Tatyasaheb Kore Institute of Engineering and Technology, Warananagar

M. Tech. Electronics & Telecommunication Engineering (CBCS)

Syllabus Effective From 2021-22

SEMESTER-I

1. ADVANCEDEMBEDDED SYSTEM

Course Details:

Class	M. Tech. Sem-I
Course Code & Course Title	PCC-ETC-101-Advanced Embedded System
Prerequisites	Embedded Systems
Teaching scheme: Lecture/Practical	3/2
Credits	3+1
Evaluation Scheme CIE/ESE for Theory	40/60

Teaching Scheme	Examination Scheme
Lectures : 03 Hrs /week	Theory : 100 Marks 60 (ESE) + 40
Practical : 02 Hrs /week	TW: 25 Marks

Course Objective: The course aims to	
1	Understandthe architecture of ARM family.
2	Understand On chip peripherals of ARM controller.
3	Understandbasic concepts of RTOS and µCOS.

Course Outcomes(COs): Upon successful completion of this course, the student will be able to	
1	Design the ARM based systems.
2	Implement use of ON CHIP peripherals of ARM
3	Implement various scheduling algorithms

Course Content:		
Unit 1	**ARM9 Architecture & programming** ARM9 architecture, Memory organization, Programmers model, instructions and assemblyprogramming.	6 Hrs.
Unit 2	**ARM caches MPU and MMU** Cache architecture, Cache policy,Coprocessor15 and caches, protected region, Initializing MPUs, caches and write buffer, virtual memory, ARM MMU, page tables,TLB,Coprocessor15 and MMU Configuration	8 Hrs.
Unit 3	**ARM Peripherals and Programming** On chip peripherals, GPIO, Event router, Interrupts, vectored interrupt controller(VIC),timers, RTC, Watchdog, UART, I^2C, CAN, LIN. programming of GPIO using Embedded „C" (LPC 29xx series Example 2921/23/25)	8 Hrs.
Unit 4	**Introduction to RTOS** RTOS basics, RTOS architecture, share data problem, critical section,	5 Hrs.

	shared resources, Task states multitasking, context switching, Kernels, pre-emptive & non-pre-emptive schedulers, mutual exclusion, semaphores, Interrupt Latency, pipes & mails boxes. Message queues, timer functions, events.	
Unit 5	**µCOS** Kernel Structure: Tasks, Task State, Task Level Context Switching, Locking and unlocking of scheduler, Idle Task, Statistics Task, Interrupts, Clock Tick, Initialization, Starting the OS, Task Management: Creating/deleting and Suspending/ Resuming Task, Task Stacks and checking, Changing Task"s	6 Hrs.
Unit 6	**Time Management and Event Control Blocks** Time Management: Delaying/Resuming Task, System Time, Event Control Blocks: Initialization of ECB, Placing/Removing Task from ECB waitlist, Finding Highest Priority Task, List of Free ECB, Task State Management. Communication in µCOS-II.	3 Hrs.

Text Books	
1	ARM System Developers Guide , Designing & Optimizing System Software, Andrew sloss, Dominic symes, Chris Wright, 1st Edition 2004.
2	Micro C/OSII the Real Time Kernel, Jean Labarosse, CMP Books, PIC C Manual, CCS Inc, 2nd Edition.

Reference Books:	
1	Embedded software primer, David Simon, Pearson Education, 1st Edition 2005.
2	ARM LPC 29xx series data sheet, ARM Datasheet

*Minimum 8 tutorials based on above syllabus

2. ERROR CONTROL CODING TECHNIQUES

Course Details:

Class	M. Tech. Sem-I
Course Code & Course Title	PCC-ETC-102-Error Control Coding Techniques
Prerequisites	Information Theory & Digital Communication
Teaching scheme: Lecture/Tutorial	3/1
Credits	3+1
Evaluation Scheme CIE/ESE for Theory	40/60

Teaching Scheme	Examination Scheme
Lectures : 03 Hrs /week	Theory : 100 Marks 60 (ESE) + 40
Tutorial : 01 Hr/week	TW: 25 Marks

Course Objectives: The course aims to:	
1	Understandbasic concept & need of Error Control Coding
2	Studyof various encoding & decoding techniques through block codes
3	Studyof various encoding & decoding techniques through Convolution Codes.

Course Outcomes: Upon successful completion of this course, the student will be able to:	
1	Understand and identify the role of Error Control Coding techniques.
2	Capable to Analyze & design the encoder & decoder of Block Codes.
3	Analyze the concept of encoding & decoding procedures in convolutional codes.

Course Content		
Unit 1	**Linear block codes** Need, Objective & Approaches of Error Control Coding, Introduction, Structure, Parameters, Generator& Parity Check Matrix, Encoding circuit for (n-k) Linear Block Code, Syndrome & Error detection, Syndrome circuit, Distance Properties, Error detecting & Correction Capabilities, Standard Array & Syndrome decoding for (n, k) linear Block Code. Hamming Codes, Product codes, Repetition code, Hadamard codes (Wash Code), Dual Code, Shortened and Extended linear Codes, Reed Muller (RM) Codes.	**6**
Unit 2	**Cyclic codes** Algebraic structure, Polynomial representation of codeword, Generator polynomial, Non-systematic & Systematic Cyclic Codes, Generator & Parity Check Matrices, Structure of Cyclic Encoder & Syndrome Calculator, Encoding of cyclic code using (n- k) & K shift register, Syndrome computation and Error detection, Decoding of Cyclic code, Error-Trapping Decoding. Cyclic Redundancy Check Code, Cyclic Hamming Codes, Golay Code, Shortened Cyclic Codes, Cyclic Product Code, Quasi Cyclic Code.	**6**

Unit 3	**Bose Chaudhuri Hocquenghem CODE (BCH)** Groups, Rings & its properties, Fields : Binary Field Arithmetic, Primitive element and primitive polynomial, Primitive BCH Code, Construction of Galois Field GF(2^m), Properties of Galois Field GF(2^m), Minimal & Generator Polynomial for BCH Code. Decoding of BCH Code , Peterson-Gorenstein-Zierler decoder, Error location and Error Evaluation Polynomials, Implementation of Galois Field Arithmetic, Implementation of Error Correction	**8**
Unit 4	**Reed-solomon codes & decoding algorithms** Introduction, Error correction capability of RS code, RS code in Nonsystematic &Systematic form, Syndrome decoding, The Euclidean Algorithm : Error location & Error Evaluation Polynomials, Decoding of RS using the Euclidean Algorithm, Decoding of RS &Nonbinary BCH codes usingthe Berlekamp Algorithm	**5**
Unit 5	**Convolutional Codes** Introduction, Convolutional Encoder, Generation of Output code sequence using Time domain & Transform domain approach, Convolutioanal code representation: Code Tree, State diagram & Trellis diagram, Structural & Distance properties of Convolutional codes, Transfer Function of Convolution Code. Optimum decoding of Convolutional Codes: Maximum Likelihood decoding, The Viterbi Algorithm, Suboptimal Decoding: Sequential Decoding, Majority Logic Decoding.	**6**
Unit 6	**Iteratively decoded codes** TURBO CODE: Introduction, Basic Turbo Encoding Structure,, Decoding Algorithms ,The Maximum Posterior decoding Algorithm. Low Density Parity Check Codes (LDPC): Introduction, Construction, Tanner Graph, Decoding LDPC Code: Hard & Soft decoding, Vertical Step updating, Horizontal Step Updating, Terminating & Initializing the decoder algorithm.	**5**

Text Books	
1	Shu Lin, Daniel J.Costello, Jr., "Error Control Coding" , IInd Edition, Pearson Education
2	Todd K Moon,"Error Correction Coding", Wiley student, Edition 2006

Reference Books:	
1	Salvatore Gravano, "Introduction to Error Control Codes",South Asia Edition, Oxford UniversityPress.
2	Jorge Castineira Moreira, Patrick Guy Farrell," Essentials of Error Control
3	W.CaryHuffman and Vera Pless," Fundamentals of Error correcting Codes", First Edition, Cambridge University Press.

*Minimum 8 tutorials based on above syllabus

ELECTIVE-I. Advanced Wireless Communication

Course Details:

Class	M. Tech. Sem-I
Course Code & Course Title	PCC-ETC 103, Advanced Wireless Communication
Prerequisites	Wireless Communication
Teaching scheme: Lecture	3
Credits	3
Evaluation Scheme CIE/ESE for Theory	40/60

Teaching Scheme	Examination Scheme
Lectures : 03 Hrs /week	Theory : 100 Marks 60 (ESE) + 40

Course Objectives: The course aims to	
1	Acquire fundamental knowledge of Wireless Communications
2	Studythe wireless channel capacities and different channel models
3	Understand the basic concepts of OFDM
4	Studymultiple input multiple output (MIMO) communication techniques
5	Understand basics of multiuser communication system

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1	Understand fundamentals as well as advanced concepts in wireless communications. They will be able to understand the wireless channel characteristics and modeling.
2	Quantify the wireless channel capacities and degrees of freedom regions for different channel models, such as point-to-point channels, multiple access channels, broadcast channels, interference channels, etc
3	Understand fundamentals of Wideband Modulation Techniques
3	Learn the recent developments such as opportunistic and multiple input multiple output (MIMO) communication techniques
4	Use and formulate mathematical models for analysis and synthesis of single and multiuser communication links over wireless channels.
5	Design and analysis the cellular systems, for example interim of spectral and energy efficiencies, coverage, etc.

Course Contents:		
Unit 1	**Wireless channel** Physical modeling for wireless channels, input/output model of wireless channel, time and frequencyresponse, statistical models.	**06 Hrs.**
Unit 2	**Point to point communication** Detection in rayleigh fading channel, time diversity, antenna diversity, frequencydiversity, impact of channel uncertainty.	**06 Hrs.**
Unit 3	**Wideband Modulation Techniques: OFDM (Multicarrier Modulation).:** Basic Principles of orthogonality, single vs multicarrier systems, OFDM block diagram and ITS Explation, OFDM signal mathematical representation, selection parameters for modulation	**06 Hrs.**
Unit 4	**Capacity of wireless channels** AWGN channel capacity, resources of AWGN channel, Linear time invariant gaussian channels, capacity of fading channels.	**06 Hrs.**
Unit 5	**MIMO and multicarrier modulation:** Narrowband MIMO model-parallel decomposition of MIMO channel-MIMO channel capacity-MIMO diversity gain Space-Time modulation and coding, Smart	**06 Hrs.**
Unit 6	**MIMO IV –multiuser communication** Uplink with multiple receive antennas, MIMO uplink, Downlink with multiple receive antennas, MIMO downlink	**06 Hrs.**

Text Books	
1	Fundamentals of wireless communication, David Tse, P. Viswanath, Cambridge, 5th Edition 2005
2	Andreas Molisch, Andreas Molisch, Wiley, 2nd Edition 2012

Reference Books:	
1	Wireless communications, Principles and Practice, Theodore S.Rappaport, Pearson, 2nd Edition 2010
2	Wireless communication, Upen Dalal, Oxford, 1st Edition, 2009
3	Wireless communications, Mark Ciampa, Jorge Olenwa, Cengage, 3rd Edition, 2013

ELECTIVE-II : RANDOM PROCESSES

Course Details:

Class	M. Tech. Sem-I
Course Code and Course Title	PCE-ETC 101- Random Processes
Prerequisite/s	Image Processing & Statistics
Teaching Scheme: Lecture	3
Credits	3
Evaluation Scheme CIE/ESE for Theory	40/60

Teaching Scheme	Examination Scheme
Lectures : 03 Hrs /week	Theory : 100 Marks 60 (ESE) + 40

Course Objectives: The course aims to	
1	Develop the logical concepts of probability theory
2	Understand basic concepts of Random variables & Random Processes
3	Study concept of Markov Chain and Queuing Theory

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1	Solve Probability Problems
2	Classify Random Variables
3	Apply statistical measures in Practical problems
4	Apply Markov Chain & Queuing Theory to solve Problems

Course Contents:		
Unit 1	**Probability Theory:** The concept of Probability; the axioms of Probability; sample space and events; Conditional probability and Baye"s theorem, Independence of events, Bernoulli trails.	**6Hrs**
Unit 2	**Random variables:** Introduction to Random Variables, Discrete Random Variable, Continuous Random Variable, Expectation of Random Variable, Moments of Random Variable(mean, mode variance, skewness, Kurtosis)	**6 Hrs**
Unit 3	**Multiple Random Variables:** Cumulative distribution function and probability density function of single and multiple Random Variables, statistical properties, Jointly distributed Gaussian random variables, Conditional probability density, properties of sum of random variables, Central limit	**6Hrs**

	theorem, Estimate of population means, Expected value and variance and covariance.	
Unit 4	**Random Processes:** Classification of Processes; Properties, Auto correlation and cross correlation function; Estimate of auto correlation function. Spectral Density: Definition, Properties, white noise, Estimation of auto-correlation function using frequency domain technique, Estimate of spectral density, cross spectral density and its estimation, coherence.	**6 Hrs**
Unit 5	**Markov Chains:** Chapman Kolmogorov equation, Classification of states, Limiting probabilities, Stability of Markov system, Reducible chains, Markov chains with continuous state space.	**6 Hrs**
Unit 6	**Queuing Theory:** Elements of Queuing System Little's Formula, M/M/1 Queue, Multi server system	**6 Hrs**

Text Books	
1	Introduction to probability Models, Sheldon M. Ross, Academic Press, 9th edition 2009
2	Random Signal Processing, Prof. G. V. Kumbhojkar, C. Jamanadas & Company, 2nd edition 2009

Reference Books:	
1	Probability and Random Processes for Electrical Engg., Alberto Lean, Pearson, 2nd edition 2009
2	Probability, Random Variables and Stochastic Processes, Athanasios Papoulis, S. Unnikrishna Pillai, PHI, 4thb edition 2010
3	Stochastic Processes, J. Medhi, New Age International 3rdedition, 2009

ELECTIVE-II: DIGITAL DATA COMPRESSION

Course Details:

Class	M. Tech. Sem-I
Course Code and Course Title	PCE-ETC 101- Digital Data Compression
Prerequisite/s	Digital Communication
Teaching Scheme: Lecture	3
Credits	3
Evaluation Scheme CIE/ESE for Theory	40/60

Teaching Scheme	Examination Scheme
Lectures : 03 Hrs /week	Theory : 100 Marks 60 (ESE) + 40

Course Objectives: The course aims to:	
1	Provide students with contemporary knowledge in Data Compression and Coding.
2	Equip students with skills to analyze and evaluate different Data Compression and Coding methods

Course Outcomes: Upon successful completion of this course, the student will be able to:	
1	Explain the evolution and fundamental concepts of Data Compression and Coding techniques.
2	Analyzethe operation of arange of commonly used Coding and Compression techniques
3	Identifythe basic software and hardware tools used for data compression.
4	Identifywhat new trends and what new possibilities of data compression are available

Course Content		
Unit 1	**Introduction** Definitions, Historical background,, Applications, Taxonomy, Intuitive Compression. Run-Length Encoding, RLE Text Compression, RLE Image Compression, Move- to Front Coding, Scalar Quantization	**4**
Unit 2	**Statistical methods** Information Theory Concepts, Variable-Size Codes, Prefix Codes, Golomb Codes, The Kraft-MacMillan Inequality, The Counting Argument, Shannon-Fano Coding, Huffman Coding, Adaptive Huffman Coding, MNP5, MNP7, Arithmetic	**7**

Unit 3	**Dictionary Methods** String Compression, Simple Dictionary Compression,LZ77 (Sliding Window), LZSS, Repetition Times, QIC-122, LZX, File Differencing: VCDIFF, LZ78, LZFG, LZRW1,LZRW 4, LZW, LZMW, LZAP, LZY, LZP	**7**
Unit 4	**Image Compression Approaches to Image Compression**; Image Transforms, Orthogonal Transforms. The Discrete Cosine Transform JPEG, JPEG-LS. Progressive Image Compression, JBIG, JBIG2, Vector Quantization, Adaptive Vector Quantization, Block Matching, Block Truncation Coding, Context- Based Methods, Wavelet Methods	**7**
Unit 5	**Video Compression** Analog Video , Composite and Components Video , Digital Video , Video Compression , MPEG , MPEG-4 , H.261	**7**
Unit 6	**Audio Compression** Sound, Digital Audio , The Human Auditory System , μ-Law and A-Law Companding , ADPCM Audio Compression , MLP Audio , Speech Compression , Shorten MPEG-1 Audio Layers	**4**

Text Books	
1	The Data Compression- Mark Nelson, Jean-Ioup Gailly, 2nd edition, M&T pub.
2	Data Compression: The complete Reference-David Salomon, D., 3rded, Springer publication.
3	Introduction to Data Compression-Khalid Sayood, 2nd edition, Academic press ltd.

Reference Books:	
1	Introduction to Information Theory and Data Compression- Darrel Hankerson, 2nd ed, Chapman and Hall/CRC publications.
2	Handbook of Image and video Processing-Al Bovik Academic press ltd. Publication.
3	Compression Algorithms for Real Programmers- Peter Wayner Academic press ltd.

ELECTIVE-I: ADVANCED BIOMEDICAL SIGNAL PROCESSING

Course Details:

Class	M. Tech. Sem-I
Course Code and Course Title	PCE-ETC 101- Advanced Biomedical Signal Processing
Prerequisite/s	Signal Processing
Teaching Scheme: Lecture	3
Credits	3
Evaluation Scheme CIE/ESE for Theory	40/60

Teaching Scheme	Examination Scheme
Lectures : 03 Hrs /week	Theory : 100 Marks 60 (ESE) + 40

Course Objectives:	
1.	Introduce students to the principles of signal processing techniques and its application to biomedical signals
2.	Understandingmethods and tools for extracting information from biomedical signals.
3.	Understand analysis of biomedical signals

Course Outcomes (COs):	
1.	Understand different types of biomedical signals and their properties.
2.	Understand different artifacts in biomedical signals and the process to remove it.
3.	Understand ECG signal and its analysis.
4.	Systematically apply advanced methods to extract relevant Information from biomedical signal measurements.
5.	Understand EEG signal and its analysis.
6.	Assess Biomedical signal processing techniques for various problems and evaluate the effectiveness of techniques

Course Contents		
Unit 1	**Introduction To Biomedical Signals** Examples of Biomedical signals - ECG, EEG, EMGetc. - Tasks in Biomedical Signal Processing - Computer Aided Diagnosis. - Review of linear systems - Fourier Transform and Time Frequency Analysis(Wavelet) of biomedical signals- Processing of Random & Stochastic signals – spectral estimation– Properties and effects of noise in biomedical instruments - Filtering in	**5Hrs**
UNIT 2	**Concurrent, Coupled and Correlated Processes** Illustration with case studies – Adaptive and optimal filtering - Modeling of Biomedical signals - Detection of biomedical signals in noise -removal of	**6 Hrs**

	artifacts of one signal embedded in another -Maternal-Fetal ECG – Muscle contraction interference. Event detection - case studies with ECG & EEG – Independent component Analysis	
UNIT 3	**Cardio logical Signal Processing and Applications** Basic Electrocardiography (ECG) - Electrical Activity of the heart- ECG data acquisition– ECG Lead System- ECG parameters & their estimation - Use of Multi-Scale analysis for parameters estimation of ECG Waveforms - Noise & Artifacts- ECG Signal Processing: Baseline Wandering, Power line interference, Muscle noise filtering – QRS detection - Arrhythmia analysis	**7Hrs**
UNIT 4	**Data Compression** Lossless &Lossy- Heart Rate Variability – Time Domain measures -Heart Rhythm representation - Spectral analysis of heart rate variability - interaction without her physiological signals.	**5 Hrs**
UNIT 5	**Introduction to EEG** The Electroencephalogram - EEG rhythms & waveform-categorization of EEG activity - recording techniques - EEG applications- Epilepsy, sleep disorders, Brain Computer Interface.	**6 Hrs**
UNIT 6	**EEG Modeling** Linear, stochastic models – Nonlinear modeling of EEG - artifacts in EEG& their characteristics and processing – Model based spectral analysis - EEG segmentation -Joint Time-Frequency analysis – correlation analysis of EEG channels - coherence analysis of EEG channels.	**7Hrs**

Text/Reference Books:

1	Biomedical Signal Processing: Principles and techniques, D.C.Reddy, Tata McGraw-Hill, New Delhi, 2005
2	Biomedical Signal Processing, Willis J Tompkins, ED, Prentice Hall, 1993
3	Compression Algorithms for Real Programmers- Peter Wayner Academic press ltd.
4	Biomedical Signal Analysis, R. Rangayan, Wiley, 2002
5	Biomedical Signal Processing and Signal Modeling, Eugene N. Bruce, Wiley, 2001
6	Introduction to Biomedical Engineering, John D. Enderle, Elsevier, 2005
7	Advanced Bio signal Processing, Amine Nait-Ali, Springer, 2009

ELECTIVE-I: OPTIMIZATION TECHNIQUES

Course Details:

Class	M. Tech. Sem-I
Course Code and Course Title	PCE-ETC 101- Optimization Techniques
Prerequisite/s	Engg. Mathematics & statistics
Teaching Scheme: Lecture	3
Credits	3
Evaluation Scheme CIE/ESE for Theory	40/60

Teaching Scheme	Examination Scheme
Lectures : 03 Hrs /week	Theory : 100 Marks 60 (ESE) + 40

Course Objectives: The course aims to:	
1	Students should understand the concept of Optimization Techniques.
2	Students should understand the concept of linear programming, Nonlinear programming, Geometricprogramming, Dynamic programming.
3	Students should understand the method for formulation of problem and assignment of models.
4	Students should understand single-dimensional and Multi-dimensional Search Methods.

Course Outcomes: Upon successful completion of this course, the student will be able to:	
1	Students should be able to apply Optimization Techniques to Engineering Problems.
2	Students should be able to implement Linear/Nonlinear, Dynamic, Geometric programming.
3	Students should be able to apply single-dimensional and Multi-dimensional Search Methods in constrained and Unconstrained problem environments

Course Content		
I	**Introduction :** Historical development, Application to Engineering Problems, Statement Of Optimization problems, Classification of Optimization, Multivariable optimization with and without constraints.	**4**
	Linear Programming : Formulation, Geometry, Graphical solution, standard and matrix form of linear programming problems, Simplex programming and its flow chart, revised simplex algorithm, Two-phase Simplex method ,Degeneracy. Duality in linear programming: Definition of Dual Problem, General Rules for converting any Primal into its Dual Simplex method and its flow chart. Decomposition principle, Transportation problem.	**6**

	Nonlinear programming : Unimodal functions, single dimensional minimization methods, Exhaustive search, Fibonnaci method, Golden section, Comparison of Elimination method, Quadrature interpolation, Cubic interpolation , Direct root method, Random search method, Steepest decent method, Fletcher-Reeves method, David- Fletcher-Powell Method, Convex sets and convex functions, Kuhn-Tucker conditions.	**8**
	Geometric programming: **P**roblems with coefficients up to one degree of difficulty, Generalized for the positive and negative coefficients dynamic programming: Descrete & contineous dynamic programming (simple illustrations). Multistage decision problems, computation procedure and case studies	**6**
	Assignment Models : Formulation of problem, Hungarian Method for Assignment Problem, Unbalanced Assignment Problems	**6**
	Genetic Algorithms: Introduction, Representation of design variables, Representation of objective function and constraints, Genetic operators, Application procedure and case studies	**6**

Text Books	
1	Linear Programming and Network Flows- Mokhtar S. Bazaraa,John J. Jarvis,
2	Chong, E. P. & Zak S. H. An introduction to optimization, John Wiley
3	Peressimi A.L., Sullivan F.E., Vhi, J.J..Mathematics of Non-linear Programming, Springer– Verlag

Reference Books:	
1	Optimization: Theory and Practices, S.S Rao ,New Age Int. P Ltd. Publishers, New Delhi
2	Optimization concepts & application in Engg. -A. D. Belegundu, Tirupati R. Chandrupatla Pearson Edn.

ELECTIVE-III MOBILE COMPUTING

Course Details:

Class	M. Tech. Sem-I
Course Code and Course Title	PCE-ETC 102- Mobile Computing
Prerequisite/s	Computer Network & wireless communication
Teaching Scheme: Lecture	3
Credits	3
Evaluation Scheme CIE/ESE for theory	40/60

Teaching Scheme	Examination Scheme
Lectures : 03 Hrs /week	Theory : 100 Marks 60 (ESE) + 40 (CIE)

Course Objective: The course aims to	
1	Define Mobile Computing study its applications and look at current trends
2	Distinguish between different types of Mobility.
3	Analyze the performance of MAC protocols used for wired network and wireless networks.
4	Explore Theory and Research areas related to Mobile Computing
5	Acquire solid knowledge about mobile networks and mobile computing.

Course Outcomes(COs): Upon successful completion of this course, the student will be able to	
1	Grasp the concepts and features of mobile computing technologies and applications;
2	Have a good understanding of how the underlying wireless and mobile communication networks work, their technical features, and what kinds of applications they can
3	Identify the important issues of developing mobile computing systems and applications;
4	Organize the functionalities and components of mobile computing systems into different layers and apply various techniques for realizing the functionalities;
5	Develop mobile computing applications by analyzing their characteristics and requirements, selecting the appropriate computing models and software architectures, and applying standard programming languages and tools;

Course Contents:		
Unit 1	**Introduction to wireless communication**: Need and Application ofwireless communication. Wireless Data Technologies Market for mobile.	**3 Hrs**
Unit 2	**Wireless transmission and Medium access Control:** Frequency for radio transmission signal antennas, signal propagation Multiplexing Modulation, Spread and Cellular systems. Medium access control: Specialized MAC, SDMA, FDMA, TDMA & CDMA.	**7 Hrs**
Unit 3	**Telecommunications systems**: GSM: Mobile services, System architecture, Radio interface, Protocols, Localization and calling, Handover, Security, New data services. UMTS and IMT-2000: UMTS releases and standardization, UMTS	**7 Hrs**
Unit 4	**Wireless LAN**: Introduction, Infrared v/s Radio transmission, Infrastructure and ad-hoc Network, IEEE 802.11,Blue Tooth.	**6 Hrs**
Unit 5	**Mobile Network Layer and Transport Layer:** Mobile IP, DHCP, Mobile ad-hoc networks, Traditional TCP, Classical TCP improvements, TCPover 2.5/3G wireless networks.	**6 Hrs**
Unit 6	**Wireless application protocol :** Architecture, Wireless datagram protocol, Wireless transport layer, security Wireless transaction protocol, Wireless session protocol, Wireless application environment , Wireless markup language, WML Script, Mobile communications, Wireless telephony application, Push architecture, Push/pull services, Example stacks with WAP 1.x 429	**7 Hrs**

Text Books	
1	Mobile Communications - Jochen Schiller - 2nd edition, Publication-Pearson Education.

Reference Books:	
1	Introduction to Wireless Telecommunications systems and Networks - Gary J. Mulett. Publications- Cengage Learning India Edition.
2	Mobile Computing – Ashok K Talukdar, Roopa R Yavagal, Publication-TATA MGH

ELECTIVE-III DESIGN OF VLSI SYSTEMS

Course Details:

Class	M. Tech. Sem-I
Course Code and Course Title	PCE-ETC 102- Design of VLSI Systems
Prerequisite/s	VLSI systems
Teaching Scheme: Lecture	3
Credits	3
Evaluation Scheme CIE/ESE for Theory	40/60

Teaching Scheme	Examination Scheme
Lectures : 03 Hrs /week	Theory : 100 Marks 60 (ESE) + 40 (CIE)

Course Objective: The course aims to	
1	Understand the concepts of sequential logic design
2	Understand the design of logic circuits
3	Provide exposure to ASIC,CPLD & FPGA
4	Provide exposure to VHDL Programming.
5	Understand simulation issues & test benches.
6	Understand the synthesis issues.

Course Outcomes(COs): Upon successful completion of this course, the student will be able to	
1	Design the sequential logic circuits
2	Differentiate between synchronous & asynchronous logic circuit design
3	Design VLSI based systems using CPLD/FPGA
4	Design logic circuits using VHDL programming
5	Use test benches for updating the design.
6	Use synthesis tools for hardware modeling

Course Contents:		
Unit 1	**Fundamentals of Sequential Logic Design** Concept of FSM and use of state diagrams, use of ASM charts, S-R Latch, D Latch J-K flip-flop, Master Slave Flip-flops and their characteristic equations, excitation tables and timing diagrams, metastability. Moore, Melay and mixed type synchronous state machines, synchronous design procedure, sync.	8 Hrs.

	using programmable devices.	
Unit 2	**Asynchronous Sequential logic Circuit Design** Asynchronous design fundamentals, differences with synchronous design, Timing diagram specification, merger diagrams, making race- free state assignment using transition diagram, essential	6 Hrs.
Unit 3	**ASIC, FPGA and CPLD** Concept of ASIC, architecture of Xilinx 95XX series CPLD, 4XXX series FPGA, specifications and noise considerations, Typical applications, choice of target devices, speed grade, I/O pins & various resources.	7 Hrs.
Unit 4	**Introduction to VHDL and Elements of VHDL** Features of VHDL, concurrency, sequential behavior, used as test language, design hierarchies, levels of abstraction. Basic building blocks like entity, architecture, language elements, concurrent statements, sequential statements, signals and variables, configuration, operators, operator overloading, data types, component instantiation. Generate statement, process, loop statements, case statements, next statements, exit statements.	8 Hrs.
Unit 5	**Simulation Issues and Test Benches** Steps in simulation, simulation process, simulation delta, types of delays, types of simulation. Function of test bench, design methodologies for test benches, interpreting the test bench reports.	6 Hrs.
Unit 6	**Synthesis Issues** Introduction to synthesis, synthesis tools and their features, hardware modeling examples, synthesis guidelines	5 Hrs.

Text Books	
1	Digital Design- principles and practices J. F. Wakerly PHI 3rd edition
2	Digital Principles and Design, Donald Givone, TMH

Reference Books:	
1	Digital Logic Design Principles, Bradley Carlson, Wiley
2	Introductory VHDL from Simulation to Synthesis, Sudhakar Yalamanchil, Pearson
3	Digital System Design using VHDL, Charles Roth, TMH

ELECTIVE-I INTERNET TRAFFIC ENGINEERING

Course Details:

Class	M. Tech. Sem-I
Course Code and Course Title	PCE-ETC 102- Internet Traffic Engineering
Prerequisite/s	Computer Networks
Teaching Scheme: Lecture	3
Credits	3
Evaluation Scheme CIE/ESE for Theory	40/60

Teaching Scheme	Examination Scheme
Lectures : 03 Hrs /week	Theory : 100 Marks 60 (ESE) + 40 (CIE)

Course Objectives: The course aims to:	
1	Determine link weights for IP traffic engineering for an interior gateway protocol (IGP) such as OSPF or IS-IS. 2. To discuss traffic engineering for IP intra-domain networks.
2	Develop the platform for understanding the basics of routers and types of routers, and as the background material to understand more details about a router's critical functions, such as address lookup and packet class classification
3	Make student to understand algorithms for efficient packet classification to offer differentiated services based agreements

Course Outcomes: Upon successful completion of this course, the student will be able to:	
1	Estimate traffic in the network, as well as what performance measures might be of interest in IP networks
2	Evaluate various IP router architectures and highlight their advantages and disadvantages
3	Evaluate performance requirements of a packet classification algorithm in terms of number of memory accesses and the amount of storage requirement
4	Solve set of routing and traffic engineering problems in which MPLS can be used by giving due consideration to path management, traffic assignment, network information dissemination, and network management.

Course Contents:		
I	**IP traffic engineering**: Evolution of Traffic engineering in internet domain, Taxonomy and recommendation for internet traffic engineering, Performance Measures and characteristics, applications view and traffic models, Architectural frame work, link weight determination,Duality of the MCNF Problem	**6**

II	**Internet Routing and RouterArchitectures**: Architectural View of the Internet, Allocation of IP Prefixes and AS Number, Policy-Based Routing, Point of Presence, Traffic Engineering Implications, Internet Routing Instability. Router Architectures: Functions, Types, Elements of a Router, Packet Flow, Packet Processing: Fast Path versus Slow Path, Router Architectures	**6**
III	**Analysis of IP address lookup Algorithms**: Network Bottleneck, Network Algorithmics, Strawman solutions, Thinking Algorithmically, Refining the Algorithm, Cleaningup, Characteristics of Network Algorithms. IP Address Lookup Algorithms : Impact, Address Aggregation, Longest Prefix Matching, Naïve Algorithms, Binary , Multibit and Compressing Multibit Tries.	**6**
IV	**IP Packet Filtering and Classification** Search by Length Algorithms, Search by Value Approaches, Hardware Algorithms, Comparing Different Approaches IP Packet Filtering and Classification: Classification, Classification Algorithms, Naïve Solutions, Two-Dimensional Solutions, Approaches for d Dimensions.	**6**
V	**Quality of Service Routing**: QoS Attributes, Adapting Routing: A Basic Framework. Update Frequency, Information Inaccuracy, and Impact on Routing, Dynamic Call Routing in the PSTN, Heterogeneous Service, Single Link Case, A General Framework for Source-Based QoS Routing with Path Caching , Routing Protocols for QoS Routing, QOSPF: Extension to OSPF for QoS Routing, ATM PNNI.	**6**
VI	**Routing and Traffic Engineering with MPLS**: Traffic Engineering of IP/MPLS Networks, VPN Traffic Engineering, Problem Illustration: Layer 3 VPN, LSP Path Determination: Constrained Shortest Path Approach, LSP Path Determination: Network Flow Modeling Approach, Layer2 VPN Traffic Engineering, Observations and	**6**

Text Books	
1	Network Routing: Algorithms, Protocols, and Architectures

1	Network Algorithmic: An Interdisciplinary Approach to Designing Fast Networked Devices George Varghese (Morgan Kaufmann Series in Networking
2	Network Analysis, Architecture, and Design , James D. McCabe, Morgan Kaufmann
3	Traffic Engineering with MPLS By Eric Osborne, Ajay Simha Publisher: Cisco Press

ELECTIVE-III ADVANCED ANTENNA THEORY

Course Details:

Class	M. Tech. Sem-I
Course Code and Course Title	PCE-ETC 102- Advanced Antenna Theory
Prerequisite/s	Antenna and wave propagation
Teaching Scheme: Lecture	3
Credits	3
Evaluation Scheme CIE/ESE for Theory	40/60

Teaching Scheme	Examination Scheme
Lectures : 03 Hrs /week	Theory : 100 Marks 60 (ESE) + 40 (CIE)

Course Objectives: The course aims to	
1	Get an idea regarding various types of arrays
2	Achieve the knowledge regarding aperture antenna with ground plane effects
3	Get the brief knowledge. of smart antenna concept
4	Get information and design ability for the reduction of size of micro strip antenna
5	Get information about different techniques to improve bandwidth of compact micro strip antenna.
6	Understand design concepts for multiple frequency i.e. dual polarization and dual frequencyantenna.

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1	Design array antenna
2	Design aperture antenna
3	Get the knowledge of smart antenna
4	Design broadband ,multiple resonating compact micro strip antenna

Course Contents:		
Unit 1	**Array Antenna:** Array factor for linear array, Uniformaly equally spaced linear array, Pattern multiplication, directivity of uniformaly excited equally spaced linear array, Nonuniformally excited equally spaced linear array, mutual impedance.	**06 Hrs.**

Unit 2	**Aperture Antenna:** Field equivalence Principle: Huygen"s Principle, radiation equations, directivity, rectangular apertures, circular apertures, design considerations, Babinet"s Principle, fourier transforms in aperture antenna theory, Ground plane Edge effect: The geometrical theory of diffraction.	**05 Hrs.**
Unit 3	**Smart Antenna:** Smart antenna analogy, cellular Radio system evolution, signalpropagation, smart antenna benefits, smart antenna drawbacks, antenna, antenna beamforming, mobile Ad hoc Networks(MANETs),smart antenna system: design, simulation and Results, Beamforming, diversity combining, Rayleigh-fading and Trellis-coded modulation, other geometries	**05 Hrs.**
Unit 4	**Compact Microstrip Antenna:** Compact Microstrip Antennas ,Compact Broadband Microstrip Antennas ,Compact Dual-Frequency Microstrip Antennas ,Compact Dual-Polarized Microstrip Antennas ,Compact Circularly Polarized Microstrip Antennas ,Compact Microstrip Antennas with Enhanced Gain ,Broadband Microstrip Antennas , Broadband Dual-Frequency and Dual-Polarized Microstrip Antennas , Broadband and Dual-Band Circularly Polarized Microstrip Antennas Use of a Shorted Patch with a Thin Dielectric Substrate , Use of a Meandered Patch ,Use of a Meandered Ground Plane ,Use of a Planar Inverted-L Patch ,Use of an Inverted U- Shaped or Folded Patch	**07Hrs.**
Unit 5	**Compact Broadband Microstrip Antennas** Use of a Shorted Patch with a Thick Air Substrate , Use of Stacked Shorted Patches , Use of Chip-Resistor and Chip-Capacitor Loading Technique, Use of a Slot-Loading Technique , Use of a Slotted Ground	**06 Hrs.**
Unit 6	**Compact Dual-Frequency and Dual-Polarized Microstrip Antennas** Some Recent Advances in Regular-Size Dual-Frequency Designs, Compact Dual-Frequency Operation with Same Polarization Planes**,** Compact Dual- Frequency Operation, Dual-Band or Triple-Band PIFA, Compact Dual- Polarized Designs.	**07 Hrs.**

Text Books	
1	Antenna Theory and design, Stutzmen, warren L, wiley, 3rd edition, 1981
2	Broad band Microstrip Antenna by Girishkumar,K.P.Ray Artech House, Inc. 2003

Reference Books:	
1	Compact And broadband microstrip Antennas by kin-Lu Wong A Wiley-Interscience Publication John Wiley & Sons, Inc. 2002
2	Antenna Theory analysis And Design by constantine A. Balanis 3rd Edition. A John Wiley & Sons, Inc., Publication 2005
3	Microstrip antenna design handbook, Ramesh garg, prakash Bhatia, Inderbahl, Artech house, boston ,london
4	Antenna engineering handbook, Richard c .johnson, MGH

SEMESTER-II

1. COMPUTER VISION

Course Details:

Class	M. Tech. Sem-II
Course Code & Course Title	PCC-ETC-201-Computer Vision
Prerequisites	Image Processing
Teaching scheme:Lecture/Tutorial	3/1
Credits	3+1
Evaluation Scheme CIE/ESE for Theory	40/60

Teaching Scheme	Examination Scheme
Lectures : 03 Hrs /week	Theory : 100 Marks 60 (ESE) + 40
Tutorial : 01 Hrs /week	TW: 25 Marks

Course Objectives: The course aims to	
1	Study wavelets for image processing
2	Provide basics for CBIR systems
3	Provide logical base for Feature Extraction
4	Studydifferent Classifiers
5	Applyconcept of ANN

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1	Applywavelets for image processing
2	Develop content based image retrieval systems
3	Extract the features from objects/Image
3	Applyclassifier techniques

Course Contents:		
Unit 1	**Wavelets and Multi resolution Processing** Background: Image Pyramids, Subband Coding, Haar Transform, Multi resolution Expansion: Series Expansion, Scaling Function, Wavelet Function Discrete Wavelet Transform in one Dimension, and DWT in 2 Dimensions. Fast wavelet Transform ,wavelet packets	**8 Hrs**
Unit 2	**Representation and Description:** Representation: Boundary Following Algorithm, Chain Codes, Polygonal Approximation, Signatures, Boundary segments, Skeletons. Descriptors: Boundary descriptors; Regional descriptors; ;Relational descriptors	**8 Hrs**
Unit 3	**Pattern Recognition :**Overview of pattern recognition; Patterns and pattern Classes	**2 Hrs**
Unit 4	**Classifier:** Matching: Minimum distance classifier, Matching by Correlation, Matching shape numbers, String matching statistical classifier: Bayes classifier, Nearest Neighbor classifier	**6 Hrs**
Unit 5	**Image Mining and Content-Based Image Retrieval:** Introduction, Image Mining, Image Features for Retrieval and Mining: Color Features, Texture Features, Shape features, Topology, Multidimensional Indexing Simple CBIR System, Video mining	**7 Hrs**
Unit 6	**Artificial neural networks:** Human Recognition system; Artificial neural networks; Different models of Artificial neural networks; Perception and learning;	**5 Hrs**

Text Books	
1	Digital Image processing and Pattern Recognition by Malay K. Pakhira PHI
2	Digital Image processing by Rafael C. Gonzalez and Richard E. Woods Pearson Education
3	Image Processing Principles and Applications, Tinku Acharya , Ajoy K. Ray,, Wiley, 2005

Reference Books:	
1	Fundamentals of Digital Image processing, by A.K.Jain PHI
2	Digital image processing and analysis by B. Chanda , D. Dutta Mujumdar PHI
3	processing, analysis and machine vision by Milan sonka , V. Hlavac , R. Boyle Thomson learning

ADHOC & WIRELESS SENSOR NETWORKS

Course Details:

Class	M. Tech. Sem-II
Course Code & Course Title	PCC-ETC 202- Adhoc and Wireless Sensor Networks
Prerequisites	Computer Network
Teaching scheme:Lecture/Tutorial	3/1
Credits	3+1
Evaluation Scheme CIE/ESE for Theory	40/60

Teaching Scheme	Examination Scheme
Lectures : 03 Hrs /week	Theory : 100 Marks 60 (ESE) + 40
Tutorial : 01 Hrs /week	TW: 25 Marks

Course Objectives: The course aims to	
1	Explain the constraints of physical layer that affect the design and performance of adhoc network
2	Discuss the operations and performance of various MAC layer protocols proposed for adhoc networks.
3	Discuss the operations and performance of various routing protocols proposed for ad hoc networks.
4	Explain challenges in Wireless Sensor Network and its applications
5	Understand basics of Sensor Network Platforms and Tools

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1	Discuss basics and need of Adhoc network
2	Recognize challenges in design of wireless ad hoc networks
3	Understand fundamentals of Wideband Modulation Techniques
3	Useproposed protocols at MAC of Ad hoc networks
4	Use proposed protocols at routing layers of Ad hoc networks
5	Use software platform for simulation work

Course Contents:		
Unit 1	**Introduction** Introduction to Adhoc networks – definition, characteristics features, applications. Characteristics of Wireless channel, Adhoc Mobility Models, Indoor and outdoor models	**05 Hrs.**
Unit 2	**Medium Access Protocols** MAC Protocols: design issues, goals and classification, Contention based protocols- with reservation, scheduling algorithms, protocols using	**07 Hrs.**

	antennas, IEEE standards: 802.11a, 802.11b, 802.1g, 802.15, HIPERLAN	
Unit 3	**Network Protocols** Routing Protocols: Design issues, goals and classification. Proactive Vs reactive routing, Unicast routing algorithms, Multicast routing algorithms, hybrid routing algorithm, Energy aware routing algorithm, Hierarchical Routing, QoS aware routing	**07 Hrs.**
Unit 4	**Overview of Wireless Sensor Networks** Challenges for Wireless Sensor Networks, Enabling Technologies For Wireless Sensor Networks, Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes , Operating Systems and Execution Environments	**06 Hrs.**
Unit 5	**Cross Layer Design And Integration of Adhoc for 4G** Cross layer Design: Need for cross layer design, cross layer optimization, parameter optimization techniques, Cross layer cautionary perspective, Integration of Adhoc with Mobile IP networks.	**06 Hrs.**
Unit 6	**Sensor Network Platforms and Tools** Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms, Node-level Simulators, State-centric programming.	**05 Hrs.**

Text Books	
1	Ad hoc Wireless Networks Architectures and protocols, Da C.Siva Ram Murthy and B.S.Manoj, 2nd edition, Pearson Education. 2007
2	Adhoc Networking, Charles E. Perkins, Addison – Wesley, 2nd edition, 2000

Reference Books:	
1	Mobile adhoc networking, Stefano Basagni, Marco Conti, Silvia Giordano and Ivan, 2nd edition, 2000
2	The handbook of adhoc wireless networks, Mohammad Ilyas, CRC press,2002
3	ÉCLAIR; An Efficient Cross-Layer Architecture for wireless protocol stacks, V. T. Raisinhani and S.Iyer, World Wireless cong., San francisco,CA, 3rd edition,

ELECTIVE IV: CRYPTOGRAPHY & NETWORK SECURITY

Course Details:

Class	M. Tech. Sem-II
Course Code & Course Title	PCE-ETC 201- Cryptography & Network Security
Prerequisites	Computer Network
Teaching scheme: Lecture	3.
Credits	3
Evaluation Scheme CIE/ESE for Theory	40/60

Teaching Scheme	Examination Scheme
Lectures : 03 Hrs /week	Theory : 100 Marks 60 (ESE) + 40

Course Objectives: The course aims to:	
1	Understand Block Chiper and DES principles
2	Understand Symmetric Encryption Methods
3	Identifynetwork security threat
4	Understand Key Resources and management resources

Course Outcomes: Upon successful completion of this course, the student will be able to:	
1	Implement Cryptography methods on Network Security concepts and Application
2	Implement Symmetric methods
3	Implement Message authentication and Hash Functions
4	Identifythe attacks and methods of web security

Course Content		
I	**Overview:** Services, Mechanisms, and attacks, The OSI Security Architecture, A model for network security, Classical Encryption Techniques: Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Rotor Machines, and Steganography	**5**
II	**Block Ciphers and the Data Encryption Standard**: Simplified DES, Block Cipher Principles, The Data Encryption Standard, The Strength of DES, Differential Linear Cryptanalysis, Block Cipher Design Principles, Block Cipher Modes of Operation.	**5**

III	**Contemporary symmetric Ciphers:** Triple DES, Blowfish, RC5, Characteristics of Advanced Symmetric Block Ciphers, Confidentially using symmetric Encryption: Placement of Encryption Function, Traffic Confidentiality, Key Distribution, and Random Number Generation	**5**
IV	**Public Key Cryptography and RSA:** Principles of Public Key cryptosystems, The RSA Algorithm, Key Management, other Public Key Cryptosystems key Management, Diffle-Hellman Key exchange	**5**
V	**Message Authentication and hash functions:** Authentication Requirements, FAuthentication Function, Message Authentication Codes, Hash Functions, Security of Hash Functions and MACs. **Hash Algorithms:** MD5 Message Digest Algorithm, Secure Hash Algorithm. Digital signatures and Authentication protocols: Digital signatures, Authentication protocols and Digital signature Standard	**8**
VI	**Authentication Applications:** Kerberos, X. 509 Authentication Service. Electronic Mail Security: Pretty Good Privacy, S/MIME, IP Security Overview, IP Security Architecture, Authentications, Header, Encapsulating Security Payload, Combining Security Associations, Key Management. **Web Security:** Web Security Considerations, Secure socket layer and Transport layer security. Secure electronic transaction. System Security: Intruders, Intrusion detection, password management. Malicious Software, Viruses, Viruses and Related Threats, Firewalls: Firewall Design Principles, Trusted systems.	**8**

Text Books	
1	Willam Stallings, Cryptography and Network Security, Third Edition, Pearson Education

Reference Books:	
1	Network Algorithmic: An Interdisciplinary Approach to Designing Fast Networked Devices George Varghese (Morgan Kaufmann Series in Networking
2	Atul Kahate, Cryptography and Network Security, Tata McGrawhill, 2003

ELECTIVE IV: MULTIRATE SYSTEMS

Course Details:

Class	M. Tech. Sem-II
Course Code & Course Title	PCE-ETC 201- Multi rate Systems
Prerequisites	Signal Processing
Teaching scheme: Lecture	3
Credits	3+1
Evaluation Scheme CIE/ESE for Theory	40/60

Teaching Scheme	Examination Scheme
Lectures : 03 Hrs /week	Theory : 100 Marks 60 (ESE) + 40

Course Objectives: The course aims to:	
1	To provide basic concepts of Multirate systems
2	To give inputs regarding details of Multirate filter banks and their types.
3	To provide concepts of Multidimensional Multirate Systems
4	To provide information of different applications of Multirate Systems

Course Outcomes: Upon successful completion of this course, the student will be able to:	
1	Understandthe basic multi-rate operations
2	Applythe concept of Multirate filter banks.
3	Implement the design of Multirate filter banks
4	Understandthe role of Multirate systems in different applications.

Course Content		
I	**Fundamentals of Multi-rate Systems:** Basic multi-rate operations, interconnection of buildingblocks, polyphase representation, multistage implementation.	**6**
II	**Multirate Filter Banks:** Maximally decimated filter banks: Errors created in the QMF bank, alias-free QMF system, power symmetric QMF banks, M-channel filter banks, poly-phase representation, perfect reconstruction systems, alias-free filter banks, tree structured filter banks, transmultiplexers.	**6**
III	**Para-unitary Perfect Reconstruction Filter Banks**: Lossless transfer matrices, filter bank properties induced by paraunitariness, two channel Para-unitary lattices, M- channel FIR Para-unitary QMF banks, transform coding.	**6**

IV	**Linear Phase Perfect Reconstruction QMF Banks**: Necessary conditions, lattice structures for linear phase FIR PR QMF banks, formal synthesis of linear phase FIR PR QMF lattice. Cosine Modulated Filter Banks: Pseudo-QMF bank and its design, efficient polyphase structures, properties of cosine matrices, cosine modulated perfect reconstruction systems	**6**
V	**Multidimensional Multirate Systems:** Introduction, Multidimensional signals and their sampling, minimum sampling density, Multirate fundamentals, Alias free decimation. Cascade connections, Multirate filter design. Special filters and filter banks.	**6**
VI	**Applications:** FSK Modems, OMC data transmission, DAB and ADSL, Asynchronous conversion of sampling rates, Speech and audio coding, Image and video coding, Simulation of room acoustics using Wavelets, Multirate techniques with sensors	**6**

Text Books

1. P. P. Vaidyanathan, "Multirate Systems and Filter Banks," Pearson Education (Asia) Third impression, 2010.
2. N. J. Fliege, "Multirate Digital Signal Processing," John Wiley & Sons, USA, 2000.engineeringand network design, oliverheckmannjohn wiley& sons ltd,

Reference Books

1. Lijiana Milic, "Multirate Filtering for Digital Signal Processing: MATLAB Applications(PremierReference Source)".
2. R. E. Crochiere, L.R. Rabiner, "Multirate Digital Signal Processing," Prentice Hall.
3. Gilbert Strang and Truong Nguyen, "Wavelets and Filter Banks," Wellesley-Cambridge Press,

ELECTIVE IV: ADVANCED LIGHT WAVE COMMUNICATION

\Course Details:

Class	M. Tech. Sem-II
Course Code & Course Title	PCE-ETC 201- Advanced Light Wave communication
Prerequisites	Communication Engg.
Teaching scheme:Lecture	3
Credits	3
Evaluation Scheme CIE/ESE for Theory	40/60

Teaching Scheme	Examination Scheme
Lectures : 03 Hrs /week	Theory : 100 Marks 60 (ESE) +40

Course Objectives: The course aims to:	
1	To expose the students to the basics of signal propagation through optical fiber impairments, components and devices and system design. fibers,
2	To provide an in-depth understanding needed to perform fiber-optic communication system engineering calculations, identify system tradeoffs, and apply this knowledge to modern fiber optic systems.

Course Outcomes: Upon successful completion of this course, the student will be able to:	
1	Understandthe basics of Optical Fibers
2	Understandthe construction & role of sources & detectors in light wave communication
3	Analyze different multiplexing techniques
4	Design long haul high band width transmission system

Course Content		
I	**Introduction to guided optical communication:** Optical Fibers, types of fibers & optical Cables, Study of losses during transmission through viz. Attenuation by Absorption & Scattering, Consideration of losses in designing of High Speed / High bandwidth optical communication systems, Selection of fiber for such systems.	**6**
II	**Optical Sources:** Types of LEDs used in optical communication, their construction & operating principle, Types of Lasers. Principle of working of Lasers, solid state & injection Lasers, Optical amplifiers, EDFA, Soliton Systems & design of system required in LAN & WAN type of applications. Calculations of Power budgets and feasibility of system design for above optical sources.	**6**

III	**Optical Detectors:** Introduction & study of type of detectors characteristics. Spectral spread and availability of detectors for 980 nm, 1.3 μm & 1.55 μm λ systems. Calculation of detector sensitivity and design considerations of suitable receivers for LAN, WAN applications.	**6**
IV	**Multiplexing Components & Techniques:** Concepts of WDM, DWDM system design parameters, Optical multiplex / Demultiplex design considerations-Angular dispersive devices, Dielectric thin film filter type devices, Hybrid & planer wave guide devices, Active WDM devices, Wavelength non selective devices, System application.	**6**
V	**Long Haul High Band Width Tx System :** Designing systems for long haul high band width consideration-Outage, Bit error rate, Cross connect, Low & high speed interphases, Multiplex / Demultiplex consideration, Regenerator spacing, Degeneration & Allowances, Application consideration.	**6**

Text Books

1. Optical Communication Systems by John Gowar (PHI)
2. Optical Fiber Communication by Gerd Keiser (MGH)
3. Optical Fiber Communication Principles & Practice by John M. Senior (PHI pub. 1996.)

ELECTIVE V: ADVANVED MICROWAVE CIRCUIT DESIGN

Course Details:

Class	M. Tech. Sem-II
Course Code & Course Title	PCE-ETC 202- Advanved Microwave Circuit Design
Prerequisites	Microwave Engg.
Teaching scheme: Lecture	3
Credits	3
Evaluation Scheme CIE/ESE for Theory	40/60

Teaching Scheme	Examination Scheme
Lectures : 03 Hrs /week	Theory : 100 Marks 60 (ESE) + 40

Course Objectives: The course aims to:	
1	Analyze transmission line circuits at RF and microwave frequencies.
2	Design impedance matching in transmission line networks
3	Perform Scattering parameter analysis of RF networks
4	Design RF Filters, Amplifiers, Oscillators & mixers
5	Study of Microwave Integrated Circuits

CourseOutcomes: Uponsuccessfulcompletionofthiscourse,thestudentwillbeableto:	
1	Understand RF and Microwave circuit analysis techniques.
2	Understand transmission line circuits and Micro strip lines
3	Understand S-parameters and network characterization techniques
4	Design microwave small signal and power amplifiers, oscillators & mixers
5	Understand Microwave Integrated Circuits & processing techniques

Course Content		
I	**Introduction:** Importance of Radio frequency design, RF behavior of passive components, Chip components and circuit board consideration. Transmission line Analysis: Strip line & micro strip line, Smith Chart	**4**
II	**Microwave Network Analysis:** Interconnecting Networks, Network properties & applications, Scattering parameters, impedance matching using discrete components, micro strip line matching networks, biasingnetworks.	**6**

III	**RF Filter Design:** Basic resonator &Filter configurations, special filter realizations,	**6**
IV	**RF Transistor Amplifier Design:** Active RF components, Active RF component modeling, Matching and biasing network, Characteristics of amplifiers, Amplifier power relations, Stability considerations, Constant gain, Noise figure circles, Constant VSWR circles, Broadband High power & Multistage Amplifiers.	**8**
V	**Oscillator and Mixture Design:** Basic Oscillator Model, High frequency Oscillator configuration, Basic characteristics of Mixers & mixer design.	**6**
VI	**Microwave Integrated Circuits:** Materials &basic fabrications technologies of Hybrid ICs & monolithic ICs, Examples of IC Fabrication flow, MICs- amplifiers, Oscillators, Mixers, Frequency dividers, Digital modulators,Switches,Phaseshifters,Multipliers&Up-converters.	**6**

Text Books	
1	Reinhold Ludwigand Pavel Bretshko,"RF Circuit Design Theory & Applications", PearsonEducation.
2	D. M. Pozar, " Microwave Engineering", John Wiley & sons

Reference Books:	
1	Yoshihiro Konishi, "Microwave Integrated Circuits" BSP Books Pvt. Ltd
2	Samuel Y Liao, "Microwave Devices & Circuits", Prentice Hall of India, 2006
3	Robert E.Colin,2 "Foundations for Microwave Engineering", Mc Graw Hill.

ELECTIVE V: SDR & COGNITIVE RADIO TECHNOLOGY

Course Details:

Class	M. Tech. Sem-II
Course Code & Course Title	PCE-ETC 202- SDR & Cognitive Radio Technology
Prerequisites	Communication Engg.
Teaching scheme: Lecture	3
Credits	3
Evaluation Scheme CIE/ESE for Theory	40/60

Teaching Scheme	Examination Scheme
Lectures : 03 Hrs /week	Theory : 100 Marks 60 (ESE) + 40

Course Objectives: The course aims to:	
1	Understandconcept of SDR and Cognitive radios.
2	Know COBRA, SCA, JTRS
3	Understandconcept of smart antenna

Course Outcomes: Upon successful completion of this course, the student will be able to:	
1	Enable the student to understand the evolving paradigm of cognitive radio communication and the enabling technologies for its implementation.
2	Enable the student to understand the essential functionalities and requirements in Designing software defined radios and their usage for cognitive
3	Exposethe student to the evolving next generation wireless networks and their Associated challenge

Course Content		
I	SDR concepts & history, Benefits of SDR, SDR Forum, Ideal SDR architecture, SDR Based End-to-End Communication, Worldwide frequency band plans, Aim and requirements of the SCA.	**6**
II	Architecture Overview, Functional View, Networking Overview, Core Framework, Real Time Operating Systems, Common Object Request Broker Architecture (CORBA), SCA and JTRS compliance.	**6**
III	Radio Frequency design, Baseband Signal Processing, Radios with intelligence, Smart antennas, Adaptive techniques, Phased array antennas, Applying SDR principles to antenna systems, Smart antenna architectures.	**6**

IV	Low Cost SDR Platform, Requirements and system architecture, Convergence between militaryand commercial systems, The Future For Software Defined Radio .	**6**
V	Cognitive radio concepts & history, Benefits of Cognitive radio, Cognitive radio Forum. Ideal Cognitive radio architecture, Cognitive radio Based End-to-End Communication, Worldwide frequency band plans. Low Cost Cognitive radio Platform, Requirements and system architecture, Convergence between military and commercial	**6**
VI	Radio Frequency design, Baseband Signal Processing, Radios with intelligence, Smart antennas, Adaptive techniques, Phased array antennas, Applying Cognitive radio principlesto antenna systems, Smart antenna architectures.	**6**

Text Books	
1	Dillinger, Madani, Alonistioti (Eds.): Software Defined Radio, Architectures, Systems and Functions, Wiley 2003
2	Reed: Software Radio, Pearson

Reference Books:	
1	Software Defined Radio for 3G, 2002, by Paul Burns.
2	Tafazolli (Ed.): Technologies for the Wireless Future, Wiley 2005
3	Bard, Kovarik: Software Defined Radio, The Software Communications Architecture, Wiley 2007

*Minimum 8 tutorials based on above syllabus

ELECTIVE V: INDUSTRY AUTOMATION & PROCESS CONTROL

Course Details:

Class	M. Tech. Sem-II
Course Code & Course Title	Pce-Etc 202- Industry Automation & Process Control
Prerequisites	Control
Teaching scheme: Lecture	3
Credits	3
Evaluation Scheme CIE/ESE for Theory	40/60

Teaching Scheme	Examination Scheme
Lectures : 03 Hrs /week	Theory : 100 Marks 60 (ESE) + 40

Course Objectives: The course aims to:	
1	Explain the General function of Industrial Automation, List basic Devices in Automated Systems, Distinguish Different Controllers Employed In Automated Systems.
2	IdentifyPractical Programmable Logic Controller Applications , Know the History of the PLC, Demonstrate Basic PLC Skills
3	To study basics fuzzy logic and control for industrial atomization

Course Outcomes: Upon successful completion of this course, the student will be able to:	
1	Applybasic knowledge of process control techniques.
2	Develop a PLC program for automatic control systems.
3	Selectthe right hardware for a given application
4	Consider such aspects of the automation system as network communication, human machine interface, safety and protection against interference

Course Content:		
I	**Process characteristics:** Incentives or process control, Process Variables types and selection criteria, process degree of freedom, The period of Oscillation and Damping, Characteristics of physical System: Resistance, Capacitive and Combination of both. Elements of Process Dynamics, Types ofprocesses- Dead time, Single/multi-capacity, self- Regulating/non self regulating, Interacting/non-interacting, Linear/nonlinear, and Selection of control action for them. Study of Liquid Processes, Gas Processes, Flow Processes, Thermal Processes in respect to above concepts	**6**
II	**Control Systems and Automation Strategy:** Evolution of instrumentation and control, Role of automation in industries, Benefits of automation, Introduction to automation tools PLC, DCS, SCADA, Hybrid DCS/PLC, Automation strategy evolution, Control system audit, performance criteria, Safety Systems	**6**

III	.**Intelligent Controllers:** Stepanalysismethodforfindingfirst,secondandmultipletimeconstantsanddead time.ModelBasedcontrollers:InternalModelcontrol,Smithpredictor,optimalcontroller, ModelPredictivecontroller,Dynamicmatrixcontroller(DMC).SelfTunningController.F uzzylogicsystemsandFuzzycontrollers,Introduction,BasicConceptsofFuzzyLogic,Fuzzy Sets, Fuzzy Relation, Fuzzy Graphs, and Fuzzy Arithmetic, Fuzzy If- Then Rules, Fuzzy Logic Applications, Neuro-Fuzzy Artificial Neural networks and ANN controller	**6**
IV	**Distributed Control Systems:** DCS introduction, functions, advantages and limitations, DC Susan automation tooltosupportEnterpriseResourcesPlanning,DCSArchitectureofdifferentmakes,specificat i ons, configuration and programming, functions including database	**6**
V	**Programmable logic controllers(PLC):** Introduction, architecture,definitionofdiscretestateprocesscontrol,PLCVsPC,PLCVsDCS,relaydiagram ,ladderdiagram,ladderdiagramexamples,relaysequencers,timers/counters,PLC design, Studyof at least one industrial PLC	**6**
VI	Automation for following industries– Power, Water and Waste Water Treatment, Food and Beverages, Cement, Pharmaceuticals, Sugar, Automobile and Building Automation.	**6**

Text Books	
1	Donald Eckman–Automatic Process Control, Wiley Eastern Limited
2	Thomas E Marlin-Process Control- Design in processes and Control Systems for Dynamic Performance, McGraw- Hill International Editions

Reference Books:	
1	Process control Systems-F.G.Shinskey, TMH
2	Programmable Logic Controllers: Principles and Applications- Webb & Reis PHI

*Minimum 8 tutorials based on above syllabus

OPEN ELECTIVE : ADVANCED OPERATING SYSTEMS

Course Details:

Class	M. Tech. Sem-II
Course Code & Course Title	OEC-ETC 201- Advanced Operating Systems
Prerequisites	Operating Systems
Teaching scheme: Lecture	3
Credits	3
Evaluation Scheme CIE/ESE for Theory	40/60

Teaching Scheme	Examination Scheme
Lectures : 03 Hrs /week	Theory : 100 Marks 60 (ESE) + 40 (CIE)

Course Objectives: The course aims to:	
1	Understandthe Concept of hardware interface and OS Interface
2	Understand parallel System along with Multiprocessor
3	Understand IPC patterns
4	Understandthe concept of Process along with I/O devices and System

Course Outcomes: Upon successful completion of this course, the student will be able to:	
1	Implement hardware interface along with addressing and interrupts
2	Implement System calls and OS Interface
3	Implement Parallel System for two process system
4	Implement I/O devices and System on OS

Course Content		
I	**Introduction & Hardware Interface** Introduction, System Levels, Hardware Resources, Resource Management, Virtual Computers, Requirement of Operating system.CPU, Memory and Addressing, Interrupts, I/O Devices.	**10**
II	**Operating System Interface** System calls & its example, Information and Meta information, Naming OS objects, Devices as Files, Process Concept, Communication between Process, Unix Style Creation, Standard Input and standard output.	**5**

III	**Parallel systems:** Parallel Hardware, An OS for Two Processor System, Race condition with a shared process table, Atomic actions,Multiprocessor OS: Grouping Shared variables, using two process tables, threads, Implementation of Mutual Exclusion, varieties of computer models.	**5**
IV	**Inter process Communication (IPC) Patterns** Using IPC, Patterns of IPC, Problems when Process complete, Race conditions and atomic actions, IPC pattern: Mutual Exclusion, Signaling, Rendezvous, procedure consumer, Client Server, Database access and update, review of IPC pattern	**5**
V	**Process** Everyday Scheduling, Preemptive Scheduling, Policy Vs Mechanism in scheduling, Scheduling in real operating System, Deadlock, Condition to occur, deal with deadlock, Two phase Locking, starvation, Message passing variation	**5**
VI	**I/O Devices & System** Device and Controllers, Terminal Devices- Basic Terminal, Communication Devices, Disk devices, Disk Controller, SCSI Interface, tape devices, CD devices. I/O System software, Access Strategies- Double Buffering, Unification of files and I/O Devices, Disk device drivers, Disk caching, SCSI Device drivers.	**6**

Text Books	
1	Modern Operating System- ANDREW S. TANENBAUM, HERBERT BOS
2	Operating Systems A concept based Approach - Dhananjay M. Dhamdhere

OPEN ELECTIVE : CYBER SECURITY

Course Details:

Class	M. Tech. Sem-II
Course Code & Course Title	OEC-ETC 201- Cyber Security
Prerequisites	Engg. logic
Teaching scheme: Lecture	3
Credits	3
Evaluation Scheme CIE/ESE for Theory	40/60

Teaching Scheme	Examination Scheme
Lectures : 03 Hrs /week	Theory : 100 Marks 60 (ESE) + 40 (CIE)

Unit No.	Topics	Hrs
1	**Introduction to Cyber Security** Cybercrime definition and origins of the world, Cybercrime and information security, Classifications of cybercrime, Cybercrime and the Indian ITA 2000, A global Perspective on cybercrimes. **Cyber offenses & Cybercrimes:** How criminal plan the attacks, Social Engg, Cyber stalking, Cyber caféand Cybercrimes, Botnets, Attack vector, Cloud computing, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices	8
2	**Tools and Methods Used in Cybercrime:** Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Over Flow, Attacks on Wireless Networks, Identity Theft (ID Theft)	06
3	**Security Risk Assessment and Risk Analysis:** Risk Terminology, Laws, Mandates, and Regulations, Risk Assessment Best Practices, The Goals and Objectives of a Risk Assessment, Best Practices for Quantitative and Qualitative Risk Assessment.	04
4	**Vulnerability Assessment and Penetration Testing (VAPT):** VAPT An Overview, Goals and Objectives of a Risk and Vulnerability Assessment, Vulnerability Assessment Phases-Discovery, Exploitation/Analysis , Reporting Penetration Testing Phases-Discover/Map, Penetrate Perimeter, Attack Resources, Network and Web VAPT	04

5	**Cyber Security Laws and Legal Perspectives:** The Concept of Cyberspace E-Commerce , The Contract Aspects in Cyber Law ,The Security Aspect of Cyber Law ,The Intellectual Property Aspect in Cyber Law, The Evidence Aspect in Cyber Law, The Criminal Aspect in Cyber Law, Global Trends in Cyber Law, Legal Framework for Electronic Data Interchange Law Relating to Electronic Banking , The Need for an Indian Cyber Law	08
6	**Indian IT Act:** Cyber Crime and Criminal Justice: Penalties, Adjudication and Appeals Under the IT Act, 2000, IT Act. 2008 and its Amendments **Information Security Standard compliances:**	04

Reference Books:	
1	Nina Godbole, Sunit Belapure, Cyber Security, Wiley India, New Delhi.
2	The Indian Cyber Law by Suresh T. Vishwanathan; Bharat Law House New Delhi
3	The Information technology Act, 2000; Bare Act- Professional Book Publishers, New Delhi.
4	Cyber Law & Cyber Crimes By Advocate Prashant Mali; Snow White Publications, Mumbai
5	Nina Godbole, Information Systems Security, Wiley India, New Delhi
6	Kennetch J. Knapp, Cyber Security & Global Information Assurance Information Science Publishing.
7	Michael Gregg & David Kim, Inside Network Security Assessment: Guarding Your IT Infrastructure, Pearson Publication
8	M. L. Srinivasan, CISSP in 21 Days - Second Edition PACT Publication
9	Charles P. Pfleeger and Shari Lawrence Pfleeger, Security in Computing, Pearson Publication
10	Douglas J. Landoll, The Security Risk, Assessment Handbook-Second Edition, Auerbach Publications