

PONDICHERRY ENGINEERING COLLEGE, PUDUCHERRY – 605 014

CURRICULUM AND SYLLABI FOR AUTONOMOUS STREAM

M.TECH. (ELECTRONICS AND COMMUNICATION ENGINEERING) 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
EC153	Low Power CMOS VLSI Circuit Design	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
EC154	Advanced Communication Systems and Networks 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	
EC155	RF System Design	TY	3	1	0	40	60	100	4
EC156	Embedded Systems and RTOS	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
EC157	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	
EC159	Project Phase I	PR	-	-	-	150	150	300	9
Total Credits									9

IV SEMESTER

Subject Code	Subjects	Category	Periods			Marks			Credits
			L	T	P	CA	SE	TM	
EC160	Project Phase II	PR	-	-	-	200	200	400	14
	Professional Development Courses	PR	-	-	-	200	-	200	2
Total Credits									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	Subjects	Category
1.	ECE51	Cryptography and Wireless Security	TY
2.	ECE52	Wireless Sensor Networks	TY
3.	ECE53	Ubiquitous Computing	TY
4.	ECE54	Soft Computing	TY
5.	ECE55	Communication Networks Modelling and Simulation	TY
6.	ECE56	Computer Aided Design of VLSI Circuits	TY
7.	ECE57	Advanced Image Processing	TY
8.	ECE58	Advanced Microprocessor and Microcontroller	TY
9.	ECE59	Mobile Satellite Communication	TY
10.	ECE60	Speech and Audio Signal Processing	TY
11.	ECE61	Advanced Radiating Systems	TY
12.	ECE62	High Speed Networks	TY
13.	ECE63	MEMS and NEMS	TY
14.	ECE64	Multimedia Networking	TY
15.	ECE65	Wavelet Transforms and Applications	TY
16.	ECE66	RADAR Signal Processing	TY
17.	ECE67	Detection and Estimation Theory	TY
18.	ECE68	DSP Integrated Circuits	TY
19.	ECE69	Automotive Electronics	TY
20.	ECE70	Free Space Optical Communication	TY
21.	PHE51	Nanotechnology and its Applications	TY

Department: Mathematics		Programme: M.Tech.(Electronics & Communication Engineering)						
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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	Transformation of Random Variables						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	Stochastic Processes						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	Queueing Models						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:								
<ol style="list-style-type: none"> KishorS.Trivedi ,Probability and Statistics with Reliability, Queueing and Computer Science Application, John Wiley & Sons Inc. Second Edition, 2002 D.Gross and C.M.Harris,Fundamentals of Queueing Theory, Wiley Students Edition, Third Edition, 1985. 								
Reference Books:								
<ol style="list-style-type: none"> J.Medhi, Stochastic Processes, New Age International (P) Ltd., Second Edition, 2012. J.Medhi, Stochastic models in Queueing Theory, Academic Press, Second Edition, 2012. 								
Website:								
1. www.nptel.ac.in								

Department: Electronics and Communication Engineering		Programme: M.Tech.(Electronics and Communication Engineering)						
Semester : One		Category : TY						
Subject Code	Subject	Hours / Week			Credit	Maximum Marks		
		L	T	P		C	CA	SE
EC151	Advanced Digital Communication	3	1	-	4	40	60	100
Prerequisite								
Objectives		<ul style="list-style-type: none"> 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		<ul style="list-style-type: none"> 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 Masoud Salehi, “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. Bernard Sklar, Digital Communications: Fundamentals and Applications, 2nd edition, Pearson Education, 2002.								
Website:								
1. www.nptel.ac.in								

Department: Electronics and Communication Engineering				Programme: M.Tech.(Electronics and Communication Engineering)				
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		<ul style="list-style-type: none"> 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		<ul style="list-style-type: none"> 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:								
<ol style="list-style-type: none"> 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. Proakis et.al., Algorithms for Statistical Signal Processing, Pearson Education, 2002. 5. Dimitris G.Manolakis et.al., Statistical and Adaptive Signal Processing, McGraw Hill, Newyork, 2000. 								
Website:								
1. www.nptel.ac.in								

Department: Electronics and Communication Engineering				Programme: M.Tech.(Electronics and Communication Engineering)					
Semester : One				Category : TY					
Subject Code	Subject	Hours / Week			Credit	Maximum Marks			
		L	T	P	C	CA	SE	TM	
EC153	Low Power CMOS VLSI Circuit Design	3	1	-	4	40	60	100	
Prerequisite									
Objectives		<ul style="list-style-type: none"> To identify the sources of power consumption in a given VLSI Circuit To understand the basic principle of low power To gain knowledge on low power circuit design styles for VLSI circuits To understand software power estimation and optimization methods for VLSI circuits 							
Outcome		<ul style="list-style-type: none"> Ability to design Low power CMOS digital circuits Ability to examine different types of SRAMs/DRAMs for low power applications Ability to design and implement low power arithmetic circuits and systems Ability to demonstrate the level of abstract at which it is advantageous to implement low power techniques in a VLSI system design 							
UNIT – I		Introduction to Low Power VLSI Design and Analysis				Hours: 9			
Introduction to low power VLSI design-Need for low power-CMOS leakage current-static current- Basic principles of low power design-probabilistic power analysis-random logic signal-probability and frequency-power analysis techniques-signal entropy.									
UNIT – II		Circuit Level and Logic Level Design Techniques				Hours: 9			
Circuit - transistor and gate sizing - pin ordering - network restructuring and reorganization - adjustable threshold voltages – logic signal gating - logic encoding. Pre-computation logic.									
UNIT – III		Special Low Power VLSI Design Techniques				Hours: 9			
Power reduction in clock networks - CMOS floating node - low power bus - delay balancing Switching activity reduction - parallel voltage reduction - operator reduction -Adiabatic computation - pass transistor logic									
UNIT – IV		Low Voltage Low Power Memories				Hours: 9			
Basics of SRAM- Memory cell –Pre-charge and equalization circuit decoder-ATD Sense amplifier-Output latch-Low power SRAM technologies-types of DRAM –Basics of DRAM-Cell refresh circuit-HVG-BBG-BVG-RVG-VDC									
UNIT – V		Software Design and Power Estimation				Hours: 9			
Low power circuit design style - Software power estimation – Co-design for low power.									
Total contact Hours: 45		Total Tutorials: 15		Total Practical Classes: -		Total Hours: 60			
Reference Books:									
<ol style="list-style-type: none"> Gary Yeap Practical Low Power Digital VLSI Design, Springer US, Kluwer Academic Publishers, 2002. Kaushik Roy, Sharat C. Prasad, Low power CMOS VLSI circuit design, Wiley Inter science Publications, 1987. Kiat-Seng Yeo, Kaushik Roy, Low Voltage Low Power VLSI Subsystems, Tata Mc-Graw Hill, 2009. 									
Website:									
<ol style="list-style-type: none"> www.nptel.ac.in 									

Department: Electronics and Communication Engineering		Programme: M.Tech.(Electronics and Communication Engineering)						
Semester : One		Category : LB						
Subject Code	Subject	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EC154	Advanced Communication Systems and Networks Laboratory	-	-	3	2	60	40	100
Prerequisite								
Objectives		<ul style="list-style-type: none"> To understand the working of communication system models To understand and implement application using embedded development board To simulate the different coding techniques suitable wireless scenario 						
Outcome		<ul style="list-style-type: none"> Ability to demonstrate the design of modulator and antenna used for wireless communication Ability to simulate the GSM network using Qualnet software and study the different parameters of the network Ability to develop code to execute display and encoder using Spartan6 FPGA board Ability to design filters suitable for wireless channel 						
List of Experiments								
<ol style="list-style-type: none"> Design of GMSK modulator for GSM system. Design of Direct sequence spread spectrum system and study the spectrum of spreaded and despreaded signals. Design of a Yagi antenna and study of the Return loss magnitude and phase characteristics. BER Performance analysis of Convolutional, Turbo and LDPC codes. Call establishment using different entities of GSM network using Qualnet. Simulation of OFDM transmitter and receiver using Matlab. Study of Spartan6 FPGA to perform the following operations <ol style="list-style-type: none"> Activating the traffic light controller interface Enabling the Keypad Matrix interface with LEDs. Enabling the graphic LCD interface in Spartan6 FPGA. Design and implementation of Manchester encoder. Implementation of FIR filter (LP,HP,BP) using DSP trainer kit. Implementation of IIR filter (LP,HP,BP) using DSP trainer kit. Development of any one network topology, establish a routing protocol and analyse using NS2. Modeling the 802.11 environment and study of the performance at network level and link level 								
Total contact Hours: -		Total Tutorials: -		Total Practical Classes: 45			Total Hours: 45	

Department: Electronics and Communication Engineering				Programme: M.Tech.(Electronics and Communication Engineering)					
Semester : Two				Category : TY					
Subject Code	Subject	Hours / Week			Credit	Maximum Marks			
		L	T	P	C	CA	SE	TM	
EC155	RF System Design	3	1	-	4	40	60	100	
Prerequisite	-								
Objectives	<ul style="list-style-type: none"> To understand the different components of RF To make RF system level design decisions To understand real time applications in the field of RF system To explain various methodologies in the RF active and passive circuits 								
Outcome	<ul style="list-style-type: none"> Knowledgeable in various types of RF filters, Mixers and Oscillators Ability to demonstrate the design of RF transistor amplifiers Ability to examine the performance of PLL and frequency synthesizers 								
UNIT – I	Transceiver Specifications and Architectures					Hours: 9			
Transceiver Specifications-Two port Noise theory-Noise Figure-Phase noise- Specification distribution over a communication link-Transceiver Architectures: Receiver: Homodyne-Heterodyne-Image reject-Low IF Architectures-Transmitter: Direct upconversion-Two step upconversion.									
UNIT – II	Impedance Matching and RF Transistor Amplifiers					Hours: 9			
Passive IC components-Impedance matching networks Amplifiers: Common Gate-Common Source Amplifiers-Open circuit time constants in bandwidth estimation and enhancement-High frequency amplifier design-Low Noise Amplifiers: Power match and Noise match-Single ended and Differential LNAs-Terminated with Resistors and Source Degeneration LNAs									
UNIT – III	RF Filter Design					Hours: 9			
Modern filter design-Normalization and Low pass prototype-Filter types-Frequency and impedance scaling-High pass filter design-Dual Network-Band pass filter design-Band rejection filter design-Effect of finite Q.									
UNIT – IV	PLL and Frequency Synthesizers					Hours: 9			
PLL: Linearised Model-Noise properties-Phase detectors-Loop filters and Charge pumps-Frequency Synthesizers: Integer-N frequency synthesizers-Direct Digital Frequency synthesizers.									
UNIT – V	Mixers and Oscillators					Hours: 9			
Mixer: characteristics-Non-linear based mixers: Quadratic mixers-Multiplier based mixers-Single balanced and double balanced mixers-sub sampling mixers-Oscillators: Colpitts oscillators-Tuned Oscillators-Negative resistance oscillators-Resonators									
Total contact Hours: 45		Total Tutorials: 15		Total Practical Classes: -		Total Hours: 60			
Text Books:									
<ol style="list-style-type: none"> 1. Reinhold Ludwig, RF circuit design theory and applications, Pearson Asia Education, Edition 2001. 2. B. Razavi, RF Microelectronics, Pearson Education, 1997 3. Jan Crols, Michiel Steyaert, CMOS Wireless Transceiver Design, Kluwer Academic Publishers, 1997. 									
Reference Books:									
<ol style="list-style-type: none"> 1. B. Razavi, Design of Analog CMOS Integrated Circuits, McGraw Hill 2001 2. D. Pozar, Microwave Engineering, John Wiley & Sons, New York 1998. 3. Bahil and P. Bhartia, Microwave Solid State Circuit Design, John Willey & Sons, New York 1998 									

Department: Electronics and Communication Engineering				Programme: M.Tech.(Electronics and Communication Engineering)				
Semester : Two				Category : TCM				
Subject Code	Subject	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EC156	Embedded Systems and RTOS	3	-	2	4	50	50	100
Prerequisite		.						
Objectives		<ul style="list-style-type: none"> To give an overview on embedded system architecture and the various communication interfaces To gain knowledge on software architectures and the services offered by RTOS To study simple design using RTOS To understand the steps involved in the embedded software development tool To understand the programming concepts in embedded system design 						
Outcome		<ul style="list-style-type: none"> Knowledgeable in communication interfaces, basic concepts involved in RTOS and the services supported by RTOS Ability to analyze the steps involved in software development tool Ability to implement an RTOS based system by considering hard real time scheduling constraints Ability to program a simple embedded system 						
UNIT – I	Introduction to Embedded Systems					Hours: 9		
Categories of embedded systems, Overview of embedded system architecture, Recent trends in embedded systems, Communication interfaces: RS232/UART RS 422/RS485, USB, IEEE1394, Bluetooth, Zigbee, Wifi, I2C, SPI, CAN, IDE, PCI, and Networking.								
UNIT – II	Survey of Software Architectures					Hours: 9		
Round Robin, Round Robin with interrupts, Function Queue scheduling Architecture, RTOS Architecture, Architecture selection, Introduction to RTOS,- Task and task states, Task and data, Semaphore and shared data, More operating system services, - Message Queues, Mail boxes and pipes, Timer functions , events, Memory Management, Interrupt routine in an RTOS environment.								
UNIT – III	Basic Design Using an RTOS					Hours: 9		
Principle, Encapsulating Semaphores and Queues, Hard Real Time scheduling considerations, Saving memory space, Saving power.								
UNIT – IV	Embedded Software Development Tools					Hours: 9		
Host and Target Machines, Linker/ Locator for Embedded Software , Getting Embedded Software into the target system, Debugging Techniques, Testing on your host machine, Instruction Set Simulators, The Assert Macro, Using Laboratory tools.								
UNIT – V	Writing Software for Embedded Systems					Hours: 9		
The compilation process, Native versus cross compilers, Run time libraries, Writing a library, Using alternative libraries, Using a standard library, Porting Kernels, C extensions for Embedded Systems, Downloading, Emulation and Debugging Techniques, Buffering and other data structures, Linear buffer, Directional buffer, Double buffering, Buffer exchanging, Linked lists, FIFO, Circular buffers, Buffer under run and overrun, Allocating buffer memory, memory leakage, Memory and performance trade- offs.								
MINI PROJECT								
Mini Project using HC9S12								
<ul style="list-style-type: none"> Design and test an unsigned 10-bit digital filter (0 to 1023). Simulate the given input and display the data using SCI. Design and test a signed 10-bit digital filter (0 to 1023). Simulate the given input and display the data using SCI. Design and analyze IIR digital filter with up to 8 poles and 8 zeros. Design a system to interface a 2 by 2 matrix keyboard by capturing the interrupts using input capture. De-bounce the keyboard using output compare interrupts. Design a system to detect the digital waveform using an IR detector. Also measure the rising edge interrupts using input capture. Design a real-time thread scheduler for fixed-time periodic threads. One task is low priority but the remaining three tasks are high priority threads. The high priority threads are run at fixed (but unequal) 								

rates

- Using Port T and Port P on the 9S12 design a system to generate waves with a fixed period, but with a user programmable duty cycle.

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

Text Books:

1. Dr. K V K K Prasad, Embedded / Real time systems: Concepts, Design and Programming, Dream Tech press, New Delhi, 2003.
2. David Simon, Embedded Software Primer, Addison- Wesley, 1999.

Reference Books:

1. Raj Kamal, Introduction to Embedded Systems, Tata McGraw Hill Publications

Websites:

1. www.tik.ee.ethz.ch/education/lectures/ES/slides/6_RTOS.pdf
2. www.en.wikibooks.org/.../Embedded_Systems/Real-Time_Operating_Systems
3. www.rtos.com
4. www.cse.iitd.ernet.in/~suban/csl373/rtos.ppt

Department: Electronics and Communication Engineering		Programme: M.Tech.(Electronics and Communication Engineering)						
Semester : Two		Category : PR						
Subject Code	Subject	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EC157	Mini project	-	-	-	2	60	40	100
Prerequisite	-							
Objectives	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Ability to undertake a piece of research work • Ability to extend the project to find an application for society 							
Mini Project								
<p>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.</p>								
Total contact Hours: -		Total Tutorials: -			Total Practical Classes: -		Total Hours: -	

Department: Electronics and Communication Engineering		Programme: M.Tech.(Electronics and Communication Engineering)						
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	<ul style="list-style-type: none"> To educate students to methods of selection of research problems To expose students to different research methods 							
Outcomes	<ul style="list-style-type: none"> 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. 							
<ul style="list-style-type: none"> 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:								
<ol style="list-style-type: none"> Dawson, Catherine, Practical Research Methods, UBS Publishers and Distributors, New Delhi, 2002 Kothari, C.R., Research Methodology-Methods and Techniques, Wiley Eastern Limited, New Delhi, 1985. 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.(Electronics and Communication Engineering)						
Semester : Three		Category : PR						
Subject Code	Subject	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EC159	Project Phase I	-	-	-	9	150	150	300
Prerequisite	-							
Objectives	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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 							
<p>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.</p>								

Department: Electronics and Communication Engineering		Programme: M.Tech.(Electronics and Communication Engineering)						
Semester : Four		Category : PR						
Subject Code	Subject	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EC160	Project Phase II	-	-	-	14	200	200	400
Prerequisite	-							
Objectives	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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 							
<p>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.</p>								

Department: Electronics and Communication Engineering		Programme: M.Tech.(Electronics and Communication Engineering)						
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		<ul style="list-style-type: none"> 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		<ul style="list-style-type: none"> 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- Euclids 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-Fermats and Eulers 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:								
<ol style="list-style-type: none"> William Stallings, Cryptography and Network Security-Principles and practice, 4th Edition, Prentice Hall of India, 2007. Nichols and Lekka, Wireless Security-Models, Threats and Solutions, Tata McGraw – Hill, New Delhi, 2006. 								

3. 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, 1st edition, 2003.
2. Bruce Schneier, Applied Cryptography, 2nd Edition, John Wiley & Sons, 1996.

Website:

1. www.nptel.ac.in

Department: Electronics and Communication Engineering		Programme: M.Tech.(Electronics and Communication Engineering)						
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		<ul style="list-style-type: none"> 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		<ul style="list-style-type: none"> Knowledgeable in the concept of Sensor network and its Protocols Ability to implement Wireless Sensor Network for various applications Ability to examine 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 modelling 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 – Localised and globalised 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, Elsevier 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 MoraesCordeiro , Dharma PrakashAgarwal, Ad hoc and Sensor Network : Theory and 4. 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.(Electronics and Communication Engineering)						
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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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-Modelling 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:								
<ol style="list-style-type: none"> Stefan Poslad, Ubiquitous Computing, John Wiley & Sons, 2010. Frank Adelstein, Sandeep K.S. Gupta,Golden G. Richard III, Loren Schweibert, Fundamentals of Mobile and Pervasive Computing, Tata McGraw-Hill, 2009 								
Reference Books:								
<ol style="list-style-type: none"> AsokeTalkuder, Roopa R Yavagal, Mobile Computing- Technology, Applications and Service Creation, Tata McGraw Hill, 2007. 								

Department: Electronics and Communication Engineering		Programme: M.Tech.(Electronics and Communication Engineering)						
Semester :		Category : TY						
Subject Code	Subject Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECE54	Soft Computing	3	1	-	4	40	60	100
Prerequisite	-							
Objectives	<ul style="list-style-type: none"> To acquire knowledge about the fundamentals of fuzzy logic To learn about neural networks and to gain thorough knowledge in NN algorithms To study about Neuro-Fuzzy systems To gain knowledge about genetic algorithms for adaptive systems 							
Outcome	<ul style="list-style-type: none"> Knowledgeable in Fuzzy set theory Ability to characterize artificial neuron and biological neuron Knowledgeable in BPN, RBF networks and genetic algorithm 							
UNIT – I	Introduction to Soft Computing					Hours: 9		
Evolution of Computing - Soft Computing Constituents – Conventional AI to Computational Intelligence - Machine Learning Basic.								
UNIT – II	Fuzzy Logic					Hours: 9		
Crisp sets – Fuzzy sets – Operation and properties. Fuzzy relations – Equivalence and tolerance relations. Fuzzy membership functions- Types and definitions. Membership value assignments – Rule based systems. Fuzzy clustering- Types of fuzzy inference- Defuzzification.								
UNIT – III	Artificial Neural Networks					Hours: 9		
Introduction – Biological neuron – Artificial neuron – Neuron model – Supervised and unsupervised learning- Single layer – Multi layer feed forward network – Learning algorithm- Back propagation network.- RBF network								
UNIT – IV	Neuro -Fuzzy Modeling					Hours: 9		
Adaptive Neuro-Fuzzy Inference Systems – Architecture – Hybrid Learning Algorithm – Learning Methods that Cross-fertilize ANFIS and RBFN – Coactive Neuro Fuzzy Modeling – Framework Neuron Functions for Adaptive Networks								
UNIT – V	Genetic Algorithms					Hours: 9		
Introduction to Genetic Algorithms – Applications of GA in Machine Learning - Machine Learning Approach to Knowledge Acquisition – Reproduction – Crossover – Mutation								
Total contact Hours: 45		Total Tutorials: 15		Total Practical Classes: -		Total Hours: 60		
Text Books:								
<ol style="list-style-type: none"> 1. Timothy J. Ross, Fuzzy Logic with Engineering Applications, Tata McGraw Hill, 1997. 2. S.N.Sivanandam and S.N.Deepa, Principles of Soft computing, Wiley India Edition, 2nd Edition, 2013. 3. S.Rajasekaran and G.A. VijayalakshmiPai, Neural Networks- Fuzzy Logic- and Genetic Algorithms Synthesis and Applications, Prentice Hall India, 2003. 4. Eiji Mizutani, Chuen Tsai Sun, JyhShing Roger Jang, Neuro-Fuzzy and Soft Computing : A Computational approach to learning and machine intelligence, Pearson Education, 2008 								
Reference Books:								
<ol style="list-style-type: none"> 1. Mitchell Melanie, An Introduction to Genetic Algorithm, Prentice Hall, 1998. 2. David E. Goldberg, Genetic Algorithms in Search, Optimization and Machine Learning, Addison Wesley, 1997. 3. S.N.Sivanandam · S.N.Deepa, Introduction to Genetic Algorithms, Springer, 2007 								

Department: Electronics and Communication Engineering		Programme: M.Tech.(Electronics and Communication Engineering)						
Semester :		Category : TY						
Subject Code	Subject	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECE55	Communication Networks Modeling and Simulation	3	1	-	4	40	60	100
Prerequisite	-							
Objectives	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	Modeling and Simulation Approach					Hours: 9		
Review of stochastic process and their properties. Methods of performance evaluation-simulation approach-Advantages and limitations. System model steps and its types involved in simulation study. Basic concepts of modeling – modeling of systems, devices, random process and hypothetical systems. Error sources in simulation. Validation, simulation environment and software issues.Role of simulation in communication system and random process. Steps involved in simulation study.								
UNIT – II	Generation and Parameter Estimation					Hours: 9		
Monte Carlo simulation, properties, random number Generation, Generating independent and correlated random sequences . Testing of random number generators.Parameter estimation: Estimating mean, variance, confidence interval, Estimating the Average Level of a Waveform, Estimating the Average power of a waveform, Power Spectral Density of a process, Delay and Phase.								
UNIT – III	Modeling of Communication Systems					Hours: 9		
Information sources, source coding, base band modulation, channel coding, RF and optical modulation, filtering, multiplexing, detection/demodulation- carrier and timing recovery for BPSK and QPSK. Modeling considerations for PLL.								
UNIT – IV	Communication Channel Models					Hours: 9		
Fading and multipath channels- statistical characterization of multipath channels and time-varying channels with Doppler effects, models for multipath fading channels. Finite state channel models – channels with and without memory. Methodology for simulating communication systems operating over fading channels.								
UNIT – V	Performance Estimation and Evaluation					Hours: 9		
Estimation of Performance Measures - Estimation of SNR, Performance Measures for Digital Systems, Importance sampling method, Efficient Simulation using Importance Sampling, Quasi analytical Estimation. Case Studies: (1) Performance of 16-QAM equalized Line of Sight Digital Radio Link, (2) performance evaluation of CDMA Cellular Radio System.								
Total contact Hours: 45		Total Tutorials: 15			Total Practical Classes: -		Total Hours: 60	
Text Books:								
<ol style="list-style-type: none"> M.C. Jeruchim, Philip Balaban and K.Samshanmugam, Simulation of communication systems, Plenum press, New York, 2007. M.Law and W.DavidKelton , Simulation Modelling and analysis ,Tata McGraw Hill, New York, 2008. 								
Reference Books:								
<ol style="list-style-type: none"> K.Hayes, Modelling and Analysis of computer communication networks, Plenum press, NewYork,1984. Banks, J.S.Carson, Nelson and D.M.Nicol, Discrete –Event system simulation, 4th Edition, PrenticeHall of India, 2005 . Z.Peebles ,Probability, Random Variable and Random Signal Principles, 4th edition, Tata McGraw Hill, 2002. 								

Department: Electronics and Communication Engineering		Programme: M.Tech.(Electronics and Communication Engineering)						
Semester :		Category : TY						
Subject Code	Subject	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECE56	Computer Aided Design of VLSI Circuits	3	1	-	4	40	60	100
Prerequisite	-							
Objectives	<ul style="list-style-type: none"> To provide an overview of the VLSI physical design automation field To introduce data structures that are used to model different problems in VLSI design To introduce the basic algorithms used in VLSI physical design automation To present the algorithms used for partitioning, floor planning, pin assignment To introduce the physical design automation problem and algorithms for FPGA and MCM 							
Outcome	<ul style="list-style-type: none"> Knowledgeable in the trends in VLSI physical design automation field Ability to apply data structures to model different problems in VLSI design Ability to apply the basic algorithms for VLSI physical design automation Ability to analyze and apply the algorithms used for partitioning, floor planning and pin assignment Ability to formulate the physical design automation problem for FPGA and MCM and select the appropriate algorithms 							
UNIT – I	VLSI Physical Design Automation						Hours: 9	
VLSI Design Cycle, Trends in VLSI Design Cycle and Physical Design Cycle, Design Styles - Full-Custom, Standard Cell, Field Programmable Gate Arrays, Comparison of Different Design Styles, System Packaging Styles, Die Packaging and Attachment Styles, Printed Circuit Boards, Multichip Modules, Wafer Scale Integration, Comparison of Different Packaging Styles, Existing Design Tools								
UNIT – II	Data Structures and Algorithms for VLSI Physical Design						Hours: 9	
Basic Data Structures- Atomic Operations for Layout Editors, Linked List of Blocks, Bin-Based Method, Neighbor Pointers, Corner Stitching, Multi-layer Operations, Limitations of Existing Data Structures, Layout Specification Languages,								
Algorithms for Physical design- Basic Terminology, Complexity Issues and NP-hardness, Classes of Graphs in Physical Design, Relationship Between Graph Classes, Graph Problems in Physical Design, Algorithms for Interval Graphs, Algorithms for Permutation Graphs, Algorithms for Circle Graphs								
UNIT – III	Partitioning						Hours: 9	
Introduction to Partitioning, Problem Formulation - Design Style Specific Partitioning Problems, Classification of Partitioning Algorithms, Group Migration Algorithms- Kernighan-Lin Algorithm, Extensions of Kernighan-Lin Algorithm, Fiduccia-Mattheyses Algorithm, Goldberg and Burstein Algorithm, Component Replication, Ratio Cut, Simulated Annealing and Evolution- Simulated Annealing, Simulated Evolution, Other Partitioning Algorithms- Metric Allocation Method, Performance Driven Partitioning								
UNIT – IV	Floor Planning, Pin Assignment and Placement						Hours: 9	
Placement - Problem Formulation, Classification of Placement Algorithms, Simulation Based Placement Algorithms, Partitioning Based Placement Algorithms, Other Placement Algorithms, Performance Driven Placement, Recent Trends								
Floorplanning- Problem Formulation, Classification of Floorplanning Algorithms, Constraint Based Floorplanning, Integer Programming Based Floorplanning, Rectangular Dualization, Hierarchical Tree Based Methods, Floorplanning Algorithms for Mixed Block and Cell Designs								
Pin Assignment- Problem Formulation, Design Style Specific Pin Assignment Problems, Classification of Pin Assignment Algorithms, General Pin Assignment, Channel Pin Assignment, Integrated Approach								
UNIT – V	Physical Design Automation						Hours: 9	
FPGAs - FPGA Technologies, Physical Design Cycle for FPGAs, Partitioning, Routing- Routing Algorithm for the Non-Segmented Model, Routing Algorithms for the Segmented Model, Basic Algorithm, Routing Algorithm for Staggered Model								
MCM - MCM Technologies, MCM Physical Design Cycle, Partitioning, Placement - Chip Array Based Approach, Full Custom Approach, Routing - Classification of MCM Routing Algorithms, Maze Routing, Multiple Stage Routing, Pin Redistribution Problem, Layer Assignment, Detailed Routing, Topological Routing, Integrated Pin Distribution and								

Routing, Routing in Programmable Multichip Modules

Total contact Hours: 45

Total Tutorials: 15

Total Practical Classes: -

Total Hours: 60

Text Books:

1. Naveed A. Sherwani, Algorithms for VLSI physical design automation, Third edition, 2009 Springer Publishers.

Reference Books:

1. Sadiq M Sait, Habib Youssef, VLSI Physical Design Automation-Theory and Practice,World Scientific Publishers.
2. S. H. Gerez, Algorithms for VLSI Design Automation, 1999, Wiley student Edition, John Wiley and Sons (Asia) Pvt. Ltd.
3. Sung Kyu Lim, VLSI Physical Design Automation, Springer International Edition.

Department: Electronics and Communication Engineering				Programme: M.Tech.(Electronics and Communication Engineering)					
Semester :				Category : TY					
Subject Code	Subject	Hours / Week			Credit	Maximum Marks			
		L	T	P	C	CA	SE	TM	
ECE57	Advanced Image Processing	3	1	-	4	40	60	100	
Prerequisite									
Objectives		<ul style="list-style-type: none"> To introduce the fundamental concepts in digital image processing To understand the need for transforms and to learn about different 2D transforms To impart knowledge in image enhancement techniques To get familiarized with image compression techniques To learn about different segmentation methods To get acquainted with the image registration and image fusion topics 							
Outcome		<ul style="list-style-type: none"> Knowledgeable in the fundamentals of image processing Ability to analyze different 2D transforms in-depth Knowledgeable in image enhancement techniques Ability to examine segmentation and various segmentation techniques and image compression techniques Ability to examine image registration and image fusion and the related topics 							
UNIT – I		Introduction					Hours: 09		
Introduction to Digital Image Processing Components of an Image Processing system-Image sensing and acquisition-Image sampling and quantisation -.Need for Imaging transforms- DFT–DCT-DST-Walsh Transform-Hadamard, Haar, Hough ,Radon, Slant, SVD and KVL transforms.									
UNIT – II		Image Enhancement					Hours: 09		
Need for image enhancement -Point operations-Spatial filtering concepts: smoothing & sharpening filters, Transform domain filtering: smoothing & sharpening filters.									
UNIT – III		Image Compression					Hours: 09		
Image compression model-Types of redundancy, lossless image compression algorithms: RLE, Bit-plane coding, Arithmetic coding, Dictionary based coding, lossless predictive coding - lossy compression algorithms: lossypredictive coding-vector quantization – Block Transform coding-Image compression standards.									
UNIT – IV		Image Segmentation					Hours: 09		
Need for segmentation – Point, line and edge detection techniques – Thresholding- Region based segmentation – Watershed segmentation algorithm.									
UNIT – V		Image Registration and Image Fusion					Hours: 09		
Registration-Block diagram of an image registration system, overview of image registration methods: Correlation and Sequential methods – Fourier method – Feature based methods- Active Contour methods- Point mapping- Mutual information methods. Image Fusion: Introduction to image fusion , Advantages and applications, Image fusion methods: Multiscale decomposition based methods and non-multiscale decomposition based methods.									
Total contact Hours: 45			Total Tutorials: 15			Total Practical Classes: -		Total Hours: 60	
Text Books:									
<ol style="list-style-type: none"> Rafael C. Gonzalez and Richard E. Woods , Digital Image Processing, , Pearson Edition, 2013. S. Sridhar, Digital Image Processing, Oxford University Press, 2013. Ricks S.Blum, Zheng Liu, Multisensor Image Fusion and its Applicaticons, Taylor &Francis , 2006 									
Reference Books:									
<ol style="list-style-type: none"> S.Jayaraman, Digital Image Processing, TMH Education Private Limited, New Delhi, 2009. William K. Pratt , Digital Image Processing, , John Wiley & Sons, 3rd Edition, 2004. Anil K. Jain, Fundamentals of Digital Image Processing, , PHI,2003. Ardeshir Goshtasby, 2D and 3D Image Registration for Medical , Remote Sensing and Industrial Applications, John Wiley and Sons, 2005 									
Website:									
<ol style="list-style-type: none"> www.nptel.ac.in 									

Department: Electronics and Communication Engineering		Programme: M.Tech.(Electronics and Communication Engineering)						
Semester :		Category : TY						
Subject Code	Subject	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECE58	Advanced Microprocessor and Microcontroller	3	1	-	4	40	60	100
Prerequisite								
Objectives		<ul style="list-style-type: none"> To understand the high performance RISC and CISC architectures To understand the programming concepts using ARM Processor To introduce Motorola 68HC11 processor and its instruction set To understand programming using Free scale HC9S9 Microcontroller 						
Outcome		<ul style="list-style-type: none"> Knowledgeable in the general microprocessor architecture Ability to examine the difference between RISC and CISC architecture Ability to write simple Program using the instruction set of ARM, Motorola and Free scale Microcontrollers 						
UNIT – I	Microprocessor Architecture						Hours: 9	
Instruction set – Data formats – Instruction formats – Addressing modes – Memory Hierarchy – Register file – Cache– Virtual memory and paging – Segmentation – Pipelining – Instruction pipeline – Pipeline hazards – Instruction level parallelism – Reduced instruction set – Computer principles – RISC versus CISC – RISC properties – RISC evaluation – On-chip register files versus cache evaluation.								
UNIT – II	High Performance CISC Architecture – Pentium						Hours: 9	
Software model – Functional description – CPU pin descriptions – RISC concepts – bus operations – Super scalar architecture – pipe lining – Branch prediction – Instruction and caches – Floating point unit – Protected mode operation – Segmentation – Paging – Protection – multitasking – Exception and interrupts – Input/Output – Virtual8086 model – Interrupt processing – Instruction types – Addressing modes – Processor flags – Instruction set – Basic programming of the Pentium Processor.								
UNIT – III	High Performance RISC Architecture						Hours: 9	
ARM: The ARM architecture – ARM organization and implementation – The ARM instruction set – The thumbinstruction set – Basic ARM Assembly language program – ARM CPU cores.								
UNIT – IV	Motorola 68HC11 Micro-Controller						Hours: 9	
68HC11 Processor architecture - Instructions and addressing modes – operating modes – Hardware reset – Interrupt system – Parallel I/O ports – Flats– Real time clock – Programmable timer – Pulse accumulator – Serial communication interface – A/D converter – Hardware expansion – Basic Assembly Language programming.								
UNIT – V	Freescall HC9S9 Micro-Controller						Hours: 9	
HC9S9 Processor architecture – Operating modes – I/O ports – Embedded C Programming - Interrupt - Key wake-up interrupt – Real time interrupt - Timers – Memory – Serial communication interface – ADC interface – Pulse width measurement.								
Total contact Hours: 45		Total Tutorials: 15		Total Practical Classes: -			Total Hours: 60	
Text Books:								
<ol style="list-style-type: none"> Daniel Tabak, Advanced Microprocessors, McGraw Hill.Inc., 1995. James L. Antonakos, The Pentium Microprocessor, Pearson Education, 1997. SteaveFurber, ARM system – on – chip architecture, Addison Wesley, 2000. Jonathan W. Valvano, Embedded Microcomputer Systems Real Time Interfacing, Cengage Learning, Third Edition, 209. 								
Reference Books:								
<ol style="list-style-type: none"> Gene. H.Miller, Micro Computer Engineering, Pearson Education, 2003. James L Antonakos, An Introduction to the Intel family of Microprocessors, Pearson Education, 1999. Barry B.Breg,, The Intel Microprocessors Architecture, Programming and Interfacing, PHI, 2002. 								
Websites:								
<ol style="list-style-type: none"> www.arm.com/Products/Processors/ARM_Architecture.pdf https://web.eecs.umich.edu/~prabal/.../ARM_Architecture_Overview.pdf www.en.wikipedia.org/wiki/Freescall_68HC11 								

4. <https://www.cs.uaf.edu/2007/fall/cs441/proj1notes/sawyer/>
5. www.dee.ufrj.br/microproc/HC11/68hc11ur.pdf
6. www.ache.freescale.com/files/microcontrollers/doc/ref.../S9CPUV2.pdf

Department: Electronics and Communication Engineering		Programme: M.Tech.(Electronics and Communication Engineering)						
Semester :		Category : TY						
Subject Code	Subject	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECE59	Mobile Satellite Communication	4	-	-	4	40	60	100
Prerequisite	-							
Objectives	<ul style="list-style-type: none"> To learn the fundamentals of mobile satellite communication To introduce the ideas and need for satellite communication To study the Satellite system architecture To understand the role of mobility management To introduce inter-networking with mobile core networks To be aware of the applications of MSS To know the recent trends in mobile satellite communication 							
Outcome	<ul style="list-style-type: none"> Knowledgeable in identifying the constituents of Mobility management Ability to demonstrate the challenges in Handover controlling schemes Ability to demonstrate the possible Integration scenarios for various applications 							
UNIT – I	Introduction					Hours: 12		
Evolution – Satellite system Architecture – Types – Categorisation of MSS – Regulatory considerations – Design objectives – Network availability – Reliability – Service coverage – Network capacity – Characteristics of mobile services through terrestrial and satellite media – Applications of MSS – Practical limitations - Related satellite systems.								
UNIT – II	Mobile Satellite Network					Hours: 12		
Satellite personal communication networks - Network architecture – Operational frequency – Mobile network propagation environment - Logical channels – Traffic channel – Control channel – Equations of satellite orbit – Aeronautical link – Maritime link – Fixed link.								
UNIT – III	S-PCN Signaling and Mobility Management					Hours: 12		
Overview of GSM signaling – S-PCN interfaces & Signaling protocol architecture – Functional interfaces of a GMR system – Mobility management – Satellite cells and Satellite location areas –Location Management – Location updates - GCA approach – Terminal based approach – Handover management – Handover strategies – Handover controlling schemes – Resource management – Effects of satellite system characteristics – Effects of mobility.								
UNIT – IV	Integrated Terrestrial - Satellite Mobile Network					Hours: 12		
Integration with PSTN – Gateway functions and operations – Protocol architecture of SS7 – Access functions – Integration with GSM – Integration Requirements – User requirements – Network operator requirements – Integration scenarios – Integration at BSC, MSC, BTS, GTS, GSC and GMSC – Dual mode terminal in terrestrial/SPCN integration – Session set up – Registration – call handling – Re-registration.								
UNIT – V	Trends in Mobile Satellite Communication					Hours: 12		
Inter-networking with mobile core networks: Satellite integration with GSM/EDGE – a GERAN approach Satellite integration with UMTS – a UTRAN approach.								
Prospective satellite markets: Service category – super GEO’s – Non-GEO stationary satellites – Hybrid constellations – Mobile broad band satellite services – Mobile IP – Fixed mobile convergence – High altitude platforms – Location based service delivery.								
Total contact Hours: 60		Total Tutorials: -		Total Practical Classes: -		Total Hours: 60		
Text Books:								
<ol style="list-style-type: none"> Ray E. Sheriff and Y. Fun Hu, Mobile Satellite communication Networks, John Wiley & Sons, 2008. Michael, J.Miller, Branka Vucetic and Les berry, Satellite Communication: mobile and fixed services, Kluwer Academic Publishers, 2007. M.Richharia Mobile Satellite Communications, Principles and Trends, Pearson Education, 2007. 								
Reference Books:								
<ol style="list-style-type: none"> StojceDimovllcev , Global mobile satellite communication for maritime land and aeronautical Applications.http://w15.easy-share.com/11522731.html. Peter Alfred Swan and Carrie L.Devieux, Global mobile satellite Systems: A systems overview, 2003. 								
Websites:								
<ol style="list-style-type: none"> www.britannica.com/EBchecked/topic/524891/satellite-communication 								

2. [www.radio-electronics.com/.../satellite/communications satellite/satellite](http://www.radio-electronics.com/.../satellite/communications%20satellite/satellite).
3. www.dot.gov.in/data-services/vsat-satellite-communication.

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Semester :		Category : TY							
Subject Code	Subject	Hours / Week			Credit	Maximum Marks			
		L	T	P	C	CA	SE	TM	
ECE60	Speech and Audio Signal Processing	3	1	-	4	40	60	100	
Prerequisite	-								
Objectives	<ul style="list-style-type: none"> To establish artificial models for speech production To estimate speech parameters To develop predictive model for speech compression To analyze and apply model for automatic speech recognition 								
Outcome	<ul style="list-style-type: none"> Knowledgeable in speech production mechanism and nature of speech signal Ability to characterize the frequency and time domain methods for speech analysis Ability to formulate the speech predictive models by estimating the speech parameters Ability to build an automatic speech recognition system 								
UNIT – I	Digital Models for Speech Signal					Hours: 9			
Speech signal - Applications of digital speech processing - mechanism of speech production- acoustic theory of speech production- lossless tube models – digital models for speech signals.									
UNIT – II	Time Domain Models for Speech Processing					Hours: 9			
Time dependent processing of speech - Short- time energy and zero-crossing rate – Short time autocorrelation function (STACF)– pitch period estimation- digital representation of speech waveform - sampling and quantization – adaptive quantization – delta modulation and differential PCM									
UNIT – III	Short Time Fourier Analysis					Hours: 9			
Fourier transform interpretation – linear filtering interpretation – filter bank summation method – design of digital filter banks – pitch detection.									
UNIT – IV	Linear Predictive Analysis					Hours: 9			
Basic principles – computation of gain for the model – solution of LPC equations – prediction error signal – frequency domain interpretation of LP analysis – comparison to other spectrum analysis methods									
UNIT – V	Homomorphic Speech Processing and ASR					Hours: 9			
Short time cepstrum – computation of cepstrum – short time homomorphic filtering of speech – Application to pitch detection – Formant Estimation – Homomorphic Vocoder – Automatic Speech Recognition – Building a speech recognition system – decision process in ASR – challenges .									
Total contact Hours: 45		Total Tutorials: 15		Total Practical Classes: -		Total Hours: 60			
Text Books:									
1. Rabiner and Schafer : Digital Processing of speech signal - fourth edition Pearson, 2009									
Reference Books:									
1. L.R. Rabiner and R.W.Schafer :Introduction to Digital speech processing , Prentice Hall, 2007									
2. Jacob Benesty, M. M. Sondhi, Yiteng Huang: Springer handbook of Speech Processing, Springer 2008									
Websites:									
1. Speech and audio signal processing – lectures notes : http://www.spg.tu-darmstadt.de/lectures/saap/lecturenotes_1/lecturenotes.en.jsp									
2. Multimedia signal processing lecture notes: http://dea.brunel.ac.uk/cmisp/courses/multimedia_signal_processing.html									

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Semester :		Category : TY						
Subject Code	Subject	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECE61	Advanced Radiating Systems	3	1	-	4	40	60	100
Prerequisite	-							
Objectives	<ul style="list-style-type: none"> To understand the concept of various theorems involved in Radiating systems To understand the effect of radiation from various types of apertures To design different microstrip patch antennas To study several array antennas To study different measurement techniques involved in Radiating system 							
Outcome	<ul style="list-style-type: none"> Ability to design and fabricate rectangular and circular patch Knowledgeable in determining the effect of adaptive antenna system Ability to describe the effect of radiation from linear, uniform and phase arrays Ability to characterize the radiations from various Slot, Horn and Reflector antennas 							
UNIT – I	Fundamental Parameters of Antennas					Hours: 9		
Antenna fundamental parameters-Radiation integrals-Radiation from surface and line current distributions–dipole, monopole, loop antenna-Mobile phone antenna-base station antenna-Image, Induction and reciprocity theorem-matching techniques-Balance to unbalance transformer.								
UNIT – II	Radiation from Apertures					Hours: 9		
Field equivalence principle-Radiation from Rectangular and Circular apertures-Uniform aperture distribution on an infinite ground plane-Slot antenna-Horn antenna-Reflector antenna-aperture blockage and design consideration								
UNIT – III	Antenna Arrays					Hours: 9		
Linear array-uniform array-end fire and broad side array-gain, beam width, side lobe level-Two dimensional uniform array-Phased array-beam scanning-grating lobe-feed network-Linear array synthesis techniques-Binomial and Chebyshev distributions.								
UNIT – IV	Microstrip Antennas					Hours: 9		
Radiation Mechanism and Excitation techniques-Microstrip dipole-Rectangular patch- Circular patch- Ring antenna–radiation analysis from cavity model-input impedance of rectangular and circular patch antenna-Microstrip array-Microstrip broadband antennas-Log periodic-Biconical-Multi turn loop								
UNIT – V	Smart Antennas and Antenna Measurements					Hours: 9		
Adaptive antenna systems-Wide band smart antennas-Digital radio receiver & software radio for smart antennas-Antenna measurement and Instrumentation– Gain, Impedance and antenna factor measurement-Antenna test range Design								
Total contact Hours: 45		Total Tutorials: 15			Total Practical Classes: -		Total Hours: 60	
Text Books:								
<ol style="list-style-type: none"> Balanis.A, Antenna Theory Analysis and Design, John Wiley and Sons, New York, 1982. Krauss.J.D, Antennas, II edition, John Wiley and sons, New York, 1997. I.J. Bahl and P. Bhartia, Microstrip Antennas ,Artech House,Inc.,1980 W.L.Stutzman and G.A.Thiele, Antenna Theory and Design, 2nd edition, John Wiley & Sons Inc., 1998. 								
Reference Books:								
<ol style="list-style-type: none"> 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. Hubregt.J.Visser, Antenna Theory and Applications 1st Edition, John Wiley & Sons Ltd, Newyork, 209. W.L.Stutzman and G.A.Thiele, Antenna Theory and Design, 2nd Edition, John Wiley& Sons Inc., 1998. S.Drabowitch, et.al,Modern Antennas , 2nd Edition Springer science business Media, Inc.2005. 								

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Semester :		Category : TY						
Subject Code	Subject	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECE62	High Speed Networks	4	-	-	4	40	60	100
Prerequisite	-							
Objectives	<ul style="list-style-type: none"> To develop a comprehensive understanding of multimedia networking To study the types of VPN and tunneling protocols for security To learn about network security in many layers and network management 							
Outcome	<ul style="list-style-type: none"> Ability to demonstrate ATM with its services Knowledgeable in the functions of ISA and DSA architectures Ability to examine the performance of MPLS based VPN Ability to demonstrate security administration for ASN.1 							
UNIT – I								Hours: 12
Review of OSI, TCP/IP and VDP; Multiplexing, Modes of Communication, Switching, Routing. SONET – DWDM – DSL – ISDN – BISDN Network elements; Network Monitoring; Network Control; network mechanisms ;Network Element Management								
UNIT – II	Multimedia Networking Applications							Hours: 12
Streaming stored Audio and Video – Best effort service – protocols for real time interactive applications – Beyond best effort – scheduling and policing mechanism – integrated services – RSVP- differentiated services. Technology Trends in IP Networks, internet protocol, IP Packet Communications in Mobile Communication Networks ; Intelligent Network (IN) Scheme; Comparison with Conventional Systems ; Merits of the IN Scheme ; CATV.								
UNIT – III	Advanced Networks Concepts							Hours: 12
VPN-Remote-Access VPN, site-to-site VPN, Tunneling to PPP, Security in VPN.MPLS- operation, Routing, Tunneling and use of FEC, Traffic Engineering, MPLS based VPN, overlay networks- P2P connections.								
UNIT – IV	ATM Networks							Hours: 12
Introduction to ATM; The ATM Reference Model ; The ATM Layer; The ATM Adaptation Layer (AAL) ;AAL1 ;AAL2 ; AAL3/4 ; AAL5; Traffic Classes; Traffic Management and Quality of Service ; Traffic Descriptor ; Traffic Shaping; ABR and Traffic Congestion ;Network Management ; Layer Management; ATM Signalling ; ATM Addressing Format ;; Connection Establishment; IP/ATM Internetworking ;IP Multicast over ATM								
UNIT – V	High Performance Networking with Wimax and Ultra Wideband (WPAN)							Hours: 12
Introduction ; WiMAX Overview ; Competing Technologies ; Overview of the Physical Layer ; PMPMode ; Mesh Mode ; Multihop Relay Mode. Introduction; Time-Hopping Ultrawideband ;Direct Sequence Ultrawideband ; Multiband; Other Types of UWB.								
Total contact Hours: 60		Total Tutorials: -		Total Practical Classes: -		Total Hours: 60		
Text Books:								
<ol style="list-style-type: none"> J.F. Kurose & K.W. Ross, Computer Networking- A top down approach featuring the internet, Pearson, 2nd edition, 2003. Walrand .J. Varatya, High performance communication network, Morgan Kauffman – Harcourt Asia Pvt. Ltd. 2 nd Edition, 2000. Leom-Garcia, Widjaja, Communication networks, TMH seventh reprint 2002. 								
Reference Books:								
<ol style="list-style-type: none"> Aunuragkumar, D. M Anjunath, Joy kuri, Communication Networking, Morgan Kaufmann Publishers, 1ed 2004. HersentGurle& petit, IP Telephony, packet Pored Multimedia communication Systems, Pearson education 2003. Fred Halsall and Lingana Gouda Kulkarni, Computer Networking and the Internet fifth edition, Pearson education 2006 Nader F.Mir ,Computer and Communication Networks, first edition 2010 8. Larry I.Peterson& Bruce S.David, Computer Networks: A System Approach- 1996. 								

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Semester :		Category : TY						
Subject Code	Subject	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECE64	Multimedia Networking	4	-	-	4	40	60	100
Prerequisite								
Objectives		<ul style="list-style-type: none"> To understand the concepts of emerging multimedia communication. To learn the different applications of multimedia networking. To understand the Performance parameters and standards of multimedia communication. To learn the ideas of middleware technology and resource management. To study distributed multimedia applications and their protocols. 						
Outcome		<ul style="list-style-type: none"> Knowledgeable in the multimedia communication model and network requirements. Ability to understand architectures for network applications and multicasting. Ability to demonstrate resource management, IP networking and multicasting. Ability to understand different multimedia standards. 						
UNIT – I	Multimedia Communications					Hours: 12		
Introduction – Multimedia communication model – Elements of multimedia systems – User requirements – Network requirements – Packet transfer concept – Multimedia requirements – Multimedia terminals.								
UNIT – II	Multimedia Networking					Hours: 12		
Human communication model – Symbol encoding - cognitive systems - convergence of telecommunication and computing – Architectures for network applications – Networked computers – integration – Transportable computation - Intelligent agents – Convergence – Technology Framework – Multimedia networking and Conferencing – Multicasting.								
UNIT – III	Multimedia Standardization					Hours: 12		
Introduction – Standardization activities – Technology Cycle - Standards to build a New Global Information Infrastructure (GII) – Performance parameters – Functional Model – Implementation Model – Digital Audio / Video Standards - ITU-T standardization for Audio Visual communication – Video Coding standards – Speech Coding Standards – Multimedia Multiplex – Synchronization Standards – MPEG Standards for Multimedia Communication – Still Image Coding Standards.								
UNIT – IV	Distributed Multimedia Systems					Hours: 12		
Distributed multimedia system – DMS resource management - IP networking – IP Multicasting – Real Time Protocol – Integrated Management Architecture for IP based Networks - Distributed Multimedia Application - IMS Evolution – Standards – Benefits - Architecture of IMS Network – Protocols – Session Control Protocol – AAA Protocol – Real Time Data Transfer Protocol – Policy Control Protocol – Call Flow in IMS Networks – Charging Functions – Online/Offline Charging Mechanisms.								
UNIT – V	Middleware Technologies and Resource Management					Hours: 12		
Middleware Technologies for Multimedia Networks – Middleware Support Sensor Network Applications – Peer to Peer Middleware – Multimedia Traffic Management – Resource allocation - Bandwidth allocation - QOS in Network Multimedia system – QOS provision – QOS control – QOS Management - QOS architecture – Parameters – Classes of service – QOS based routing – Hybrid QOS management								
Total contact Hours: 60		Total Tutorials: -		Total Practical Classes: -		Total Hours: 60		
Text Books:								
<ol style="list-style-type: none"> Nalin K. Sharda, Multimedia Information Networking, PHI, 2002 K.R.Rao, Zoran S. Bojkovic, Dragorad A. Milovanovic, Multimedia Communication Systems, PHI, 2010 K.R.Rao, Zoran S. Bojkovic, Dragorad A. Milovanovic, Introduction to Multimedia Communication, John Wiley & Sons, 2011 Asoke K Talukder, Hasan Ahmed and Roopa R Yavagal, Mobile Computing, Tata McGraw Hill, 2010 								
Reference Books:								
<ol style="list-style-type: none"> Raj Kamal, Mobile Computing, Oxford University Press, 2010. Stefan Poslad, Ubiquitous Computing, Wiley India Edition, 2010 Frank Adelstein, Sandeep K.S Gupta, Golden G. Richard III and Loren Schwiebert, Fundamentals of Mobile and Pervasive Computing, Tata McGraw Hill, 2010 								

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Semester :		Category : TY						
Subject Code	Subject	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECE65	Wavelet Transforms and Applications	3	1	-	4	40	60	100
Prerequisite								
Objectives		<ul style="list-style-type: none"> To study the basics of signal representation and Fourier theory To understand Multi Resolution Analysis and Wavelet concepts To study the wavelet transform in both continuous and discrete domain To understand the design of wavelets using Lifting scheme To understand the applications of Wavelet transform 						
Outcome		<ul style="list-style-type: none"> Ability to demonstrate the use of Fourier tools to analyse signals Knowledgeable in MRA and representation using wavelet bases Knowledgeable in various wavelet transforms and design wavelet transform Ability to demonstrate the applications of wavelet transform in various signal and image processing techniques 						
UNIT – I	Fundamentals					Hours:9		
Vector Spaces – Properties– Dot Product – Basis – Dimension, Orthogonality and Orthonormality Relationship Between Vectors and Signals – Signal Spaces – Concept of Convergence – Hilbert Spaces for Energy Signals- Fourier Theory: Fourier series expansion, Fourier transform, Short time Fourier transform, Time-frequency analysis.								
UNIT – II	Multi Resolution Analysis					Hours: 9		
Definition of Multi Resolution Analysis (MRA) – Haar Basis – Construction of General Orthonormal MRA – Wavelet Basis for MRA – Continuous Time MRA Interpretation for the DTWT– Discrete Time MRA – Basis Functions for the DTWT – PRQMF Filter Banks.								
UNIT – III	Continuous Wavelet Transforms					Hours: 9		
Wavelet Transform – Definition and Properties – Concept of Scale and its Relation with Frequency– Continuous Wavelet Transform (CWT) – Scaling Function and Wavelet Functions (Daubechies Coiflet, Mexican Hat, Sinc, Gaussian, Bi Orthogonal)– Tiling of Time – Scale Plane for CWT.								
UNIT – IV	Discrete Wavelet Transform					Hours: 9		
Filter Bank and Sub Band Coding Principles – Wavelet Filters – Inverse DWT Computation by Filter Banks – Basic Properties of Filter Coefficients – Choice of Wavelet Function Coefficients – Derivations of Daubechies Wavelets – Mallat's Algorithm for DWT – Multi Band Wavelet Transforms Lifting Scheme- Wavelet Transform Using Polyphase Matrix Factorization – Geometrical Foundations of Lifting Scheme – Lifting Scheme in Z – Domain.								
UNIT – V	Applications					Hours: 9		
Wavelet methods for signal processing- Image Compression Techniques: EZW–SPHIT Coding –Image Denoising Techniques: Noise Estimation – Shrinkage Rules – Shrinkage Functions –Edge Detection and Object Isolation, Image Fusion, and Object Detection.								
Total contact Hours: 45		Total Tutorials: 15		Total Practical Classes: -		Total Hours: 60		
Text Books:								
<ol style="list-style-type: none"> Rao R M and A S Bopardikar, —Wavelet Transforms Introduction to theory and Applications, Pearson Education, Asia, 2000. L. Prasad & S.S.Iyengar, Wavelet Analysis with Applications to Image Processing, CRC Press, 1997. 								
Reference Books:								
<ol style="list-style-type: none"> J. C. Goswami and A. K. Chan, Fundamentals of wavelets: Theory, Algorithms and Applications Wiley Interscience Publication, John Wiley & Sons Inc., 1999. M. Vetterli, J. Kovacevic, Wavelets and subband coding Prentice Hall Inc, 1995. Stephen G. Mallat, A wavelet tour of signal processing 2 nd Edition Academic Press, 2000. Soman K P and Ramachandran K I, Insight into Wavelets From Theory to practice, Prentice Hall, 2004. 								

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Semester :		Category : TY						
Subject Code	Subject	Hours / Week			Credit	Maximum Marks		
		L	T	P		C	CA	SE
ECE66	RADAR Signal Processing	4	-	-	4	40	60	100
Prerequisite								
Objectives		<ul style="list-style-type: none"> To understand the Radar Signal acquisition and sampling in multiple domains To provide clear instruction in radar DSP basics To equip the skills needed in both design and analysis of common radar algorithms To understand the basics of synthetic aperture imaging and adaptive array processing To illustrate how theoretical results are derived and applied in practice 						
Outcome		<ul style="list-style-type: none"> Knowledgeable in basic RADAR signal processing and signal models Ability to demonstrate the sampling and quantization of pulsed RADAR signals Ability to demonstrate moving target detection 						
UNIT – I	Introduction to Radar Systems					Hours: 12		
History and application of radar, basic radar function, elements of pulsed radar, review of signal processing concepts and operations, A preview of basic radar signal processing, radar system components, advanced radar signal processing								
UNIT – II	Signal Models					Hours: 12		
Components of a radar signal, amplitude models, types of clutters, noise model and signal-to-noise ratio, jamming, frequency models: the doppler shift, spatial models, spectral model.								
UNIT – III	Sampling and Quantization of Pulsed Radar Signals					Hours: 12		
Domains and criteria for sampling radar signals, Sampling in the fast time dimension, Sampling in slow time: selecting the pulse repetition interval, sampling the doppler spectrum, Sampling in the spatial and angle dimension, Quantization, I/Q Imbalance and Digital I/Q.								
UNIT – IV	Radar Waveforms					Hours: 12		
Introduction, The waveform matched filter, Matched filtering of moving targets, The ambiguity function, The pulse burst waveform, frequency-modulated pulse compression waveforms, Range sidelobe control for FM waveforms, the stepped frequency waveform, Phase-modulated pulse compression waveforms, COSTAS Frequency Codes.								
UNIT – V	Doppler Processing					Hours: 12		
Alternate forms of the Doppler spectrum, Moving target indication (MTI), Pulse Doppler processing, dwell-to-dwell stagger, Pulse pair processing, additional Doppler processing issues, clutter mapping and the moving target detector, MTI for moving platforms: adaptive displaced phase center antenna processing.								
Total contact Hours: 60		Total Tutorials: -		Total Practical Classes: -		Total Hours: 60		
Reference Books:								
<ol style="list-style-type: none"> 1. Mark A. Richards McGraw-Hill, Fundamentals of Radar Signal Processing, New York, 2005 2. Francois Le Chevalier, Principles of Radar and Sonar Signal Processing, Artech House. 3. Michael O Kolawole, Radar systems, Peak Detection and Tracking, 2010, Elsevier. 4. McGraw Hill, Introduction To Radar Systems 3/E, Skolnik. 5. Peyton Z. Peebles, Radar Principles, 2009 Wiley India 6. Fred E. Nathanson, Radar Design Principles-Signal Processing and the environment, PHI 								

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Semester :		Category : TY						
Subject Code	Subject	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECE68	DSP Integrated Circuits	3	1	-	4	40	60	100
Prerequisite	-							
Objectives	<ul style="list-style-type: none"> To study the procedural flow of system design in DSP and Integrated circuit To analyse the frequency response and transfer function of DSP systems To compare and study the performance of various transforms for signal processing To design FIR and IIR filters for the given specifications To study the architectures for DSP system To study the design layout for VLSI circuits 							
Outcome	<ul style="list-style-type: none"> Knowledgeable in the various process technologies in VLSI Ability to demonstrate the difference between the standard DSP architecture and application specific processor architecture Knowledgeable in the various DSP algorithms Ability to design FIR and IIR filter structure and analyze the sampling rate change with respect to integer factor Ability to demonstrate the effects of noise due to scaling of the signal Ability to design the necessary arithmetic units in a DSP and to generate VLSI layout 							
UNIT – I	DSP Integrated Circuits and VLSI Circuit Technologies					Hours: 9		
Standard digital signal processors, Application specific ICs for DSP, DSP systems, DSP system design, Integrated circuit design. MOS transistors, MOS logic, VLSI process technologies, Trends in CMOS technologies.								
UNIT – II	Digital Signal Processing					Hours: 9		
Digital signal processing, Sampling of analog signals, Selection of sample frequency, Signal processing systems, Frequency response, Transfer functions, Signal flow graphs, Filter structures, Adaptive DSP algorithms, DFT-The Discrete Fourier Transform, FFT-The Fast Fourier Transform Algorithm, Image coding, Discrete cosine transforms.								
UNIT – III	Digital Filters and Finite Word Length Effects					Hours: 9		
FIR filters, FIR filter structures, FIR chips, IIR filters, Specifications of IIR filters, Mapping of analog transfer functions, Mapping of analog filter structures, Multirate systems, Interpolation with an integer factor L, Sampling rate change with a ratio L/M, Multirate filters. Finite word length effects –Parasitic oscillations, Scaling of signal levels, Round-off noise, Measuring round-off noise, Coefficient sensitivity, Sensitivity and noise.								
UNIT – IV	DSP Architectures and Synthesis of DSP Architectures					Hours: 9		
DSP system architectures, Standard DSP architecture, Ideal DSP architectures, Multiprocessors and Multicomputers, Systolic and Wave front arrays, Shared memory architectures. Mapping of DSP algorithms onto hardware, Implementation based on complex PEs, Shared memory architecture with Bit – serial PEs.								
UNIT – V	Arithmetic Units and Integrated Circuit Design					Hours: 9		
Conventional number system, Redundant Number system, Residue Number System, Bit-parallel and Bit-Serial arithmetic, Basic shift accumulator, Reducing the memory size, Complex multipliers, Improved shift-accumulator. Layout of VLSI circuits, FFT processor, DCT processor and Interpolators as case studies. Cordic algorithm.								
Total contact Hours: 45		Total Tutorials: 15		Total Practical Classes: -		Total Hours: 60		
Reference Books:								
<ol style="list-style-type: none"> Lars Wanhammer, DSP Integrated Circuits, 1999 Academic press, New York A.V.Oppenheim et.al, Discrete-time Signal Processing, Pearson Education, 2000. Emmanuel C. Ifeachor, Barrie W. Jervis, Digital signal processing – A practical approach, Second Edition, Pearson Education, Asia. KeshabK.Parhi, VLSI Digital Signal Processing Systems design and Implementation, John Wiley & Sons, 1999. 								

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Semester :		Category : TY						
Subject Code	Subject	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECE69	Automotive Electronics	3	1	-	4	40	60	100
Prerequisite	-							
Objectives	<ul style="list-style-type: none"> To understand the concepts of automotive electronics To become aware of the different types of sensors and actuators used in automotive. To understand the principles electronic fuel injection, ignition and digital control systems To understand the basic electronic dashboard instruments To understand the microcontroller architecture and its usage in IVN To understand the IVN, its benefits and protocols 							
Outcome	<ul style="list-style-type: none"> Ability to demonstrate the concepts of automotive electronics Ability to identify the type of sensor and actuator required for a specific function in automotive Knowledgeable in the basic electronic dashboard instruments Ability to demonstrate microcontroller's usage in IVN Ability to implement IVN protocols 							
UNIT – I								Hours: 9
Current trends in modern automobiles, Open and close loop systems-Components for electronic engine management, Electronic management of chassis system, Vehicle motion control								
UNIT – II								Hours: 9
Basic sensor arrangement, Types of sensors such as-Oxygen sensors, Crank angle position sensors-Fuel metering/vehicle speed sensor and detonation sensor- Altitude sensor, flow sensor. Throttle position sensors. Solenoids, stepper motors, and relays								
UNIT – III								Hours: 9
Introduction, feedback carburetor systems. Throttle body injection and multi-port or point fuel injection, fuel injection systems, Injection system controls. Advantages of electronic ignition systems: Types of solid-state ignition systems and their principle of operation, Contact less electronic ignition system, and electronic spark timing control								
UNIT – IV								Hours: 9
Open loop and closed loop control systems-Engine cranking and warm up control-Acceleration enrichment-Deceleration leaning and idle speed control. Distributor less ignition-Integrated engine control systems, Exhaust mission control engineering. Electronic dashboard instruments-Onboard diagnosis system, security and warning system.								
UNIT – V								Hours: 9
Microcontroller Architecture – Memory, Low-Speed Input/Output Ports, High-Speed I/O Ports Need and benefits of IVN, Classes of IVN protocols, Multiplexed electrical systems, Vehicle multiplexing, Bitwise contention, Network elasticity, Error processing and management.								
Total contact Hours: 45		Total Tutorials: 15		Total Practical Classes:			Total Hours: 60	
Text Book:								
1. Ronald K.Jurgen , Automotive Electronics Handbook, Mc-Graw Hill Inc,1999.								
Reference Book:								
1. William B. Ribbens, Understanding Automotive Electronics, Butterworth, Heinemann Woburn, 5 th Edition, 1998.								

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Semester :		Category : TY						
Subject Code	Subject	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECE70	Free Space Optical Communication	3	1	-	4	40	60	100
Prerequisite	-							
Objectives	<ul style="list-style-type: none"> To learn the fundamentals, recent developments and applications of free space optics To study about the factors affecting FSO communication To learn the modulation, detection and coding techniques for FSO To learn the mitigation techniques for improving the performance of FSO To compare FSO with other approaches 							
Outcome	<ul style="list-style-type: none"> Knowledgeable in FSO systems, their installation and applications Ability to model and analyze the effects of various factors like atmospheric turbulence on FSO signal communication Knowledgeable in the tradeoff involved in choice of modulation and coding Knowledgeable in the latest development and applications of FSO communication 							
UNIT – I	Fundamentals of Free Space Optics (FSO)					Hours: 9		
<p>Introduction to FSO communication- FSO architectures/topologies- FSO network implementation – integrated FSO for satellite, terrestrial and home networks – FSO MANET –underwater FSO communication-indoor FSO communication</p> <p>FSO communication signal propagation through atmospheric channel: FSO communication in the presence of atmosphere- optical propagation through atmospheric turbulence relevant to FSO communications- PDF models for FSO communication systems</p>								
UNIT – II	Modulation, Detection and Coding for FSO					Hours: 9		
<p>FSO communication channel models- AWGN channel, band limited channel, fading and randomly varying optical channel- modulation schemes in FSO communication- on/off keying, PPM and BPSK-channel capacity and coding for FSO communication.</p> <p>Mitigation techniques for improved system performance: Mitigation techniques for improved FSO communications -aperture averaging- diversity techniques-spatial diversity- time diversity- coding techniques- adaptive optics techniques</p>								
UNIT – III	Non-Line-of-Sight Ultraviolet and Indoor FSO Communication					Hours: 9		
<p>NLOS UV communication- UV communications- source-detector-channel model- performance analysis- indoor FSO system- indoor link configurations- indoor optical wireless system- propagation modeling</p> <p>Free space optical platforms: unmanned aerial vehicle FSO communication- UAV scenarios for FSO communication link- alignment and tracking- practical issues and recent development- mobile FSO communication</p>								
UNIT – IV	Chaotic and THz Free Space Communications					Hours: 9		
<p>Basics of chaotic optical communication- Chaotic FSO communication over turbulent channel- chaos based secure FSO communication link- indoor THz communication- THz wireless communication. Fundamental of free space quantum communication-quantum cryptography</p>								
UNIT – V	Installation of FSO Systems, Laser Safety and Alternative Access Technologies					Hours: 9		
<p>Installation of FSO systems –infrastructure installation-verifying the link-maintaining and supporting. Lasers and eyes- laser safety regulations-laser classification-methods to ensure eye safety. DSL-cable modems-power line communications-LMDS-MMDS-licensed microwave systems-fiber access-FSO versus the other alternatives</p>								
Total contact Hours: 45		Total Tutorials: 15		Total Practical Classes: -		Total Hours: 60		
Text Books								
<ol style="list-style-type: none"> Arun K. Majumdar, Advanced Free space optics – A systems approach, Springer, 2015 Heinz Willebrand and Bhaksheesh S. Ghuman, Free space optics: Enabling optical Connectivity in Today's network, SAMS publishing, 2002 								
Reference Book:								
<ol style="list-style-type: none"> Arun K. Majumdar and JenifferRicklin, Free space laser communications, Springer, 2008 								

Websites:

1. www.freespaceoptics.org
2. www.lightpointe.com

Department: Electronics and Communication Engineering				Programme: M.Tech.(Electronics and Communication Engineering)					
Semester :				Category : TY					
Subject Code	Subject	Hours / Week			Credit	Maximum Marks			
		L	T	P	C	CA	SE	TM	
ECE63	MEMS and NEMS	3	1	-	4	40	60	100	
Prerequisite		-							
Objectives		<ul style="list-style-type: none"> To introduce the concepts of micro electromechanical devices To know the fabrication process of Microsystems To understand the design concepts of micro sensors and micro actuators To pioneer the concepts of quantum mechanics and nano systems 							
Outcome		<ul style="list-style-type: none"> Knowledgeable in the design of MEMS and NEMS Systems Knowledgeable in the fabrication process of MEMS Knowledgeable in the design of micro sensors and construction of micro actuators Knowledgeable in the atomic structures and quantum mechanics of the nano systems Ability to demonstrate the molecular and nanostructure dynamics; molecular wires and molecular circuits involved in the nano systems 							
UNIT – I		Overview and Introduction					Hours: 9		
New trends in Engineering and Science: Micro and Nanoscale systems Introduction to Design of MEMS and NEMS, Overview of Nano and Microelectromechanical Systems, Applications of Micro and Nanoelectromechanical systems, Microelectromechanical systems, devices and structures Definitions, Materials for MEMS: Silicon, silicon compounds, polymers, metals.									
UNIT – II		MEMS Fabrication Technologies					Hours: 9		
Microsystem fabrication processes: Photolithography, Ion Implantation, Diffusion, Oxidation. Thin film depositions: LPCVD, Sputtering, Evaporation, Electroplating; Etching techniques: Dry and wet etching, electrochemical etching; Micromachining: Bulk Micromachining, Surface Micromachining, High Aspect-Ratio (LIGA and LIGA-like) Technology; Packaging: Microsystems packaging, Essential packaging technologies, Selection of packaging materials.									
UNIT – III		Micro Sensors					Hours: 9		
MEMS Sensors: Design of Acoustic wave sensors, resonant sensor, Vibratory gyroscope, Capacitive and Piezo Resistive Pressure sensors- engineering mechanics behind these Microsensors. Case study: Piezo-resistive pressure sensor.									
UNIT – IV		Micro Actuators					Hours: 9		
Design of Actuators: Actuation using thermal forces, Actuation using shape memory Alloys, Actuation using piezoelectric crystals, Actuation using Electrostatic forces (Parallel plate, Torsion bar, and Comb drive actuators), Micromechanical Motors and pumps. Case study: Comb drive actuators.									
UNIT – V		Nanosystems and Quantum Mechanics					Hours: 9		
Atomic Structures and Quantum Mechanics, Molecular and Nanostructure Dynamics: Shrodinger Equation and Wavefunction Theory, Density Functional Theory, Nanostructures and Molecular Dynamics, Electromagnetic Fields and their quantization, Molecular Wires and Molecular Circuits.									
Total contact Hours: 45		Total Tutorials: 15			Total Practical Classes: -		Total Hours: 60		
Reference Books:									
<ol style="list-style-type: none"> Marc Madou, Fundamentals of Microfabrication, CRC press 1997. Stephen D. Senturia, Micro system Design, Kluwer Academic Publishers,2001 Tai Ran Hsu, MEMS and Microsystems Design and Manufacture,TataMcraw Hill, 2002. Chang Liu, Foundations of MEMS, Pearson education India limited, 2006, Sergey Edward Lyshevski, MEMS and NEMS: Systems, Devices, and Structures CRC Press,2002 									
Websites:									
<ol style="list-style-type: none"> http://ihome.ust.hk/~microsys/index.html http://www.analog.com/en/index.html --MEMS and sensors. http://home.earthlink.net/~trimmerw/mems/Stroud_Dbase.html 									

Department: Electronics and Communication Engineering		Programme : M.Tech (Electronics and Communication Engineering)						
		Category : TY						
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ECE67	Detection and Estimation Theory	3	1	-	4	40	60	100
Prerequisite:	-							
Objectives:	<ul style="list-style-type: none"> To enable the student to understand the basic principles of random signal processing, spectral estimation methods and their applications To enable the student to understand the different signal detection and estimation methods Communication system design and the implications of proper synchronization methods for proper functioning of the system 							
Outcome:	<ul style="list-style-type: none"> Ability to demonstrate an understanding of the basic principles of random signal processing, spectral estimation methods and their applications Ability to demonstrate an understanding of the different signal detection and estimation methods used in communication system design and the implications of proper synchronization methods for proper functioning of the system Ability to design a baseband system addressing the channel impairments 							
UNIT – I	Discrete Random Signal Processing						Hours: 9	
Discrete Random Processes- Ensemble Averages, Stationary processes, Bias and Estimation, Autocovariance, Autocorrelation, Parsevals theorem, Wiener-Khintchine relation, White noise, Power Spectral Density, Spectral factorization, Filtering Random Processes, Special types of Random Processes – ARMA, AR, MA – Yule-Walker equations.								
UNIT – II	Spectral Estimation						Hours: 9	
Estimation of spectra from finite duration signals, Nonparametric methods – Periodogram, Modified periodogram, Bartlett, Welch and Blackman-Tukey methods, Parametric methods – ARMA, AR and MA model based spectral estimation, Solution using Levinson-Durbin algorithm.								
UNIT – III	Detection and Estimation Criteria						Hours: 9	
Detection criteria : Bayes detection techniques, MAP, ML, – detection of M-ary signals, Neyman-Pearson, minimax decision criteria. Estimation: linear estimators, non-linear estimators, Bayes, MAP, ML, properties of estimators, phase and amplitude estimation.								
UNIT – IV	Synchronization						Hours: 9	
Signal parameter estimation, carrier phase estimation, symbol timing estimator, joint estimation of carrier phase and symbol timing.								
UNIT – V	Receivers for AWGN and Fading Channels						Hours: 9	
Optimum receivers for AWGN channel -Correlation demodulator, matched filter, maximum likelihood sequence detector, envelope detectors for M-ary signals; Characterization of fading multipath channels, RAKE demodulator, Multiuser detection techniques.								
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, John Wiley and Sons, Inc, Singapore, 2002								
2. John J. Proakis, Dimitris G. Manolakis, : Digital Signal Processing, Pearson Education, 2002.								
3. John G. Proakis., Digital Communication, 4th edition, McGraw Hill Publication, 2001.								
4. Bernard Sklar and Pabitra Kumar Roy, Digital Communications: Fundamentals & Applications, 2/E, Pearson Education India, 2009								

5. John G. Proakis, MasoudSalehi, Communication Systems Engineering, Prentice Hall, 1994.
6. Heinrich Meyer, Mare Moeneclacy, Stefan.A.Fechtel, Digital communication receivers, Vol I &Vol II, John Wiley, New York, 1997.
7. Sergio Verdu, Multiuser Detection, Cambridge University Press, 1998.

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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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 An analysis 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:								
<ol style="list-style-type: none"> A Textbook of Nanoscience and nanotechnology, T.Pradeep, A.Ashok Reddy and B.R Buergi,TataMcGraw Hill, New Delhi, 2012. Nanotechnology and NanoelectronicsMaterials, Devices, Measurement Techniques, W.R.Fahrner (Editor), Springer,(Germany),2005. Nanostructured materials and nanotechnology, Concise Edition, Editor:- Hari Singh Nalwa; Academic Press, USA (2002). Hand book of Nanostructured Materials and Technology, Vol.1-5, Editor:- Hari Singh Nalwa; Academic Press, USA (2000). 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.