PONDICHERRY ENGINEERING COLLEGE, PUDUCHERRY – 605 014

CURRICULUM AND SYLLABI FOR AUTONOMOUS STREAM

M.TECH. (WIRELESS COMMUNICATION) COURSES

(FOR STUDENTS ADMITTED FROM ACADEMIC YEAR 2015-16 ONWARDS)

CURRICULUM[a]

I SEMESTER

Subject Code	Subjects	Category	Periods			Marks			Credits
			L	T	P	CA	SE	TM	
MA155	Probability and Stochastic Process	TY	3	1	0	40	60	100	4
EC151	Advanced Digital Communication	TY	3	1	0	40	60	100	4
EC152	Advanced Digital Signal Processing	TY	3	1	0	40	60	100	4
EC161	Emerging Wireless Technologies	TY	3	1	0	40	60	100	4
	Elective I	TY	4	-	0	40	60	100	4
	Elective II	TY	4	-	0	40	60	100	4
EC162	Wireless Communication and Networking Laboratory	LB	-	-	3	60	40	100	2
Total Credits									**26**

II SEMESTER

Subject Code	Subjects	Category	Periods			Marks			Credits
			L	T	P	CA	SE	TM	
EC163	CDMA and OFDM for Wireless Communication	TY	3	1	0	40	60	100	4
EC164	Advanced Wireless Communication Systems	TCM	3	-	2	50	50	100	4
	Elective III	TY	4	-	0	40	60	100	4
	Elective IV	TY	4	-	0	40	60	100	4
	Elective V	TY	4	-	0	40	60	100	4
	Elective VI	TY	4	-	0	40	60	100	4
EC165	Mini-project	PR	-	-	-	60	40	100	2
EC158	Research Methodology	PR	-	-	3	100	-	100	1
Total Credits									**27**

[a] ***Approved in 3rd Academic Council Meeting***

III SEMESTER

Subject Code	Subjects	Category	Periods			Marks			Credits
			L	T	P	CA	SE	TM	
EC166	Project Phase I	PR	-	-	-	150	150	300	9
Total								**300**	**9**

IV SEMESTER

Subject Code	Subjects	Category	Periods			Marks			Credits
			L	T	P	CA	SE	TM	
EC167	Project Phase II	PR	-	-	-	200	200	400	14
	Professional Development Courses	PR	-	-	-	200	-	200	2
Total									**16**

A representative list of *professional development courses* is given below:

a) Industrial Training(Limited to one credit)
b) Specific Field Knowledge Training (Limited to a maximum of two credits)
c) Seminar related with directed study(Limited to a maximum of two credits)
d) Paper Publication in SCI Journals(Limited to one credit)

CA- Continuous Assessment, **SE**-Semester Examination, **TM**- Total Marks **TY**-Theory,
TCM-Theory with a Mini Project**, LB**-Laboratory, **PR**- Practice

LIST OF ELECTIVES

Sl.No.	Subject Code	Name of the Subject	Category
1.	**ECE51**	Cryptography and Wireless Security	TY
2.	**ECE52**	Wireless Sensor Networks	TY
3.	**ECE53**	Ubiquitous Computing	TY
4.	**ECE71**	Optical Networks	TY
5.	**ECE72**	VLSI for Wireless Communication	TY
6.	**ECE73**	Modelling and Simulation of Communication Networks	TY
7.	**ECE74**	Microwave Integrated Circuits	TY
8.	**ECE75**	Convergence Technologies	TY
9.	**ECE76**	Radio Over Fiber Systems	TY
10.	**ECE77**	Advanced Satellite Systems	TY
11.	**ECE78**	ASIC and FPGA Design	TY
12.	**ECE79**	UMTS	TY
13.	**ECE80**	Reconfigurable Computing	TY
14.	**ECE81**	Cognitive Radio	TY
15.	**ECE82**	Multimedia Communication Systems	TY
16.	**ECE83**	Network Management	TY
17.	**ECE84**	Ultra Wide Band Communication	TY
18.	**ECE85**	Digital Communication Receivers	TY
19.	**ECE86**	Space Time Wireless Communication	TY
20.	**PHE51**	Nanotechnology and its Applications	TY

Department : Mathematics				**Programme:** M.Tech. (Wireless Communication)				
Semester : One				**Category :** TY				
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
MA155	Probability and Stochastic Process	3	1	-	4	40	60	100
Prerequisite	Basic Probability and Statistics.							
Objectives	• To introduce Moment Generating function, Probability generating function, Characteristic function • To familiarize students with Discrete and continuous distributions and stochastic Process • To introduce Queuing Theory							
Outcome	• Knowledgeable in Distributions and Stochastic processes • Ability to demonstrate the application of stochastic processes and Queuing theory							
UNIT – I	**Random Variables-Discrete Random Variables**					**Hours: 9**		
Random Variables and their Probability Distributions Random variables, Probability distribution function, Probability density function, Conditional probability, Statistical Independence, Bayes formula. Discrete Random Variables and their Distributions, Moment Generation Function, Characteristics Function, Cumulants, Probability generating function, Binomial Distribution, Negative Binomial Distribution, Hypergeometric distribution, Multinomial, Poisson Distributions, Relationship between various Discrete-Type distributions.								
UNIT – II	**Continuous Random Variables**					**Hours: 9**		
Continuous Random Variables and their Distributions Normal, Log - Normal, Multivariate Normal, Gamma, Exponential, Chi-square, Weibull, Rayleigh distributions. Relationship between continuous distributions.								
UNIT – III	**Stochastic Processes**					**Hours: 9**		
Transformation of Random Variables: Transformation of Single, Several Random Variables, Function of Random Variables, Sum, Differences, Product and Ratio of Two Random Variables, Transformation through characteristic Functions.								
UNIT – IV	**Queueing Models**					**Hours: 9**		
Stochastic Processes Introduction- Classification of stochastic process, Stationary process (SSS and WSS) Stationary process, Ergodic Process, Independent increment Process, Markov Process, Counting Process, Narrow- Band Process, Normal Process, Wiener-Levy Process, Poisson, Bernoulli, Shot noise Process, Autocorrelation Function.								
UNIT – V	**Continuous Parameter Markov Chain**					**Hours: 9**		
Introduction, Little's formula, M/G/1 queueing model, Continuous Parameter Markov Chain: The Birth and Death process : M/M/1, M/M/c, M/M/1/N, M/M/c/N (c<N), M/M/c/c, M/M/∞ models only - derivation of mean number of customer in the system, in the queue and waiting time - Simple applications, Special case of Birth and Death model (Pure Birth and Pure Death Processes).								
Total contact Hours: 45	**Total Tutorials: 15**	**Total Practical Classes: -**				**Total Hours: 60**		

Text Books:

1. KishorS.Trivedi, Probability and Statistics with Reliability, Queueing and Computer Science Applications, John Wiley & Sons Inc. Second Edition, 2002
2. D.Gross and C.M.Harris, Fundamentals of Queuing Theory, Wiley Students Edition, Third Edition, 1985.
3. J.Medhi, Stochastic models in Queueing Theory, Academic Press, Second Edition, 2002.

Reference Books:

1. J.Medhi, Stochastic Processes, New Age International (P) Ltd., Second Edition, 2012.
2. J.Medhi, Stochastic models in Queueing Theory, Academic Press, Second Edition, 2012.

Department: Electronics and Communication Engineering					**Programme:** M.Tech. (Wireless Communication)			
Semester : One					**Category :** TY			
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
EC151	Advanced Digital Communication	3	1	-	4	40	60	100
Prerequisite								
Objectives	• To understand the concept of different digital modulation schemes • To study optimum receivers suitable for communication channels • To understand the concepts of Pulse shaping and equalization • To have an in depth knowledge on concepts and theoretical limits set by Information theory • To learn the various coding schemes in detail							
Outcome	• Ability to select an appropriate modulation scheme when the transmitted signal is corrupted by AWGN in the channel • Knowledgeable in equalization techniques • Ability to set the limit for compression and transmission of information • Ability to use appropriate channel coding scheme to improve the performance of communication system over noisy channel							
UNIT – I	**Information Theory**					**Hours: 9**		
Information Measure and Entropy, Source coding and Shannon's Theorem, Source coding for Discrete Memoryless Sources, Discrete Memoryless Channels, Mutual Information and Channel capacity, Channel Coding Theorem, Continuous Sources and Differential Entropy.								
UNIT – II	**Channel Coding**					**Hours: 9**		
Introduction to linear block codes, Convolution coding,Systematic, Non-recursive and recursive codes, Maximum likelihood decoding, Viterbi algorithm,Punctured convolutional codes, Dual-k codes, Concatenated codes . MAP and BCJR algorithms, Iterative decoding, Factor graphs, LDPC codes and Trellis coded modulation								
UNIT – III	**Digital Modulation Schemes**					**Hours: 9**		
Elements of digital communication system, Representation of Digitally Modulated Signals, Memory less modulation methods, Signaling Scheme with memory, Power spectrum of digitally modulated signals. Synchronization.								
UNIT – IV	**Receivers for AWGN Channel**					**Hours: 9**		
Waveform and vector Channel models, Waveform and vector AWGN Channel, Optimum detection and error probability for band limited signaling and power limited signaling- Non Coherent detection, A comparison of digital signaling methods, Optimum receiver for CPM.								
UNIT – V	**Band Limited Channels**					**Hours: 9**		
Characterization of Band Limited Channels, ISI, Nyquist Criterion, Controlled ISI channel with ISI and AWGN, Pulse Shaping for optimum transmission and reception, MLSE, Linear Equalization, Decision feedback equalization, ML detectors, Turbo and Blind Equalization methods.								
Total contact Hours: 45	**Total Tutorials: 15**	**Total Practical Classes: -**			**Total Hours: 60**			
Text Books:								
1. John G. Proakis and MasoudSalehi, Digital Communications, 5th edition, Tata McGraw Hill, 2008.								
Reference Books:								
1. Ian A. Glover and Peter M. Grant, Digital communications, 2nd edition, Pearson education, 2008. 2. Marvin K. Simon, Sami M. Hinedi and William C. Lindsey, Digital Communication Techniques: Signal Design and Detection Prentice Hall of India, 2009. 3. 3.BernardSklar, Digital Communications: Fundamentals and Applications, 2nd edition, Pearson Education, 2002.								
Website								
1. www.nptel.ac.in								

Department: Electronics and Communication Engineering					**Programme:** M.Tech. (Wireless Communication)			
Semester : One					**Category :** TY			
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
EC152	Advanced Digital Signal Processing	3	1	-	4	40	60	100
Prerequisite								

Objectives	• To learn about random signals and their processing techniques • To study the parametric and non-parametric methods of spectrum estimation • To understand the concepts of linear prediction and estimation • To design adaptive filters for non-stationary processes • To study and understand the multirate signal processing techniques
Outcome	• Knowledgeable in random signals, random processes and filtering techniques for random processes • Knowledgeable in spectrum estimation methods • Ability to design predictors and estimators • Knowledgeable in adaptive filtering for non-stationary processes • Knowledgeable in multirate signal processing techniques

UNIT – I	**Discrete Time Random Signal Processing**	**Hours: 9**

Discrete Random Processes- Ensemble averages, Stationary processes, Autocorrelation and Autocovariance matrices, Ergodicity. Parseval's Theorem, Wiener-Khintchine Relation- White noise, Power Spectral Density, Filtering random processes, Low Pass Filtering of White Noise, Spectral Factorization, Parameter Estimation: Bias and Consistency.

UNIT – II	**Spectrum Estimation**	**Hours: 9**

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

UNIT – III	**Linear Estimation and Prediction**	**Hours: 9**

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

Unit – IV	**Adaptive Filters**	**Hours: 9**

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

UNIT – V	**Multirate Digital Signal Processing**	**Hours: 9**

Mathematical description of sampling rate conversion - Interpolation and Decimation, Decimation by an integer factor - Interpolation by an integer factor, Sampling rate conversion by a rational factor, Filter implementation for sampling rate conversion- direct form FIR structures, Polyphase filter structures. Multistage implementation of sampling rate conversion. Applications – Phase shifters – Interfacing of digital systems with different sampling rates - Sub band coding.

Total contact Hours: 45	**Total Tutorials: 15**	**Total Practical Classes: -**	**Total Hours: 60**

Reference Books:

1. Monson H.Hayes, Statistical Digital Signal Processing and Modeling, Wiley India, 2008.
2. Simon Haykin, Adaptive Filter Theory, Fourth Edition, Pearson India, 2002.
3. John G. Proakis, DimitrisG.Manolakis, Digital Signal Processing, Fourth Edition, Prentice Hall of India, New Delhi, 2007.
4. John G. Proakiset.al., Algorithms for Statistical Signal Processing, Pearson Education, 2002.
5. Dimitris G.Manolakiset.al., Statistical and Adaptive Signal Processing, McGraw Hill, Newyork, 2000.

Website:

1. www.nptel.ac.in

Department: Electronics and Communication Engineering				**Programme:** M.Tech. (Wireless Communication)				
Semester : One				**Category :** TY				
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
EC161	Emerging Wireless Technologies	3	1	-	4	40	60	100
Prerequisite	-							
Objectives	• To understand the basic concepts of emerging technologies • To gain knowledge on LTE and Femtocell • To study the performance of Intelligent Autonomous communication systems • To acquire knowledge about Smart devices and content delivery networks							
Outcome	• Knowledgeable in Emerging Wireless technologies • Able to demonstrate the architecture and reference model of LTE • Ability to examine the concepts of intelligent system • Knowledgeable in future wireless technologies							
UNIT – I	**Emerging Technologies**					**Hours: 9**		
Bluetooth –Radio frequency Identification – Wireless Broadband (WiMax) – IP and Mobile IP– Packet delivery and Handover management – Location management – Registration – Tunnelling and Encapsulation - Cellular IP – Internet Protocol Version_4 - Internet Protocol Version_6 – Wireless Application Protocol.								
UNIT – II	**Long Term Evolution**					**Hours: 9**		
Overview – LTE Evolution - Architecture - Reference Model - Functional Description of LTE Network - Reference Points - Control and User Planes – LTE advanced								
UNIT – III	**Femtocell**					**Hours: 9**		
Femtocell Technology - Femtocell Benefits - User Benefits - Operator Benefits - LTE Femtocell Design Issues - Architecture - Deployment Scenarios - Femtocell Access Control Strategy - CSG Concept - Physical Cell Identity. **LTE Femtocell Challenges and Technical Issues**- Interference - Spectrum Allocation - Access Mode Impact - Security and Privacy Challenges - Synchronization - Mobility								
UNIT – IV	**Intelligent Autonomous Communications**					**Hours: 9**		
Introduction – Basic Autonomous Intra-acting systems – Limitations- Intelligent Systems – Self aware systems- Self describing – Self explaining – Self modifying – Self management and Autonomic computing- Internet of Things(IoT)								
UNIT – V	**Future Technologies**					**Hours: 9**		
Challenges – Future technologies – Smart devices – Interaction – Interoperability – Smart physical environment device interaction – Smart Human device Interaction - Human intelligence – Machine Intelligence - Content delivery Networks- Content delivery Evolution- CDN Functions- Distribution Model - Content Generation Tier- Integration Tier – Content delivery and Assembly Tier.								
Total contact Hours: 45	**Total Tutorials: 15**	**Total Practical Classes: -**				**Total Hours: 60**		

Text Books:

1. Savo G. Glisic, ' Advanced Wireless Networks -4G Technologies', University of Oulu, Finland
2. Ashok K Talukder, "Mobile Computing", Tata McGraw Hill, 2010
3. Stefan Poslad, "Ubiquitous Computing", John Wiley & Sons, 2010
4. Erik Dahlman, Stefan Parkvall, and Johan Sköld, ' 4G LTE/LTE-Advanced for Mobile Broadband', Elsevier 2011.
5. KavehPahlavan and Prashant Krishnamurthy, "Principles of Wireless Networks" , Pearson Education, 2004

Websites:

1. http://go.radisys.com/rs/radisys/images/paper-femto-lte-roadmap.pdf
2. http://www.3gpp.org/technologies/keywords-acronyms/98-lte
3. http://www.saitechnology.com/index.php/saiproducts/sai-m2m/sai-4g-femto-pico-cell

Department : Electronics and Communication Engineering		**Programme :** M.Tech (Wireless Communication)						
Semester : One		**Category :** LB						
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
EC162	Wireless Communication and Networking Laboratory	**-**	**-**	**3**	**2**	**60**	**40**	**100**
Prerequisite:	-							
Objectives:	• To understand the working of communication system models • To understand and implement application using embedded development board • To simulate the different channel models for wireless networks							
Outcome:	• Ability to demonstrate the design of modulator and antenna used for wireless communication • Ability to implement the GSM and HTTP data transfer using Qualnet software and study the different parameters of the network • Ability to design simple digital systems using Spartan6 FPGA board • Ability to design filters suitable for wireless channel							

LIST OF EXPERIMENTS

1. Design of GMSK modulator for GSM system.
2. Study of wireless sensor network using NI Labview
3. Study and comparison of various wireless channel models
4. Call establishment using different entities of GSM network using Qualnet.
5. Development of a network to run HTTP application using Qualnet.
6. Developing any one network topology, establishing a routing protocol and analysing using NS2.
7. Study of serial data transfer using HCS959 module.
8. Designing Yagi antenna and study the Return loss magnitude and phase characteristics
9. FFT of real time input signals using DSP trainer kits.
10. Simulation of OFDM transmitter and receiver in Matlab.
11. Study of Spartan6 FPGA and perform the following operations
    i. Activating the traffic light controller interface
    ii. Enabling the Keypad Matrix interface with LEDs.
    iii. Enabling the graphic LCD interface in Spartan6 FPGA.
    iv Design and implementation of Manchester encoder.
12. Image compression using Matlab.

Total contact Hours: -	**Total Tutorials: -**	**Total Practical Classes: 45**	**Total Hours: 45**

Department: Electronics and Communication Engineering		**Programme:** M.Tech. (Wireless Communication)						
Semester : Two		**Category :** TY						
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
EC163	CDMA and OFDM for Wireless Communication	3	1	-	4	40	60	100
Prerequisite								
Objectives	• To addresses radio resource allocation, sharing, control and management for CDMA and OFDM based systems • To understand call establishment, call processing, traffic management • To address Uplink and downlink interference management, scheduling issues and capacity evaluation • To analyze the system and channel requirements for OFDM system • To study system description of OFDM based resource allocation schemes							
Outcome	• Ability to demonstrate the impact of spread spectrum techniques on forward link and reverse link • Ability to characterize resource handling in terms of capacity in real time scenario • Ability to demonstrate call processing and traffic states by link budget and traffic analysis • Ability to illustrate the choice of modulation, channel estimation in time and frequency domain, and synchronization in OFDM/OFDMA systems							
UNIT – I	**Principles of Code Division Multiple Access**					**Hours: 9**		
Spread spectrum technique – Direct sequence and frequency hopping spread spectrum communication system – PN codes and Walsh codes – Rake receiver – Capacity – Effects of loading, sectorization and voice activity – Power control – Hand off – Link structure – Forward link – Pilot, synchronization, paging and traffic channels – Reverse Link – access and traffic channel.								
UNIT – II	**Call Processing and Traffic**					**Hours: 9**		
Call processing states – Initialization, idle, access and traffic states – Forward link and Reverse link analysis - Calculation of Ec/I0 and Eb/N0 – Traffic intensity – Grade of Service – Erlang-B and C models.								
UNIT – III	**OFDM Basics**					**Hours: 9**		
OFDM principles – System model –Comparison with single carrier –FEC coding – Interleaving – QAM – Coded modulation–Generation of sub carrier using IFFT, guard time and cyclic extensions – windowing - Choice of OFDM parameters - OFDM signal processing.								
UNIT – IV	**Coding, Modulation and Channel Estimation**					**Hours: 9**		
Timing and Frequency offset in OFDM –Synchronization – Synchronization using cyclic extension and special training symbols – Coherent detection – One and two dimensional channel estimation – Special training symbols – Decision directed channel estimation – Differential detection in the time and frequency domain.								
UNIT – V	**OFDMA and MC-CDMA**					**Hours: 9**		
Frequency hopping in OFDMA - OFDMA system description – Channel coding, modulation, time and frequency synchronization, Combination of OFDM and CDMA - MC-CDMA, MT-CDMA and MC-DSCDMA systems - Difference between OFDMA and MC-CDMA								
Total contact Hours: 45	**Total Tutorials: 15**	**Total Practical Classes: -**			**Total Hours: 60**			

Text Books:

1. Samuel C Yang, CDMA RF System Engineering, Artech House, 1998.
2. Richard Van Nee and Ramjee Prasad, OFDM for wireless Multimedia Communication, Artech House, 2000.

Reference Books:

1. LajasHanzo, OFDM and MC-CDMA for Broadband Multiuser Communications, 2003.
2. Khaled Fazal and Stephen Kaiser, Multicarrier and Spread Spectrum Systems, 2008
3. Y. Li. G. Stuber, OFDM for Wireless communication, Springer, 2006

Department: Electronics and Communication Engineering				**Programme:** M.Tech. (Wireless Communication)				
Semester : Two				**Category :** TCM				
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
EC164	Advanced Wireless Communication Systems	3	-	2	4	50	50	100
Prerequisite								
Objectives	• To understand the evolution trends involved in mobile wireless systems. • To enable the postgraduates to distinguish and quantify the various fading effects and propagation models along with Channel measurements. • To know and compare the various antennas and diversity reception techniques adopted in wireless communication systems. • To analyze the overall system performance of wireless communication system and to introduce the emerging advanced wireless standards.							
Outcome	• Ability to track the growth trend of the Wireless Communication Systems • Ability to Characterize and measure the mobile channel quantitatively • Design and demonstrate mobile antennas and reception techniques for any specific application • Ability to carry out the system performance for both in-door and out-door wireless communications • Ability to demonstrate the knowledge of present day and advanced wireless communication technologies befitting for a potential researcher							
UNIT – I	**Trends In Mobile Wireless**					**Hours: 9**		
UMTS-WCDMA, CDMA-2000 network. Multi-Carrier Modulation concept: Data transmission with multiple carriers, Implementation of multicarrier, Challenges in Multicarrier systems - Multicarrier modulation with overlapping sub channels, Mitigation of subcarrier fading. Advanced Wireless system:Intelligent cell concept and applications – Applications of intelligent microcell systems, in-building communications, Advanced Intelligent Network (AIN) – elements and interfaces, SS7 networks and ISDN for AIN, AIN for mobile communications, Future of IP.								
UNIT – II	**Propogation and Shadowing**					**Hours: 9**		
Review on Propagation effects of EM signals in Multipath and propogation models: COST -231 Hata model, Longley-Rice Model, NLOS Multipath Fading Models. **Shadowing :** Statistical characterisation, Impact on coverage, correlated shadowing and microcell shadowing								
UNIT – III	**Fading Channel Characterisation**					**Hours: 9**		
Channel behaviour, statistical Characterisation using Rayleigh, Rice, Nakagami –m and other distributions – Second order fast fading statistics, Narrowband mobile radio channel simulations. Wideband Fading: Effects, Channel model and parameters, frequency domain effects. Channel measurements for mobile Systems: Impact of measurement inaccuracy, Measurement systems, outdoor and indoor measurements.								
UNIT – IV	**Performance Evaluation**					**Hours: 9**		
Performance evaluation, signalling evaluation, measurement of average received level and level crossings, spectral efficiency, OFDMA Vs CDMA Evaluation, Evaluation of data services, WiMAX Vs 3G for mobile broadband wireless.								
UNIT –V	**Quality Improvement**					**Hours: 9**		
Antennas: Adaptive antennas: Basic concepts, adaptive antenna applications, optimum combining, MIMO, Cooperative and Massive MIMO, adaptive antennas in a practical system. Diversity Realization of Independent Fading Paths: Receiver Diversity – Transmitter Diversity – The Alamouti Scheme-basic concepts of RAKE receivers, Role of moment generating function in diversity analysis.								
	Mini Project					**Hours: 30**		
PG students will be motivated to carry out the Mini Project in • Design, fabrication/analytical modeling/simulation of OFDM, CDMA 2000, WCDMA networks,								

- Design and simulation of AIN and IP networks, Modeling/Simulation of propagation models,
- Performance evaluation of different traffic for various propagation models.
- Performance evaluation of OFDMA/CDMA/3G/Mobile WiMAX service, Design ,fabrication and testing of antennas for different applications
- Performance improvement through MIMO/Receive diversity/Transmit diversity and coding.

Total contact Hours: 45	Total Tutorials: -	Total Practical Classes: 30	Total Hours: 75

Text Books:

1. William C.Y. Lee, Wireless and Cellular Telecommunications, McGraw Hill Publishers, 3rd edition, 2006.
2. Simon R. Saunders, Alenjandro Aragon- Zavala, Antennas and propogation for Wireless Communication systems, John Wiley – India edition, second edition ,2007.
3. Andrea Goldsmith, Wireless Communication, Cambridge University Press, 2005.
4. Andreas F. Molisch, Wireless Communications, John Wiley – India, 2006.

Reference Books:

1. David Tse and Prasad Viswanath, Fundamentals of Wireless Communications,Cambridge
2. University press, 2005.
3. Theodore. S.Rappaport, Wireless Communication: Principles and Practice, Second Edition,
4. Prentice Hall India, 2006.
5. John G.Prokias, Digital Communications, McGraw Hill Publishers,2000.
6. Vijay. K. Garg, Wireless Communication and Networking, Morgan Kaufmann Publishers, 2007.

Website:

1. http://www.eecs.berkeley.edu/~dtse/book.html
2. http://www.see.ed.ac.uk/~hxh/ADCCourseMaterial/0902_WComms_Intro.pdf
3. http://ee.sharif.edu/~pr.wireless.comm/references/Goldsmith.pdf

Department: Electronics and Communication Engineering				**Programme:** M.Tech. (Wireless Communication)				
Semester : Two				**Category :** PR				
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
EC165	Mini project	-	-	-	2	60	40	100
Prerequisite	-							
Objectives	• To apply engineering concepts in order to come out with a technical solution • To analyze the outcomes and present the results in an appropriate way • To prepare a technical report of the project • To move from competitive learning to collaborative learning							
Outcome	• Ability to undertake a piece of research work • Ability to extend the project to find an application for society							
MINI PROJECT								
In the course of the degree Programme each group of not more than three students has to identify a mini project work in the area of their specialization and the mini project will be implemented under the supervision of a faculty. The progress of the work will be monitored and assessed internally. A project report has to be submitted at the end of the semester after completion of the project work. The semester examination will be evaluated by a panel of examiners.								
Total contact Hours: -	**Total Tutorials: -**	**Total Practical Classes: -**			**Total Hours: -**			

Department: Electronics and Communication Engineering				**Programme:** M.Tech. (Wireless Communication)				
Semester : Two				**Category :** PR				
Subject code	**Subject**	**Hours/week**			**Credit**	**Maximum marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
EC158	Research Methodology	-	-	3	1	100	-	100
Prerequisite	-							
Objectives	• To educate students to methods of selection of research problems • To expose students to different research methods							
Outcomes	• Students will be capable to identify and narrow down to the area of research on the basis the requirements of industrial and global requirements • Students will exhibit the domain skill to choose suitable research methods to execute research effectively • Students will possess knowledge to further their academic program, namely, Ph.D program.							

- **Definition of research:** Research – Definition; Concept of Construct, Postulate, Proposition, Thesis, Hypothesis, Law, Principle. Definition and Dimension of a Theory, Functions and Characteristics; Types of Theory: General Theory and Particular/ Empirical Theory. Cases and their Limitations; Causal Relations. Philosophy and validity of research. Objective of research.
- **Characteristics of research:** Various functions that describe characteristics of research such as systematic, valid, verifiable, empirical and critical approach.
- **Types of research:** Pure and applied research. Descriptive and explanatory research. Qualitative and quantitative approaches.
- **Research procedure:** Formulating the Research Problem, Literature Review, Developing the objectives, Preparing the research design including sample. Design, Sample size.
- **Considerations in selecting research problem:** Relevance, interest, available data, choice of data, Analysis of data, Generalization and interpretation of analysis.
- **Outcome of research:** Significance of report writing – Layouts of the research report – Types of reports – Oral presentation – Mechanics of writing research report – Precautions for writing research reports – Plagiarism and copy right violation – Patent writing and filing.

Total contact hours: -	**Total tutorials: -**	**Total practical classes:15**	**Total hours: 15**

Reference books:

1. Dawson, Catherine, Practical Research Methods, UBS Publishers and Distributors, New Delhi, 2002
2. Kothari, C.R., Research Methodology-Methods and Techniques, Wiley Eastern Limited, New Delhi, 1985.
3. Kumar, Ranjit, Research Methodology, A Step-by-Step Guide for Beginners, (2nd.ed), Pearson Education, Singapore, 2005.

Department: Electronics and Communication Engineering		**Programme:** M.Tech. (Wireless Communication)						
Semester : Three		**Category :** PR						
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
EC166	Project Phase I	-	-	-	9	150	150	300
Prerequisite	-							
Objectives	• To identify a research problem • To develop an abstract model that addresses the research problem • Build a prototype system or constrained implementation of the system that acts as a proof • Understanding the evaluation of the system • To present a critical analysis and present it as a report							
Outcome	• Ability to transform knowledge into an experimental process • Ability to demonstrate the motivation to extend the work to a research • Ability to identify and apply appropriate tools to solve a problem • Ability to examine hypotheses							
Each student will do an exhaustive literature survey and identify an experimental and / or a theoretical project to be carried out under a supervision of a guide. The phase I of the project work has to be completed by the end of third semester. The progress of the work will be monitored and assessed internally for 150 marks by a committee comprising departmental faculty members and project guide. A project report has to be submitted at the end of the semester after completion of the phase I of the project work. The external assessment will be carried out for 150 marks as per regulations.								

Department: Electronics and Communication Engineering		**Programme:** M.Tech. (Wireless Communication)						
Semester : Four		**Category** : PR						
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
EC167	Project Phase II	-	-	-	14	200	200	400
Prerequisite	-							
Objectives	• To identify a research problem • To develop an abstract model that addresses the research problem • Build a prototype system or constrained implementation of the system that acts as a proof • Understanding the evaluation of the system • To present a critical analysis and present it as a report							
Outcome	• Ability to transform knowledge into an experimental process • Ability to demonstrate the motivation to extend the work to a research • Ability to identify and apply appropriate tools to solve a problem							
The phase II of the project work has to be completed by the end of the fourth semester. The progress of the work will be monitored and assessed internally for 200 marks by a committee comprising departmental faculty members and project guide. A project report summarizing the entire project work has to be submitted at the end of the semester after completion of the phase II of the project work. The external evaluation will be carried out as per regulations for 200 marks.								

Department: Electronics and Communication Engineering				**Programme:** M.Tech. (Wireless Communication)				
Semester :				**Category :** TY				
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
ECE51	Cryptography and Wireless Security	3	1	-	4	40	60	100
Prerequisite	-							
Objectives	• To understand Security Services, Attacks and Mechanisms as well as Symmetric Key Cryptographic techniques • To gain knowledge on number theory and public key management schemes • To understand the various Authentication Techniques • To study about system security and security blueprint • To analyze the basic concepts on wireless security and threats							
Outcome	• Ability to develop different symmetric key algorithms • Ability to develop application oriented PKC protocols • Ability to develop authentication schemes pertaining to system requirements • Ability to demonstrate the evaluation of security among different network configurations by implementing security mechanisms and meeting out efficient security standards • Ability to implement efficient cryptosystems for Wireless systems							
UNIT – I	**Introduction and Symmetric Key Encryption**					**Hours: 9**		
Attacks-Services-Mechanisms-OSI Security architecture-Model for Network Security- Symmetric Cipher Model-Substitution and Transposition Techniques- Simplified DES-DES Block Cipher Principles-The Strength of DES-Differential and Linear Cryptanalysis-Block Cipher Design Principles- Block Cipher Modes of Operation- Groups, Rings and Fields-Modular Arithmetic- Euclid's Algorithm- Finite Fields of the Form GF(p)- Polynomial Arithmetic-Finite Fields of the Form GF(2n)-AES cipher- Triple DES								
UNIT – II	**Number Theory and Public Key Encryption and Authentication Schemes**					**Hours: 9**		
Prime Numbers-Fermat's and Euler's Theorems-Testing of Primality-The Chinese Remainder Theorem-Discrete Logarithms-Principles of Public Key Cryptosystems-The RSA Algorithm-Key Management-Diffie-Hellman Key Exchange-Elliptic Curve Arithmetic- Elliptic Curve Cryptography. Authentication Requirements- Authentication functions-message Authentication Codes- Hash Functions-Security of Hash Functions and MACs-MD5 Message Digest Algorithm-Digital Signatures- Authentication Protocols-Digital Signature Standard.								
UNIT – III	**Network Security**					**Hours: 9**		
Authentication Application-Kerberos-Electronic Mail Security-Pretty Good Privacy-S/MIME-IP-Security Overview-IP Security Architecture-Authentication Header Encapsulation Security Payload- Web Security Considerations-Secure Sockets Layer and Transport Layer Security-Secure Electronic Transaction.								
UNIT – IV	**System Security and its Blueprint**					**Hours: 9**		
Intruders- Intrusion Detection-Password Management-Viruses and Related Threats- Viruses Counter Measures-Firewall Design Principles-Types of Firewalls-Firewalls Configurations-Trusted Systems- Blue Print for Security-Security Policy-Systems Specific Policy-NIST Security Models-VISA -International Security Model-Hybrid Framework.								
UNIT – V	**Wireless Threats and Security**					**Hours: 9**		

Kinds of security breaches - Eavesdropping - Communication Jamming - RF interference – Covert wireless channels - DOS attack – Spoofing - Theft of services - Traffic Analysis – Cryptographic threats - Wireless security Standards- Wireless Device security issues - CDPD security (Cellular Digital Packet Data)-GPRS security-(General Packet Radio Service) - GSM (Global System for Mobile Communication) security-– Security at the baseband layer and link layer-Security in heterogeneous wireless networks.

Total contact Hours: 45	Total Tutorials: 15	Total Practical Classes: -	Total Hours: 60

Text Books:

1. William Stallings, Cryptography and Network Security-Principles and practice, 4th Edition, Prentice Hall of India, 2007.
2. Nichols and Lekka, Wireless Security-Models, Threats and Solutions, Tata McGraw – Hill,
3. New Delhi, 2006.
4. Merritt Maxim and David Pollino, Wireless Security, Osborne/McGraw Hill, New Delhi, 2005.

Reference Books:

1. Michael E.Whitman and Herbert J.Mattord ,Principles of Information security, 1 st edition, 2003.
2. Bruce Schneier,Applied Cryptography, 2nd Edition, John Wiley & Sons, 1996.

Department: Electronics and Communication Engineering					**Programme:** M.Tech. (Wireless Communication)			
Semester :					**Category :** TY			
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
ECE52	Wireless Sensor Networks	4	-	-	4	40	60	100
Prerequisite								
Objectives	• To expose the students to the fundamentals of wireless communication technologies • To introduce the ideas and need for Sensor networks • To study the Architecture and Middleware of WSN • To teach the role of MAC and Routing protocols • To introduce energy management in network protocols • To expose the students to the Applications of WSN • Enable the students to know techniques involved in network management							
Outcome	• Knowledgeable in the concept of Sensor network and its Protocols • Ability to implement Wireless Sensor Network for various applications • Ability to understand the challenges in coverage and routing for energy efficiency • Ability to examine the possible node architectures for specific applications • Ability to sense Global Phenomena							
UNIT – I	**Introduction**							**Hours: 12**
Cellular and Ad hoc wireless Networks – Mobile Ad-Hoc Networks – Sensor Networks – Comparison - Applications – Categories – Issues and challenges in designing a sensor network - Operating environment- Architecture – Sensor node technology – Hardware and Software – Performance Metrics – Taxonomy.								
UNIT – II	**Middleware And Transmission Technologies**							**Hours: 12**
Middleware - Functions – Architecture – Data management functions - **Operating Systems** – Design issues – Examples **Available wireless Technologies** – WSN Campus Applications - Bluetooth – WLAN – Zigbee – WiMax – 3G and beyond - Performance modeling of WSN - Metrics – Task-driven sensing– **Basic models** –Traffic model – Energy model – Node model - **Network models –** MAC model – Routing model – System model								
UNIT – III	**Mac Protocols for WSN**							**Hours: 12**
Fundamentals of MAC – Requirements and design constrains – MAC protocols for WSN - Schedule-based protocols - SMAC – LEACH – TRAMA – Contention-based protocols – CSMA – PAMAS – IEEE 802.15.4 – PHY layer – MAC layer. **Case study:** Sensor-MAC								
UNIT – IV	**Routing Protocols FOR WSN**							**Hours: 12**
Challenges and Issues – Data Dissemination and Gathering – Location Discovery - Routing strategies – Flooding and Gossiping – SPIN – PEGASIS **–** Geographical routing – Localized and globalized forwarding – Greedy perimeter stateless routing - GEAR - **Attribute-based routing** – Direct diffusion – Rumor routing – Geographic hash tables.								
UNIT – V	**Transport Protocols and Applications of WSN**							**Hours: 12**
Design Issues – Feasibility of using TCP/UDP for WSN – Design Considerations – CODA – GARUDA – Performance of Transport Control Protocols. **Case Study:** Sensing Global Phenomena								
Total contact Hours: 60	**Total Tutorials: -**	**Total Practical Classes: -**						**Total Hours: 60**

Text Books:

1. Holger Karl, Andreaswillig, Protocol and Architecture for Wireless Sensor Networks, John wiley publication, Jan 2006.
2. C. Siva Ram Murthy and B. S. Manoj, Ad Hoc Wireless Networks Architectures and Protocols, Prentice Hall, PTR, 2004
3. Feng Zhao, Leonidas Guibas, Wireless Sensor Networks: an information processing approach, Else vier publication, 2004.

Reference Books:

1. C. K. Toh, Ad Hoc Mobile Wireless Networks Protocols and Systems, Prentice Hall, PTR, 2001.
2. Charles E. Perkins, Ad Hoc Networking, Addison Wesley, 2000.
3. Carlos de Morais Cordeiro , Dharma Prakash Agarwal, Ad hoc and Sensor Network : Theory and Applications, 2nd Edition, World Scientific Publishing Corporation.

Websites:

1. http://www.ni.com/wsn/
2. http://www.sensor-networks.org/
3. http://www.crcpress.com/
4. Philip Levis, TinyOS Programming, 2006 – www.tinyos.net.

Department: Electronics and Communication Engineering					**Programme:** M.Tech. (Wireless Communication)			
Semester :					**Category :** TY			
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
ECE53	Ubiquitous Computing	4	-	-	4	40	60	100
Prerequisite	-							
Objectives	• To understand the basics and vision of Ubiquitous computing • To study the emerging technologies • To study wireless LAN and security methods • To analyze the performance of Intelligent systems and interworking • To study different Ubiquitous communication networks							
Outcome	• Ability to characterize the wireless LAN in terms of mobility and deployment • Ability to demonstrate the performance of Ad hoc networks in terms of security issues • Ability to examine the performance of IS systems and IN • Knowledgeable in the types of Pervasive communication networks							
UNIT – I	**Ubiquitous Computing Basics and Vision**					**Hours: 12**		
Ubiquitous or Pervasive computing-Types of contexts-Enumeration based-Role based-Middleware and gateways-Core properties of UbiCom systems-Distributed ICT systems-Implicit Human-Computer Interaction-Autonomy-Architectural design for UbiCom systems-Ambient Computing-Elements of Pervasive Architecture-Requirements of Computational infrastructure-Ubiquitous computing applications-Standards								
UNIT – II	**Human-Computer Interaction**					**Hours: 12**		
Introduction- User interfaces and interaction for four widely used devices – Hidden UI via basic smart devices – Hidden UI via wearable and implanted devices – Human-centred design – User models								
UNIT – III	**Context Aware Systems**					**Hours: 12**		
Introduction-Modeling Context aware Systems-Types of Context- Architecture - Mobility awareness-Spatial awareness-Temporal awareness-Coordinating and Scheduling-ICT System awareness								
UNIT – IV	**Intelligent Systems, Networks and Interworking**					**Hours: 12**		
Introduction-Basic concepts-Types of IS-Use of intelligence in Ubiquitous Computing-IS Architectures-Types of IS models -IS Systems operation- Intelligence in Networks-IN Conceptual Model-Soft switch-Programmable Networks-Technologies and interfaces for IN.								
UNIT – V	**Ubiquitous Communications**					**Hours: 12**		
Audio Networks – Data Networks - Wireless data networks - Universal and Transparent Audio, Video and Alphanumeric Data Network Access-Ubiquitous Networks-Further Network Design Issues-Service Oriented Networks								
Total contact Hours: 60	**Total Tutorials: -**	**Total Practical Classes: -**			**Total Hours: 60**			
Text Books:								
1. Stefan Poslad, Ubiquitous Computing, John Wiley & Sons,2010. 2. Frank Adelstein, Sandeep K.S. Gupta,Golden G. Richard III, Loren Schweibert, 3. Fundamentals of Mobile and Pervasive Computing, Tata McGraw-Hill, 2009								
Reference Books:								
1. AsokeTalkuder, Roopa R Yavagal, Mobile Computing- Technology, Applications and Service Creation, Tata McGraw Hill, 2007.								

Department: Electronics and Communication Engineering		**Programme:** M.Tech. (Wireless Communication)						
Semester :		**Category :** TY						
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
ECE71	Optical Networks	3	1	-	4	40	60	100
Prerequisite	-							
Objectives	• To learn the various architectures of optical networks and to introduce the issues and challenges related to optical networks • To study about the factors enabling next generation optical networks • To learn the applications of wavelength routing, wavelength conversion and re-routing • To understand the design of virtual topology and construction of multicast trees • To expose the students to the concepts of network control and management							
Outcome	• Knowledgeable in different WDM architectures and their applications and limitations • Ability to examine the performance of various RWA algorithms and virtual topology design algorithms • Ability to examine the tradeoff involved in choice of various switching techniques • Ability to apply the knowledge to identify a suitable architecture and algorithms to design an Optical network for satisfying the ever-increasing bandwidth intensive applications of the future • Knowledgeable in protection and survivability approaches suitable for WDM optical networks							
UNIT – I	**Optical Network Architectures**						**Hours: 9**	
Introduction to WDM optical networks-WDM networks architectures- broadcast and select networks-wavelength routed networks- linear lightwave networks- issues in wavelength routed networks. Next generation optical services- Programmable silicon and network processors –software building blocks for the intelligent optical network- enabling the smart optical network- future applications for the intelligent optical network. Hybrid hierarchical optical networks- problems and challenges- hierarchical routing on hybrid cross connects-uniform and non-uniform wavebands- Future directions in WDM systems and networks								
UNIT – II	**Routing and Wavelength Assignment**						**Hours: 9**	
Introduction- Classification of RWA algorithms-RWA algorithms-fairness and admission control- distributed control protocols. Need for wavelength conversion-wavelength convertible node architectures-converter placement and allocation problems. Benefits of wavelength rerouting-issues in wavelength rerouting -rerouting schemes-rerouting in networks with sparse wavelength conversion								
UNIT – III	**Virtual Topology Design and Optical Multicasting**						**Hours: 9**	
Introduction- virtual topology design problems- virtual topology design subproblems-virtual topologydesign heuristics-need for virtual topology design reconfiguration. Introduction to multicast routing-multicasting node architectures-multicast tree generation-source based tree generation-Steiner tree based generation.								
UNIT – IV	**Control and Management**						**Hours: 9**	
Network management functions- management frame work and protocols- performance management-configuration management. Fault management -failures and recovery- single and dual link failures- channel failures and node failures- protection in SONET- benefits of optical layer protection-restoration schemes in WDM networks-multiplexing schemes-metrics of evaluation- quality of protection								
UNIT – V	**Optical Packet and Burst Switching**						**Hours: 9**	
OBS node architecture- burst assembly approaches - burst switching protocols-wavelength channel scheduling. Introduction to optical packet switching- node architecture- contention resolution protocols-test beds. PON architectures- hybrid optical- wireless access network architectures								
Total contact Hours: 45	**Total Tutorials: 15**	**Total Practical Classes: -**			**Total Hours: 60**			

Text Books:

1. C. Siva Ram Murthy and Mohan Gurusamy, WDM Optical Networks: Concepts, Design and Algorithms, Prentice Hall of India, 2008.
2. Rajiv Ramaswami and Kumar N. Sivarajan, Optical Networks: A Practical Perspective, 2 nd Edition, Morgan Kaufmann Publishers, 2007.

Reference Books:

1. Krishna M. Sivalingam and Suresh Subramanian, Emerging optical network architectures, Springer, 2005
2. Jason P. Jue and Vinod M. Vokkarane, Optical Burst Switched networks, Springer, 2005
3. L.G.Kazovsky, Ning Cheng, W.T. Shaw, David Gutierrez and S.Wong, Broadband Optical access networks, Wiley, 2011

Websites:

1. www.advaoptical.com
2. www.opticsexpress.org
3. www.ciena.com
4. www.lightreading.com
5. www.photonicsonline.com
6. www.tellabs.com

Department: Electronics and Communication Engineering		**Programme:** M.Tech. (Wireless Communication)						
Semester :		**Category :** TY						
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
ECE72	VLSI for Wireless Communication	3	1	-	4	40	60	100
Prerequisite	-							
Objectives	• To introduce different receiver architectures used in wireless communication • To introduce the design process involved in the receiver front-end • To provide an overview of different types of mixer circuits suitable for VLSI implementation • To introduce the different types of ADCs with reference to wireless communication • To introduce the design process of frequency synthesizer and its blocks • To provide an overview about the transmitter design process and architectures							
Outcome	• Ability to design the transmitter and receiver front-end • Ability to design ADCs for wireless communication • Ability to demonstrate the building blocks of frequency synthesizer							
UNIT – I	**Receiver Architectures and Low Noise Amplifier**					**Hours: 9**		
Receiver Architectures: Heterodyne and Other Architectures, Filter Design, Band Selection Filter (BPF1), Image Rejection Filter (BPF2), Channel Filter (BPF3), Nonlinearity and Noise, Derivation of NF, IIP3 of Receiver FrontEnd **Low Noise Amplifier :** Matching Networks, Comparisons of Narrowband and Wideband LNA, Wideband LNA Design: DC Bias, Gain and Frequency Response, Noise Figure, NarrowBand LNA: Impedance Matching, Interpretation of Power Matching, Core Amplifier, Noise Figure, Power Dissipation, Trade-Off Between Noise Figure and Power, Noise Contribution from other Sources, Gain, Other Real-Life Design Considerations							
UNIT – II	**Active Mixer and Passive Mixer**					**Hours: 9**		
Active Mixer : Unbalanced Mixer, Single Balanced Mixer, Double Balanced Mixer: Gilbert Mixer, Qualitative Description of the Gilbert Mixer, Conversion Gain, Distortion, Low Frequency and High Frequency Analysis of Gilbert Mixer, Distortion, Analysis of Noise in Unbalanced Mixer, A complete Active Mixer **Passive Mixer :** Switching Mixer, Unbalanced, Single and Double Balanced Switching Mixer, Distortion in Unbalanced Switching Mixer, Assumptions on Model, Low-Frequency Case, High-Frequency Case, Conversion Gain in Unbalanced Switching Mixer , Noise in Unbalanced Switching Mixer, A practical Unbalanced Switching Mixer, Sampling Mixer Qualitative Description, Nonidealties , Conversion Gain and Distortion in Single-Ended Sampling Mixer, Extrinsic Noise in Single Ended Sampling Mixer, High Frequency Limitations.							
UNIT – III	**Analog-To-Digital Converters**					**Hours: 9**		
A/D converters Used in a Receiver, Wideband Versus Narrowband A/D Converters, Narrowband A/D Converters: General Description, Low-Pass Sigma-Delta Modulators, First Order Modulator, High Order Modulators, Implementation of Low-Pass Sigma-Delta Modulators, 1-bit ADC, 1-bit DAC, Design of Passive Low-Pass Sigma-Delta Modulator, Bandpass Sigma-Delta Modulators, Comparisons of Low-Pass and Bandpass Modulators, Conversion of Low Pass Modulator to Bandpass Modulator, Implementation of Bandpass Sigma-Delta Modulators, Design Procedure Bandpass Versus Low-Pass Modulators, I/Q mismatch in Mixer and A/D Converters Origin of Mismatch and Its Impact, Techniques to Combat Problems Due to Mismatch.							
UNIT – IV	**Phase/Frequency Processing Components, Loop Filter and System Design**					**Hours: 9**		
Phase/Frequency Processing Components : PLL-Based Frequency Synthesizer, Phase Detector/Charge Pump, Phase Frequency Detector, EXOR Phase Detector, Charge Pump, Spurs, Kpd, Dividers, Survey of Different Types of Divider, A Complete Divider for DECT Application, VCO, LC Oscillators, Ring Oscillators, Phase Noise, Basic Phase Noise Models **Loop Filter and System Design :** Loop Filter: General Description, Basic Equations and Definitions First-Order Filter, Second-Order Filter, High-Order Filters, Loop Filter: Design Approaches Phase Noise Based Approach, Spur-Based Approach, A Complete Synthesizer Design for DECT Application							

UNIT – V	TRANSMITTER ARCHITECTURES AND POWER AMPLIFIER		Hours:9
Transmitter Back End: General Discussion, Motivations and General Design Philosophy, Direct Conversion and Other Architectures, Quadrature LO Generator, Single Ended RC, Single Ended LC, R-C with Differential Stages, Polyphase I/Q Generator, Divider Based Generator **Power Amplifier Design:** Power Output Control, PA Design Issues, Class A Amplifiers, Class AB/B/C Amplifiers, Choice of Class A vs AB/C Amplifiers, Class E Amplifiers.			
Total contact Hours: 45	**Total Tutorials: 15**	**Total Practical Classes: -**	**Total Hours: 60**

Text Books:

1. Bosco Leung, "VLSI for Wireless Communication, Second Edition, Springer

Reference Books:

1. Emad N Farag, M.I Elmasry, Mixed Signal VLSI Wireless Design Circuits and Systems, KluwerPublication.
2. Gray, Meyer, Hurst, Lewis, "Analysis and Design of Analog Integrated Circuits" Fifth Edition, Wiley, 2008.
3. T. Lee, "The design of CMOS radio frequency integrated circuits", 2nd edition, Cambridge Press 2004.
4. B. Razavi, "RF microelectronics", 2nd edition, Prentice Hall, 2011.

Department: Electronics and Communication Engineering		**Programme:** M.Tech. (Wireless Communication)						
Semester :		**Category :** TY						
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
ECE73	Modeling and Simulation of Communication Networks	3	1	-	4	40	60	100
Prerequisite	-							
Objectives	• To understand the concept of modeling • To generate and perform the parameter estimation • To analyze the source coding theorem • To analyze the performance of wireless communication system • To analyze the performance of CDMA cellular radio system							
Outcome	• Knowledgeable in steps involved in simulation study • Ability to demonstrate the methodology for simulating communication system operating over fading channels • Ability to demonstrate the cellular concept of Wireless Communication Systems							
UNIT – I	**Introduction o Modeling and Simulation**					**Hours: 9**		
Introduction, Discrete-event Simulation, Modeling for Computer Simulation, Tools and Methods for Network Simulation, The Simulation Platform, Simulation Framework, Tools and Modeling Approaches for Simulating Hardware.								
UNIT – II	**Monte Carlo Simulation**					**Hours: 9**		
Fundamental concepts, Application to communication systems, Monte Carlo integration, Semi analytic techniques, Case study: Performance estimation of a wireless system.								
UNIT – III	**Lower Layer and Link Layer Wireless Modeling**					**Hours: 9**		
Physical Layer Modeling, Description of the Main Components of the PHY Layer, AccurateSimulation of Physical Layers, Physical Layer Modeling for Network Simulations, Link Layer Modeling, Medium Access Control (MAC) Protocols, Logical Link Control, Forward Error Detection and Correction, Backward Error Detection and Correction, Queuing and Processing Delay.								
UNIT – IV	**Channel Modeling and Mobility Modeling**					**Hours: 9**		
Channel Modeling :The Physics of Radiation, The Nature of Electromagnetic Radiation,Classification of Propagation Models, Deterministic Approaches by Classical Field Theory,Deterministic Geometric Optical Approaches, Empirical Path Loss Approaches, StochasticShadowing Models, Stochastic Fading Models, MIMO Channel Models. Mobility modeling :Categorization of Mobility Models, Mobility Models, Random Walk Model, Random Waypoint Model, Random Direction Model, Gauss-Markov Model, Manhattan Model,Column Model , Pursue Model, Nomadic Community Model, Selection of Appropriate Mobility Models.								
UNIT – V	**Higher Layer Modeling and Modeling the Network Topology**					**Hours: 9**		
Higher Layer Modeling :Modeling the Network Layer and Routing Protocols, Components of a Routing Protocol, Metrics, Virtual Routing on Overlays, Modeling Transport Layer Protocols, Modeling Application Traffic. Modeling the Network Topology : Abstraction of Network Topologies by Graphs, Characterizing Graphs, Common Topology Models, Geometric Random Graphs – The Waxman Model, Hierarchical Topologies, Preferential Linking – The Barabasi-Albert Model , Modeling the Internet.								
Total contact Hours: 45	**Total Tutorials: 15**	**Total Practical Classes: -**				**Total Hours: 60**		
Reference Books:								

1. K.Wehrie. Gunes, J.Gross, Modeling and Tools for Network simulation, Springer, 2010.
2. Irene Karzela, Modeling and Simulating Communications Networks, Prentice Hall India, 1998,
3. William.H.Tranter, K. Sam Shanmugam, Theodore. S. Rappaport, Kurt L. Kosbar, Principles of Communication Systems Simulation, Pearson Education (Singapore) Pvt. Ltd, 2004.
4. M.C. Jeruchim, P.Balaban and K. Sam Shanmugam, Simulation of Communication Systems:
5. Modeling, Methodology and Techniques, Plenum Press, New York, 2001.

6. Nejat; Bragg, Arnold, Recent Advances in Modeling and Simulation Tools for Communication Networks and Services, Springer, 2007

Department: Electronics and Communication Engineering		**Programme:** M.Tech. (Wireless Communication)						
Semester :		**Category :** TY						
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
ECE74	Microwave Integrated Circuits	3	1	-	4	40	60	100
Prerequisite	-							
Objectives	• To understand different technologies in MICs • To analyze the performance of planar transmission lines • To design different types of lumped elements • To study several non-reciprocal components • To study various amplifier and oscillator designs							
Outcome	• Knowledgeable in design and fabrication of microwave devices • Ability to analyze and design various planar micro strip lines • Ability to examine different types of Microwave Integrated Circuits • Ability to characterize various non reciprocal components and active devices							
UNIT – I	**Introduction to Microwave Integrated Circuits**					**Hours: 9**		
MMIC technology- advantages and applications-Active device technologies-designapproaches-multichip module technology-Dielectric substrates.								
UNIT – II	**Lumped Elements and Non Reciprocal Components**					**Hours: 9**		
Lumped elements-Inductors, capacitors and resistors-microstrip components-micromachined passive components-switches–attenuators-filter design-microstripcirculators-latching circulators-isolators-phase shifters.								
UNIT – III	**Analysis of Microstrip Line, Slot Line and Coplanar Waveguides**					**Hours: 9**		
Transmission lines-Characteristics of conventional transmission structures-Characteristics of planar transmission lines-strip line-microstrip line-suspended and inverted microstrip lines-slot lines-coplanar lines-Comparison of various MIC transmission media-coupled line-discontinuities.								
UNIT – IV	**Amplifiers**					**Hours: 9**		
Monolithic low distortion variable gain amplifier-Stability & Gain analysis-matching techniques-reactively matched amplifier design-Low Noise Amplifiers-Power amplifiers-Drivers								
UNIT – V	**Oscillators**					**Hours: 9**		
Design principles, active device CAD techniques for large signal oscillators design- phase noise-VCO-mixers-Phase detectors								
Total contact Hours: 45	**Total Tutorials: 15**	**Total Practical Classes: -**				**Total Hours: 60**		

Text Books:

1. I.J.Bhar and P. Bhartia, Microwave solid state circuit design John Wiley & sons 2003.
2. David M. Pozar, Microwave Engineering, John Wiley & sons 1998.
3. Hoffman R.K, Handbook of Microwave Integrated Circuit, Artech House 1987.

Reference Books:

1. S.Y.Liao, Microwave circuit Analysis and Amplifier Design, Prentice Hall 1987.
2. Gupta K.C and Amarjit Singh, Microwave Integrated Circuits .John Wiley & sons-Wiley Eastern Reprint 1978.
3. Hoffman R.K, Handbook of Microwave Integrated Circuits, Artech House, Boston 1987.
4. Ulrich L. Rohde and David P.N., RF / Microwave Circuit Design for Wireless Applications, John Wiley 2000.

Department: Electronics and Communication Engineering				**Programme:** M.Tech. (Wireless Communication)				
Semester :				**Category :** TY				
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
ECE75	Convergence Technologies	4	-	-	4	40	60	100
Prerequisite	-							
Objectives	• To understand the integration of different traffic in one flexible network • To distinguish the services, protocols and access schemes between different networks • To analyze traffic management in convergent networks • To explore the network and security management in convergent networks							
Outcome	• Ability to examine the need for convergence • Knowledgeable in the compatibility issues among different networks • Ability to manage the traffic in convergent networks • Ability to implementsecurity in convergent networks							
UNIT – I	**Introduction**					**Hours: 12**		
Communication model, Data Communication, Data representation. Transmission- modes of data transmission, synchronous and asynchronous communication, Network and services. Introduction to 2G, 3G and 4G Wireless communication system. Convergence Technology- The blending or integration of voice, video, data and image into one flexible network- overview of network topology.								
UNIT – II	**Network Services and Protocol Layering**					**Hours: 12**		
Connectionoriented& connectionless services-Layered architecture, services Interface primitives and service access points, Ad-hoc wireless networks- Handoff Algorithms- Bluetooth Technology and Infrared Technology.**Transmission and Multiple Accesses:** Transfer Modes circuit switching, routing, virtual circuit switching,Comparison of transfer modes, Asynchronous transfer mode. Multiple access concepts- FDMA/TDMA in GSM networks, CDMA in UMTS Networks								
UNIT – III	**Communication Network Functions**					**Hours: 12**		
Addressingtechniques- classification of addressing techniques- addressing structure in Internet- addressing structure in Telecom Networks.Signaling complexity in Different Networks, Classification of signaling techniques- signaling issues- Signaling models- point to multipoint signaling- ISDN signaling, Routing protocols/techniques- core routing concepts. **Traffic Management:** Concept of traffic, concept of service, Network capabilities, Types of traffic, Traffic Management, Traffic contract management, traffic policing, priority control, Flow control versus congestion control, Traffic Management in ATM.								
UNIT – IV	**Network Management**					**Hours: 12**		
Goals of Network Management- Functional Areas of Network Management -Telecommunications management Network (TMN). **Security Management:** Security Management, symmetric (secret key) Encryption Techniques, Asymmetric encryption techniques, Key management, Hash functions, Digital signatures and certificates, Firewalls, Security management in Third generation UMTS network and Fourth generation Mobile WiMAX and LTE Networks.								
UNIT – V	**Convergence Technologies for 3G and 4G networks**					**Hours: 12**		
Operation and integration of GSM, GPRS, EDGE, UMTS, CDMA2000,Mobile WiMAX and LTE , IP and ATM, practical examples of 3G and 4G connection scenarios. Signaling flows and protocol stacks, issues of QoS and real-time application support- IP/SS7 internetworking and IP soft switching, Architecture of the IP Multimedia Subsystem (IMS).								
Total contact Hours: 60	**Total Tutorials: -**	**Total Practical Classes: -**				**Total Hours: 60**		
Text Books:								
1. SumitKasera, NishitNarang, SumitaNarang, Communication Networks Principles and Practice Tata McGraw-Hill Publishing company Limited New Delhi 2. Jeffrey Bannister, Paul Mather, Sebastian Cooperative Convergence Technologies for 3G Networks: IP,								

UMTS, EGPRS and ATM, Wily india

3. Lean Garcia, Widjaja, Communication Networks, Tata McGraw Hill, 2nd Edition.

Reference Books:

1. Forouzan, Data Communication & Networking, Tata Mcgraw Hill, 3rd Edition.
2. Raj Pandya, Mobile & Personal Communication system & services, Prentice Hall of India.

Websites:

1. www.informit.com

Department: Electronics and Communication Engineering		**Programme:** M.Tech. (Wireless Communication)						
Semester :		**Category :** TY						
Subject Code	**Subject Name**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
ECE76	Radio Over Fiber Systems	4	-	-	4	40	60	100
Prerequisite	-							
Objectives	• To understand the microwave properties of optic link • To learn about LASER diode • To study the role of ROF in cellular communication							
Outcome	• Knowledgeable in fiber optic links • Ability to apply ROF in cellular communication • Ability to examine the fiber optic networks							
UNIT – I	**Introduction to Radio Over Fiber**					**Hours: 12**		
Radio Over Fiber – applications, advantages, limitations, Microwave properties of optical links,Direct modulated optical links, external modulators, types,modulation transfer in microwave fiber optic links nonlinearities.								
UNIT – II	**Analog Fiber Optic Links**					**Hours: 12**		
Sub carrier Optical fiber transmission systems, Fiber optic transmission of 64-QAM, 256- QAMsignals, Capacity of coaxial and fiber optic links, LASER diode and Photodiode								
UNIT – III	**Components for ROF Systems**					**Hours: 12**		
Analog modulation of LASER diode, LASER diode fundamentals, Rate equation analysis, Intensitymodulation, Frequency modulation, Low cost LASER diode driver, LASER diode noise and theirinfluence on link performance.								
UNIT – IV	**ROF Technology for the Cellular Applications**					**Hours: 12**		
3G cellular systems, cellular architecture, UMTS architecture, WCDMA ROF systems,Microdiversity, Macro diversity, Traffic estimation, Spectral efficiency, power level, multiple userinterference, ROF for Hiper LAN2, Micro cellular communication networks								
UNIT – V	**Fiber Optic Radio Networks**					**Hours: 12**		
Introduction to radio highway – types of radio highway, Photonic TDMA Highway – Natural samplingof photonic TDMA, Photonic CDMA – Conventional CDMA, DOSCDMA, Photonic chirp multipleaccess – architecture and performance, routing networks, chirp multiplexing transform.								
Total contact Hours: 60	**Total Tutorials: -**	**Total Practical Classes: -**				**Total Hours: 60**		
Reference Books:								

1. Hameed Al-Raweshidy, Shozo Komaki, Radio Over fiber technologies for mobile communication networks Artech House publications, London. 2002.
2. William S.C.Chang, RF Photonic technology in optical fiber links Cambridge University press.2002.

Department: Electronics and Communication Engineering		**Programme:** M.Tech. (Wireless Communication)						
Semester :		**Category :** TY						
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
ECE77	Advanced Satellite Systems	4	-	-	4	40	60	100
Prerequisite								
Objectives	• To gain deep knowledge about satellite networks • To understand the working of navigation, tracking and safety in satellite systems • To comprehend the knowledge about sensors in remote sensing • To study about the different broadcast satellite services • To understand the IPv4 and IPv6 satellite networking systems							
Outcome	• Knowledgeable in differentiating satellites based on their coverage and services. • Ability to examine the necessary parameters for design of Navigation and tracking satellite systems • Ability to develop image processing tools to process the signals from different sensors • Knowledgeable in establishing a broadcast satellite networks for different services • Knowledgeable in on-board processing on satellite for different data oriented networks							
UNIT – I	**Introduction**						**Hours: 12**	
Configuration of satellite communication systems – Radio regulations – useful orbit for satellite communication – Overall link performance of Monobeam, Multibeam and Intersatellite links – Characteristics of payload – Satellite installation in orbit - Vacuum, Mechanical environment, Radiation flux of high energy particles, Environment during installation.								
UNIT – II	**Navigation, Tracking and Safety Systems**						**Hours: 12**	
Global Navigation Satellite Systems - Basic concepts of GPS. Space segment - Control segment - user segment - GPS constellation - Applications of Satellite and GPS for 3D position Regional Navigation Systems- Distress and Safety- Cospas-Sarsat-Inmarsat Distress System- Location-Based service.								
UNIT – III	**Remote Sensing Systems and Techniques**						**Hours: 12**	
Introduction - Commercial Imaging –DigitalGlobe – GeoEye - Meteorology – Meteosat – Land Observation – Landsat- Remote Sensing Data- Sensors- Overview - Optical Sensors: Cameras- Non- Optical Sensors- Image Processing - Image Interpretation- System Characteristics.								
UNIT – IV	**Broadcast Systems**						**Hours: 12**	
Introduction - Satellite Radio Systems - Sirius Satellite Radio –world space - Direct Multimedia Broadcast- MBCO and TU Multimedia - Direct-to- Home Television - Implementation Issues - DTH Services- Military Multimedia Broadcasts - US Global Broadcast Service (GBS)- Business TV(BTV), GRAMSAT, Specialized services – E –mail, Video conferencing, Internet.								
UNIT – V	**Satellite Networking System**						**Hours: 12**	
Architecture and characteristics of satellite networks – IPv6 Infrastructure - Routing and Route Management- IP networking with satellite links –On board processing - VSAT systems – TCP state machine for three way handshake connection - Use of IPv6 for satellite based access to remote WSN.								
Total contact Hours: 60	**Total Tutorials: -**	**Total Practical Classes: -**					**Total Hours: 60**	
Text Books:								
1. Global Positioning Systems, Inertial Navigation, and Integration. MOHINDER S. GREWAL California State University at Fullerton, A John Wiley & Sons, Inc. Publication.								

2. Satellite systems for personal Applications, MadhavendraRichharia, A John Wiley and sons,Ltd.,Publication.
3. Satellite Systems Engineering in an IPv6 Environment, Daniel Minoli, CRC Press.
4. Satellite Communication Systems Techniques and Technology ,3rd edition, Maral and M. Bousquet.John Wiley and sons.
5. VASAT Networks G. Maral, John Wiley and sons.

Reference Books:

1. Satellite Communication. Firs quartercentury of service David W.E. Rees John Wiley and Sons.
2. Satellite Communications Systems Design principles – Richard M. McGraw Hill
3. 3. Dennis Roddy, Satellite Communication, McGraw Hill International, 4th Edition, 2006.
4. 4. Wilbur L. Pritchard, HendriG.Suyderhoud, Robert A. Nelson, Satellite Communication Systems Engineering, Prentice Hall/Pearson, 2007.

Websites:

1. www.kemt-old.fei.tuke.sk/predmety/KEMT559_SK/Cvicenia/IPOLITO_SAT_COM.pdf

Department: Electronics and Communication Engineering		**Programme:** M.Tech. (Wireless Communication)						
Semester :		**Category :** TY						
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
ECE78	ASIC and FPGA Design	3	1	-	4	40	60	100
Prerequisite	-							
Objectives	• To study the design flow of different types of ASIC • To familiarize with different types of programming technologies and logic devices • To learn the architecture of different types of FPGA • To gain knowledge about partitioning, floor planning, placement and routing including circuit extraction of ASIC • To synthesis, simulate and test systems • To understand the design issues of SoC • To know about different high performance algorithms and their applications in ASICs							
Outcome	• Ability to programme the various PLDs based on the required digital system • Knowledgeable in the nuances of ASIC design • Ability to design, analyse and test a digital system • Ability to design filters and equalizers • Knowledgeable in SoC design							
UNIT – I	**Overview of Asic and Pld**						**Hours: 9**	
Types of ASICs - Design flow – CAD tools used in ASIC Design – Programming Technologies -Antifuse – static RAM – EPROM and EEPROM technology,Programmable Logic Devices : ROMs and EPROMs – PLA –PAL. Gate Arrays – CPLDs and FPGAs								
UNIT – II	**ASIC Physical Design**						**Hours: 9**	
System partition -partitioning - partitioning methods – interconnect delay models and measurement of delay - floor planning - placement – Routing - global routing –detailed routing - special routing - circuit extraction – Design Rule Check(DRC).								
UNIT – III	**Logic Synthesis, Simulation and Testing**						**Hours: 9**	
Design systems - Logic Synthesis - Half gate ASIC -Schematic entry - Low level design language - PLA tools -EDIF-CFI design representation. Verilog and logic synthesis -VHDL and logic synthesis - types of simulation -boundary scan test - fault simulation -automatic test pattern generation.								
UNIT – IV	**FPGA**						**Hours: 9**	
Logic blocks, routing architecture, Design flow technology - mapping for FPGAs, Xilinx XC4000 - ALTERA's FLEX 8000/10000,ACTEL's ACT-1,2,3 and their speed performance Case studies: Altera MAX 5000 and7000 - Altera MAX 9000 – Spartan II and Virtex II FPGAs - Apex and Cyclone FPGAs								
UNIT – V	**SOC Design**						**Hours: 9**	
Design Methodologies – Processes and Flows - Embedded software development for SoC – Techniques for SOC Testing – Configurable SoC – Hardware / Software codesign-Case studies: Digital camera, Bluetooth radio / modem, SDRAM and USB								
Total contact Hours: 45	**Total Tutorials: 15**	**Total Practical Classes: -**			**Total Hours: 60**			
Reference Books:								

1. M.J.S .Smith, Application Specific Integrated Circuits, Addison -Wesley Longman Inc., 1997
2. S. Trimberger, Field Programmable Gate Array Technology, Edr, Kluwer Academic Publications, 1994.
3. John V.Oldfield, Richard C Dore, Field Programmable Gate Arrays, Wiley Publications 1995.
2. P.K.Chan& S. Mourad, Digital Design Using Field Programmable Gate Array, Prentice Hall, 1994.
3. Parag.K.Lala, Digital System Design using Programmable Logic Devices , BSP, 2003.
4. S. Brown, R. Francis, J. Rose, Z. Vransic, Field Programmable Gate Array, Kluwer Pubin, 1992.

5. J. Old Field, R.Dorf, Field Programmable Gate Arrays, John Wiley & Sons, Newyork, 1995.
6. FarzadNekoogar and FaranakNekoogar, From ASICs to SOCs: A Practical Approach, Prentice Hall PTR, 2003.
7. Wayne Wolf, FPGA-Based System Design, Prentice Hall PTR, 2004.
8. R. Rajsuman, System-on-a-Chip Design and Test. Santa Clara, CA: Artech House Publishers, 2000.
9. 11. F. Nekoogar. Timing Verification of Application-Specific Integrated Circuits (ASICs). Prentice Hall PTR, 1999.

Websites:

1. http://nptel.ac.in/courses/117106092/
2. http://staff.fit.ac.cy/com.tk/MSc-Digital/

Department: Electronics and Communication Engineering		**Programme:** M.Tech. (Wireless Communication)						
Semester :		**Category :** TY						
Course Code	**Course Name**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
ECE79	UMTS	4	-	-	4	40	60	100
Prerequisite								
Objectives	• To understand thetrend involved in UMTS networks • To learn about the radio network architecture and terminal features used in UMTS environment • To comprehend the protocol aspects at different layers, services and security associated with it • To learn and compare the various operating techniques and technology adopted in UMTS • To gain knowledge on perspective 4G systems and its features with case studies							
Outcome	• Ability to appreciate the features of physical layer issues pertaining to UMTS systems • Ability to identify the technological advances in the layered architecture of the network and end user UMTS terminals • Ability to examine the performance of protocols at different layers and security features in-built in UMTS • Knowledgeable in operational techniques for enhancing capacity and flexibility • Knowledgeable in forthcoming advanced technologies so as to contribute towards research							
UNIT – I	**Basics of UMTS**						**Hours: 12**	
Basics of UMTS Radio Communication – Radio Communication Fundamentals, Multiple Access Techniques, Regulation, Essentials of 3G radio path. WCDMA vs CDMA 2000. WCDMA-UMTS (UTRA-FDD) Physical Layer, WCDMA-TDD Physical Layer, WCDMA-ARIB Physical Layer -Common Physical Layers for Both FDD and TDD Modes. Overview of 3GPP Release 99 Network, Evolution of UMTS-3GPP Release 4 and Beyond.								
UNIT – II	**UMTS Network and User Terminal**						**Hours: 12**	
UTRAN - UTRAN Architecture, UMTS Base Station, Radio network Controller. UMTS Core Network – Core network architecture in 3GPP, Mobility management, Communication management, Architecture aspects in 3GPP R4 and R5. UMTS Terminal – terminal architecture, Terminal capabilities, subscription and user interface.								
UNIT – III	**UMTS Protocols, services and Security Issues**						**Hours: 12**	
UMTS Protocols – Protocol reference architecture in 3GPP R99, Interworking architecture, transport protocol aspects, Radio and system network protocols. Services: Services in UMTS environment, QoS architecture, Services capabilities, UMTS services and service concepts. Security Aspects: Access Security in UMTS, Security aspects on system and network level, Protection of applications and services.								
UNIT – IV	**Additional Techniques for Capacity and Flexibility Enhancement**						**Hours: 12**	
General Principle of Multiple Antenna Diversity, BLAST Architecture, Space–Time Coding, Achievable Capacity, Diversity Techniques for Multi-Carrier Transmission, Transmit and Receive Diversity, OFDM and MC-CDMA with Space–Frequency Coding. Examples of Applications of Diversity Techniques: FWA Multi-Carrier Systems, Software-Defined Radio, Basic Concept, MC-CDMA-Based Software-Defined Radio.								
UNIT – V	**Perspective Systems of 4G and Related Topics**						**Hours: 12**	
Perspective Systems of 4G : Introduction, A CDD System: CS-OFDMA, Realization of a CDD System, Code Attributes, CS-OFDMA System, Complementary Code Keying (CCK) Codes and Modulation, Turbo Codes and LDPC, Turbo Code, LDPC (Low Density Parity Check) Code, Study of A 60-GHz Cellular System,- Propagation in the Scattered Environment, Fixed Terminals, Moving Terminal, System Consideration, Diversity Media System With Millimeter-WAVE Link and Optical-Wave Link, MVNO (Mobile Virtual Network operator) and MVNE								

(Mobile Virtual Network Enabler.

Total contact Hours: 60	Total Tutorials: -	Total Practical Classes: -	Total Hours: 60

Text Books:

1. HeikkiKaaranen et al, UMTS Networks: Architecture, Mobility and Services, John Wiley and Sons Ltd., 2001.
2. K. Fazal and S.Kalsar, Multicarrier and Spread Spectrum Systems, John Wiley Publishers, 2003.
3. William C.Y. Lee, Wirelessand Cellular Telecommunications McGraw Hill Publishers, 3rd edition, 2006.

Reference Books:

1. Andrea Goldsmith, Wireless Communication, Cambridge University Press, 2005
2. John G.Prokias, Digital Communications, McGraw Hill Publishers,2000.

Department: Electronics and Communication Engineering					**Programme:** M.Tech. (Wireless Communication)			
Semester :					**Category :** TY			
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
ECE80	Reconfigurable Computing	3	1	-	4	40	60	100
Prerequisite	-							
Objectives	• To understand the need for reconfigurable computing • To learn about various device architectures • To examine the various reconfigurable computing systems. • To understand the different types of computing models for programming reconfigurable architectures • To expose the students to HDL programming and familiarize with the development environment • To understand to the various placement and routing protocols • To develop applications with FPGAs							
Outcome	• Knowledge in device architectures used for reconfigurable computing • Knowledgeable in HDL Programming for the Programming Reconfigurable systems • Ability to map designs to reconfigurable platforms • Ability to do application development with FPGAs							
UNIT – I	**Device Architecture**					**Hours: 9**		
General Purpose Computing Vs Reconfigurable Computing – Simple Programmable Logic Devices– Complex Programmable Logic Devices – FPGAs – Device Architecture - Case Studies.								
UNIT – II	**Reconfigurable Computing Architectures And Systems**					**Hours: 9**		
Reconfigurable Processing Fabric Architectures – RPF Integration into Traditional Computing Systems – Reconfigurable Computing Systems – Case Studies – Reconfiguration Management.								
UNIT – III	**Programming Reconfigurable Systems**					**Hours: 9**		
Compute Models - Programming FPGA Applications in HDL – Compiling C for Spatial Computing – Operating System Support for Reconfigurable Computing.								
UNIT – IV	**Mapping Designs to Reconfigurable Platforms**					**Hours: 9**		
The Design Flow - Technology Mapping – FPGA Placement and Routing – Configuration Bitstream Generation – Case Studies with Appropriate Tools.								
UNIT – V	**Application Development WITH FPGAS**					**Hours: 9**		
Case Studies of FPGA Applications – System on a Programmable Chip (SoPC) Designs.								
Total contact Hours: 45	**Total Tutorials: 15**	**Total Practical Classes: -**				**Total Hours: 60**		
Reference Books:								
1. Maya B. Gokhale and Paul S. Graham, Reconfigurable Computing: Accelerating Computation with Field-Programmable Gate Arrays, Springer, 2005. 2. Scott Hauck and Andre Dehon (Eds.), Reconfigurable Computing – The Theory and Practice of FPGA-Based Computation, Elsevier / Morgan Kaufmann, 2008. 3. Christophe Bobda, Introduction to Reconfigurable Computing – Architectures, Algorithms and Applications, Springer, 2010.								
Websites:								
1. http://tcfpga.org/bib/index.html 2. http://www.ecs.umass.edu/ece/tessier/courses/636/								

Department: Electronics and Communication Engineering					**Programme:** M.Tech. (Wireless Communication)			
Semester :					**Category :** TY			
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
ECE81	Cognitive Radio	4	-	-	4	40	60	100
Prerequisite	-							
Objectives	• To understand essential background of SDR and CR technologies • To discuss the relevant radio propagation channel models • To focus on the fundamentals of spectrum management • To study about radio spectrum regulatory policies and fundamentals of digital Communication • To know about networking aspects of CRs and security issues							
Outcome	• Ability to demonstrate the fundamental capacity limits and associated transmission techniques for different cognitive radio network paradigms • Ability to examine the fundamental tradeoffs in spectrum sensing • Ability to demonstrate the fundamental constraints and properties of a digital communication system of a cognitive radio • Ability to implement cognitive radio network (CRN) architectures • Ability to demonstrate security threats to CR networks							
UNIT – I	**Cognitive Radio Technology**					**Hours: 12**		
Introduction - Software-Defined Radio - Cognitive Radio – Spectrum policy - Applications of cognitive radio - Cognitive radio network design - Hardware and system design considerations - Spectrum coexistence – Standardization - Cognitive radio network paradigms -performance limits of wireless networks - Interference channels.								
UNIT – II	**Propagation Issues for Cognitive Radio**					**Hours: 12**		
Introduction - Generic channel response - path loss - Path loss models - Small-scale fading and the Ricean*K*-factor - Small-scale fading and the Doppler spectrum - Delay dispersion - Angle dispersion – Polarization - Special environments - key model parameters								
UNIT – III	**Spectrum Management**					**Hours: 12**		
Spectrum sensing and identification - Introduction - Primary Signal Detection - Detecting Spectrum Opportunities - Trade-offs - **Spectrum access and sharing –** Introduction - Unlicensed Spectrum Sharing - Licensed Spectrum Sharing - Secondary Spectrum Access - Non-Real-Time SSA - Real-Time SSA – Dynamic Spectrum access – water filling – game theory.								
UNIT – IV	**Cognitive Radio Communication Techniques**					**Hours: 12**		
Radio frequency spectrum and regulation – Spectrum - Emerging Regulatory Challenges and Actions - Regulatory Issues of Cognitive Access - **Digital communication fundamentals for cognitive radio** – Introduction - Data Transmission - Digital Modulation Techniques - Probability of Bit Error - Multicarrier Modulation - Multicarrier Equalization Techniques - Intersymbol Interference – Pulse shaping -Agile transmission techniques.								
UNIT – V	**Cognitive Radio Network Architectures and Security**					**Hours: 12**		
Fundamentals of communication networks – Architecture and Building Blocks - New Challenges in Wireless Networks - Mobility Modeling - Power Control and Multiuser Diversity - Multiple Access Schemes - Routing, Energy Efficiency, Network Lifetime Congestion Control **Cognitive Radio Network Architectures** - Topology-Aware CRN Architectures - Publish-Subscribe CRN Architecture **Cognitive radio network security** – Introduction **-** Primary-User Emulation Attacks- Security Vulnerabilities in IEEE 802.22 - Security Threats to the Radio Software								
Total contact Hours: 60	**Total Tutorials: -**	**Total Practical Classes: -**			**Total Hours: 60**			
Text Books:								

1. EzioBiglieriAndreaj .GoldsmithLarryJ .GreensteinNarayan B .Mandayam& H. Vincent Poor Principles of Cognitive RadioCambridge University Press
2. Alexander M. Wyglinski, MaziarNekovee, Y. Thomas Hou ,Cognitive Radio Communications and Networks Principles and Practice, Academic Press

Reference Books:

1. Ke-Lin Du, M. N. S. SwamyWireless Communication Systems: From RF Subsystems to 4G Enabling Technologies
2. Bruce A. Fette Cognitive Radio TechnologyNewnes publicationsYan Zhang, Jun Zheng& Hsiao-Hwa Chen Cognitive Radio Networks Architectures, Protocols, and Standards CRC Press.

Department: Electronics and Communication Engineering				**Programme:** M.Tech. (Wireless Communication)				
Semester :				**Category :** TY				
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
ECE82	Multimedia Communication Systems	3	1	-	4	40	60	100
Prerequisite:	-							
Objectives:	• To learn the Techniques, Applications, Multimedia Networking, Multimedia characteristics-Protocols and Standards-bandwidth and compression issues in Multimedia communication • To understand the BMP, PNG, TIFF, JPEG, DFX, AVI, MPEG Audio/ Video Standards and Compression Techniques • To introduce the Protocols of Multimedia communication • To understand Media on Demand • To understandApplications ofMultimedia communication							
Outcome:	• Knowledgeable in Multimedia Networking, Multimedia characteristics, Protocols, and Standards-Bandwidth and compression issues • Ability to characterize BMP, PNG, TIFF, JPEG, DFX, AVI, MPEG audio/ video standards and compression techniques • Knowledgeable in protocols of multimedia communication • Ability to demonstrate media on demand and its applications							
UNIT – I	**Introduction**						**Hours: 9**	
Introduction to various multimedia communication. Techniques- Applications, Multimedia Networking, Multimedia characteristics-Protocols and Standards-bandwidth and compression issues. Multimedia communication in wireless network.								
UNIT – II	**Multimedia Representation and Compression Techniques**						**Hours: 9**	
Different types of multimedia information- Information representation. Multimedia File Formats-Various files formats for multimedia and their applications, BMP, PNG, TIFF, JPEG, DFX, AVI, MPEG Audio/ Video Standards. Compression Techniques- Text compression techniques-Image compression techniques-Audio and Video Compression, Standards for Multimedia Compression, Huffman, Run length, Variable length, Lossy/ Lossless compression.								
UNIT – III	**Protocols**						**Hours: 9**	
Multicast over shared media network, multicast routing and addressing, scaping multicast and NBMA networks, Reliable transport protocols, TCP adaptation algorithm, RTP, RTCP.								
UNIT – IV	**Media on Demand**						**Hours: 9**	
IPV6, High speed switching, resource reservation, Buffer management, traffic shaping, caching, scheduling and policing, Storage and media servers, voice and video over IP, MPEG-2 over ATM/IP, indexing synchronization of requests, recording and remote control.								
UNIT – V	**Applications**						**Hours: 9**	
MIME, Peer-to-peer computing, shared application, video conferencing, centralized and distributed conference control, distributed virtual reality, light weight session.								
Total contact Hours: 45	**Total Tutorials: 15**	**Total Practical Classes: -**			**Total Hours: 60**			
Text Books:								
1. Fred Halsall, Multimedia Communications: Applications, Networks, Protocols and Standards, Pearson Education, Asia, Second Indian reprint 2002. 2. Jon Crowcroft, Mark Handley, Ian Wakeman. Internetworking Multimedia, Harcourt Asia Pvt.Ltd.,								

Singapore, 1998.

3. B.O. Szuprowicz, Multimedia Networking, McGraw Hill, NewYork. 1995

Reference Books:

1. NalinK.Sharda,Multimedia Information Networking, PHI, 2003.
2. TayVaughan,Multimedia making it to work, 4ed,Tata McGrawHill, New Delhi,2000.
3. Ellen kayatawesel, Ellen Khayata, Wireless Multimedia Communication: Networking Video, Voice and Data, Addison Wesley Longman Publication, USA, 1998.

Websites:

1. http://multimediacommunication.blogspot.in/
2. cmc.rice.edu/

Department: Electronics and Communication Engineering					**Programme:** M.Tech. (Wireless Communication)			
Semester :					**Category :** TY			
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
ECE83	Network Management	4	-	-	4	40	60	100
Prerequisite	-							
Objectives	• To learn about the fundamentals of wireless communication • To study the architectures of different wireless networks • To understand the concepts of LTE and Femtocells • To gain knowledge on ubiquitous computing • To be aware of the emerging technologies in wireless communication							
Outcome	• Ability to analyze the concepts of different emerging wireless technologies • Knowledgeable in Femtocell concepts and LTE evolution • Knowledgeable in the concepts of ubiquitous computing • Knowledgeable in concepts of intelligent system and its application • Ability to demonstrate the ideas of smart devices and their interoperability							
UNIT – I	**Emerging Technologies**					**Hours: 12**		
Bluetooth – Radio frequency Identification – Wireless Broadband (WiMAX) – Mobile IP – Internet Protocol Version_6 – Wireless Application Protocol – MMS – GPRS and Packet Data Networks – Architecture – Operations and Services								
UNIT – II	**LTE and Femtocell**					**Hours: 12**		
Overview – LTE Evolution - Architecture – Multimedia Services over LTE – Femtocell Concept – Femtocell base station – Standards – LTE-Femtocell heterogeneous network								
UNIT – III	**Ubiquitous Communication**					**Hours: 12**		
Wireless Networks – Power line communication – Personal Area Networks – Mobile user networks – Ad hoc networks – Sensor Networks – Service Oriented networks – Content based Networks – Overlay Networks – Heterogeneous networks								
UNIT – IV	**Intelligent Autonomous Communication**					**Hours: 12**		
Introduction – Basic Autonomous – Intra-acting systems – Intelligent Systems – Self aware systems- Self describing – Self explaining – Self modifying – Self management and Autonomic computing.								
UNIT – V	**Future Trends**					**Hours: 12**		
Challenges – Future technologies – Smart devices – Interaction – Interoperability – Smart physical environment device interaction – Human device Interaction - Human intelligence – Machine Interaction								
Total contact Hours: 60	**Total Tutorials: -**	**Total Practical Classes: -**			**Total Hours: 60**			

Text Books:

1. Stefan Poslad, Ubiquitous Computing, John Wiley & Sons, 2010
2. Ashok K Talukder, Mobile Computing, Tata McGraw Hill, 2010
3. William Stallings, Wireless Communication and Networks, Pearson Education, 2003
4. KavehPahlavan and Prashant Krishnamurthy, Principles of Wireless Networks , Pearson Education, 2004
5. Theodore. S.Rappaport C, Wireless Communication:Principles and Practice , Second Edition Prentice Hall India,2006

Websites

1. http://go.radisys.com/rs/radisys/images/paper-femto-lte-roadmap.pdf
2. http://www.3gpp.org/technologies/keywords-acronyms/98-lte
3. http://www.saitechnology.com/index.php/saiproducts/sai-m2m/sai-4g-femto-pico-cell

Department: Electronics and Communication Engineering		**Programme:** M.Tech. (Wireless Communication)						
		Category : TY						
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
ECE84	Ultra Wide Band Communication	3	1	-	4	40	60	100
Prerequisite	-							
Objectives	• To learn about the basics of UWB Technology • To understand the signal processing in UWB communication • To be aware of UWB applications							
Outcome	• Knowledgeable in UWB channel modeling • Ability to examine UWB signal processing technology • Ability to design UWB antennas • Knowledgeable in UWB regulations							
UNIT – I	**Introduction to UWB**						**Hours: 9**	
History, Definition, FCC Mask, UWB features, UWB Interference: IEEE 802.11.a Interference,Signal to Interference ratio calculation, Interference with other wireless services.Impulse Radio, Pulsed Multiband, Multiband OFDM, features : Complexity, Power Consumption,								
UNIT – II	**UWB Technologies and Channel Models**						**Hours: 9**	
Security and achievable data rate. MIMO Multiband OFDM, Differential multiband OFDM ,Performance characterization Ultra Wide Band Wireless ChannelsChannel model: Impulse Response Modeling of UWB Wireless Channels, IEEE UWB channelmodel, Path loss, Delay profiles, Time and frequency modeling.								
UNIT – III	**UWB Signal Processing**						**Hours: 9**	
Data Modulation schemes, UWB Multiple Access Modulation, BER, Rake Receiver, Transmit-Reference (T-R) Technique, UWB Range- Data Rate Performance, UWB Channel CapacityUWB Wireless Locationing: Position Locationing Methods, Time of Arrival Estimation, NLOSLocation Error , Locationing with OFDM.								
UNIT – IV	**UWB Antennas**						**Hours: 9**	
Antenna Requirements, Radiation Mechanism of the UWB Antennas, Types of Broad bandantennas, Parameters, Analysis of UWB Antennas, Link Budget for UWB System. Designexamples of broad band UWB antennas.								
UNIT – V	**UWB Applications and Regulations**						**Hours: 9**	
Wireless Ad hoc Networking, UWB Wireless Sensor, RFID , Consumer Electronics and Personal,Asset Location, Medical applications UWB Regulation and standards in various countries , UWBRegulation in ITU, IEEE Standardization								
Total contact Hours: 45	**Total Tutorials: 15**	**Total Practical Hours: -**			**Total Hours: 60**			

Text Books:

1. Balanis.A, Antenna Theory Analysis and Design, John Wiley and Sons, New York, 1982.
2. Krauss.J.D, Antennas, II edition, John Wiley and sons, New York, 1997.
3. I.J. Bahl and P. Bhartia, Microstrip Antennas ,Artech House,Inc.,1980
4. W.L.Stutzman and G.A.Thiele, Antenna Theory and Design, 2nd edition,John Wiley& Sons Inc.,1998.

Reference Books:

1. Joseph C. Liberti, Theodore S. Rappaport, Smart Antennas for Wireless Communications: IS95 and third generation CDMA Applications, Prentice Hall Communications Engineering and Emerging Technologies Series,1999.
2. Hubregt.J.Visser, Antenna Theory and Applications 1st Edition, John Wiley & Sons Ltd, Newyork, 209.
3. W.L.Stutzman and G.A.Thiele, Antenna Theory and Design, 2nd Edition, John Wiley& Sons Inc., 1998.
4. S.Drabowitch, et.al,Modern Antennas , 2nd Edition Springer science business Media, Inc.2005.

Department: Electronics and Communication Engineering					**Programme:** M.Tech. (Wireless Communication)			
Semester :					**Category :** TY			
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
ECE85	Digital Communication Receivers	3	1	-	4	40	60	100
Prerequisite	-							
Objectives	• To gain knowledge in receivers under AWGN and fading channels • To understand the significance of synchronization and adaptive equalization							
Outcome	• Ability to design and demonstrate the performance of receivers in AWGN and fading channels • Ability to demonstrate any synchronization technique • Knowledgeable in various algorithms used for adaptive equalization							
UNIT – I	**Review of Digital Communication Techniques**					**Hours: 9**		
Base band communication; signal space representation, linear and nonlinear modulationtechniques, Error tracking and Spectral characteristics of digital modulation.								
UNIT – II	**Optimum Receivers for AWGN Channel**					**Hours: 9**		
Correlation demodulator, matched filter, maximum likelihood sequence detector,optimum receiver for CPM signals, M-ary orthogonal signals, envelope detectors for M-ary and correlated binary signals.								
UNIT – III	**Receivers for Fading Channels**					**Hours: 9**		
Characterization of fading multiple channels, statistical models, flat and frequency selective fading, diversity technique, Optimal receivers for data detection and synchronization parameter estimation, coded waveform for fading channel.								
UNIT – IV	**Synchronization Techniques**					**Hours: 9**		
Carrier and signal synchronization, carrier phase estimation-PLL, Decision directed loops, symbol timing estimation, maximum likelihood and non-decision directed timing estimation, joint estimation.								
UNIT – V	**Adaptive Equalization**					**Hours: 9**		
Zero forcing algorithm, LMS algorithm, adaptive decision-feedback equalizer and Equalization of Trellis-coded signals. Kalman algorithm, blind equalizers and stochastic gradient algorithm.								
Total contact Hours: 45	**Total Tutorials: 15**	**Total Practical Classes: -**				**Total Hours: 60**		
Reference Books:								

1. Heinrich Meyer, Mare Moeneclacy, Stefan.A.Fechtel, Digital communication receivers, Vol I & Vol II, John Wiley, New York, 1997.
2. U.Mengali&A.N.D'Andrea, Synchronization Techniques for Digital Receivers, Kluwer, 1997.
3. John.G.Proakis, Digital communication 4th Edition, McGraw-Hill, New York, 2001.
4. E.A.Lee and D.G. Messerschmitt, Digital communication , 2nd Edition, Allied
5. Publishers, New Delhi, 1994.
6. Simon Marvin, Digital communication over fading channel; An unified approach to performance Analysis , John Wiley, New York, 2000.
7. H.Meyr & G.Ascheid, Synchronization in Digital Communications, John Wiley, 1990.

Department: Electronics and Communication Engineering		**Programme:** M.Tech. (Wireless Communication)						
Semester :		**Category :** TY						
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
ECE86	Space Time Wireless Communication	3	1	-	4	40	60	100
Prerequisite	-							
Objectives	• To understand multiple antenna propagation • To learn about MIMO channels • To gain knowledge on spatial diversity • To understand the significance of coding and MIMO techniques							
Outcome	• Knowledgeable in fading and MIMO channels • Ability to examine antenna diversity • Ability to demonstrate the antenna coding and multiuser detection							
UNIT – I	**Multiple Antenna Propagation and St Channel Characterization**					**Hours: 9**		
Wireless channel, Scattering model in macrocells, Channel as a ST random field, Scattering functions, Polarization and field diverse channels, Antenna array topology, Degenerate channels, reciprocity and its implications, Channel definitions, Physical scattering model, Extended channel models, Channel measurements, sampled signal model, ST multiuser and ST interference channels, ST channel estimation.								
UNIT – II	**Capacity of Multiple Antenna Channels**					**Hours: 9**		
Capacity of frequency flat deterministic MIMO channel: Channel unknown to the transmitter, Channel known to the transmitter, capacity of random MIMO channels, Influence of ricean fading, fading correlation, XPD and degeneracy on MIMO capacity, Capacity of frequency selective MIMO channels.								
UNIT – III	**Spatial Diversity**					**Hours: 9**		
Diversity gain, Receive antenna diversity, Transmit antenna diversity, Diversity order and channel variability, Diversity performance in extended channels, Combined space and path diversity ,Indirect transmit diversity, Diversity of a space-time- frequency selective fading channel.								
UNIT – IV	**Multiple Antenna Coding and Receivers**					**Hours: 9**		
Coding and interleaving architecture, ST coding for frequency flat channels, ST coding for frequency selective channels, Receivers(SISO,SIMO,MIMO),Iterative MIMO receivers, Exploiting channel knowledge at the transmitter: linear pre-filtering, optimal pre-filtering for maximum rate, optimal pre-filtering for error rate minimization, selection at the transmitter, Exploiting imperfect channel knowledge.								
UNIT – V	**ST OFDM, Spread Spectrum and MIMO Multiuser Detection**					**Hours: 9**		
SISO-OFDM modulation, MIMO-OFDM modulation, Signaling and receivers for MIMO- OFDM,SISO-SS modulation, MIMO-SS modulation, Signaling and receivers for MIMO- S.MIMO-MAC,MIMO-BC, Outage performance for MIMO-MU,MIMO-MU with OFDM,CDMA and multiple antennas.								
Total contact Hours: 45	**Total Tutorials: 15**	**Total Practical Classes: -**				**Total Hours: 60**		

Reference Books:

1. A. Paulraj, RohitNabar, Dhananjay Gore., Introduction to Space Time Wireless Communication Systems, Cambridge University Press, 2003
2. Sergio Verdu Multi User Detection Cambridge University Press, 1998
3. Andre Viterbi Principles of Spread Spectrum Techniques Addison Wesley 1995

Department: Physics				**Programme:** M.Tech. (Wireless Communication)				
Semester :				**Category :** TY				
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
PHE51	Nanotechnology and its Applications	4	-	-	4	40	60	100
Prerequisite	-							
Objectives	• To understand the size effect • To introduce the changes in the dimension of the material from 3D to zero dimension • To study the latest characterisation techniques and instrumentation • To analyse the changes in microelectronics to nano electronics • To apply size effect for nano sensors and nano devices							
Outcome	• Quantum mechanical knowledge about reduced size, wave nature and discrete energy of nano system • Ability to analyse dimensional changes from three dimension to zero dimension in the energy and density of states • Understanding of spectroscopic, optical and electroanalytical Characterization • techniques of nanomaterials • Ananlysis of basic principles of micro electronics to nano electronics • Application of size effect to devices and sensor • Ability to implement the construction and working of devices based on size effect							
UNIT – I	**Basic Properties of Nanoparticles**						**Hours: 12**	
Introduction -Size effect and properties of nanoparticles - particle size - particle shape - particle density - melting point, surface tension, wettability - specific surface area and pore size – Reason for change in optical properties, electrical properties, and mechanical properties – advantages.								
UNIT – II	**Nanostructures-One Dimension and Zero Dimension**						**Hours: 12**	
Nanotube properties- Single walled and Multi walled Nanotubes (SWNT and MWNT) - synthesis and purification -pyrolysis and arc discharge method- Quantum dots-Nanolithography and Lithography techniques.								
UNIT – III	**Mobile Data Networks**						**Hours: 12**	
X-ray Diffraction-Electron microscopy- Scanning, Tunneling and Scanning Conducting microscopy (SCM) –AFM - Scanning Probe Optical Microscopy - Absorption and emission PL spectra - Photoelectron spectroscopy-Raman scattering and Electroanalytical techniques.								
UNIT – IV	**Nanoelectronics**						**Hours: 12**	
Overview of basic nanoelectronic technologies-single electron devices-quantum mechanical tunnelling devices-spin nanoelectronics (spintronics)-Molecular electronics-molecular devices-Transistor from micro to nano and Nano-MOSFETS								
UNIT – V	**Nanodevices**						**Hours: 12**	
Nano sensors-Molecular nano machines-Micro-electro mechanical systems(MEMS) &NEMS-Nanotechnology for data storage-Magnetic storage-High density quantised magnetic disks-MRAMS.								
Total contact Hours: 60		**Total Tutorials: -**		**Total Practical Classes: -**			**Total Hours: 60**	

Text Books:

1. A Textbook of Nanoscience and nanotechnology, T.Pradeep, A.Ashok Reddy and B.R Buergi,TataMcGraw Hill, New Delhi, 2012.
2. Nanotechnology and NanoelectronicsMaterials, Devices, Measurement Techniques, W.R.Fahrner (Editor), Springer,(Germany),2005.
3. Nanostructured materials and nanotechnology, Concise Edition, Editor:- Hari Singh Nalwa; Academic

Press, USA (2002).
4. Hand book of Nanostructured Materials and Technology, Vol.1-5, Editor:- Hari Singh Nalwa; Academic Press, USA (2000).
5. NANO:The Essentials - Understanding Nnaoscience and Technology,T.Pradeep, Tata McGraw Hill, New Delhi, 2007.
6. Textbook of Nanoscience and Nanotechnology, B.S.Murty, P.Shankar, BaldevRaj,
7. B.B.Rath and James Murday, Orient BlackswanPvt Ltd.-New Delhi; First edition (2012).

Reference Books:

1. Nanomaterials, A.K.Bandyopathyay, New age international Limited (P) Publishers,(New Delhi) 2008.
2. Springer Handbook of NanoTechnology - B. Bhushan, Springer, (Germany) 2004.

Department : Electronics and Communication Engineering		**Programme :** M.Tech (Wireless Communication)						
Semester : One		**Category :** LB						
Subject Code	**Subject**	**Hours / Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
EC162	Wireless Communication and Networking Laboratory	**-**	**-**	**3**	**2**	**60**	**40**	**100**
Prerequisite:	-							
Objectives:	• To understand the working of communication system models • To understand and implement application using embedded development board • To simulate the different channel models for wireless networks							
Outcome:	• Ability to demonstrate the design of modulator and antenna used for wireless communication • Ability to implement the GSM and HTTP data transfer using Qualnet software and study the different parameters of the network • Ability to design simple digital systems using Spartan6 FPGA board • Ability to design filters suitable for wireless channel							

LIST OF EXPERIMENTS

13. Design of GMSK modulator for GSM system.
14. Study of wireless sensor network using NI Labview
15. Study and comparison of various wireless channel models
16. Call establishment using different entities of GSM network using Qualnet.
17. Development of a network to run HTTP application using Qualnet.
18. Developing any one network topology, establishing a routing protocol and analysing using NS2.
19. Study of serial data transfer using HCS959 module.
20. Designing Yagi antenna and study the Return loss magnitude and phase characteristics
21. FFT of real time input signals using DSP trainer kits.
22. Simulation of OFDM transmitter and receiver in Matlab.
23. Study of Spartan6 FPGA and perform the following operations
    iv. Activating the traffic light controller interface
    v. Enabling the Keypad Matrix interface with LEDs.
    vi. Enabling the graphic LCD interface in Spartan6 FPGA.
    iv Design and implementation of Manchester encoder.
24. Image compression using Matlab.

Total contact Hours: -	**Total Tutorials: -**	**Total Practical Classes: 45**	**Total Hours: 45**