread spectrum. CDMA system based on FH spread spectrum signals. Synchronization of spread spectrum signals.		7	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 EC 6611	**NETWORK ROUTING ALGORITHMS**	**3-0-0:3**	**2015**

Pre-requisites: Nil

Course Objectives:
After Learning this course, the student will be able to:-

- Define and Describe the concepts of Networks and Internet Protocol
- Define and Describe the Different Routing Algorithms associated with Networks
- Enumerate the different types of routing algorithms in Optical Networks
- Explain and enumerate the Basic and Advanced concepts associated with Mobile and Ad0Hoc Networks
- Explain how Communication happens in fading multi-path channels

Syllabus:
Overview on Networks and the Internet, The Internet Protocol (IP), TDynamicNon hierarchical Routing, Multicast Routing, Mobile - IP Networks, Wireless Access Internet Infrastructure, Routing algorithms Proactive routing, Texture descriptors.

Course Outcome:
At the end of the course the student should be able to choose different routing protocols and different routing algorithms for different networks.

Text Books:
1. Radia Perlman, Interconnections, 2nd Edition - Bridges, Routers, Switches, and Internetworking .2000 Addison-Wesley
2. William Stallings, ' High speed networks and Internets Performance and Quality of Service', IInd Edition, Pearson Education Asia. Reprint India 2002

References:
1.M. Steen Strub, ' Routing in Communication network, Prentice –Hall International, Newyork,1995
2.S. Keshav, 'An engineering approach to computer networking' Addison Wesley 1999.
3.William Stallings, 'High speed Networks TCP/IP and ATM Design Principles, Prentice-Hall, New York, 1995
4.C.E Perkins, 'Ad Hoc Networking', Addison – Wesley, 2001
5.Ian F. Akyildiz, Jiang Xie and ShantidevMohanty, " A Survey of mobility Management in Next generation All IP- Based Wireless Systems", IEEE Wireless Communications Aug.2004, pp 16-27.
6.A.T Campbell et,al. Comparison of IP Micromobility Protocols, IEEE Wireless Communications

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 EC 6611	NETWORK ROUTING ALGORITHMS	3-0-0:3	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE 1:Overview on Networks and the Internet - Protocol Layers and Their Service Models, An Introduction to Network Routing and Network Interface-Router ,Virtual Circuit and Datagram Networks		7	15
MODULE 2: The Internet Protocol (IP): Forwarding and Addressing in the Internet, Based Internetworking (IP), Network Layer Addresses - Hierarchal Addresses with Fixed Boundaries Hierarchal Addresses with Flexible Boundaries, Types of Addresses, IP, IPX, IP+, IPv6,CLNP Network Layer Addresses		7	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3: TDynamicNon hierarchical Routing (DNHR), real-time network routing (RTNR), Distance vector routing, Link state routing, Hierarchical routing. Internet Routing Interior protocol: (RIP), (OSPF), Bellman Ford Distance Vector Routing. Exterior Routing Protocols: (EGP) and (BGP).		7	15
MODULE 4: Multicast Routing: Overview, Advantages, Disadvantages - Distance Vector Multicast Routing Protocol (DVMRP), Multicast Open Shortest Path First (MOSPF), MBONE, Core Based Tree Routing Application layer protocols:-WWW and HTTP, FTP, DNS, SMTP, SNMP, RPC, P2P File sharing, Domain Name system (DNS) Mobile - Ip Networks: Mobility Protocols: Macro & Micro. Hierarchical Mobile IP, Intra domain Mobility Management, Routing based: Cellular IP, Handoff		7	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5: Wireless Access Internet Infrastructure (HAWAII). Mobile Ad Hoc Networks: Internet-based mobile ad-hoc networking communication strategies, Routing algorithms Proactive routing: destination sequenced Distance Vector Routing (DSDV), Reactive routing: Dynamic Source Routing (DSR), Ad hoc On-Demand Distance Vector Routing (AODV), Hybrid Routing: Zone Based Routing (ZRP).		7	20
MODULE 6: First and second order edge detection operators, Phase congruency, Localized feature extraction detecting image curvature, shape features Hough transform Texture descriptors- Autocorrelation, Co-occurrence features, Run length features, Fractal model based features, Gabor filter, wavelet features. Image Fusion-Overview of image fusion, pixel fusion, Curvelet transforms.		7	20

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 EC 6613	EMBEDDED SYSTEM DESIGN AND APPLICATION	3-0-0:3	2015

Pre requisites :

Microelectronic Circuits

Course Objectives:

1.To provide an introduction to the design of embedded systems including their hardware and software architectures, design methodologies and tools, and communication protocols..

2.To get a clear understanding of the various interfacing concepts and to learn more on RTOS.

Syllabus:

Embedded Design Process, Embedded System Development Environment, Memory Systems, Embedded Programing, Embedded Communication Protocols , Embedded Firmware Design And Development

Course Outcome:

After Learning this course, the student will be able to understand:-

•Systems approach to Embedded Systems

•Industrial applications of embedded systems

•Deal with complex issues in embedded systems both systematically and creatively

Text Books:

1.Steve Heath, Embedded System Design Elsevier Publications 2005

2.Gajski and Vahid, “Specification and Design of Embedded systems”, Prentice Hall. 2002

References:

1.Embedded Systems Design: An Introduction to Processes, Tools, and Techniques by Arnold S. Berger CMP Books, 2002

2.FrankVahid and Tony Givargis, Embedded System Design-A Unified Hardware/Software Introduction”,,John Wiley & Sons,2002.

3.K. V. Shibu,” Introduction To Embedded Systems“, Tata McGraw-Hill Education Pvt. Ltd. 2009

4.Raj Kamal, Embedded Systems Tata McGraw-Hill Education, 2008

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 EC 6613	EMBEDDED SYSTEM DESIGN AND APPLICATION	3-0-0:3	
MODULES		Contact Hours	Sem. Exam Marks (%)
MODULE 1: EMBEDDED DESIGN PROCESS: Embedded system overview, Design challenge ,Product specification , Hardware / Software partitioning , Hardware and software design , Integration ,Product testing Selection Processes , General-purpose Processors, Single-purpose Processors, and Application Specific Processors,Use of software tools for development of an Embedded system.		8	15
MODULE 2:EMBEDDED SYSTEM DEVELOPMENT ENVIRONMENT Fundamental issues in hardware software co-design, Computational models in embedded design The Integrated development environment (IDE), Types of files generated on cross compilation, Disassembler/Decompilers, Emulators and debugging, Boundary scan		6	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3:MEMORY SYSTEMS: Memory Technologies, DRAM Technology, Video RAM,SRAM ,DRAM,EPROM and OTP ,Memory organization ,Cache memory -Cache size and organization ,Cache coherency,RTOS: Introduction, Basic OS functions, Process Management, Scheduling and Interrupt-latency control functions, Timer Functions and Time Management, IPC Synchronization.		6	15
MODULE 4: EMBEDDED PROGRAMING: Integrated development environment Tools, Compiling, Linking and locating Downloadingand debugging, Emulators and simulators processor, Overview of PIC AVR family of microcontrollers and ARM processors.		9	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5: EMBEDDED COMMUNICATION PROTOCOLS : Embedded Networking: Introduction – Serial/Parallel Communication –Serial communication protocols -RS232 standard – RS485 – Synchronous Serial Protocols -Serial Peripheral Interface (SPI) The I2C Bus, The CAN bus, SHARC link Ports, Ethernet, Internet,Bluetooth: Specification, Protocol, Cable replacement protocol.		7	20

MODULE 6:EMBEDDED FIRMWARE DESIGN AND DEVELOPMENT Embedded firmware design approaches, Embedded firmware development language.Real time operating system (RTOS) based embedded system design: Operating system basics, Types of OS, Tasks, Process and threads Multiprocessing and multitasking, Task scheduling, Threads, Processing and scheduling: Putting them altogether, Task communication, task synchronization, Device drivers, How to choose an RTOS.	6	20
END SEMESTER EXAM		

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 EC 6615	MICROWAVE INTEGRATED CIRCUITS	**3-0-0:3**	**2015**

Pre-requisites: Nil

Course Objectives: To get a clear understanding of the various integrated circuits and their manufacturing and testing.

Syllabus
Microstrip Circuit Design And Applications, MMIC Technology, Testing.

Course Outcome:

At the end of the course the student should be able to design and analyse microstip circuits.

Text Books:

1. Gupta K.C and Amarjit Singh, “Microwave Integrated Circuits”, John Wiley, New York,1975.

References:

1. Hoffman R.K."HandBook of Microwave integrated circuits", Artech House, Bostan, 1987.

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 EC 6615	MICROWAVE INTEGRATED CIRCUITS	3-0-0:3	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE 1: Introduction, Types of MICs and their technology, Propagating models, Analysis of MIC by conformal transformation, Numerical method, Hybrid mode analysis, Losses in microstrip, Introduction to slot line and coplanar waveguide.			15
MODULE 2: Introduction to coupled microstrip, Even and odd mode analysis, Branch line couplers, Design and fabrication of lumped elements for MICs, Comparison with distributed circuits.			15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3: Ferromagnetic substrates and inserts, Microstrip circulators, Phase shifters, Microwave transistors, Parametric diodes and amplifiers. PIN diodes, Transferred electron devices, Avalanche, IMPATT, BARITT diodes			15
MODULE 4: Introduction, Impedance transformers, Filters, High power circuits, Low power circuits, MICs in Satellite and Radar.			15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5: Fabrication process of MMIC, Hubrid MMICs, Dielectricsubstances, Thick film and thin film technology and materials			20
MODULE 6: Testing methods Encapsulation and mounting of devices.			20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 GN 6001	RESEARCH METHODOLOGY	0 -2-0:2	2015

Pre-requisites: Nil

Course Objectives:

- To get introduced to research philosophy and processes in general.
- To formulate the research problem and prepare research plan
- To apply various numerical /quantitative techniques for data analysis
- To communicate the research findings effectively

Syllabus

Introduction to the Concepts of Research Methodology, Research Proposals, Research Design, Data Collection and Analysis, Quantitative Techniques and Mathematical Modeling, Report Writing

Course Outcome:

Students who successfully complete this course would learn the fundamental concepts of Research Methodology; apply the basic aspects of the Research methodology to formulate a research problem and its plan. They would also be able to deploy numerical/.quantiative techniques for data analysis. They would be equipped with good technical writing and presentation skills.

Text Books:

1. Research Methodology: Methods and Techniques', by Dr. C. R. Kothari, New Age International Publisher, 2004

2 Research Methodology: A Step by Step Guide for Beginners' by Ranjit Kumar, SAGE Publications Ltd; Third Edition

Reference Books:

1. Research Methodology: An Introduction for Science & Engineering Students', by Stuart Melville and Wayne Goddard, Juta and Company Ltd, 2004
2. Research Methodology: An Introduction' by Wayne Goddard and Stuart Melville, Juta and Company Ltd, 2004
3. Research Methodology, G.C. Ramamurthy, Dream Tech Press, New Delhi
4. Management Research Methodology' by K. N. Krishnaswamy et al, Person Education

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 GN 6001	**RESEARCH METHODOLOGY**	**3-0-0:3**	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE 1: Introduction to Research Methodology, Concepts of Research, Meaning and Objectives of Research, Research Process, Types of Research, Type of research: Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, and Conceptual vs. Empirical		5	15
MODULE 2: Criteria of Good Research, Research Problem, Selection of a problem, Techniques involved in definition of a problem, Research Proposals – Types, contents, Ethical aspects, IPR issues like patenting, copyrights.		4	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3: Meaning, Need and Types of research design, Literature Survey and Review, Identifying gap areas from literature review, Research Design Process, Sampling fundamentals, Measurement and scaling techniques, Data Collection – concept, types and methods, Design of Experiments.		5	15
MODULE 4: Probability distributions, Fundamentals of Statistical analysis, Data Analysis with Statistical Packages, Multivariate methods, Concepts of correlation and regression, Fundamentals of time series analysis and spectral analysis		5	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5: Principles of Thesis Writing, Guidelines for writing reports & papers, Methods of giving references and appendices, Reproduction of published material, Plagiarism, Citation and acknowledgement		5	20
MODULE 6: Documentation and presentation tools – LATEX, Office Software with basic presentations skills, Use of Internet and advanced search techniques,		4	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
EC CI 6607	COMMUNICATION SIMULATION LAB	0-0-2: 1	2015

COURSE OBJECTIVES:

1. To experiment the concepts introduced in the core and elective courses offered in the first semester with the help of simulation tools and related hardware. These are minimum requirements; Topics could be added in concurrence with the syllabus.

Experiments: The followings are the list of experiments that can be conducted in the wireless technology lab I & II. However the faculty can replace these experiments with any other relevant experiments related to the elective taken.

1. Implementation of an adaptive equalizer based on LMS algorithm and studies the effect of step size on MSE.
2. Determination of error probabilities for orthogonal signaling (i)Hard Decision (ii) Soft decision decoding.
3. Simulation and analysis of the performance of a QPSK digital radio link in a Rayleigh fading Environment.
4. Routing and wavelength assignment algorithms for WDM Optical networks. (optional)
5. Comparison of Digital modulation schemes over AWGN and flat fading channels.
6. Channel modeling

SEMESTER II

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 EC 6602	ADHOC AND WIRELESS SENSOR NETWORKS	**4-0-0:4**	**2015**

Pre-requisites:

Nil

Course Objectives:

1. To understand the basic concepts of ad-hoc networks
2. To learn about energy efficient communication in ad-hoc networks
3. To learn about sensor networks
4. To get a clear insight of routing approaches
5. To get a clear insight of security issues and counter measures in the networks

Syllabus

Mobile ad hoc networking, Wireless Communications, Data Gathering, Routing and Querying,Collaborative Signal Processing and Distributed Computation.

Course Outcome:

After Learning this course, the student will be able to:

- Define and describe the fundamentals concepts of wireless ad-hoc and sensor networks
- Distinguish between different types of energy efficient communication protocols
- Describe different types of routing approaches
- Enumerate the collaborative signal processing and distributed computation
- Describe the security issues and counter measures

Text Books:

1. Holger Karl & Andreas Willig, " Protocols And Architectures for Wireless Sensor Networks" , John Wiley, 2005.
2. Feng Zhao & Leonidas J. Guibas, “Wireless Sensor Networks- An Information Processing Approach", Elsevier, 2007.

References:

1. KazemSohraby, Daniel Minoli, &TaiebZnati, “Wireless Sensor Networks- Technology, Protocols, And Applications”, John Wiley, 2007.
2. Anna Hac, “Wireless Sensor Network Designs”, John Wiley, 2003.

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 EC 6602	**ADHOC AND WIRELESS SENSOR NETWORKS**	**3-0-0:3**	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE 1: Mobile ad hoc networking: Imperatives, Challenges, Characteristics & Applications,Deployment & Configuration,Localization-Coverage and connectivity ,Topology control, Connected dominating sets		10	15
MODULE 2: Wireless Communications, Link quality, Shadowing and fading effects, Medium Access, Scheduling sleep cycles, Random access MAC, S MAC		9	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3: Energy efficient communication in Ad Hoc networks, Power save protocols		6	15
MODULE 4: Data Gathering: Tree construction algorithms and analysis, Asymptotic capacity, Lifetime optimization formulations		6	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5: Routing and Querying, Routing approaches, Proactive and reactive protocols, Clustering and hierarchical routing, Multi-path routing, Security aware routing ,Maximum life time routing		13	20
MODULE 6: Collaborative Signal Processing and Distributed Computation: Detection, Estimation, Classification problems ,Characterization of network traffic, QOS classification, Self similar processes, Statistical analysis of non-real time traffic and realtime services, Security issues: Attacks and countermeasures, Intrusion detection, Security considerations in Ad Hoc sensor networks		12	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 EC 6604	ADVANCED WIRELESS MOBILE COMMUNICATIONS	**3-0-0:3**	**2015**

Pre-requisites:

Nil

Course Objectives:

1. To describe Multiple Access Techniques
2. To have the concept of adaptive modulation techniques
3. Explain UWB data modulation
4. To enumerate Co-operative communication and Smart antennas
5. To enumerate 4G Technology of cellular mobile communication.

Syllabus

Multi user channel-adaptive modulation-adaptive coded modulation-UWB-Cooperative Diversity-Smart antennas-LTE

Course Outcome:

After Learning this course, the student will be able to:-

- Understand advanced concepts of Multiple Access Schemes
- Explain and illustrate the various concepts used in Adaptive Modulation
- Describe the concept of UWB
- Understand Cooperative communication Describe advanced mobile communication standards in 4 G

Text Books:

1.Fundamentals of Wireless Communications David Tse and Pramod Viswanath, Cambridge University Press 2006.
2.Wireless Communications: Andrea Goldsmith, Cambridge University Press 2009.

References:

1.Wireless Communications: Principles and Practice Theodore Rappaport Prentice Hall 2007.

2.MIMO Wireless Communications Ezio Biglieri Cambridge University Press 2010.

3.Digital Communication John G Proakis McGraw Hill 2010

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 EC 6604	**ADVANCED WIRELESS MOBILE COMMUNICATIONS**	**3-0-0:3**	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE 1: Multi User Channel, Multiple access, FDMA, TDMA ,CDMA, SDMA, Random access- power control ,Downlink channel capacity-uplink channel capacity –multi user diversity		10	15
MODULE 2: Adaptive Modulation: Adaptive Techniques, Variable-Rate Variable-Power MQAM: adaptive rate and power techniques, channel inversion with fixed rate, discrete-rate adaptation, exact versus approximate bit error probability, channel estimation and error delay		10	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3: Adaptive Coded Modulation, Adaptive Techniques in Combined Fast and Slow Fading		9	15
MODULE 4: UWB : UWB Definition and Features UWB Wireless Channels, UWB Multipath Propagation Channel Modeling UWB Data Modulation, Uniform Pulse Train Bit-Error Rate Performance of UWB, Multiband Pulsed-OFDM UWB system.		9	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5: Cooperative Communication: Introduction to Cooperative Diversity , MIMO and smart antennas amplify and forward, relaying, Implementation issues		9	20
MODULE 6: Channel capacity Achievable rate region. Open issues, Introduction to LTE, LTE advanced		9	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 EC 6606	MIMO & OFDMA for Wireless Communication	**3-0-0**	**2015**

Pre-requisites:

Probability & Stochastic process, Wireless Communications

Course Objectives:

This course is intended to impart to the students the principles of

- The fundamental concepts and design principles in "Multiple-Input Multiple-Output" (MIMO) wireless communications –channel capacity, antenna diversity, space-time coding.
- The fundamental concepts in "Orthogonal Frequency-Division Multiplexing" (OFDM) communications – transmission, synchronization, peak-to-average power ratio (PAPR) reduction.

Syllabus

OFDM Basics, OFDM Synchronization, OFDM Issues, Introduction to MIMO, Space-Time Modulation and Coding.

Course Outcome:

After Learning this course, the student will be able to gain knowledge and understanding of:-

- OFDM's transceiver architecture
- The problem of PAPR and how to reduce the PAPR.
- To understand how the OFDM receiver performs synchronization
- Channel modeling and propagation
- MIMO Capacity, space-time coding

Text Books:

1.MIMO-OFDM for LTE, WiFi and WiMAX Li Wang, Ming Jiang, Lajos L. Hanzo, YosefAkhtman Weily 2011
2. MIMO-OFDM Wireless Communications with MATLAB Yong Soo Cho,Jaekwon Kim, Won YoungYang, Chung G. Kang John Wiley & Sons (2010)

References:

1. OFDM for Wireless Communications Systems Ramjee Prasad, Artech House Publishers (2004)
2. MIMO Wireless Communications EzioBiglieri Robert Calderbank Anthony Constantinides Andrea Goldsmith ArogyaswamiPaulraj H. Vincent Cambridge University Press (2007)

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 EC 6606	**MIMO & OFDMA for Wireless Communication**	**3-0-0:3**	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE 1: OFDM Basics: Multi-carrier transmission- Data Transmission using Multiple Carriers-Multicarrier Modulation with Overlapping Sub channels, OFDM modulation & demodulation, BER; coded-OFDM;Orthogonal frequency-division multiple-access (OFDMA).		9	15
MODULE 2: OFDM Synchronization: Effect/estimation of symbol-time offset (STO); Effect/estimation of carrier-frequency offset (CFO); Effect/compensation of Sampling-clock offset (SCO), Frequency and Timing Offset Issues		6	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3: OFDM Issues - Peak-to-Average Power Ratio Reduction (PAPRR): Distribution of OFDM-signal amplitude, PAPR & oversampling; Frequency and Timing Offset Issues -Mitigation methods, SNR performance		7	15
MODULE 4: Introduction to MIMO, MIMO Channel Capacity, SVD and Eigen modes of the MIMO Channel, MIMOSpatial Multiplexing		6	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5: MIMO Diversity Gain: Beam forming Antennas ,Diversity: Receive-antennadiversity; Transmit-antenna diversity, MIMO Diversity and applications		6	20
MODULE 6: Space-Time Modulation and Coding: ML detection, rank and determinant criteria, Space-time trellis andblock codes ,Detection for Spatially Multiplexed MIMO Systems - MIMO - OFDM		8	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 EC 6608	**ANALYTICAL AND COMPUTATIONAL TECHNIQUES IN** ELECTROMAGNETICS	**3-0-0:3**	**2015**

Pre-requisites:

Electromagnetic Theory

Course Objectives:

- Students will develop analytical skills in applied electromagnetics
- Will achieve the ability to combine mathematical tools and physical understanding to effectively solve complex electromagnetic problems.
- Will expose students to examples of real-world applications of advanced electromagnetic theory, covering propagation, guidance, radiation, and scattering of electromagnetic waves.
- Will develop the very basics of numerical techniques for time-harmonic electromagnetic field and wave computation

Syllabus

Review of Basic Electromagnetics, Propagation of Errors, Time Varying Electromagnetic Fields, Numerical Techniques, Fem Analysis, **Microwaves.**

Course Outcome:

At the end of this course, the student will be able to:-

- Illustrate the most common numerical techniques adopted for the electromagnetic modeling of microwave and millimeter-wave circuits and antennas.
- Choose the most appropriate numerical technique to solve a specific electromagnetic problem, and to implement computer programs to solve simple problems.
- Choose some of the most popular commercial electromagnetic programs and to critically evaluate the numerical results.

Text Books:

1.Ramesh Garg, Analytical and Computational Methods in Electromagnetics, ArtechHouse, 2008,ISBN-10: 1596933852

2.R.F. Harrington, Field Computation by Moment Method., Wiley,199

3.John L. Volakis, and KubilaySertel, Frequency Domain Hybrid Finite Element\MethodsforElectromagnetics, Morgan & Claypool Publishers ,2006

References:

1. Matthew N. O. Sadiku, Numerical Techniques in Electromagnetics, CRC press,2/e, 2000.2. David B. Davidson, Computational Electromagnetics for RF and Microwave Engineering, Cambridgeuniversity press,2/e,2010

3.Allen Teflove, Susan C Hagness, Computational Electrodynamics: The Finite Difference Time DomainMethod., Artech House publications,3/e,2005

4. Balanis.C.A. Advanced Engineering Electromagnetics,Wiley Publications, 1989,

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 EC 6608	**ANALYTICAL AND COMPUTATIONAL TECHNIQUES IN ELECTROMAGNETICS**	**3-0-0:3**	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE 1: Introduction: Elements of Computational Methods, Basis Functions, Sub-domain Basis Functions, Entiredomain Basis Functions, Applications of electromagnetics, Historical development of Computational Methods.		4	15
MODULE 2: Convergence and Discretization Error Convergence Test, Order of Convergence, Discretization Error and Extrapolation, Discretization of Operators, Discretization Error in FDM, FDTD, and FEM, Stability of Numerical Solutions, Stability of FDTD Solution, Stability of Matrix Solution, Accuracy of Numerical Solutions, Modeling Errors, Truncation Error, Round-off Error, Validation, Spurious Solutions, Formulations for the Computational Methods		8	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3: Finite Difference Time Domain Analysis: FDTD Analysis in One-Dimension: Pulse Propagation in aTransmission Line, Spatial Step Δxand Numerical Dispersion, Time Step Δtand Stability of the Solution, Source or Excitation of the Grid, Absorbing Boundary Conditions, Applications of One-DimensionalFDTD Analysis, Reflection at an Interface, Determination of Propagation Constant, Design of Material Absorber, Exponential Time-stepping Algorithm in the Lossy Region ,FDTD Analysis in Two-Dimensions, Unit Cell, Numerical Dispersion in Two-Dimensions, Time Step Δtfor Two-DimensionalPropagation, Absorbing Boundary Conditions for Propagation in Two Dimensions ,Perfectly MatchedLayer ABC's FDTD Analysis in Three-Dimension, Yee Cell, Numerical Dispersion in Three-Dimension,Time Step Δtfor Three-Dimensional Propagation, Absorbing Boundary Conditions and PML for Three-Dimensions Implementation of Boundary Conditions in FDTD, Perfect Electric and Magnetic Wall Boundary Conditions, Interface conditions		11	15
MODULE 4: Basics of Numerical Techniques - Method of Moments, Finite Element Method.Finite Element Method: Basic Steps in Finite Element Analysis, Discretization or Meshing of theGeometry, Derivation of the Element Matrix, Assembly of Element Matrices, Solution of System Matrix,Post-processing		6	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5: FEM Analysis in One-dimension, Treatment of Boundary and Interface Conditions,Accuracy and Numerical Dispersion, FEM Analysis in		6	20

Two-dimension, Element Matrix for Rectangular Elements, Element Matrix for Triangular Elements, Assembly of Element Matrices and System Equations Capacitance of a Parallel Plate Capacitor, Cut-off Frequency of Modes in a Rectangular Waveguide, FEM Analysis of Open Boundary Problems		
MODULE 6: Method of Moments: Basis Functions, Sub-domain Basis Functions, Entire-domain Basis Functions Point Matching and Galerkin's Methods, Eigen value Analysis using MoM.Solution of Integral Equations using MoM, Static Charge Distribution on a Wire, Analysis of Stripline, Analysis of Wire Dipole Antenna, Scattering from a Conducting Cylinder of Infinite Length, Greens functions	7	20
END SEMESTER EXAM		

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 EC 6612	ELECTROMAGNETIC INTERFERENCE & COMPATIBILITY	3-0-0:3	2015

Pre-requisites:

Electromagnetic Theory, Radio Communication

Course Objectives:

- Serve as an introduction to one of the most significant fields in wireless technology.
- Makes students familiar with fundamental concepts as well as giving them a broad perspective of emerging synergistic effects and their practical implications.
- Give a very basic concept on various EMI reduction and measurement methods, PCB design techniques.

Syllabus

Introduction to EMC, Non Ideal behavior of components, EMI Controlling Techniques, EMC Design of PCBs, Conducted Emission and Susceptibility.

Course Outcome:

Students will be able to

1. Identify the type of interferences that affects a system.
2. Provide an interference cancellation method which is suitable to the system under study.
3. Describe the methods of PCB design that minimizes the EMI effects.

Text Books:

1. Clayton R. Paul, Introduction to Electromagnetic compatibility, John Wiley and Sons Inc,1992, ISBN- 10: 0471549274, ISBN-13: 978-0471549277
2. Henry W Ott, Electromagnetic Compatibility Engineering, John Wiley and Sons,1/e,2009, ISBN-13: 978-0470189306, ISBN-10: 0470189304

References:

1. Archambeault Bruce R, Ramihi Omar M, Brench, EMI/EMC Computational Modelling Handbook, Springer publications,2/e,2001
2. James E. Vinson, Joseph C. Bernier, Gregg D. Croft , JuinJeiLiou, ESD Design and Analysis Handbook, Springer, 1/e, 2002, ISBN-10: 140207350X, ISBN-13: 978-1402073502
3. Ernest O Doebelin, Dhanesh.N.Manik, Doeblin's Measurement System, TMH, 6/e, 2011

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 EC 6612	ELECTROMAGNETIC INTERFERENCE & COMPATIBILITY	3-0-0:3	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE 1: Introduction to EMC, Aspects of EMC, decibels and common EMC units. EMC requirements for Electronic systems: Governmental requirements, Product requirements. Antennas, elemental dipole antennas, characterization of antennas, Directivity and gain, effective aperture, Antenna Factor		7	15
MODULE 2: Non Ideal behavior of components: Wires, resistance and internal inductance of wires, External inductance and capacitance of parallel wires, Resistors, Capacitors, Inductors Ferrites and common-mode chokes		8	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3: EMI Controlling Techniques: Shielding, Filtering,Bonding, Isolation Transformer.Transient Suppressors, Cable Routing		7	15
MODULE 4: EMC Design of PCBs: Component Selection and mounting,PCB Trace Impedance, Routing, Power distribution decoupling, Zoning, Grounding, Vias connection, Termination		7	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5: Spectra of digital waveforms, spectral bounds for Trapezoidal waveforms, Spectrum Analyzers, Radiated Emissions and Susceptibility : Simple Emission models of wires and PCB lands, Common mode versus Differential mode currents		7	20
MODULE 6: Conducted Emission and Susceptibility: Measurement of conducted emissions, Line Impedance Stabilization Network(LISN), Electro Static Discharge(ESD), effects of ESD		6	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 EC 6614	SPEECH AND AUDIO PROCESSING	3-0-0:3	2015

Pre-requisites:

Nil

Course Objectives:

1. To explain basics of speech production mechanisms
2. To describe principles of speech synthesis
3. To enumerate speech recognition methods
4. To understand speech coding and enhancement techniques
5. To explain audio compression techniques

Syllabus

Human speech model-analysis and synthesis-Recognition methods-coding techniques-enhancement-audio processing-compression

Course Outcome:

After Learning this course, the student will be able to:-

- Describe the human speech system and how it is analysed and synthesized
- Explain and illustrate the various concepts used in speech recognition
- Describe various methods for speech coding and enhancements.

Explain the methods used for audio compression

Text Books:

1. Douglas O'Shaugnessy, "Speech Communication, Human and Machine", IEEE Press, 2000L.

2. Rabiner and B. H. Juang, "Fundamentals of Speech Recognition", Prentice Hall, 1993

References:

1.T.F Quatieri, "Discrete-Time Speech Signal pPocessing- Principles and Practice", Pearson,2002

2.Zi Nian Li, "Fundamentals of Multimedia", Pearson Education, 2003

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 EC 6614	SPEECH AND AUDIO PROCESSING	3-0-0:3	
MODULES		Contact Hours	Sem. Exam Marks (%)
MODULE 1: Speech Production and Acoustic Phonetics: Human speech production mechanism, acoustic theory of speech production, nature of speech signal, articulatory phonetics, acoustic phonetics, coarticulation, prosody. Speech Analysis and Synthesis: Time and frequency domain analysis of speech, speech parameter estimation		7	15
MODULE 2: Linear prediction analysis, cepstral analysis, vector quantization(VQ) methods, principles of speech synthesis;Speech Recognition :Speech recognition, baye's rule, segmental feature extraction,		7	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3: Speaker and language recognition Methods: Mel frequency cepstral coefficient(MFCC), dynamic time –wrapping(DTW) ,Hidden markov model(HMM) for speech speaker and language recognition.		7	15
MODULE 4: Speech Coding Techniques: Speech coding, quality measures, speech redundancies, time-domain waveform coding, Linear predictive coding		7	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5: Speech enhancement techniques. Audio Processing Audio processing, characteristics of audio signals, sampling.		7	20
MODULE 6: Audio compression techniques, standards for audio compression in multimedia applications, MPEG audio encoding and decoding, audio databases and applications		7	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 EC 6616	RF SYSTEM DESIGN FOR WIRELESS COMMUNICATION	3-0-0:3	2015

Pre-requisites:

Nil

Course Objectives:

1. To understand radio architecture
2. To enumerate radio receiver system analysis and design methods
3. To enumerate radio transmitter system analysis and design methods
4. To describe applications of system Design

Syllabus

Superheterodyne receiver-different architectures-receiver sensitivity-NF-AGC-transmitter-modulation-transceivers

Course Outcome:

At the end of the course the student will be able to

1. Understand how to design and analyse radio recivers
2. Describe de-sensitization, selectivity and dynamic range of Receivers
3. Design a radio transmitter system and
4. Find numerous applications in radio system design

Text Books:

1.Rf System Design Of Transceivers For Wireless Communications"Qizheng Gu,Springer

2.S. Haykin, Communication System, 3rd ed., John Wiley & Sons, Inc.,1994

References:

1.B. Razavi, "Challenges in Portable RF Transceiver Design,"IEEE,Circuits and Devices Magazine, vol. 12, no. 5, pp. 12-25, Sept. 1996

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 EC 6616	RF SYSTEM DESIGN FOR WIRELESS COMMUNICATION	3-0-0:3	
MODULES		Contact Hours	Sem. Exam Marks (%)
MODULE 1: Radio Architectures and Design Considerations:Superheterodyne Architecture,Direct-Conversion (Zero IF) Architecture, Low IFArchitecture,		7	15
MODULE 2: Band-pass Sampling Radio Architecture, Receiver System Analysis and Design:Sensitivity and Noise Figure of Receiver,Inter modulation Characteristics		7	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3: Single-Tone Desensitization,Adjacent /Alternate Channel Selectivity and Blocking Characteristics,Receiver Dynamic Range and AGC System,System Design and Performance Evaluation		7	15
MODULE 4: Transmitter System Analysis and Design:Introduction, Transmission Power and Spectrum Modulation Accuracy		7	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5: Adjacent and Alternate Channel Power,Noise-Emission Calculation,Some Important Considerations in System Design		7	20
MODULE 6: Applications of System Design: Multimode and Multiband Superheterodyne,Transceiver,Direct Conversion Transceiver		7	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 EC 6618	IMAGE &VIDEO PROCESSING	**3-0-0:3**	**2015**

Pre-requisites:

Nil

Course Objectives:

1. To give basic idea of image transforms
2.To understand different image processing techniques
3.To give basic understanding of video processing

Syllabus

It gives basics of different image transforms frequently used.Familiarizes different image processing techniques such as segmentation, edge detection, Image restoration,morphological operations.The subject also givesdetails of image/video compression techniques and video processing

Course Outcome:

1. The student will be able to solve various image processing problems involving segmentation, restoration and morphological operations
2. The student will be able to understand image and video compression techniques
3. The student understand basics of video signal processing

Text Books:

1.A. K. Jain, Fundamentals of digital image processing, Prentice Hall of India, 1989.

2.R. C. Gonzalez, R. E. Woods, Digital Image Processing, Pearson Education.

References:

1.Iain E Richardson, H.264 and MPEG-4 Video Compression, John Wiley & Sons, September 2003

2.A. M. Tekalp, Digital Video Processing , Prentice-Hall

3.A Bovik, Handbook of Image & Video Processing, Academic Press, 2000

4. W. K. Pratt, Digital image processing, Prentice Hall

5. A. Rosenfeld and A. C. Kak, Digital image processing, Vols. 1 and 2, Prentice Hall, 1986

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 EC 6618	**IMAGE &VIDEO PROCESSING**	**3-0-0:3**	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE 1: Image representation: Gray scale and colour Images, image sampling and quantization. Image Transforms:2D DFT, DCT, DST, Hadamard, Haar Transforms, Image enhancement - filters in spatial and frequency domains, histogram-based processing, homomorphic filtering..		7	15
MODULE 2: Detection of discontinuities: Point Line and Edge Detection - Edge linking and boundary detection - Hough transform – Thresholding, Region based segmentation: Region growing-Region splitting and merging - Use of motion in segmentation		7	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3: Image Restoration: Degradation Models, Restoration using spatial and frequency domain filters ,Linear position invariant degradations-Estimating the degradation function-Iinverse filtering-Wiener filtering		7	15
MODULE 4: Fundamental concepts of image compression - Compression models elements of error free compression Error free compression, lossy compression, Binary image compression standards		7	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5: Morphological image processing:Dilation, Erosion,Opening ,closing,Hit/miss ttranformation, Basic morphological algorithms		7	20
MODULE 6: Fundamental Concepts in Video – Types of video signals, Analog video, Digital video, Color models in video, Video Compression Techniques – Motion compensation, Search for motion vectors,		7	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 EC 6620	RF MEMS FOR WIRELESS COMMUNICATION	**3-0-0**	**2015**

Pre-requisites:

Nil

Course Objectives:

1. To give basic idea of MEMS
2.To understand different Elements of RF Circuit Design
3.To give basic understanding of Reconfigurable antennas

Syllabus
It gives basics idea of MEMS and various components of RF circuit design.

Course Outcome:

The student will be able to use MEMS for wireless system design

Text Books:

1.Tai- Ran Hus," MEMS & Microsystems design and manufacture", McH 2002

2.Hector J. De, Los Santos, "RF MEMS Circuit Design for Wireless Communications", Artech House, 2002.

References:

1.Banks H T, Smith R C,Wang Y Smart,"Material structures,modeling, estimation & control" John Wiley & sons,1996.

2.Gabriel M. Rebeiz, "RF MEMS Theory, Design & Technology", Wiley Interscience, 2002

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 EC 6620	**RF MEMS FOR WIRELESS COMMUNICATION**	**3-0-0:3**	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE 1: MEMS Introduction & their applications :Aeronautics, aerospace, automobiles, biomedical engineering, smart materials introduction, piezoelectric, magnetic, shape memory alloys, ferroelectric and rheological materials. Introduction to MEMS, surface, bulk and LIGA process. Sensors, actuators and working principles, transducer classifications, electrostatic, resistive, capacitive etc..		10	15
MODULE 2: Elements of RF Circuit Design :Recent developments in MEMS. RF circuit design, physical aspects of RF circuit design, skin effect, transmission lines on thin substrates, self-resonance frequency, quality factor packaging, practical aspects of RF circuit design, DC biasing, impedance mismatch effects in RF MEMS		10	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3: RF MEMS :RF MEMS, enabled circuit elements and models, RF/microwave substrate properties, micro machined, enhanced elements, capacitors, inductors, varactors, MEM switch, shunt MEM switch, push-pull series switch		5	15
MODULE 4: Resonators. transmission line planar resonators, cavity resonators, micromechanical resonators, film bulk acoustics wave resonators, MEMS modeling- mechanical modeling, electromagnetic modeling		6	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5: Novel RF MEMS :Novel RF MEMS enabled reconfigurable circuits, the resonant MEMS switch, capacitors, inductors, tunable CPW resonator, MEMS micro-switch arrays		5	20
MODULE 6: Reconfigurable antennas, tunable dipole antennas, tunable microstrip patch-array antenna, reconfigurable circuits, double stud tuner, Nth-stub tuner, filters, resonator tuning system,		7	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 EC 6622	ADVANCED TECHNIQUES FOR WIRELESS RECEPTION	3-0-0	2015

Pre-requisites:

Nil

Course Objectives:

1. To design an Optimum multiuser detection for wireless environment
2. To apply signal processing algorithms to design an optimum wireless reception.

Syllabus

Blind Multiuser Detection, Group Blind MUD, Space-Time MUD, Optimal space time MUD, Narrow band Interference Suppression, : Signal Processing for wireless reception.

Course Outcome:

The student will be able to

1. Evaluate the performance of wireless signaling environment.
2. Apply mathematical formulation to find Optimum detection of wireless signal.
3. Analyze wireless channel conditions.
4. Develop signal processing algorithms for wireless signal reception.

Text Books:

1.X.Wang and H.V.Poor," Wireless Communication Systems," Pearson,2004

2.ItiSahaMisra,"Wireless Communications and Networks,"Tata McGraw Hill,2009.

References:

1.Mohamed Ibnkahla, Signal Processing for Mobile Communications, CRC Press

2.A.V.H. Sheikh, Wireless Communications Theory & Techniques, Kluwer Academic Publications

3.A.Paulrajetal, Introduction to Space-time Wireless Communications, CambridgeUniversity Press

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 EC 6622	ADVANCED TECHNIQUES FOR WIRELESS RECEPTION	3-0-0:3	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE 1: Blind Multiuser Detection:Wireless signaling environment, Basic receiver signal processing for wirelessreception Matched filter/raked receiver, equalization and MUD. Linear receiver for synchronous CDMAdecorrelating and MMSE detectors. Blind MUD, direct and subspace methods.		7	15
MODULE 2: Group Blind MUD:Linear group blind MUD for synchronous CDMA, Non-linear group blind multiuserdetectors for CDMA-slowest descent search.Group blind multiuser detection in multipath channels-Linear group blind detectors		7	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3: Space-Time MUD:Adaptive array processing in TDMA systems, Linear MMSE combining, Sub-space based training algorithm - extension to dispersive channels.		7	15
MODULE 4: Optimal space time MUD. Linear space time MUD Linear MUD via iterative interference cancellation, single user space-time detection and combined single user/multiuser linear detection		7	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5: Narrow band Interference Suppression: Linear predictive techniques-linear predictive methods. Nonlinearpredictive techniques-ACM filter, Adaptive non-linear predictor Code-aided techniques, Performance comparison.		7	20
MODULE 6: Signal Processing for wireless reception: Bayesian signal processing- Bayesian framework, sequential Monte-Carlo signal processing. Blind adaptive equalization of MIMO channels, Signal processing for fading channels. Coherent detection based on the EM algorithm, Decision-feedback differential detection.		7	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 EC 6624	COOPERATIVE WIRELESS COMMUNICATION SYSTEM	**3-0-0**	**2015**

Pre-requisites: Nil

Course Objectives:

This course is intended to

1. Enable the student to understand the evolving paradigm of cooperative communication,the challenges and trade-offs involved in such networks.
2. Expose the student to the usage of various Relay selection schemes according to the Requirement
3. Serve as a platform to designnovel cooperative protocols and routing algorithms.

Syllabus

The course serves an introduction to the field of wireless cooperative communication networks from the perspective of the channel and physical layer. It discusses cooperative networks protocols and its application. It deals with wireless channels and relay networks. Transparent and regenerative physical layer algorithms are discussed to facilitate the analysis of different architectures.

Course Outcome:

1. Evaluate the different cooperative communication protocols and their trade-offs.
2. Devise new techniques and demonstrate their feasibility using mathematical validations and simulation tools.

Text Books:

1.K.J.R. Liu, A.K. Sadek, W. Su, A. Kwasinski, Cooperative Communications and Networking,Cambridge University Press, 2008.
2.MischaDohler, Yonghui Li, “Cooperative Communications: Hardware, Channel & PHY”, John Wiley & Sons, 2010
3.Yan Zhang, Hsiao-Hwa Chen, Mohsen Guizan,“Cooperative Wireless Communications”’Auerbach Publications 2009.
4.S. Haykin and K.J.R. Liu, Eds., Handbook on Array Processing and Sensor Networks, IEEE Wiley, 2009.

References:

1. K.J.R. Liu and B. Wang, Cognitive Radio Networking and Security: A Game Theoretical View,Cambridge University Press, 2010.
2. H. V. Zhao, W.S. Lin, and K.J.R. Liu, Behavior Dynamics in Media-Sharing Social Networks,Cambridge University Press, 2011Cambridge University Press, 1996
3. Kwang-Cheng Chen and Ramjee Prasad, “Cognitive Radio Networks”, John Wiley & Sons, 2009

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 EC 6624	COOPERATIVE WIRELESS COMMUNICATION SYSTEM	3-0-0:3	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE 1: Introduction to Cooperative Communications Systems, Cooperation in Wireless Network, Cooperation protocols - Hierarchical cooperation, Cooperative Communications with single relay; Multi-node cooperative communications		7	15
MODULE 2: Cooperative Diversity, Capacity theorems for the relay channel, spatial diversity in wireless networks, Cooperative strategies and capacity theorems for relay networks, Capacity bounds for cooperative diversity		7	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3: Cooperative Demodulation , Modulation and demodulation for cooperative diversity in wireless systems, performance of cooperative demodulation with decode-and-forward relays, Symbol error probabilities for general cooperative links		7	15
MODULE 4: Cooperative Space-Time Coding, Space-Time Codes for High Data Rate Wireless Communication, Distributed space-time-coded protocols, Fading relay channels: performance limits and space-time signal design, Space-time diversity enhancements using collaborative communications		7	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5: Channel access issue, Cooperative Multiple Access Communication ,Relay channel and protocol ,Relay selection, Energy efficiency, Content-aware Cooperative multiple access protocol		7	20
MODULE 6: Distributed cooperative routing- Network Model, Cooperation based routing protocol, Source–channel coding with cooperation, Broadband cooperative communications - System model - Cooperative protocol and relay assignment scheme		7	20
END SEMESTER EXAM			

04 EC 6694 COMMUNICATION LAB WITH CORE COURSE

COURSE No.	COURSE NAME	L-T-P-C	YEAR
04 EC 6694	COMMUNICATION LAB WITH CORE COURSE	0-0-2 :1	2015

Objectives: To experiment the concepts introduced in the core and elective courses offered in the second semester with the help of simulation tools and related hardware. The faculty can replace these experiments with any other relevant experiments related to the core/elective taken.

Experiments:

1. Design and implementation of a network security algorithm

2. Medium access protocol development (CSMA, ALOHA).

3. Smart antennas

4. Wireless Sensor network protocol

5. Routing protocols

6. Signal processing applications

COURSE CODE	COURSE NAME	L-T-P-C	YEAR
04 EC 7601	SMART ANTENNAS	3-0-0-3	2015

Pre-requisites:

NIL

Course Objectives:

Able to design and configure smart antenna for targeted applications.

Syllabus

Introduction to Smart Antennas, DOA Estimation Fundamentals, Beamforming Fundamentals, Space–Time Processing, Inter symbol and Co-Channel Suppression.

Course Outcome:

1.Clear understanding of need ,application and composition of smart antennas

2.Get the ability to understand design constraints of smart antennas for different application.

Text Books:

1. Constantine A. Balanis, Panayiotis I. Ioannides, Introduction to Smart Antennas Morgan & Claypool Publishers

References:

1.Ahmed El Zooghby, Smart Antenna Engineering, Artech HouseM.J. Bronzel, Smart Antennas, John Wiley, 2004

2.T.S.Rappaport & J.C.Liberti, Smart Antennas for Wireless Communication, Prentice Hall (PTR) , 1999.

3.R.Janaswamy, Radio Wave Propagation and Smart Antennas for Wireless Communication, Kluwer, 2001

4.Lal. P.Godara Smart Antennas CRC press 2004

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 EC 7601	**SMART ANTENNAS**	**3-0-0:3**	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE1. Introduction To Smart Antennas: Need for Smart Antennas, Smart Antenna Configurations, Switched-Beam Antennas, Adaptive Antenna Approach, Space Division Multiple Access (SDMA),		7	15
MODULE2. Architecture of a Smart Antenna System, Receiver, Transmitter, Benefits and Drawbacks, Mutual Coupling Effects.		7	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3: **DOA Estimation Fundamentals :** Introduction The Array Response Vector, Received Signal Model, The Subspace-Based Data Model, Signal Autocovariance Matrices ,Conventional DOA Estimation Methods, Conventional Beamforming Method, Capon's Minimum Variance Method, Subspace Approach to DOA Estimation , The MUSIC Algorithm, The ESPRIT Algorithm, Uniqueness of DOA Estimates.		7	15
MODULE 4: **Beamforming Fundamentals:** The Classical Beamformer-Statistically Optimum Beamforming Weight Vectors, The Maximum SNR Beamformer, The Multiple Sidelobe Canceller and the Maximum, SINR Beamformer- Minimum Mean Square Error (MMSE). Direct Matrix Inversion (DMI), Linearly Constrained Minimum Variance (LCMV) , Adaptive Algorithms for Beamforming .		7	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5: The Least Mean-Square (LMS) Algorithm, The Recursive Least-Squares (RLS) Algorithm, Space–Time Processing**:** Introduction, Discrete Space–Time Channel and Signal Models, Space–Time Beamforming, Intersymbol and Co-Channel Suppression.		7	20
MODULE 6: Inter symbol and Co-Channel Suppression, ISI Suppression, CCI Suppression, Joint ISI and CCI Suppression, Space–Time Processing for DS-CDMA, Capacity and Data Rates in MIMO Systems, Single-User Data Rate Limits, Multiple-Users Data Rate Limits, Data Rate Limits Within a Cellular System, MIMO in Wireless Local Area Networks.		7	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 EC 7603	OPTICAL & WIRELINE TECHNOLOGY	3-0-0-3	2015

Pre-requisites: Nil

Course Objectives:

1. Gives basics of optical fibers
2. Details of optical sources and transmitters
3. Give understanding of Coherent systems and amplifiers
4. Give clear understanding of concepts of DTMF,ISDN,ATM standard cell switching etc

Syllabus

The course gives the understanding of basics of optical fibers. It gives details of devices used as optical sources, transmitters and amplifiers. It also gives details of keying formats. The last module gives an understanding of the networks and issues involved in the maintenance of network traffic.

Course Outcome:

The student will be able to

1. Clearly understand the technology involved in optical fibre transmission and details of components required to device an optical fiber communication system

2. Apply the techniques required to implement optical fiber system in a network so as to manage the traffic without cell loss, delay e.t.c

Text Books:

1. J.F.Kurose & K.W. Ross, Computer Networking,(3/e), Pearson Education,2005
2. A.Pattavina, Switching Theory, Wiley, 1998.

References:

1. Franze & Jain, Optical communication, systems and components, Narosa Publication, New Delhi, 2000
2. G Keiser, Optical fibre communication, system, McGraw Hill, Newyork, 2000
3. S.Basagni, Mobile Ad Hoc Networking, Wiley,2004.
4. J.M.Pitts & J.A.Schormans, Introduction to IP and ATM Design and Performance (2/e), Wiley, 2000.
5. C.Siva Ram Murthy & B.S.Manoj, Adhoc Wireless Networks (2/e), Pearson Education, 2005
6. Jean warland and Pravin Varaiya, High, Performance communication Networks, 2nd Edition, Harcourt and Morgan Kauffman, London, 2000
7. G. P. Agarwal, Fibre optic communication system, 2nd Edition, John Wiley & b sons, New York 1997
8. Franz and Jain, Optical communication system, Narosa Publications, New Delhi, 1995

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 EC 7603	**OPTICAL & WIRELINE TECHNOLOGY**	**3-0-0:3**	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE 1: Fibre Optic Guides, Light wave generation systems, systems components, optical fibers, SI, GI fibre, modes, Dispersion in fibers limitations due to dispersions, fibre loss, non liner effects.		7	15
MODULE 2: Optical Transmitters and Fibres, Basic concepts, LED structures spectral distribution semiconductor lasers, gain coefficients, modes, SIM and SIM operation. Transmitter design, Receive PIN and APD diodes design noise sensitivity degradation.		7	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3: Coherent systems: homodyne and Hetro dyne keying formats, BER in synchronous and Asynchronous. Amplifiers, Basic concepts, Semiconductor laser amplifiers Raman and Brillouin-fibre amplifiers,		7	15
MODULE 4: Erbium doped-fibre and amplifiers, pumping phenomenon Dispersion Compensation Limitations, post and pre-compensation techniques, equalizing filters,SONET/SDH		7	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5: Analogue fixed line, broadband cable access, cabling, DTMF, ISDN Numbering & addressing Broadband ISDN. Protocol reference model.		7	20
MODULE 6: ATM standard. Multistage networks. Traffic models; delay and loss performance.Cell switching. Cell scale and burst scale queuing		7	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 EC 7605	DETECTION AND ESTIMATION OF SIGNALS	3-0-0-3	2015

Pre-requisites: Nil

Course Objectives:

1. Gives the basics of decision theory
2. Gives details of detection of deterministic aand random signals
3. Different methods of estimation of signals

Syllabus

The subject gives basics of random variables and random process .It gives different methods of detection of deterministic and random signals. The subject also gives the statistics and methods involved in the estimation of signals

Course Outcome:

The student will be able to

1. Differentiate and apply methods of detection for deterministic and random signals to solve problems

2. Solve problems involving estimation of different signals

Text Books:

1. H. L. Van Trees, "Detection, Estimation and Modulation Theory: Part I, II, and III", John Wiley, NY,1968.

2. H. V. Poor, "An Introduction to Signal Detection and Estimation", Springer, 2/e, 1998.

References:

1. S. M. Kay, "Fundamentals of Statistical Signal Processing: Estimation Theory", Prentice Hall PTR, 1993.

2. S. M. Kay, "Fundamentals of Statistical Signal Processing: Detection Theory", Prentice Hall PTR, 1998.

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 EC 7605	**DETECTION AND ESTIMATION OF SIGNALS**	**3-0-0:3**	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE 1: Review of Gaussian variables and processes; problem formulation and objective of signal detection and signal parameter estimation in discrete-time domain. Statistical Decision Theory: Bayesian, minimax, and Neyman-Pearson decision rules.		7	15
MODULE 2: likelihood ratio, receiver operating characteristics, composite hypothesis testing, locally optimum tests, detector comparison techniques, asymptotic relative efficiency Detection of Deterministic Signals: Matched filter detector and its performance; generalized matched filter; detection of sinusoid with unknown amplitude, phase, frequency and arrival time, linear model		7	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3: Detection of Random Signals: Estimator-correlated, linear model General Gaussian detection, detection of Gaussian random signal with unknown parameters, weak signal detection.		7	15
MODULE 4: Nonparametric Detection: Detection in the absence of complete statistical description of observations, sign detector, robustness of detectors Estimation of Signal Parameters: Minimum variance unbiased estimation, Fisher information matrix, Cramer-Rao bound, sufficient statistics, minimum statistics, complete statistics.		7	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5: linear models; best linear unbiased estimation; maximum likelihood estimation, invariance principle; estimation efficiency; Bayesian estimation: philosophy, nuisance parameters, risk functions, minimum mean square error estimation, maximum a posterior estimation.		7	20
MODULE 6: Signal Estimation in Discrete-Time:Linear Bayesian estimation Weiner filtering, dynamical signal model, discrete Kalman filtering		7	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 EC 7607	MULTIMEDIA COMPRESSION TECHNIQUES	**3-0-0-3**	**2015**

Pre-requisites:

NIL

Course Objectives:

1. To understand the need for data compression for multimedia signals

2. To give basics of lossy and lossless compression algorithms.

3. Give detailed description of audio, video and image compression techniques and its standards

Syllabus

The gives brief introduction to multimedia and the need for data compression. It gives details of lossy and lossless compression standards. The last modules of the subjects concentrates on audio,video and image compression techniques and standards.

Course Outcome:

The student will be able to

1 Evaluate the need for data compression

2. Differentiate and apply lossy and lossless compression algoriths

3. Compare and contrast different audio/video/image compression technologies and their standards

Text Books:

1. Mark S.Drew and Ze-Nian Li, “Fundamentals of Multimedia,” Springer 2nd Edition, 2008.

References:

1. David Salomon, “Data Compression – The Complete Reference,” Springer Verlag New York Inc.,3rd Edition, 2008.

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 EC 7607	**MULTIMEDIA COMPRESSION TECHNIQUES**	**3-0-0:3**	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE 1: Introduction to Multimedia – components of multimedia-overview of multimedia software tools- Graphics and Image Data Representations – Graphics/image data types, popular file formats - Fundamental Concepts in video – analog and digital video.		7	15
MODULE 2: Basics of Digital Audio – Digitization of sound-MIDI-Quantization & transmission of audio Loss less compression algorithms ;Basics of information theory: basics of information theory-run length coding-variable length coding- Dictionary based coding-Arithmetic Coding.		7	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3: Loss less image compression-differential coding of images-lossless JPEG, Lossy compression algorithms:introduction-quantization-transform coding –wavelet based coding-wavelet packets-SPIHT.		7	15
MODULE 4: Image compression standards: the JPEG standard , JPEG 2000 standard Bit level image compression standards		7	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5: Video Compression: Introduction to video compression-search for motion vectors-H.261 MPEG Video Coding–video compression standards-MPEG1,2, and 7.		7	20
MODULE 6: Basic audio compression techniques:ADPCM in speech coding Vocoders		7	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 EC 7609	GLOBAL POSITIONING SYSTEMS	3-0-0:3	2015

Pre-requisites: Nil

Course Objectives:

To get an in-depth knowledge about GPS

Syllabus

History of GPS, User Segment, Kepler Elements, : C/A code; P-code; Y-code; Tracking Networks, Ionospheric Effects on GPS Observations

Course Outcome:

Student should be able to Identify and solve various aspects in designing a GPS system.

Text Books:

1. B.Hoffman-Wellenhof,H.Lichtenegger and J.Collins, "GPS: Theory and Practice", 4th revised edition, Springer, Wein, New york,1997.

2. A.Leick, "GPS Satellites Surveying", 2nd edition, John Wiley & Sons,NewYork,1995.

References:

1. B.Parkinson, J.Spilker, Jr.(Eds), "GPS: Theory and Applications", Vol.I & Vol.II, AIAA, 370 L'Enfant Promenade SW, Washington, DC 20024, 1996.

2. A.Kleusberg and P.Teunisen(Eds), “GPS for Geodesy”, Springer-Verlag, Berlin,1996.

3. L.Adams, "The GPS - A Shared National Asset”, Chair, National Academy Press, Washington, DC, 1995

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 EC 7609	GLOBAL POSITIONING SYSTEMS	**3-0-0:3**	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE 1: History of GPS – BC-4 System – HIRAN – NNSS – NAVSTAR GLONASS and GNSS Systems – GPS Constellation – Space Segment – Control Segment –		7	15
MODULE 2: User Segment – Single and Dual Frequency – Point – Relative – Differential GPS – Static and Kinematic Positioning – 2D and 3D – reporting Anti Spoofing (AS); Selective Availability (SA) – DOP Factors. Coordinate Systems – Geo Centric Coordinate System – Conventional Terrestrial Reference System – Orbit Description – Keplerian Orbit.		7	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3: Kepler Elements – Satellite Visibility – Topocentric Motion – Disturbed Satellite Motion – Perturbed Motion – Disturbing Accelerations - Perturbed Orbit – Time Systems – Astronomical Time System – Atomic Time – GPS Time – Need for Coordination – Link to Earth Rotation – Time and Earth Motion Services.		7	15
MODULE 4: C/A code; P-code; Y-code; L1, L2 Carrier frequencies – Code Pseudo Ranges – Carries Phases – Pseudo Ranges – Satellite Signal Signature – Navigation Messages and Formats – Undifferenced and Differenced Range Models – Delta Ranges – Signal Processing and Processing Techniques .		7	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5: Tracking Networks – Ephemerides – Data Combination: Narrow Lane; Wide Lane – OTF Ambiguity. Propagation Media – Multipath – Antenna Phase Centre – Atmosphere in brief – Elements of Wave Propagation .		7	20
MODULE 6: Ionospheric Effects on GPS Observations – Code Delay – Phase Advances – Integer Bias – Clock Error – Cycle Slip – Noise-Bias – Blunders – Tropospheric Effects on GPS Oberservables – Multipath Effect – Antenna Phase Centre Problems and Correction.		10	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 EC 7611	BROADBAND WIRELESS TECHNOLOGIES	3-0-0-3	2015

Pre-requisites: Nil

Course Objectives:

1.To get an in-depth knowledge about wireless broadband technologies and its architecture.
2.To familiar with different wireless networks and standards used for it.
3.To get an overview about 1G,2G,3G,4G and 5G communication.

Syllabus

Wireless networks, IEEE 802.11a,802.11b standards, HIPERLAN, Bluetooth and PANs, Zigbee technology, WIMAX, CDMA, link Budget for a CDMA System, OFDM,Evolution of Mobile Communication from 1G to 4G

Course Outcome:

1.Student will be able to analyse different technologies and give justification to the use of a particular technology in a communication network.
2.Student will be able to calculate parameters like bandwidth efficiency of a given technology.

Text Books:

1.Vijay K. Garg , “Wireless communications and networking”, Morgan Kaufmann publishers.

References:

1. K.Fazel & S. Kaiser, Multi-carrier and Spread Spectrum Systems, Wiley, 2003.

2. A.F.Molisch, Wireless Communications, Wiley, 2005.

3. T.S.Rappaport,Wireless digital communications; Principles and practice, Prentice Hall

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 EC 7611	**BROADBAND WIRELESS TECHNOLOGIES**	**3-0-0:3**	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE 1: Wireless networks-wireless local loop(WLL) and LMDS, Wireless local area networks(WLANs): IEEE 802.11 Architecture & services, , physical layer, Data Link Layer, MAC layer.		10	15
MODULE 2: IEEE 802.11a,802.11b standards, HIPERLAN, Bluetooth and PANs, Zigbee technology, WIMAX			15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3: CDMA: Basic Principle of DS-CDMA, Capacity of a DS-CDMA System, WCDMA, MC-CDMA			15
MODULE 4: link Budget for a CDMA System, Technical Differences between CDMA2000 and WCDMA		10	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5: OFDM: Basic principle, transmission and reception, OFDM with code division, Peak-to-Average Ratio Reduction (PARR) Techniques in OFDM, MIMO OFDM.UWB generation and Transmission.		10	20
MODULE 6: Evolution of Mobile Communication from 1G to 4G. Features and Drawbacks of 2G		10	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAMEe	L-T-P:C	YEAR
04 EC 7613	ADVANCED INFORMATION CODING THEORY AND TECHNIQUES	3-0-0:3	2015

Pre-requisites: Nil

Course Objectives:

This course is intended to

1. Enable the student to understand the relevance of information theory and coding in communication systems.

2. Expose the student tounderstand the trade-offs involved in the design of basic and advanced coding techniques.

Syllabus

Introduction to information theory, Communication channels, Channel models, Source Coding, Channel Coding

Course Outcome:
1. The student will be able to demonstrate an understanding of the trade-offs involved in the design of basic and advanced coding and modulation techniques evolved for exploiting the channel and user application characteristics.
2. Given the user requirements and the type of channel over which the system has to function the student will be in a position to apply his knowledge for designing the baseband signaling waveforms that would address the channel impairments.

Text Books:
1. Error Control Coding- Fundamentals and Applications –Shu Lin, Daniel J.Costello,Jr, Prentice Hall,Inc.
2. Error Correcting Coding Theory-Man Young Rhee- 1989, McGraw-Hill Publishing.
3. J.Das,S.K. Mullick and P.K.Chatterjee, “Principles of Digital Communication”,Wiley Eastern Limited,2008.
References:
1. Digital Communications- Simon Haykin John Wiley and sons 1988.
2. Digital Communications- John G. Proakis, 5th ed., 2008, TMH.

3. Introduction to Error Control Codes-Salvatore Gravano-oxford

4. Error Correction Coding – Mathematical Methods and Algorithms – Todd K.Moon, 2006, Wiley India.

5. Information Theory, Coding and Cryptography – Ranjan Bose, 2nd Edition, 2009, TMH.

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 EC 7613	**ADVANCED INFORMATION CODING THEORY AND TECHNIQUES**	**3-0-0:3**	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE 1: Introduction to information theory- Uncertainty and information- average mutual information, Average self-information,Average conditional self-information Measures of information- Information content of a message- Average information content of symbols in long independent sequences Average information content of symbols in long dependent sequences Information measure for continuous random variables.		7	15
MODULE 2: Communication channels, Discrete communication channel Rate of information transmission over a discrete channel-capacity of a discrete memoryless channel- continuous channel Shannon- Hartley theorem and its implications		7	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3: Channel models – channel capacity- BSC -BEC-cascade channels symmetric channel- unsymmetric channel and their capacities- Information capacity theorem, Shannon limit, channel capacity for MIMO system.		7	15
MODULE 4: Source Coding: Purpose of coding, Shannon's I and II fundamental theorem- Source coding theorem- Huffman coding- Shannon Fano-Elias coding, Arithmetic coding-Lempel-Ziv-algorithm- Run length encoding, Rate distortion function- Optimum quantizer design		7	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5: Channel Coding|: Linear block codes and cyclic codes- Galois fields, Vector spaces and matrices, Noisy channel coding theorem, Matrix description of linear blocks codes- parity check matrix, Decoding of linear block codes, Error detection and error correction capability perfect codes, Hamming codes, Low density parity check(LDPC) turbo codes- Turbo decoding- Space Time Codes.		7	20
MODULE 6: Channel Coding: Convolution codes and Trellis codes-Tree codes and Trellis codes, polynomial description of convolutional codes- Viterbi decoding of convolutional codes-distance bounds-performance bounds, Turbo codes-Turbo decoding-Interleaver design concept of coded modulation		7	20

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 EC 7615	SOFT COMPUTING TECHNIQUES	3-0-0	2015

Pre-requisites: Artificial Neural Networks

Course Objectives:

1. Serve as an introduction to the field of soft computing and illustrate the potential of presented methods in a range of case study applications.

2. Makes students familiar with fundamental concepts as well as giving them a broad perspective of emerging synergistic effects and their practical implications.

3. Give a very basic concept on neural networks, fuzzy systems, genetic algorithm, neuro fuzzy modeling and evolutionary computing paradigms with applications in pattern recognition, optimization, forecasting and control among others.

Syllabus

Genetic modelling, Optimization Derivative, Neural Networks Supervised Learning Neural Networks, Fuzzy Set Theory, Neuro Fuzzy Modeling.

Course Outcome:

The student will be able to

1.Identify the exact mathematical basis as well as the general principles of various soft computing techniques.

2.Provide exact theoretical or empirical aspects of intelligent modeling, optimization and control of non-linear systems.

3.Helps to prepare the students in developing intelligent systems by using case ASSESSMENTS TOOLS such as studies, simulation examples and experimental results.

Text Books:

1. S. Rajasekaran, G. A. VijayalakshmiPai , “Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis and Applications” .Prrentice Hall of India,2010.

2. Elie Sanchez, Takanori Shibata, Lotfi Asker Zadeh ,“Genetic algorithms and fuzzy logic systems: soft computing perspectives”, World Scientific Publishing Company,2002.

3. J.S.R.Jang, C.T.Sun and E.Mizutani, “Neuro-Fuzzy and Soft Computing”, PHI, 2004, Pearson Education 2004.

References:

1.Timothy J.Ross, “Fuzzy Logic with Engineering Applications”, McGraw-Hill, 1997.

2.Davis E.Goldberg, “Genetic Algorithms: Search, Optimization and Machine Learning”, Addison Wesley, N.Y., 1989

3.S.Rajasekaran and G.A.V.Pai, “Neural Networks, Fuzzy Logic and Genetic Algorithms”, PHI, 2003.

4.R.Eberhart, P.Simpson and R.Dobbins, “Computational Intelligence - PC Tools”, AP Professional Boston, 1996.

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 EC 7615	**SOFT COMPUTING TECHNIQUES**	**3-0-0:3**	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE 1: Introduction- Evolution of Computing –Constituents of Soft Computing – Conventional Artificial intelligence, Computational Intelligence - Basics of Machine Learning		4	15
MODULE 2: Introduction, gene, encoding, fitness function and reproduction, Genetic modeling: Significance of Genetic operators, Inheritance operator, cross over, inversion & deletion, mutation operator, Bitwise operator Differences & similarities between GA & other traditional methods, Applications of GA		6	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE 3: Optimization Derivative-based Optimization – Descent Methods The Method of Steepest Descent – Classical Newton's Method – Step Size Determination– Derivative-free Optimization – Genetic Algorithms – Simulated Annealing – Random Search – Downhill Simplex Search.		7	15
MODULE 4: Neural Networks Supervised Learning Neural Networks – Perceptrons -Adaline – Backpropagation MutilayerPerceptrons – Radial Basis Function Networks – Unsupervised Learning Neural Networks – Competitive Learning Networks – Kohonen Self-Organizing Networks – Learning Vector Quantization –Hebbian Learning.		8	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE 5: Fuzzy Set Theory- Fuzzy Sets – Basic Definition and Terminology – Set- theoretic Operations – Member Function Formulation and Parameterization – Fuzzy Rules and Fuzzy Reasoning – Extension Principle and Fuzzy Relations – Fuzzy If- Then Rules – Fuzzy Reasoning – Fuzzy Inference Systems – Mamdani Fuzzy Models – Sugeno Fuzzy Models – Tsukamoto Fuzzy Models–Input Space Partitioning and Fuzzy Modeling		9	20
MODULE 6: Neuro Fuzzy Modeling Adaptive Neuro-Fuzzy Inference Systems – Architecture – Hybrid Learning Algorithm – Learning Methods that Cross-fertilize ANFIS and RBFN – Coactive Neuro Fuzzy Modeling – Framework Neuron Functions for Adaptive Networks – Neuro Fuzzy Spectrum.		8	20

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 EC 7691	SEMINAR	**0-0-2-2**	**2015**

Each student shall present a seminar on any topic of interest related to the core / elective courses offered in the first semester of the M. Tech. Programme. He / she shall select the topic based on the References: from international journals of repute, preferably IEEE journals. They should get the paper approved by the Programme Co-ordinator / Faculty member in charge of the seminar and shall present it in the class. Every student shall participate in the seminar. The students should undertake a detailed study on the topic and submit a report at the end of the semester. Marks will be awarded based on the topic, presentation, participation in the seminar and the report submitted.

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
ECWT 7693	**PROJECT (PHASE 1)**	**0-0-12-6**	**2015**

In Master's Project Phase-I, the students should select an emerging research area in the field that has direct or indirect relation to the area of specialization. After conducting a detailed literature survey, they should compare and analyze research work done and review recent developments in the area and prepare an initial design of the work to be carried out as Master's Project. It is mandatory that the students should refer National and International Journals and conference proceedings while selecting a topic for their Project. He/She should select a recent topic from a reputed International Journal, preferably IEEE, ACM, Springer. Emphasis should be given for introduction to the topic, literature survey, and scope of the proposed work along with some preliminary work carried out on the Project topic.

Students should submit a copy of Phase-I Project report covering the content discussed above and highlighting the features of work to be carried out in Phase-II of the Project. The candidate should present the current status of the Project work and the assessment will be made on the basis of the work and the presentation, by a panel of internal examiners in which one will be the internal guide. The examiners should give their suggestions in writing to the students so that it should be incorporated in the Phase–II of the Project.

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 EC 7694	PROJECT (PHASE 2)	0-0-21-12	2015

In the fourth semester, the student has to continue the project work and after successfully finishing the work, he / she has to submit a detailed bounded Project report. The work carried out should lead to a publication in a National / International Conference or Journal. The papers received acceptance before the M. Tech evaluation will carry specific weightage.

TOTAL MARKS :100

Project evaluation by the supervisor/s : 30 Marks

Evaluation by the External expert : 30 Marks

Presentation & evaluation by the Committee : 40 Marks