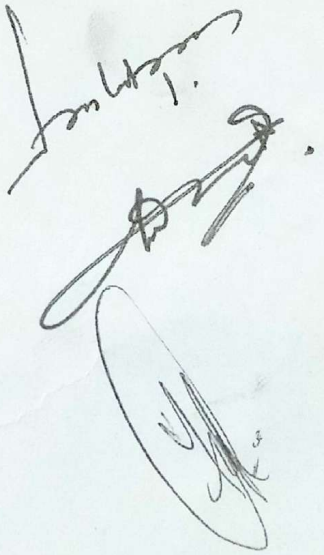
M.Tech. (Electronics & communication Engineering)

BATCH-2018

Curriculum & Scheme of Examination

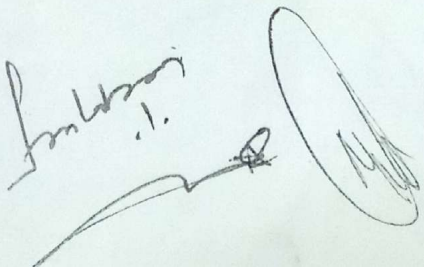


SEMESTER - I

S.no.	Course Code	Course Title	Teaching Periods Per Week			Hrs.	Cdts.	Evaluation(Marks)		
			L	T	P			Int.	Ext.	Total.
1.	EC 901	Probability and random Process.	3	1	0	4	4	40	60	100
2.	EC 902	Advanced Embedded Systems Design	2	1	0	3	3	40	60	100
3.	EC 903	Antenna Theory and Design	2	1	0	3	3	40	60	100
4.	EC91x	Elective – I	3	1	0	4	4	40	60	100
5.	EC91x	Elective - II	3	1	0	4	4	40	60	100
6.	EC 902L	Lab-I	0	0	6	6	3	40	60	100
7.	EC903L	Lab-II	0	0	4	4	2	40	60	100
		Total					**23**	**280**	**420**	**700**

SEMESTER - II

S.no.	Course Code	Course Title	Teaching Periods Per Week			Hrs.	Cdts.	Evaluation(Marks)		
			L	T	P			Int.	Ext.	Total.
1.	**ECEM-906**	Advanced Engineering Mathematics-II	3	1	0	4	4	40	60	100
2.	**ECEM-907**	Digital System Design	2	1	0	3	3	40	60	100
3.	**ECEM-908**	Advanced DSP	2	1	0	3	3	40	60	100
4.	**ECEM-909**	Advanced Digital Communication systems	2	1	0	3	3	40	60	100
5.	**ECEM-910E***	Elective - II	2	1	2	4	4	40	60	100
6.	**ECEM-907L**	Digital system design lab.	0	0	4	4	2	40	60	100
7.	**ECEM-908L**	Advanced DSP lab	0	0	4	4	2	40	60	100
8.	**ECEM-909L**	Digital Communication system Lab.	0	0	4	4	2	40	60	100
10.		**Total**					**23**	**320**	**480**	**800**

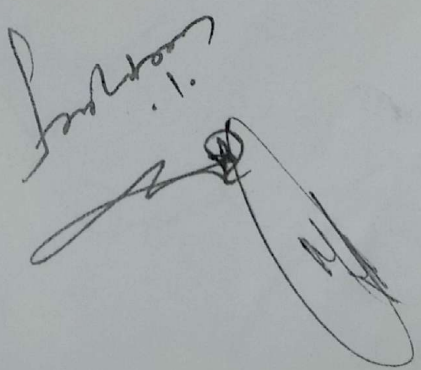


SEMESTER - III

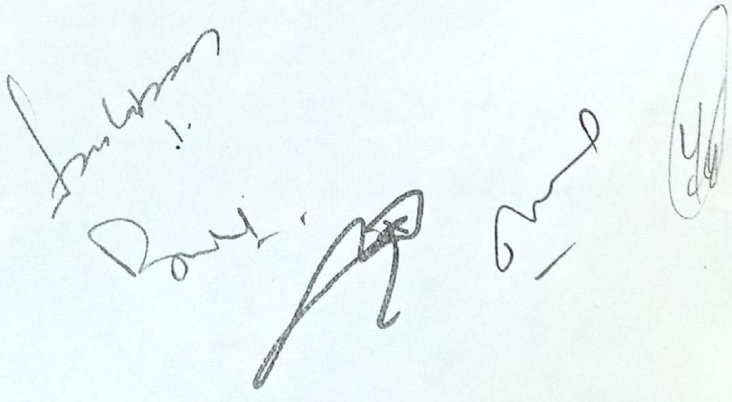
S.no.	Course Code	Course Title	Teaching Periods Per Week			Hrs.	Cdts.	Evaluation(Marks)		
			L	T	P			Int.	Ext.	Total.
1.	ECEM-911	Wireless & mobile communication Systems	2	1	0	3	3	40	60	100
2.	ECEM-912E*	Elective-III	2	1	2	5	4	40	60	100
3.	ECEM-911L	Wireless & mobile communication Lab	0	0	4	4	2	40	60	100
4.	ECEM-913	Project	0	2	12	14	8	100	150	250
5.	ECEM-914	Seminar-I	0	2	0	2	2	50	00	50
	Total						**19**	**270**	**330**	**600**

SEMESTER - IV

S.no.	Course Code	Course Title	Teaching Periods Per Week			Hrs.	Cdts.	Evaluation(Marks)		
			L	T	P			Int.	Ext.	Total.
1.	ECEM-915	Dissertation	4	6	14	24	17	100	400	500
2.	ECEM-916	Seminar -II	0	2	0	2	2	100	100	200
	Total						**19**	**200**	**500**	**700**



SEMESTER II



ECEM-906
ADVANCED ENGINEERING MATHEMATICS-II

Unit-1: : QUEUING THEORY

General concepts of queuing system and Introduction to stochastic processes, Measures of performance, Arrival and Service processes, Kendall's notation, Single server and multi-server models, channels in parallel with limited and unlimited queues –M/M/1/K, M/M/C. Queues with unlimited service, Finite source queues, Applications of Simple Queuing Decision Models, Design and Control Models.

Unit-2: RELIABILITY MODELS

Basics of reliability, classes of life distributions, Reliability function, Mean time before failure (MTBF)and Hazard rate of Exponential and Weibull distributions, Reliability of configurationsseries, parallel, mixed configuration, k out of n system and standby system, Reliability models, Concepts and definitions of Preventive Maintenance, Corrective Maintenance and Age Replacement.

Unit-3: LINEAR PROGRAMMING-I

Introduction, geometry, duality, sensitivity analysis. Simplex method, large scale optimization, network simplex. Ellipsoid method, problems with exponentially many constraints, equivalence of optimization and separation. Convex sets and functions, generalized inequalities and convexity, convex optimization problems, quasi-convex, linear, quadratic, geometric, vector, semi-definite.

Unit-4: LINEAR PROGRAMMING-II

Duality, optimality conditions, sensitivity analysis. Unconstrained minimization, equality constrained minimization and interior point methods. Integer Programming: formulations, complexity, duality. Lattices, geometry, cutting plane and branch and bound methods. Mixed integer optimization.

Unit-5: APPLIED LINEAR ALGEBRA

Linear independence ,Linear transformations, Cramer`s rule, volume and linear transformations, Vector spaces and subspaces, Null spaces, column spaces, and linear transformations, Linearly independent sets; bases, Coordinate system, The dimension of a vector space, Matrix of a linear transformation, Linear models in business, science and engineering .

1. Sen, M. K. and Malik, D. F.-Fundamental of Abstract Algebra, Mc. Graw Hill
2. Khanna, V. K. and Ghamdri, S. K.- Course of Abstract Algebra, Vikash Pub.
3. Halmos, T. R.-Naïve Set Theory, Van Nostrand
4. Scarborough, J. B.-Numerical Mathematical Analysis, Oxford University Press
5. Cone, S. D.-Elementary Numerical Analysis, Mc. Graw Hill.

6Mukhopadhyay ,P.-Mathematical Statistics ,New Central Book Agency 7. Kapoor, V. K and Gupta, S.C.-Fundamental of Mathematical Statistics, Sultan Chand and Sons

7. Gross, D., Shortle, J.F, Thompson, J.M and Harris, C.M., —Fundamentals of Queueing Theory", Wiley Student 4th Edition, 2014.

ECEM-907

DIGITAL SYSTEM DESIGN

UNIT I:

Review of flip-flop basics -Excitation tables, and characteristic equations of flip-flops. Analysis and Design of synchronous sequential circuits-state table , state diagram and State- Equations Derivation of state table and state diagrams for sequential circuits. State Reduction, state assignment, Rules for state assignments.

UNIT II:

Design of sequential circuits using state assignment rules for assigning states. Design of the clocked sequential circuits for given state diagram. Design of the clocked sequential circuits for given state diagram using state reduction technique. Lockout conditions. Design of clocked sequential circuits avoiding lock-out condition.

UNIT III:

Sequence generators using counters and shift registers. Design digital system to generate the sequence 1101011 using JK flip-flops. Design digital system to generate the sequence 1101011 by shift register method. Modulus –N synchronous counter. Design of Digital watch. Design of 3-bit up/down counter.

UNIT IV:

Deterministic Machine ,Mealy machine, Block diagram of Mealy machine Moore machine, block diagram of Moore machine Hazards, gate delays, the generation of spikes, production of static hazards in combinational circuits. Elimination of static hazards

UNIT V:

Design and implementation of carry look ahead adder circuit. Implementation of Boolean functions using PLA and PAL.

Reference Books:

1. Digital logic Design by B. Holdsworth (Tata McGraw-Hill)
2. VHDL Programming by Example by Douglas L. Perry(Tata McGraw-Hill).
3. Digital Logic Applications and Design by John M. Yarbrough.(Thomson Brooks/cole).
4. Introduction to Logic Design by Alan B. Marcovitz(Tata McGraw-Hill).

ECEM-907L

DIGITAL SYSTEM DESIGN LAB

List of experiments:

1. Write VHDL code for basic AND gate.
2. Using VHDL program, Design J-K Flip-Flop using (if-then-else) Sequential Constructs
3. Designing of D Flip flop using Asynchronous Reset.
4. Design of 2:1 Multiplexer using "IF Statement".
5. Designing of BCD to Seven Segment Decoder.
6. Write VHDL code for Synchronous 8-bit Johnson Counter.
7. Designing of T Flip Flop using Asynchronous Reset
8. Using VHDL program, Design a decimal counter that counts up from 0 to 9.

Learning beyond Syllabus

9. Write a VHDL program for memory.
10. Write VHDL program to perform Arithmetic Logic Unit (ALU) operation.

ECEM-908

ADVANCED DSP

Unit-1: REVIEW OF FILTER CONCEPTS- Review of design techniques and structures for FIR and IIR filters, representation of numbers, quantization of filter coefficients, round-off effects in digital filters.

Unit-2: FILTERS: Weiner filtering, optimum linear prediction, Levinson-Durbin algorithm, prediction error filters. Adaptive filters: FIR adaptive LMS algorithm, Convergence of adaptive algorithm, fast algorithms. Applications: Noise canceller, echo canceller and equalizer.

Unit-3: MULTIRATE DIGITAL SIGNAL PROCESSING: Introduction, Decimation by a factor D, Interpolation by a factor I, sampling rate conversion by rational factor I/D, implementation of sampling rate conversion, multistage implementation of sampling rate conversion, sampling rate conversion of band pass signals, sampling rate conversion by an arbitrary factor, application of Multirate signal processing, digital filter bank, two-channel quadrature-mirror filter bank, M-channel QMF bank.

Unit-4: WAVELET TRANSFORM: Introduction to wavelet transform- Short Time Fourier Transform (STFT), Wavelet transform, Haar wavelet and Multirate resolution analysis, Daubechies wavelet, some other standard wavelets, applications of wavelet transform.

Unit-5: POWER SPECTRUM ESTIMATION: Estimation of spectra from finite-duration observation of signals, non-parametric methods for power spectrum estimation, parametric methods for power spectrum estimation,filter bank methods, Eigen analysis algorithms for spectrum estimation.

Text Books:

1) Digital Signal Processing : Principles, Algorithms, and Applications, 4/e, Authors : John G. Proakis Dimitris G Manolakis Imprint : Pearson Education
2) Digital Signal Processing, Authors, Oppenheim, Alan V, Schafer, Ronald W., PHI

Reference Books:

1) Advanced Digital Signal Processing, Authors: Dr. Shaila D. Apte, Imprint: Wiley
2) Digital Signal Processing, 3/e, Authors: S.K.Mitra, Imprint : McGraw Hill
3) Digital Signal Processing and Applications with the TMS 320C6713 and TMS 320C6416 DSK, 2/e,Authors: RulphChassaing,Donald Reay, Imprint : Wiley
4) Digital Signal Processing, Authors: Tarun Kumar Rawat, Imprint: Oxford

5) Digital Signal Processing, Spectral Computation and Filter Design, Authors:CHI-Tsong Chen, Indian Edition, Imprint: Oxford
6) Theory and Applications of Digital Signal Processing,Authors: Lawrence R. Rabiner, Bernard Gold,Imprint:Prentice- Hall
7) Digital Signal Processing, Authors:Thomas J. Cavicchi, Imprint: Wiley
8) Modern Digital Signal Processing, Authors: V. Udayshankar, Imprint: PHI
9) Digital Signal Processing using MAT and Wavelets,2/e, Authors: Michael Weeks, Imprint: Jones & Bartlett Publishers.

ECEM-908L

ADVANCED DSP LAB

1) Write a program for cascade and parallel realization of an FIR transfer function.
2) Write a program for cascade and parallel realization of an IIR transfer function.
3) Write a program to design a Butterworth IIR Band Pass Filter.
4) Write a program to design an FIR filter using various window functions.
5) Write a program to implement the interpolation and decimation.
6) Write a program to design two channels QMF Bank.
7) Write a program to compute the CWT.
8) Write a program to compute the DWT.
9) Write a program to design a wavelet filter.
10) Write a program to find the magnitude response of a wavelet.

ECEM-909

ADVANCED DIGITAL COMMUNICATIONS SYSTEMS

UNIT I:Introduction Elements of Digital Communication System:

Communication channels and their characteristics - mathematical models for channels - representation of digitally modulated signals - performance of memoryless modulation methods - signalling schemes with memory - CPFSK - CPM.

UNIT II: Optimum Receivers for AWGN Channels Waveform and Vector Channel Models: Detection of signals in Gaussian noise - optimum detection and error probability for band limited signalling and power limited signalling - non coherent detection - comparison of digital signalling methods - lattices and constellations based on lattices - detection of signalling schemes with memory - optimum receiver for CPM - performance analysis for wireline and radio communication systems; Introduction to partially coherent, double differentially coherent communication systems.

UNIT III:Channel Coding Introduction to Linear Block Codes:

Convolution coding - Tree, Trellis and state diagrams – systematic - non-recursive and recursive convolutional codes - the inverse of a convolutional encoder and catastrophic codes - decoding of convolutional codes - maximum likelihood decoding - Viterbi algorithm and other decoding algorithms - distance properties - punctured convolutional codes - dual k codes - concatenated codes - MAP and BCJR algorithms - turbo coding and iterative decoding - factor graphs and sum-product algorithms - LDPC codes - trellis coded modulation - performance comparison.

UNIT IV:Pulse Shaping and Equalization Pulse Shaping:

Characterization of band limited channels - ISI - Nyquist criterion - controlled ISI - channels with ISI and AWGN - pulse shaping for optimum transmissions and reception; Equalization: MLSE - linear equalization - decision feedback equalization - ML detectors - iterative equalization - turbo equalization - adaptive linear equalizer - adaptive decision feedback equalization - blind equalization.

UNIT V:Synchronization, Signal Parameter Estimation:

Carrier phase estimation - symbol timing estimation - joint estimation of carrier phase and symbol timing - performance characteristics of ML estimators.

Reference Books:

1. John G. Proakis and MasoudSalehi, "Digital communications", 5th Edition, Tata McGraw Hill, 2008.

2. Ian A. Glover and Peter M. Grant, "Digital Communications", 2nd Edition, Pearson Education, 2008.

3. Bernard Sklar, "Digital Communications: Fundamentals and Applications", 2nd Edition, Pearson Education, 2002.

4. Marvin K.Simon, M. Hinedi and William C. Lindsey, "Digital Communication Techniques: Signal Design and Detection", Prentice Hall of India, 2009.

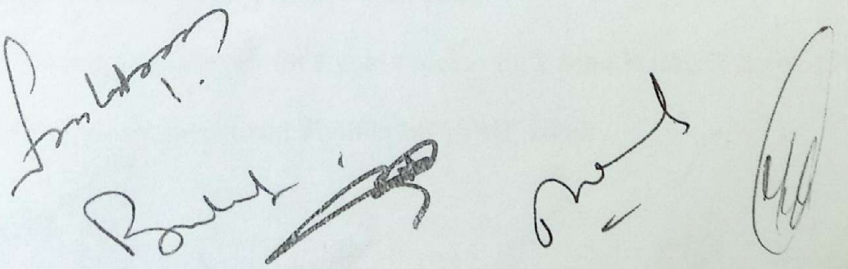
5. John R. Barry, Edward A. Lee, David G. Messerschmitt, "Digital Communication", Kluwer Academic Publishers, 2004.

ECEM-909L

ADVANCED DIGITAL COMMUNICATION SYSTEMS LAB

Experiments

1. Analysis of relation between bit rate, symbol rate and chip rate.
2. Generation of different PN codes like barker code, gold code and maximum length sequence code.
3. Study of Root-Raised Cosine filter with variable chip rate and its time and frequency domain analysis
4. Time and Frequency domain analysis of complete CDMA-Direct Sequence Spread Spectrum modulator with variable chip rate, PN code, BPSK, QPSK and OQPSK baseband modulation and with & without spectral shaping filter.
5. Study and analysis of BPSK, QPSK and OQPSK constellation with or without spectral shaping filter.
6. Bit Error Rate (BER) measurement of CDMA-DSSS complete system using different signal gain and noise gain i.e. SNR.
7. Study of frequency offset i.e. Doppler Effect as an impairment using QPSK baseband modulation.



ELECTIVES II Semester

ECEM-910E1

CMOS MIXED SIGNAL DESIGN ECEM

Unit I - Simple CMOS Current Mirror, Common-Source Amplifier, Source-Follower, SourceDegenerated Current Mirrors, cascode Current Mirrors, MOS Differential Pair and Gain StageProcess and temperature independent compensation

Unit II - Sampling Circuits Performance of Sample-and-Hold Circuits, Testing Sample and Holds, MOS Sample-andHold Basics, Examples of CMOS S/H Circuits, Bipolar and BiCMOS Sample-and-Holds. Sample-and-Hold Architectures- Open-loop & closed-loop architectures, open-loop architecture with miller capacitance, multiplexed-input architectures, recycling architecture, switched capacitor architecture.

Unit III- D/A Converter Architectures Input/output characteristics of an ideal D/A converter, , performance metrics of D/A converter, D/A converter in terms of voltage, current, and charge division or multiplication, switching functions to generate an analog output corresponding to a digital input. Resistor-Ladder architectures, Current steering architectures

Unit IV - A/D Converter Architectures Input/output characteristics and quantization error of an A/D converter, performance metrics, Performance Limitations, Resolution, Offset and Gain Error, Accuracy and Linearity, Successive approximation architectures, Flash architectures.

Unit V - Integrator Based Filters Low Pass filters, active RC integrators, MOSFET-C integrators, transconductance-c integrator, discrete time integrators. Filtering topologies - bilinear transfer function and biquadratic transferfunction.

Books:

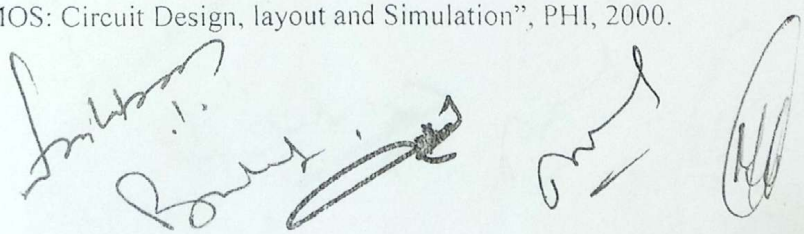
1. Razavi. "Design of analog CMOS integrated circuits", McGraw Hill, Edition 2002.

2. Razavi, "Principles of data conversion system design", Wiley IEEE Press, 1st Edition, 1994.

3. Jacob Baker, "CMOS Mixed-Signal circuit design", IEEE Press, 2009.

4. Gregorian, Temes, "Analog MOS Integrated Circuit for signal processing", John Wiley & Sons, 1986.

5. Baker, Li, Boyce, "CMOS: Circuit Design, layout and Simulation", PHI, 2000.



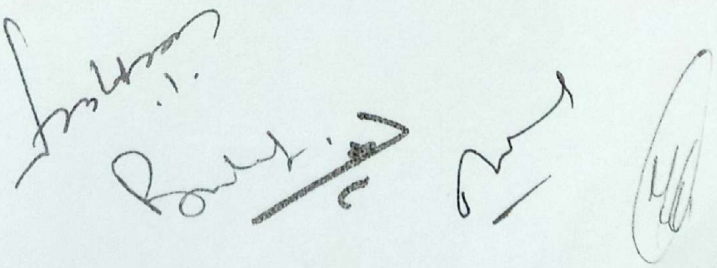
ECEM-910E2

MACHINE LEARNING

Unit-1: Introduction - Well-posed learning problems, Designing a learning system, Perspectives and issues in machine learning Concept learning and the general to specific ordering – Introduction, A concept learning task, Concept learning as search, Find-S: finding a maximally specific hypothesis, Version spaces and the candidate elimination algorithm, Remarks on version spaces and candidate elimination, Inductive bias

Unit-2: Decision Tree learning – Introduction, Decision tree representation, Appropriate problems for decision tree learning, The basic decision tree learning algorithm, Hypothesis space search in decision tree learning, Inductive bias in decision tree learning, Issues in decision tree learning Artificial Neural Networks – Introduction, Neural network representation, Appropriate problems for neural network learning, Perceptions, Multilayer networks and the back propagation algorithm, Remarks on the back propagation algorithm, An illustrative example face recognition Advanced topics in artificial neural networks Evaluation Hypotheses – Motivation, Estimation hypothesis accuracy, Basics of sampling theory, A general approach for deriving confidence intervals, Difference in error of two hypotheses, Comparing learning algorithms

Unit-3: Bayesian learning – Introduction, Bayes theorem, Bayes theorem and concept learning, Maximum likelihood and least squared error hypotheses, Maximum likelihood hypotheses for predicting probabilities, Minimum description length principle, Bayes optimal classifier, Gibs algorithm, Naïve Bayes classifier, An example learning to classify text, Bayesian belief networks The EM algorithm Computational learning theory – Introduction, Probability learning an approximately correct hypothesis, Sample complexity for Finite Hypothesis Space, Sample Complexity for infinite Hypothesis Spaces, The mistake bound model of learning - Instance-Based Learning- Introduction, k -Nearest Neighbour Learning, Locally Weighted Regression, Radial Basis Functions, Case-Based Reasoning, Remarks on Lazy and Eager Learning Genetic Algorithms – Motivation, Genetic Algorithms, An illustrative Example, Hypothesis Space Search, Genetic Programming, Models of Evolution and Learning, Parallelizing Genetic Algorithms



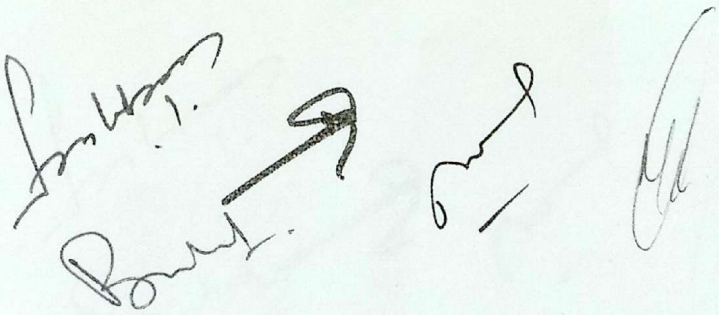
Unit-4: Learning Sets of Rules – Introduction, Sequential Covering Algorithms, Learning Rule Sets: Summary, Learning First Order Rules, Learning Sets of First Order Rules: FOIL, Induction as Inverted Deduction, Inverting Resolution Analytical Learning - Introduction, Learning with Perfect Domain Theories: Prolog-EBG Remarks on Explanation-Based Learning, Explanation-Based Learning of Search Control Knowledge

Unit-5: Combining Inductive and Analytical Learning – Motivation, Inductive-Analytical Approaches to Learning, Using Prior Knowledge to Initialize the Hypothesis, Using Prior Knowledge to Alter the Search Objective, Using Prior Knowledge to Augment Search Operators, Reinforcement Learning – Introduction, The Learning Task, Q Learning, Non-Deterministic, Rewards and Actions, Temporal Difference Learning, Generalizing from Examples, Relationship to Dynamic Programming

REFERENCE BOOKS:

1.Machine Learning – Tom M. Mitchell, - MGH 2. Machine Learning: An Algorithmic Perspective, Stephen Marsland, Taylor & Francis (CRC)

2.Machine Learning Methods in the Environmental Sciences, Neural Networks, William W Hsieh, Cambridge Univ Press. 2. Richard o. Duda, Peter E. Hart and David G. Stork, 3.Pattern classification, John Wiley & Sons Inc., 2001 3. Chris Bishop, Neural Networks for Pattern Recognition, Oxford University Press, 1995. 4. Machine Learning by Peter Flach , Cambridge.



ECEM-910E3

OPTICAL COMMUNICATION SYSTEMS

Unit-1: Optical Fibers:

Structures, wave guiding and Fabrication: Nature of Light, Basic optical laws and definitions, Single mode fibers, Graded index fiber structure, Attenuation, Signal Dispersion in fibers. Optical Sources- LEDs, Laser Diodes, Line Coding.

Unit-2: Photo detectors:

Photo detector Noise, Detector Response Time, Avalanche Multiplication Noise. Optical Receiver Operation- Fundamental receiver operation, Digital receiver performance, Eye diagrams. WDM Concepts and Components- Passive optical Couplers, Isolators and Circulators

Unit-3: Digital Links:

Point to point links, power penalties, error control, Coherent detection, Differential Quadrature Phase Shift Keying. Analog Links: Carrier to noise ration, Multichannel Transmission Techniques, RF over Fiber, Radio over fiber links, Microwave Photonics.

Unit-4: Optical Networks:

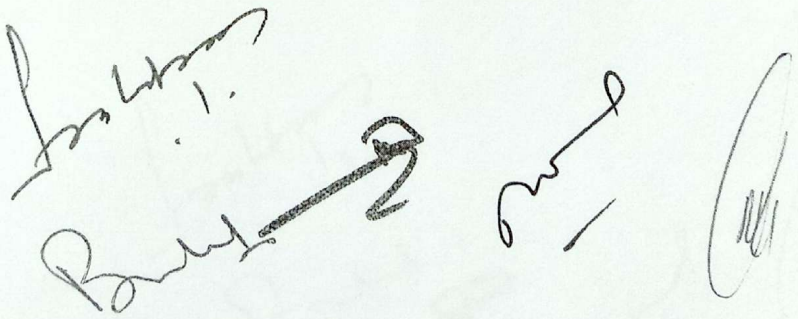
Network Concepts, Network Topologies, SONET/SDH, High speed lightwave links, Optical add/ Drop Multiplexing, Optical Switching, WDM Network, Passive Optical Networks, IP Over DWDM, Optical Ethernet, Mitigation of Transmission Impairments

Unit-5: Performance Measurement and Monitoring:

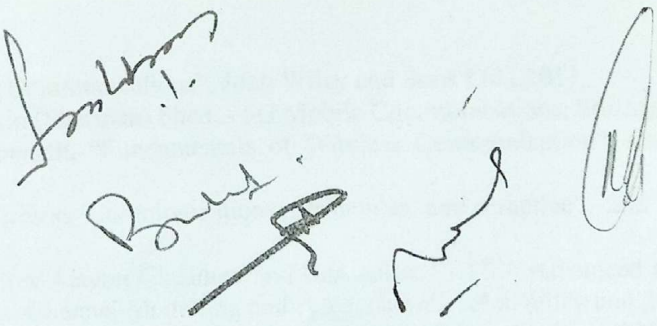
Measurement standards, Basic Test Equipment, Optical power measurement, Optical fiber characterization, Eye diagram tests, optical time domain reflectometer, optical performance monitoring, optical fiber system performance measurements.

TEXTBOOKS:

Gerd Keiser, "Optical Fiber Communications", 5th Edition, McGraw Hill.



SEMESTER III



ECEM-907

WIRELESS AND MOBILE COMMUNICATION SYSTEM DESIGN

Unit-I The cellular concept: System Design Fundamentals
Introduction, Frequency reuse, channel Assignment strategies, Handoff strategies: Prioritizing handoffs, Practical Handoff considerations, interference and system capacity: co-channel interference and system capacity, channel planning for wireless system, adjacent channel interference, power control for reducing interference, trunking and grade of service, cell splitting, sectoring,

Unit-II Mobile Radio Propagation: Large Scale Path Loss
Introduction to Radio Wave Propagation, Free-Space Propagation model, Two-Ray Model, Propagation Mechanisms: Reflection, Refraction, and Scattering, Practical Link budget design using path loss models, outdoor propagation models: Okumura and Hatta Model, Indoor propagation models, Signal penetration into buildings, Ray tracing and site specific modelling

Unit-III Mobile Radio Propagation: Small Scale Path Loss
Small scale multipath propagation, factors influencing small scale fading, Doppler shift, parameters of mobile multipath channels, time dispersion parameters model, coherence bandwidth, Doppler spread and coherence time, fast fading, slow fading, Rayleigh and Ricean distributions, Statistical models for multipath fading channels: Clarks model for flat fading

Unit-IV MIMO Systems
Types of MIMO Systems: MIMO Channel Modelling, Mathematical Modelling, Beam forming - spatial multiplexing - basic space time code design principles- Alamouti scheme - orthogonal and quasi orthogonal space time block codes, The Frequency Flat MIMO Channel, The Frequency-Selective MIMO Channel, Block Transmission, Matrix Formulations.

Unit-V ERROR PROBABILITY ANALYSIS
Error Probability Analysis for SISO Channels, Error Probability Analysis for MIMO Channels, Pairwise Error Probability and Union Bound, Coherent Maximum-Likelihood Detection, Detection with Imperfect Channel Knowledge, Joint ML Estimation/Detection.

INSTRUCTIONAL ACTIVITIES
Simulation of minimum of (2) modulation and multiple access technique for wireless communication using related simulation tools.

Reference Books:

1. Andreas Molisch F, "Wireless Communications", John Wiley and Sons Ltd., 2011.
2. Wei Xiang, Kan Zheng, Xuemin (Sherman) Shen, - 5G Mobile Communications, Springer, 2017
3. David Tse and Pramod Viswanath, "Fundamentals of Wireless Communication", Cambridge University Press, 2005.
4. Theodore S. Rappaport, "Wireless Communications: Principles and Practice", 2nd Edition, Prentice Hall of India, 2005.
5. Guillaume De La Roche, Andres Alayon Glazunov and Ben Allen, "LTE – Advanced and Next Generation Wireless Networks: Channel Modelling and Propagation", John Wiley and Sons Ltd., 2013 Andrea Goldsmith, "Wireless Communications", Cambridge University Press, 2005.
6. Michel DaoudYacoub, "Wireless Technology: Protocols, Standards, and Techniques", CRC Press, 2002.
7. Jafarkhani H, "Space-Time Coding: Theory & Practice", Cambridge University Press, 2005

3. David Tse and PramodViswanath, "Fundamentals of Wireless Communication", Cambridge University Press, 2005.
4. Theodore S. Rappaport, "Wireless Communications: Principles and Practice", 2nd Edition, Prentice Hall of India, 2005.
5. Guillaume De La Roche, Andres Alayon Glazunov and Ben Allen, "LTE – Advanced and Next Generation Wireless Networks: Channel Modelling and Propagation", John Wiley and Sons Ltd., 2013 Andrea Goldsmith, "Wireless Communications", Cambridge University Press, 2005.
6. Michel DaoudYacoub, "Wireless Technology: Protocols, Standards, and Techniques", CRC Press, 2002.
7. Jafarkhani H, "Space-Time Coding: Theory & Practice", Cambridge University Press, 2005

ECEM-911L
WIRELESS AND MOBILE COMMUNICATION SYSTEM LAB

List of Experiments

1. Study different Modem commands in AT mode?
2. Study different call commands in AT mode?
3. Study different Message commands in AT mode?
4. Add contact into SIM memory in User Mode?
5. Delete contact from SIM memory in user mode?
6. Send message via User mode?
7. Make a call in user mode?
8. Disconnect call in user mode?
9. Study of different signals.

LIST OF ELECTIVES-III SEMESTER

ECEM-912E1

ADVANCED COMMUNICATION NETWORKS

UNIT-I: Overview of Communication Networks: Telephone networks - computer networks - cable television networks - wireless networks - networking principles - digitalization - network externalities - service integration; Network Services and Layered Architecture: Traffic characterization and QoS - network services - network elements - network mechanisms - layered architecture - network bottlenecks.

UNIT-II: Broadband Networks, Multihop wireless broadband networks - mesh networks - MANET importance of routing protocols - classification of routing protocols in MANET - routing metrics - packet scheduling algorithms - admission control mechanism.

UNIT-III: Internet: Internet protocol - technology trends in IP networks - IP packet communications in mobile communication networks; TCP and UDP - Internet success and limitation - performance of TCP/ IP networks; Circuits Switched Networks: SONET - DWDM - fiber to home - DSL - intelligent network (IN) scheme - comparison with conventional systems - merits of the IN scheme - CATV and layered network - services over CATV.

UNIT-IV: ATM Networks, ATM reference model - addressing - signaling - routing- ATM Adaptation Layer (AAL) - traffic classes - traffic management and quality of service - traffic descriptor - traffic shaping - management and control - traffic and congestion control - network status monitoring and control - user/ network signaling - internetworking with ATM - IP over ATM - multiprotocol over ATM.

UNIT-V: High Performance Networks,WiMAX overview - competing technologies - overview of the physical layer - PMP mode - mesh mode - multihop relay mode; Introduction: UWB overview - time hopping UWB - direct sequence UWB - multiband UWB; Introduction: LTE and LTE– A overview - system model - specifications - frame structure - comparison with broadband technologies.

Reference Books:

1) Jean Warland and PravinVaraiya, "High Performance Communication Networks", 2nd Edition, Harcourt and Morgan Kanffman Publishers, London, 2008.
2) Leon Gracia and Widjaja, "Communication Networks", Tata McGraw Hill, 2008.
3) LumitKasera and PankajSethi, "ATM Networks: Concepts and Protocols", Tata McGraw Hill, 2007.
4) Jeffrey G. Andrews, Arunabha Ghosh and RiasMuhamed, "Fundamentals of WiMAX Understanding Broadband Wireless Networking", Prentice Hall of India, 2008.
5) Amitabha Ghosh and RapeepatRatasuk, "Essentials of LTE and LTE-A", Cambridge University, 2011.
6) David Tung Chong Wong, Peng-Yong Kong, Ying-Chang Liang, KeeChaing Chua and Jon W. Mark, "Wireless Broadband Networks", John Wiley and Sons, 2009.

MIMO WIRELESS COMMUNICATIONS

Unit-I MIMO Systems

Introduction to MIMO Wireless communications, MIMO System Model, MIMO Zero- Forcing (ZF) Receiver: Properties of the Zero-Forcing Reciver Matrix, Principle of Orthoganality Interpretation of ZF Receiver, MIMO MMSE Receiver, Singular Value Decomposation (SVD) of the MIMO, Examples of SVD.

Unit-II MIMO Capacity and Coding

Introduction to MIMO information theory, Singular value Decomposition and MIMO Capacity, optuimal MIMO Capacity, Asympotic MIMO Capacity, Almouti and Space-Time Codes, Almouti code procedure, Non-linear MIMO Receiver- V-BLAST

Unit-III MIMO Channel Models

Statistical MIMO Model: Spatial Correlation, PAS Model, Statistical Model of Correlated Fading Channel, Generation of correlated MIMO Channel coefficients, I- METRA MIMO Channel Model, 3GPP MIMO Channel Model, SCM Link- Level Channel Parameters, SCM Link- Level Channel Modeling, Spatial Correlation of Ray- based Channel Model

Unit-IV Antenna Diversity and Space- Time Coding Techniques

Antenna Diversity: Receive Diversity, Transmit Diversity, Space- Time Coding (STC): System Model, Pairwise Error Probability, Space- Time Code Design, Almouti Space- Time Code, Generalization of Space- Time Block Coding, Decoding for Space- Time Block Codes, Space- Time Trellis Code.

Unit- V Multi- User MIMO

Mathematical Model for Multi-User MIMO System, Channel Capacity of Multi- User MIMO System: Capacity of MAC, Capacity of BC, Transmission methods for Broadcast Channel: Channel inversion, block diagonalization, Dirty Paper Coding (DPC), Tomlinson – Harashima Precoding

Textbook:

1. R.S. Kshetrimayum, *Fundamentals of MIMO Wireless Communications*, Cambridge University Press, 2017.
2. Yong-Soo Cho Jaekwon King MIMO- OFDM Wireless Communications with MATLAB

References:

A.Chockalingam and B. Sundar Rajan, *Large-MIMO systems,* Cambridge University Press, 2014

Brijesh Kumbhani, Rakhesh Singh Kshetrimayum, *MIMO Wireless Communications over Generalized Fading Channels,* CRC Press, 2017

T.L.Marzetta,, E.G. Larsson, h. Yang and H. Q. Ngo, *Fundamentals of massive MIMO,* Cambridge University Press, 2016

ECEM-912E3
INTERNET OF THINGS

UNIT-I: Introduction to Internet of Things: Definition and Characteristics of IoT, Physical Design of IoT – IoT Protocols, IoT communication models, Iot Communication APIs IoT enabaled Technologies – Wireless Sensor Networks, Cloud Computing, Big data analytics, Communication protocols, Embedded Systems, IoT Levels and Templates, Challenges in IoT Design, Domain specific applications of IoT . Home automation, Industry applications, Surveillance applications, Other IoT applications.

UNIT-II: Network & Communication aspects Wireless medium access issues, MAC protocol survey, Survey routing protocols, Sensor deployment & Node discovery, Data aggregation & dissemination .

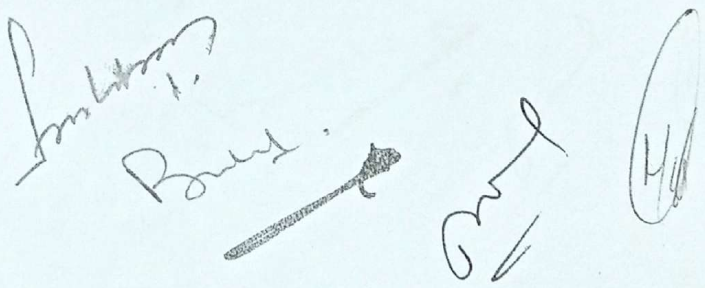
UNIT-III: IoT and M2M : Software defined networks, network function virtualization, difference between SDN and NFV for IoT Basics of IoT System Management with NETCOZF, YANG- NETCONF, YANG, SNMP NETOPEER

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

UNIT-V: IoT Physical Devices and Endpoints: Introduction to Raspberry PI-Interfaces (serial, SPI, I2C) Programming – Python program with Raspberry PI with focus of interfacing external gadgets, controlling output, reading input from pins.**IoT Physical Servers and Cloud Offerings**: Introduction to Cloud Storage models and communication APIs Webserver – Web server for IoT, Cloud for IoT, Python web application framework Designing a RESTful web APIs

Reference Books:

1.Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2014.
2. Waltenegus Dargie, Christian Poellabauer. "Fundamentals of Wireless Sensor Networks: Theory and Practice" .
3. Arshdeep Bahga and Vijai Madisetti "Internet of Things: A Hands-on Approach", Bahga & Madisetti, 2014



CEM-913 Project
CEM-914 Seminar-I

Project description

The project work shall be carried out by students individually. In the project work, students shall choose a specific topic/area for the project. The selected areas shall encompass recent and emerging trends in technologies that prove beneficial for society in general. Supervisor will be assigned to each student in the beginning of the 3rd semester of their course. Each student at the end of the course will submit a Project report and the workable prototype/Simulation regarding the project and the same will be evaluated by the external examiner for final award of the course. The student needs to submit a working prototype/Simulation with a project report encompassing full scale work. Moreover, the student needs to present a Seminar of at least thirty minute duration before an audience comprising of the faculty and students of the department concerned.

ECEM-915 Dissertation
ECEM-916 Seminar -II

In the Thesis part, the students are required to carry out the project work on a specific topic/area and conclude with a hardware prototype or a software solution preferably providing a scientific solution to an existing problem feared by the society at large. The dissertation work is to be carried out in the last semester, however can be an execution of the project work. The students need to submit the dissertation report at the end of the programme. These reports will be evaluated by at least one external examiner .A viva voice exam of individual students shall be conducted on the dissertation work by an external examiner in partial fulfillment for the award of the degree of Masters in Technology. Moreover, the student needs to present a Seminar of at least thirty minute duration before an audience comprising of the faculty and students of the department concerned before the last thesis presentation date.

M.Tech. (Electronics &communication Engineering)

BATCH-2019 & onwards

Curriculum & Scheme of Examination

Total number of credits required for the completion of programme: 84

SEMESTER -I

S.no.	Course Code	Course Title	Teaching Periods Per Week			Hrs.	Cdts.	Evaluation(Marks)		
			L	T	P			Int.	Ext.	Total.
1.	ECEM-901	Advanced Engineering Mathematics-I	3	1	0	4	4	40	60	100
2.	ECEM-902	Embedded Systems	2	1	0	3	3	40	60	100
3.	ECEM-903	VLSI Design	2	1	0	3	3	40	60	100
4.	ECEM-904	Antenna Theory and Design	2	1	0	3	3	40	60	100
5.	ECEM-905E	Elective - I	2	1	2	5	4	40	60	100
6.	ECEM-901L	Embedded Systems Lab.	0	0	4	4	2	40	60	100
7.	ECEM-902L	VLSI Design Lab	0	0	4	4	2	40	60	100
8.	ECEM-903L	Antenna Theory and design lab	0	0	4	4	2	40	60	100
	Total						23	320	480	800

SEMESTER -II

S.no.	Course Code	Course Title	Teaching Periods Per Week			Hrs.	Cdts.	Evaluation(Marks)		
			L	T	P			Int.	Ext.	Total.
1.	ECEM-906	Advanced Engineering Mathematics-II	3	1	0	4	4	40	60	100
2.	ECEM-907	Digital System design	2	1	0	3	3	40	60	100
3.	ECEM-908	Advanced DSP	2	1	0	3	3	40	60	100
4.	ECEM-909	Advanced Digital Communication Systems	2	1	0	3	3	40	60	100
5.	ECEM-910E	Elective - II	2	1	2	4	4	40	60	100
6.	ECEM-907L	Digital System design Lab.	0	0	4	4	2	40	60	100
7.	ECEM-908L	Advanced DSP lab	0	0	4	4	2	40	60	100
8.	ECEM-909L	Advanced Digital Communication Systems Lab.	0	0	4	4	2	40	60	100
10.	Total						23	320	480	800

SEMESTER - III

Course Code	Course Title	Teaching Periods Per Week			Hrs.	Cdts.	Evaluation(Marks)		
		L	T	P			Int.	Ext.	Total.
ECEM-911	Wireless & mobile communication Systems	2	1	0	3	3	40	60	100
ECEM-912E*	Elective -III	2	1	2	5	4	40	60	100
ECEM-911L	Wireless & mobile communication Systems Lab	0	0	4	4	2	40	60	100
ECEM-913	Project	0	2	12	14	8	100	150	250
ECEM-914	Seminar-I	0	2	0	2	2	50	00	50
Total						**19**	**270**	**330**	**600**

SEMESTER - IV

Course Code	Course Title	Teaching Periods Per Week			Hrs.	Cdts.	Evaluation(Marks)		
		L	T	P			Int.	Ext.	Total.
ECEM-914	Dissertation	4	6	14	24	17	100	400	500
ECEM-915	Seminar -II	0	2	0	2	2	100	100	200
Total						**19**	**200**	**500**	**700**

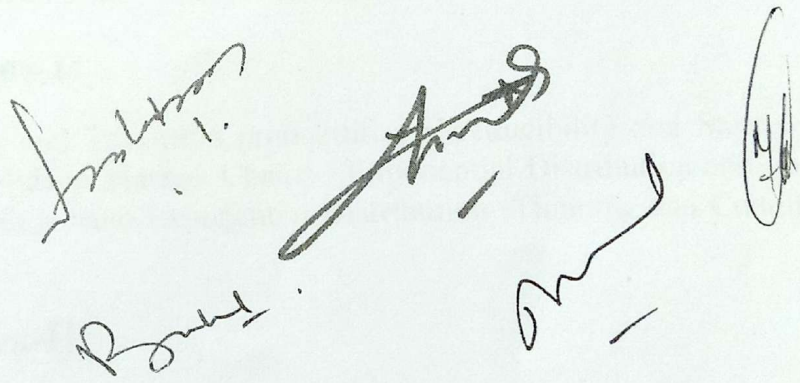
Note: The Dissertation should be done at the home institution's and when required the co-Guides can be chosen from industry or reputed instituitions.Student should be encouraged to publish technical/research article as their dissertation work in UGC approved journal.

The student should opt one of the following course as Elective-II:

S.No.	Course Title of Elective	Code
1.	CMOS Mixed signal design	ECEM-910E1
4.	Machine learning	ECEM-910E2
5.	Optical Communication Systems	ECEM-910E3

The student should opt one of the following course as Elective-III:

S.No.	Course Title of Elective	Code
1.	Advanced Communication Networks	ECEM-912E1
4.	Advanced Wireless MIMO Systems.	ECEM-912E2
5.	Internet of Things.	ECEM-912E3



ECEM-901

ADVANCED ENGINEERING MATHEMATICS - I

Unit-1: Introductory Probability:

Defining Random Variables (RVs) Events, Measurability, Independence •Sample Spaces, Events, Measures, Probability •Independence, Conditional probability, Bayes' theorem Random Variables •RVs: Bernoulli, Binomial, Geometric, Poisson; Uniform, Exponential, Normal, Lognormal •Expectations, Moments and Moment generating functions Random Vectors •Random Vectors: Joint and Marginal distributions, Dependence, Covariance, Copulas •Transformations of random vectors, Order statistics

Unit-2: Intermediate Probability-I:

Manipulating RVs Conditioning RVs •Conditional Distribution of a RV •Computing probabilities and expectations by conditioning •IT Application: Time-to-a-pattern for password security Inequalities and Limits of Events, RVs, Distributions •Inequalities: Markov, Chebyshev, Jensen, Holder. •Convergence of RVs: Weak and Strong laws

Unit-3: Intermediate Probability-II:

Central limit theorem, Distributions of extreme •Marketing Application: Multinomial choice model Classifying and Ordering RVs •Increasing failure rate and Polya densities •Sochastic order, Hazard rate order, Likelihood ratio order, Convex order •Marketing Applications: Concavity of profits

Unit-4: Stochastic Processes-I:

Markov Chains •Markovian property and Transition probabilities •Irreducibility and Steady-State probabilities •Generic Applications: Hidden Markov Chains : Exponential Distribution and Poisson Process •Construction of Poisson Process from Exponential Distribution •Thinning and Conditional Arrival Times •

Unit-5: Stochastic Processes-II:

Service Applications: Waiting Times, Normal Distribution and Brownian Process •Construction of Brownian Process from Normal Distribution •Hitting Times and Maximum Values •Finance Applications: Option Pricing and Arbitrage Theorem

BOOKS:

1. Probability, Random Variables & Random Signal Principles -Peyton Z. Peebles, TMH, 4th Edition, 2001.
2. Probability and Random Processes-Scott Miller, Donald Childers,2Ed,Elsevier,2012
3. Theory of probability and Stochastic Processes-Pradip Kumar Gosh, University Press
4. Probability and Random Processes with Application to Signal Processing - Henry Stark and John W. Woods, Pearson Education, 3rd Edition.
5. Probability Methods of Signal and System Analysis- George R. Cooper, Clave D. MC Gillem, Oxford, 3rd Edition, 1999.
6. Statistical Theory of Communication -S.P. Eugene Xavier, New Age Publications 2003
7. Probability, Random Variables and Stochastic Processes Athanasios Papoulis and S.Unnikrishna Pillai, PHI, 4th Edition, 2002.

ECEM-902

EMBEDDED SYSTEMS

Unit-1

The PIC Microcontrollers: Introduction to Computer Systems, Introduction to Harvard & Von Neuman Architectures, CISC & RISC,Architecture,History and features, Microcontrollers and Embedded Processors, Overview of PIC- 18 Family. Working Register in the PIC.PIC-18 File Registers, PIC Data format and Directives, Program counter and program ROM space in the PIC -18.Program Ram Space in the PIC-18.Viewing registers and memory with MPLAB Simulator.

Unit-2

Port programming in PIC-18: TRIS register role in outputting, TRIS register role in inputting, Reading LATx for ports, BSF, BCF, BTG, BTFSS, and BTFSC instructions. Bank Switching in the PIC-18.

Unit-3

PIC18F458: PIC18F458 pin diagram, Configuration Registers (CONFIG1H, CONFIG2L), programming of Timers 0and 1.PIC-18 Serial Port programming. SPBRG register and baud rate in PIC-18.TXREG, RCREG TXSTA and RCSTA registers. Importance of the TXIF Flag.

Unit-4

Interrupt programming in assembly and C: Sources of interrupts in the PIC-18, steps in executing an interrupt, Interrupt priority in PIC-18, steps in enabling an interrupt. programming using Microchip MPLAB software.

Unit-5

Interfacing with PIC-18: interfacing and programming of LCD with pic-18 using C and assembly programming, interfacing of 4x4 keypad to PIC-18.Programming PIC18F458 ADC in C and assembly.DAC interfacing and programming in C. Interfacing of temperature sensorLM35 to the PIC-18.DC Motor interfacing and PWM.

Text and Reference Books:

1. Designing Embedded Systems with PIC Microcontrollers: Principles and Applications, 2nd Edition, Tim Wilmshurst,
Elsevier Publication.
2. Interfacing PIC Microcontrollers Embedded Design by Interactive Simulation by Martin Bates, Elsevier Publication.
3. PIC Microcontroller and Embedded Systems Using Assembly and C for PIC 18 by Muhammad Ali Mazidi, Rolin D.
McKinlay and Danny Causey, Pearson Publication.

ECEM 902L

EMBEDDED SYSTEMS

List of Experiments

1. Study of implementation, analysis and interfacing of LED Bar Graph using Microchip MPLAB software and PIC-16/18.
2. Study and analyze the interfacing of 16x2 LCD Microchip MPLAB software and PIC-16/18.
3. Study of implementation, analysis and interfacing of seven segment display using PIC-16/18.
4. Study and Interfacing of ADC Microchip MPLAB software and PIC-16/18.
5. Study and Interfacing of DAC Microchip MPLAB software and PIC-16/18.
6. To study & observe direction control of Steeper Motor using NV500X series Microcontroller Development Platform using PIC-16/18
7. To study & implement Steeper Motor angle control using NV500X series PIC-18 Microcontroller Development Platform
8. To study & implement ultrasonic sensor for finding range using Arduino UNO Development Platform
9. To study & implement pulse sensor using Arduino UNO Development Platform
10. To study how advanced microcontroller PIC 16/18 pins are used as input and output pin using NV500X series Microcontroller Development Platform

ECEM-903

VLSI DESIGN

UNIT I: Issues in Digital Integrated Circuit Design, Review of MOS transistor models. –Static and Dynamic Behavior, Secondary effects.

CMOS Inverter Static and Dynamic Behavior, Noise Margin, Power Consumption and Power Delay Product, Latch up, Technology Scaling.

UNIT II: Low power design, scaling effects, Scaling versus power consumption, power reduction using Voltage scaling and multiple voltage supplies, Timing Issues in synchronous design. Interconnect Parasitics: Resistance, Capacitance and Inductance.

UNIT III: Circuit design style, Non-clocked logic families and clocked logic families, CMOS logic families including static, dynamic and dual rail logic,DCSL. Logic gates- Static CMOS Design: Complementary CMOS, Ratioed Logic, Pass Transistor Logic. Dynamic CMOS Design: basic principles, performance of dynamic logic, Noise consideration, Power consumption in CMOS gates – switching activity, Glitches. Logical effort in basic CMOS circuits,Predicting Delay, Logical area and logical efficiency, Logical paths,

UNIT IV: Sequential Circuits: introduction Bistability, bistable elements, CMOS static flip-flop, Pseudostatic latch, Dynamic two-phase flip-flop, C2 MOS latch, NORA (no race)-CMOS logic design style, CMOS D latch and edge triggered Flip Flop, Schmitt Trigger, Astable and monostable circuits.

UNIT V: Arithmetic Building blocks: CMOS full Adder and Multiplier, organisation of a static RAM, MOS static RAM cell, 4T SRAM.

Reference Books:

1) Neil Weste and K. Eshragian, "Principles of CMOS VLSI Design: A System Perspective", Pearson Education (Asia) Pvt. Ltd., 2nd Edition ,2000.
2) Wayne Wolf, "Modern VLSI design: System on Silicon" Pearson Education, Second Edition, 1998
3) Douglas A Pucknell& Kamran Eshragian , "Basic VLSI Design" PHI 3rd Edition (original Edition – 1994)
4) Sung Mo Kang &YosufLeblebici, "CMOS Digital Integrated Circuits: Analysis and Design", McGraw- Hill, 3rd Edition, 2003

ECEM-903L

VLSI DESIGN LAB

LIST OF EXPERIMENTS FPGA BASED EXPERIMENTS

1. Write VHDL code for two input ADD Gate and implement using Spartan FPGA.
2. Design 4:1 multiplexer using case statement, and hardware description language.
3. Write VHDL code for 1:4 De-multiplexers and implement using Spartan FPGA.
4. Designing of D Flip flop using Asynchronous Reset.
5. Designing of D Flip Flop using synchronous Reset.
6. Designing of D Latch with reset.
7. Design of 2:1 Multiplexer using "IF Statement".
8. Designing of T Flip Flop using Asynchronous Reset
9. Designing of BCD to Seven Segment Decoder.
10. Designing of counter to count from 0 to F. Output of the counter to be displayed on Seven-segment.
11. Designing of counter to count from 0 to F. Output of the counter to be displayed on seven-segment

ECEM-904

ANTENNA THEORY & DESIGN

Unit-1: Antenna Fundamentals and Definitions: Radiation mechanism - over view. Electromagnetic Fundamentals. Solution of Maxwell's Equations for Radiation Problems. Ideal Dipole. Radiation Patterns. Directivity and Gain. Antenna Impedance. Radiation Efficiency. Antenna Polarization

Unit-2: Resonant Antennas: Wires and Patches. Dipole antennas. Yagi - Uda Antennas. Micro strip Antenna.**Arrays**: Array factor for linear arrays. uniformly excited. equally spaced Linear arrays. pattern multiplication. directivity of linear arrays. non- uniformly excited -equally spaced linear arrays. Mutual coupling. multidimensional arrays. phased arrays. feeding techniques. perspective on arrays.

Unit-3: Broad band Antennas: Traveling - wave antennas. Helical antennas. Biconical antennas. sleave antennas. and Principles of frequency - independent Antennas. spiral antennas. and Log - Periodic Antennas. **Aperture Antennas:** Techniques for evaluating Gain. reflector antennas - Parabolic reflector antenna principles. Axi -symmetric parabolic reflector antenna. offset parabolic reflectors. dual reflector antennas. Gain calculations for reflector antennas. feed antennas for reflectors. field representations. matching the feed to the reflector. general feed model. feed antennas used in practice.

Unit-4: Antenna Synthesis: Formulation of the synthesis problem. synthesis principles. line sources shaped beam synthesis. linear array shaped beam synthesis — Fourier Series. Woodward — Lawson sampling method. comparison of shaped beam synthesis methods. low side lobe narrow main beam synthesis methods Dolph Chebyshev linear array. Taylor line source method.
Method of Moments : Introduction to method of Moments. Pocklington's integral equation. integral equations and Kirchoff's Networking Equations. Source Modeling Weighted residuals formulations and computational consideration. calculation of antenna and scatter characteristics.

Unit-5: CEM for Antennas : Finite Difference Time Domain Method Geometrical Optics Wedge diffraction theory. ray fixed coordinate system. uniform theory of wedge diffraction. E - Plane analysis of Horn antennas. Cylindrical parabolic antenna. radiation by a slot on a finite ground plane. radiation by a monopole on a finite ground plane. equivalent current concepts. multiple diffraction formulation. by curved surfaces. physical optics. method of stationary phase. **Basic Concepts of Smart Antennas**: Concept and benefits of smart antennas. Fixed weight beam forming basics. Adaptive beam forming.**Instructional Activities:** Design. simulation and analysis of different antennas for wireless applications using related simulation tools.

Reference Books:

1. Stutzman and Thiele, "Antenna Theory and Design", 2nd Ed. John Wiley and Sons Inc.
2. C. A. Balanis: "Antenna Theory and Design", John Wiley, 3rd Edition, 2005
3. Kraus J D and Marhefka R J, "Antennas for All Applications", 3rd Edition, Tata McGraw Hill, 2002.
4. Elliot R S, "Antenna Theory and Design", Revised Edition, John Wiley and Sons, India, 2006.
5. F. B. Gross, "Smart Antennas for Wireless Communications", McGraw-Hill., 2005.
6. Jordan E C and Balmain K G, "Electromagnetic Waves and Radiating Systems", 2nd Edition, Pearson Education, 2015.

ECEM-904L

ANTENNA THEORY AND DESIGN LAB.

LIST OF EXPERIMENTS

1. Study of the structure and operation of wired, aperture, planar and array antennas.
2. Proof of Inverse square law
3. Proof of Reciprocity theorem
4. Measurement of radiation pattern of all wired and aperture antennas
5. Measurement of radiation pattern of planar antennas
6. Measurement of radiation pattern of reflector antennas
7. Measurement of radiation pattern of array anLennas
8. Analysis of co-polarization and cross polarization
9. Study of variation in the radiation strength at a given distance from the antenna
10. Study of Yagi-UDA 5 Element Simple dipole antenna

List Of First Semester Electives:-

ECEM-905E1

MICROWAVE INTEGRATED CIRCUITS

UnitI: MICROSTRIP LINES DESIGN ANALYSIS
Introduction, Types of MICs and their technology, Propagating models, Analysis of MIC by conformal transformation, Numerical method, Hybrid mode analysis, Losses in microstrip, Introduction to slot line and coplanar waveguide.

Unit II: COUPLED MICROSTRIP, DIRECTIONAL COUPLERS AND LUMPED ELEMENTS
Introduction to coupled microstrip, Even and odd mode analysis, Branch line couplers, Design and fabrication of lumped elements for MICs, Comparison with distributed circuits.

Unit III: NON-RECIPROCAL COMPONENTS AND ACTIVE DEVICES
Ferromagneticsubstratesandinserts,Microstripcirculators,Phaseshifters,Microwavetransistors, Parametric diodes and amplifiers, PIN diodes, Transferred electron devices, Avalanche, IMPATT, BARITTdiodes.

Unit IV: MICROSTRIP CIRCUIT DESIGN AND APPLICATIONS
Introduction,Impedancetransformers,Filters,Highpowercircuits,Lowpowercircuits,MICsin Satellite andRadar.

UnitV: MMICTECHNOLOGY
Fabrication process of MMIC, Hubrid MMICs, Dielectric substances, Thick film and thin film technology and materials, Testing methods, Encapsulation and mounting of devices.

Text Book:

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

Reference Book:

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

ECEM-905E2

Advanced Analog System Design

Unit I - Review of transistor basis-Transistor as a switch, transistor as amplifier. Problems in the transistor amplifier. Temperature drift and device to device variation. How to solve them. 3-transistor op amp to solve the above problem. Use of op-amp for different applications and basic issues in use of op amps. Designing a linear power supply using op amp.

Unit II – Design of heat sink and design of transformer for the linear power supply. Design of low drop out regulators. Design of temperature indicator using IC sensors. Errors due to resistance drift, Op amp offset voltage drift, offset current drift. Error budgeting. Design of an on/off temperature controller. Design of different types of heater drive circuits.

Unit III- Design of proportional temperature controller circuit using thermocouple temperature Sensor. Error budgeting. Design of heater drive circuits using triacs and transistors. Use of pulse width modulation circuits.Use of MOSFETS . Short circuit protection techniques. Design of PID temperature controllers. Basics of PID parameter selection. Design of constant current sources with error budgeting. Design of 4-20 ma current transmitter for resistance sensors.

Unit IV - Design of 4-20 ma current transmitter for LVDT sensor.Design of oscillator circuits. Errors in the op amp circuit for ac amplifiers, Errors in ac application. Use of Instrumentation amplifier and its basis. Designing of a capacitor measurement circuit. Ratio transformer technique. Differential capacitor measurement. Errors in the capacitance measurement.

Unit V - Phase sensitive detection and use of the same for lock -in amplifier design. ADC /DAC converter types. Use of ratio metric converters. Error budgeting for the different types of ADC/DAC.

Books:

1. Franco S, Design with Operational Amplifiers and Analog Integrated Circutis, McGraw Hill Book Co., 1988.
2. Paul Horowitz and Winfield Hill, The Art of Electonics (2nd Edition), Cambridge University Press, 1992.

ECEM-905E3

Solar Engineering Technology

Unit I:

Introduction to Solar Engineering, Energy and Dependence on External Sources and Sun, Physical Descriptions and Reactions.

Unit II:

Sun - Earth Geometry, Terminology Extra - Terrestrial Radiation Terrestria Radiation, Measuring Instruments. Estimation of Solar Radiation or Details,

Unit III:

Radiation Processing - Long Term, Evaluation of the Apparent Sunrise and Sunset Angles, Estimation of Daily/Monthly Average daily Tilt Factor Under Terrestrial Conditions, Solar Colector Basics,

Unit IV:

Transmission - Absorptance Product, Daily (Or Monthly Average Daily) Transmittance - Absorptance Product Analytical Evaluation, Theory of Flat Plate Collectors - Liquid Based (A), Theory of Flat Plate Collectors - Liquid Based (B), Theory of Flat Plate Collectors - Liquid Based (C), Mean temperature and Heat Capacity Effects, Theory of Air Based Solar Flat Plate Collectors, Concentrating Collectors, Compound Parabolic Collectors, Device and System Performance,

Unit V:

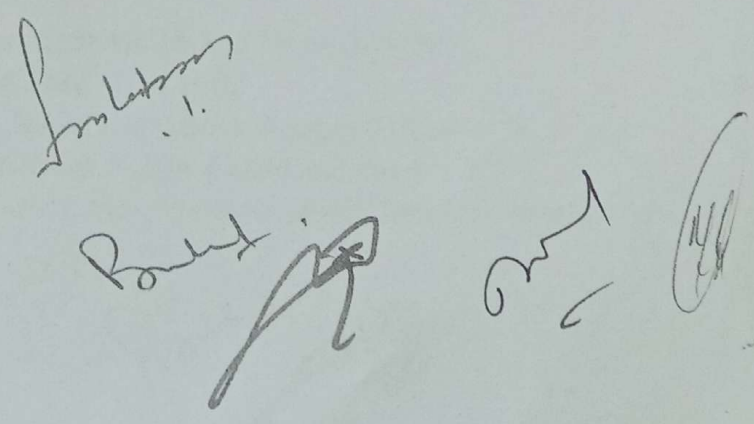
Long Term Solar Energy System Performance, Long Term Solar Energy System Performance Simplified Design Methods, Monthly Average Daily Utilizability, The phi(bar) - f chart method Tank Losses and Finite Heat Exchanger, Economic Analysis, Life Cycle Savings : The P1 and P2 Method, Passive Devices, Passive Architecture, Overhangs and Wing Walls.

Text Books

Solar engineering of thermal Process by J A Duffie and W A Beekman.

1. Solar Engineering by W M Robert.

SEMESTER II



ECEM-906
ADVANCED ENGINEERING MATHEMATICS-II

Unit-1: : QUEUING THEORY

General concepts of queuing system and Introduction to stochastic processes, Measures of performance, Arrival and Service processes, Kendall's notation, Single server and multi-server models, channels in parallel with limited and unlimited queues –M/M/1/K, M/M/C. Queues with unlimited service, Finite source queues, Applications of Simple Queuing Decision Models, Design and Control Models.

Unit-2: RELIABILITY MODELS

Basics of reliability, classes of life distributions, Reliability function, Mean time before failure (MTBF)and Hazard rate of Exponential and Weibull distributions, Reliability of configurationsseries, parallel, mixed configuration, k out of n system and standby system, Reliability models, Concepts and definitions of Preventive Maintenance, Corrective Maintenance and Age Replacement.

Unit-3: LINEAR PROGRAMMING-I

Introduction, geometry, duality, sensitivity analysis. Simplex method, large scale optimization, network simplex. Ellipsoid method, problems with exponentially many constraints, equivalence of optimization and separation. Convex sets and functions, generalized inequalities and convexity, convex optimization problems, quasi-convex, linear, quadratic, geometric, vector, semi-definite.

Unit-4: LINEAR PROGRAMMING-II

Duality, optimality conditions, sensitivity analysis. Unconstrained minimization, equality constrained minimization and interior point methods. Integer Programming: formulations, complexity, duality. Lattices, geometry, cutting plane and branch and bound methods. Mixed integer optimization.

Unit-5: APPLIED LINEAR ALGEBRA

Linear independence ,Linear transformations, Cramer`s rule, volume and linear transformations, Vector spaces and subspaces, Null spaces, column spaces, and linear transformations, Linearly independent sets; bases, Coordinate system, The dimension of a vector space, Matrix of a linear transformation, Linear models in business, science and engineering .

1. Sen, M. K. and Malik, D. F.-Fundamental of Abstract Algebra, Mc. Graw Hill
2. Khanna, V. K. and Ghamdri, S. K.- Course of Abstract Algebra, Vikash Pub.
3. Halmos, T. R.-Naïve Set Theory, Van Nostrand
4. Scarborough, J. B.-Numerical Mathematical Analysis, Oxford University Press
5. Cone, S. D.-Elementary Numerical Analysis, Mc. Graw Hill.

6Mukhopadhyay ,P.-Mathematical Statistics ,New Central Book Agency 7. Kapoor, V. K and Gupta, S.C.-Fundamental of Mathematical Statistics, Sultan Chand and Sons

7. Gross, D., Shortle, J.F, Thompson, J.M and Harris, C. M., —Fundamentals of Queueing Theory", Wiley Student 4th Edition, 2014.

ECEM-907

DIGITAL SYSTEM DESIGN

UNIT I:

Review of flip-flop basics -Excitation tables, and characteristic equations of flip-flops. Analysis and Design of synchronous sequential circuits-state table , state diagram and State- Equations Derivation of state table and state diagrams for sequential circuits. State Reduction, state assignment, Rules for state assignments.

UNIT II:

Design of sequential circuits using state assignment rules for assigning states. Design of the clocked sequential circuits for given state diagram. Design of the clocked sequential circuits for given state diagram using state reduction technique. Lockout conditions. Design of clocked sequential circuits avoiding lock-out condition.

UNIT III:

Sequence generators using counters and shift registers. Design digital system to generate the sequence 1101011 using JK flip-flops. Design digital system to generate the sequence 1101011 by shift register method. Modulus –N synchronous counter. Design of Digital watch. Design of 3-bit up/down counter.

UNIT IV:

Deterministic Machine ,Mealy machine, Block diagram of Mealy machine Moore machine, block diagram of Moore machine Hazards, gate delays, the generation of spikes, production of static hazards in combinational circuits. Elimination of static hazards

UNIT V:

Design and implementation of carry look ahead adder circuit. Implementation of Boolean functions using PLA and PAL.

Reference Books:

1. Digital logic Design by B. Holdsworth (Tata McGraw-Hill)
2. VHDL Programming by Example by Douglas L. Perry(Tata McGraw-Hill).
3. Digital Logic Applications and Design by John M. Yarbrough.(Thomson Brooks/cole).
4. Introduction to Logic Design by Alan B. Marcovitz(Tata McGraw-Hill).

ECEM-907L

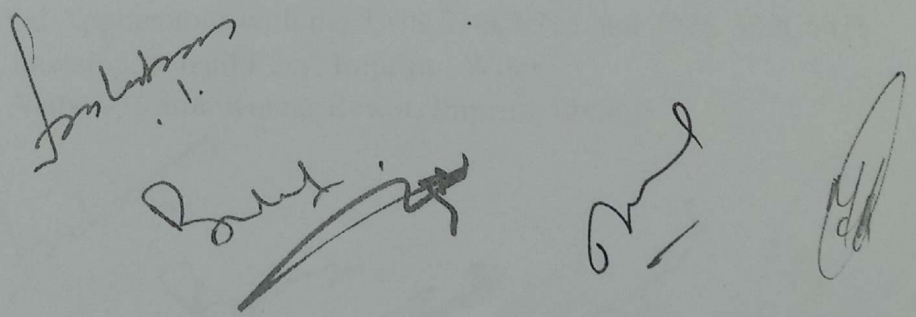
DIGITAL SYSTEM DESIGN LAB

List of experiments:

1. Write VHDL code for basic AND gate.
2. Using VHDL program, Design J-K Flip-Flop using (if-then-else) Sequential Constructs
3. Designing of D Flip flop using Asynchronous Reset.
4. Design of 2:1 Multiplexer using "IF Statement".
5. Designing of BCD to Seven Segment Decoder.
6. Write VHDL code for Synchronous 8-bit Johnson Counter.
7. Designing of T Flip Flop using Asynchronous Reset
8. Using VHDL program, Design a decimal counter that counts up from 0 to 9.

Learning beyond Syllabus

9. Write a VHDL program for memory.
10. Write VHDL program to perform Arithmetic Logic Unit (ALU) operation.



ECEM-908

ADVANCED DSP

Unit-1: REVIEW OF FILTER CONCEPTS- Review of design techniques and structures for FIR and IIR filters, representation of numbers, quantization of filter coefficients, round-off effects in digital filters.

Unit-2: FILTERS: Weiner filtering, optimum linear prediction, Levinson-Durbin algorithm, prediction error filters. Adaptive filters: FIR adaptive LMS algorithm, Convergence of adaptive algorithm, fast algorithms. Applications: Noise canceller, echo canceller and equalizer.

Unit-3: MULTIRATE DIGITAL SIGNAL PROCESSING: Introduction, Decimation by a factor D, Interpolation by a factor I, sampling rate conversion by rational factor I/D, implementation of sampling rate conversion, multistage implementation of sampling rate conversion, sampling rate conversion of band pass signals, sampling rate conversion by an arbitrary factor, application of Multirate signal processing, digital filter bank, two-channel quadrature-mirror filter bank, M-channel QMF bank.

Unit-4: WAVELET TRANSFORM: Introduction to wavelet transform- Short Time Fourier Transform (STFT), Wavelet transform, Haar wavelet and Multirate resolution analysis, Daubechies wavelet, some other standard wavelets, applications of wavelet transform.

Unit-5: POWER SPECTRUM ESTIMATION: Estimation of spectra from finite-duration observation of signals, non-parametric methods for power spectrum estimation, parametric methods for power spectrum estimation,filter bank methods, Eigen analysis algorithms for spectrum estimation.

Text Books:

1) Digital Signal Processing : Principles, Algorithms, and Applications, 4/e, Authors : John G. Proakis Dimitris G Manolakis Imprint : Pearson Education
2) Digital Signal Processing, Authors, Oppenheim, Alan V, Schafer, Ronald W., PHI

Reference Books:

1) Advanced Digital Signal Processing, Authors: Dr. Shaila D. Apte, Imprint: Wiley
2) Digital Signal Processing, 3/e, Authors: S.K.Mitra, Imprint : McGraw Hill
3) Digital Signal Processing and Applications with the TMS 320C6713 and TMS 320C6416 DSK, 2/e,Authors: RulphChassaing,Donald Reay, Imprint : Wiley
4) Digital Signal Processing, Authors: Tarun Kumar Rawat, Imprint: Oxford

5) Digital Signal Processing, Spectral Computation and Filter Design, Authors:CHI-Tsong Chen, Indian Edition, Imprint: Oxford
6) Theory and Applications of Digital Signal Processing,Authors: Lawrence R. Rabiner, Bernard Gold,Imprint:Prentice- Hall
7) Digital Signal Processing, Authors:Thomas J. Cavicchi, Imprint: Wiley
8) Modern Digital Signal Processing, Authors: V. Udayshankar, Imprint: PHI
9) Digital Signal Processing using MAT and Wavelets,2/e, Authors: Michael Weeks, Imprint: Jones & Bartlett Publishers.

ECEM-908L

ADVANCED DSP LAB

1) Write a program for cascade and parallel realization of an FIR transfer function.
2) Write a program for cascade and parallel realization of an IIR transfer function.
3) Write a program to design a Butterworth IIR Band Pass Filter.
4) Write a program to design an FIR filter using various window functions.
5) Write a program to implement the interpolation and decimation.
6) Write a program to design two channels QMF Bank.
7) Write a program to compute the CWT.
8) Write a program to compute the DWT.
9) Write a program to design a wavelet filter.
10) Write a program to find the magnitude response of a wavelet.

ECEM-909

ADVANCED DIGITAL COMMUNICATIONS SYSTEMS

UNIT I:Introduction Elements of Digital Communication System:

Communication channels and their characteristics - mathematical models for channels - representation of digitally modulated signals - performance of memoryless modulation methods - signalling schemes with memory - CPFSK - CPM.

UNIT II: Optimum Receivers for AWGN Channels Waveform and Vector Channel Models: Detection of signals in Gaussian noise - optimum detection and error probability for band limited signalling and power limited signalling - non coherent detection - comparison of digital signalling methods - lattices and constellations based on lattices - detection of signalling schemes with memory - optimum receiver for CPM - performance analysis for wireline and radio communication systems; Introduction to partially coherent, double differentially coherent communication systems.

UNIT III:Channel Coding Introduction to Linear Block Codes:

Convolution coding - Tree, Trellis and state diagrams – systematic - non-recursive and recursive convolutional codes - the inverse of a convolutional encoder and catastrophic codes - decoding of convolutional codes - maximum likelihood decoding - Viterbi algorithm and other decoding algorithms - distance properties - punctured convolutional codes - dual k codes - concatenated codes - MAP and BCJR algorithms - turbo coding and iterative decoding - factor graphs and sum-product algorithms - LDPC codes - trellis coded modulation - performance comparison.

UNIT IV:Pulse Shaping and Equalization Pulse Shaping:

Characterization of band limited channels - ISI - Nyquist criterion - controlled ISI - channels with ISI and AWGN - pulse shaping for optimum transmissions and reception; Equalization: MLSE - linear equalization - decision feedback equalization - ML detectors - iterative equalization - turbo equalization - adaptive linear equalizer - adaptive decision feedback equalization - blind equalization.

UNIT V:Synchronization, Signal Parameter Estimation:

Carrier phase estimation - symbol timing estimation - joint estimation of carrier phase and symbol timing - performance characteristics of ML estimators.

Reference Books:

1. John G. Proakis and MasoudSalehi, "Digital communications", 5th Edition, Tata McGraw Hill, 2008.

2. Ian A. Glover and Peter M. Grant, "Digital Communications", 2nd Edition, Pearson Education, 2008.

3. Bernard Sklar, "Digital Communications: Fundamentals and Applications", 2nd Edition, Pearson Education, 2002.

4. Marvin K.Simon, M. Hinedi and William C. Lindsey, "Digital Communication Techniques: Signal Design and Detection", Prentice Hall of India, 2009.

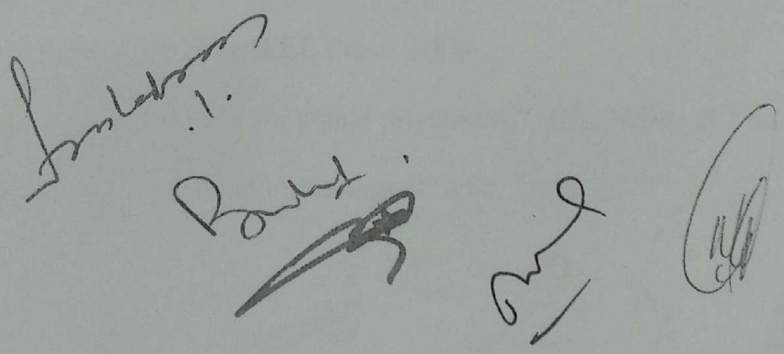
5. John R. Barry, Edward A. Lee, David G. Messerschmitt, "Digital Communication", Kluwer Academic Publishers, 2004.

ECEM-909L

ADVANCED DIGITAL COMMUNICATION SYSTEMS LAB

Experiments

1. Analysis of relation between bit rate, symbol rate and chip rate.
2. Generation of different PN codes like barker code, gold code and maximum length sequence code.
3. Study of Root-Raised Cosine filter with variable chip rate and its time and frequency domain analysis
4. Time and Frequency domain analysis of complete CDMA-Direct Sequence Spread Spectrum modulator with variable chip rate, PN code, BPSK, QPSK and OQPSK baseband modulation and with & without spectral shaping filter.
5. Study and analysis of BPSK, QPSK and OQPSK constellation with or without spectral shaping filter.
6. Bit Error Rate (BER) measurement of CDMA-DSSS complete system using different signal gain and noise gain i.e. SNR.
7. Study of frequency offset i.e. Doppler Effect as an impairment using QPSK baseband modulation.



ELECTIVES II Semester

ECEM-910E1

CMOS MIXED SIGNAL DESIGN ECEM

Unit I - Simple CMOS Current Mirror, Common-Source Amplifier, Source-Follower, SourceDegenerated Current Mirrors, cascode Current Mirrors, MOS Differential Pair and Gain StageProcess and temperature independent compensation

Unit II - Sampling Circuits Performance of Sample-and-Hold Circuits, Testing Sample and Holds, MOS Sample-andHold Basics, Examples of CMOS S/H Circuits, Bipolar and BiCMOS Sample-and-Holds. Sample-and-Hold Architectures- Open-loop & closed-loop architectures, open-loop architecture with miller capacitance, multiplexed-input architectures, recycling architecture, switched capacitor architecture.

Unit III- D/A Converter Architectures Input/output characteristics of an ideal D/A converter, , performance metrics of D/A converter, D/A converter in terms of voltage, current, and charge division or multiplication, switching functions to generate an analog output corresponding to a digital input. Resistor-Ladder architectures, Current steering architectures

Unit IV - A/D Converter Architectures Input/output characteristics and quantization error of an A/D converter, performance metrics, Performance Limitations, Resolution, Offset and Gain Error, Accuracy and Linearity, Successive approximation architectures, Flash architectures.

Unit V - Integrator Based Filters Low Pass filters, active RC integrators, MOSFET-C integrators, transconductance-c integrator, discrete time integrators. Filtering topologies - bilinear transfer function and biquadratic transferfunction.

Books:

1. Razavi, "Design of analog CMOS integrated circuits", McGraw Hill, Edition 2002.
2. Razavi, "Principles of data conversion system design", Wiley IEEE Press, 1st Edition, 1994.
3. Jacob Baker, "CMOS Mixed-Signal circuit design", IEEE Press, 2009.
4. Gregorian, Temes, "Analog MOS Integrated Circuit for signal processing", John Wiley & Sons, 1986.
5. Baker, Li, Boyce, "CMOS: Circuit Design, layout and Simulation", PHI, 2000.

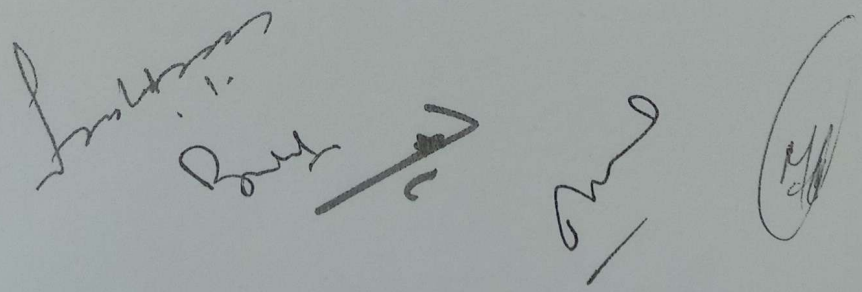
ECEM-910E2

MACHINE LEARNING

Unit-1: Introduction - Well-posed learning problems, Designing a learning system, Perspectives and issues in machine learning Concept learning and the general to specific ordering – Introduction, A concept learning task, Concept learning as search, Find-S: finding a maximally specific hypothesis, Version spaces and the candidate elimination algorithm, Remarks on version spaces and candidate elimination, Inductive bias

Unit-2: Decision Tree learning – Introduction, Decision tree representation, Appropriate problems for decision tree learning, The basic decision tree learning algorithm, Hypothesis space search in decision tree learning, Inductive bias in decision tree learning, Issues in decision tree learning Artificial Neural Networks – Introduction, Neural network representation, Appropriate problems for neural network learning, Perceptions, Multilayer networks and the back propagation algorithm, Remarks on the back propagation algorithm, An illustrative example face recognition Advanced topics in artificial neural networks Evaluation Hypotheses – Motivation, Estimation hypothesis accuracy, Basics of sampling theory, A general approach for deriving confidence intervals, Difference in error of two hypotheses, Comparing learning algorithms

Unit-3: Bayesian learning – Introduction, Bayes theorem, Bayes theorem and concept learning, Maximum likelihood and least squared error hypotheses, Maximum likelihood hypotheses for predicting probabilities, Minimum description length principle, Bayes optimal classifier, Gibs algorithm, Naïve Bayes classifier, An example learning to classify text, Bayesian belief networks The EM algorithm Computational learning theory – Introduction, Probability learning an approximately correct hypothesis, Sample complexity for Finite Hypothesis Space, Sample Complexity for infinite Hypothesis Spaces, The mistake bound model of learning - Instance-Based Learning- Introduction, k -Nearest Neighbour Learning, Locally Weighted Regression, Radial Basis Functions, Case-Based Reasoning, Remarks on Lazy and Eager Learning Genetic Algorithms – Motivation, Genetic Algorithms, An illustrative Example, Hypothesis Space Search, Genetic Programming, Models of Evolution and Learning, Parallelizing Genetic Algorithms



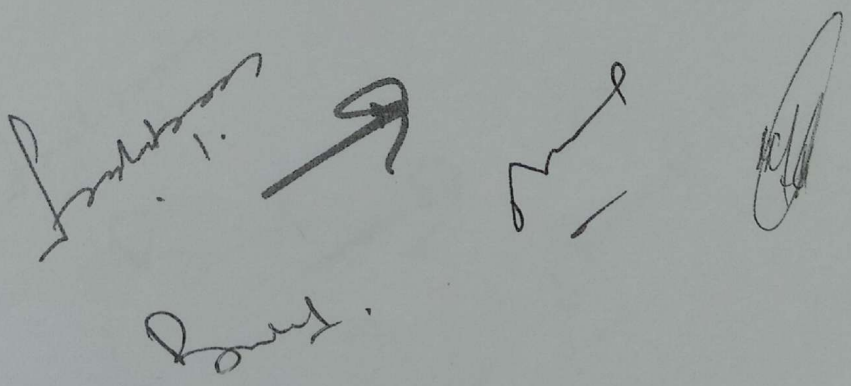
Unit-4: Learning Sets of Rules – Introduction, Sequential Covering Algorithms, Learning Rule Sets: Summary, Learning First Order Rules, Learning Sets of First Order Rules: FOIL, Induction as Inverted Deduction, Inverting Resolution Analytical Learning - Introduction, Learning with Perfect Domain Theories: Prolog-EBG Remarks on Explanation-Based Learning, Explanation-Based Learning of Search Control Knowledge

Unit-5: Combining Inductive and Analytical Learning – Motivation, Inductive-Analytical Approaches to Learning, Using Prior Knowledge to Initialize the Hypothesis, Using Prior Knowledge to Alter the Search Objective, Using Prior Knowledge to Augment Search Operators, Reinforcement Learning – Introduction, The Learning Task, Q Learning, Non-Deterministic, Rewards and Actions, Temporal Difference Learning, Generalizing from Examples, Relationship to Dynamic Programming

REFERENCE BOOKS:

1.Machine Learning – Tom M. Mitchell, - MGH 2. Machine Learning: An Algorithmic Perspective, Stephen Marsland, Taylor & Francis (CRC)

2.Machine Learning Methods in the Environmental Sciences, Neural Networks, William W Hsieh, Cambridge Univ Press. 2. Richard o. Duda, Peter E. Hart and David G. Stork, 3.Pattern classification, John Wiley & Sons Inc., 2001 3. Chris Bishop, Neural Networks for Pattern Recognition, Oxford University Press, 1995. 4. Machine Learning by Peter Flach , Cambridge.



ECEM-910E3

OPTICAL COMMUNICATION SYSTEMS

Unit-1: Optical Fibers:

Structures, wave guiding and Fabrication: Nature of Light, Basic optical laws and definitions, Single mode fibers, Graded index fiber structure, Attenuation, Signal Dispersion in fibers. Optical Sources- LEDs, Laser Diodes, Line Coding.

Unit-2: Photo detectors:

Photo detector Noise, Detector Response Time, Avalanche Multiplication Noise. Optical Receiver Operation- Fundamental receiver operation, Digital receiver performance, Eye diagrams. WDM Concepts and Components- Passive optical Couplers, Isolators and Circulators

Unit-3: Digital Links:

Point to point links, power penalties, error control, Coherent detection, Differential Quadrature Phase Shift Keying. Analog Links: Carrier to noise ration, Multichannel Transmission Techniques, RF over Fiber, Radio over fiber links, Microwave Photonics.

Unit-4: Optical Networks:

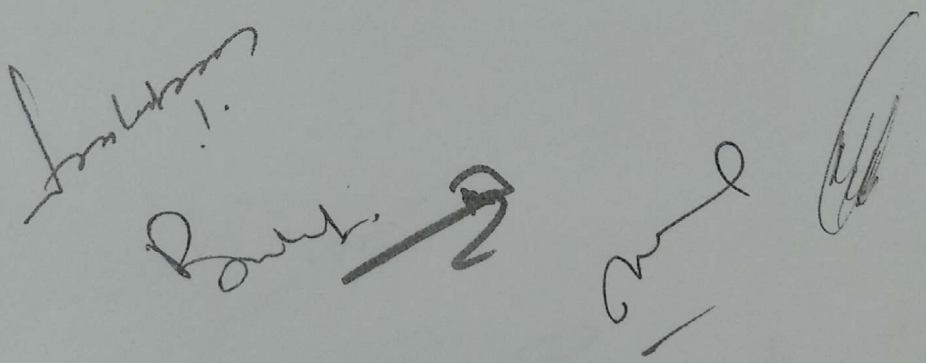
Network Concepts, Network Topologies, SONET/SDH, High speed lightwave links, Optical add/ Drop Multiplexing, Optical Switching, WDM Network, Passive Optical Networks, IP Over DWDM, Optical Ethernet, Mitigation of Transmission Impairments

Unit-5: Performance Measurement and Monitoring:

Measurement standards, Basic Test Equipment, Optical power measurement, Optical fiber characterization, Eye diagram tests, optical time domain reflectometer, optical performance monitoring, optical fiber system performance measurements.

TEXTBOOKS:

Gerd Keiser, "Optical Fiber Communications", 5th Edition, McGraw Hill.



SEMESTER III

ECEM-907

WIRELESS AND MOBILE COMMUNICATION SYSTEM DESIGN

Unit-I The cellular concept: System Design Fundamentals
Introduction, Frequency reuse, channel Assignment strategies, Handoff strategies: Prioritizing handoffs, Practical Handoff considerations, interference and system capacity: co-channel interference and system capacity, channel planning for wireless system, adjacent channel interference, power control for reducing interference, trunking and grade of service, cell splitting, sectoring,

Unit-II Mobile Radio Propagation: Large Scale Path Loss
Introduction to Radio Wave Propagation, Free-Space Propagation model, Two-Ray Model, Propagation Mechanisms: Reflection, Refraction, and Scattering, Practical Link budget design using path loss models, outdoor propagation models: Okumura and Hatta Model, Indoor propagation models, Signal penetration into buildings, Ray tracing and site specific modelling

Unit-III Mobile Radio Propagation: Small Scale Path Loss
Small scale multipath propagation, factors influencing small scale fading, Doppler shift, parameters of mobile multipath channels, time dispersion parameters model, coherence bandwidth, Doppler spread and coherence time, fast fading, slow fading, Rayleigh and Ricean distributions, Statistical models for multipath fading channels: Clarks model for flat fading

Unit-IV MIMO Systems
Types of MIMO Systems: MIMO Channel Modelling, Mathematical Modelling, Beam forming - spatial multiplexing - basic space time code design principles- Alamouti scheme - orthogonal and quasi orthogonal space time block codes, The Frequency Flat MIMO Channel, The Frequency-Selective MIMO Channel, Block Transmission, Matrix Formulations.

Unit-V ERROR PROBABILITY ANALYSIS
Error Probability Analysis for SISO Channels, Error Probability Analysis for MIMO Channels, Pairwise Error Probability and Union Bound, Coherent Maximum-Likelihood Detection, Detection with Imperfect Channel Knowledge, Joint ML Estimation/Detection.

INSTRUCTIONAL ACTIVITIES
Simulation of minimum of (2) modulation and multiple access technique for wireless communication using related simulation tools.

Reference Books:

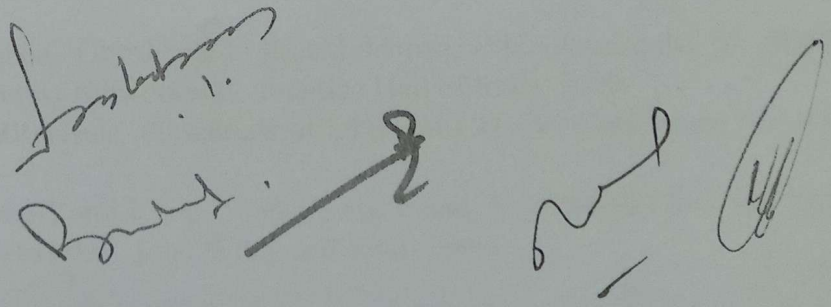
1. Andreas Molisch F, "Wireless Communications", John Wiley and Sons Ltd., 2011.
2. Wei Xiang, Kan Zheng, Xuemin (Sherman) Shen, - 5G Mobile Communications, Springer, 2017
3. David Tse and Pramod Viswanath, "Fundamentals of Wireless Communication", Cambridge University Press, 2005.
4. Theodore S. Rappaport, "Wireless Communications: Principles and Practice", 2nd Edition, Prentice Hall of India, 2005.
5. Guillaume De La Roche, Andres Alayon Glazunov and Ben Allen, "LTE – Advanced and Next Generation Wireless Networks: Channel Modelling and Propagation", John Wiley and Sons Ltd., 2013 Andrea Goldsmith, "Wireless Communications", Cambridge University Press, 2005.
6. Michel DaoudYacoub, "Wireless Technology: Protocols, Standards, and Techniques", CRC Press, 2002.
7. Jafarkhani H, "Space-Time Coding: Theory & Practice", Cambridge University Press, 2005

3. David Tse and PramodViswanath, "Fundamentals of Wireless Communication", Cambridge University Press, 2005.
4. Theodore S. Rappaport, "Wireless Communications: Principles and Practice", 2nd Edition, Prentice Hall of India, 2005.
5. Guillaume De La Roche, Andres Alayon Glazunov and Ben Allen, "LTE – Advanced and Next Generation Wireless Networks: Channel Modelling and Propagation", John Wiley and Sons Ltd., 2013 Andrea Goldsmith, "Wireless Communications", Cambridge University Press, 2005.
6. Michel DaoudYacoub, "Wireless Technology: Protocols, Standards, and Techniques", CRC Press, 2002.
7. Jafarkhani H, "Space-Time Coding: Theory & Practice", Cambridge University Press, 2005

ECEM-911L
WIRELESS AND MOBILE COMMUNICATION SYSTEM LAB

List of Experiments

1. Study different Modem commands in AT mode?
2. Study different call commands in AT mode?
3. Study different Message commands in AT mode?
4. Add contact into SIM memory in User Mode?
5. Delete contact from SIM memory in user mode?
6. Send message via User mode?
7. Make a call in user mode?
8. Disconnect call in user mode?
9. Study of different signals.



LIST OF ELECTIVES-III SEMESTER

ECEM-912E1

ADVANCED COMMUNICATION NETWORKS

UNIT-I: Overview of Communication Networks: Telephone networks - computer networks - cable television networks - wireless networks - networking principles - digitalization - network externalities - service integration; Network Services and Layered Architecture: Traffic characterization and QoS - network services - network elements - network mechanisms - layered architecture - network bottlenecks.

UNIT-II: Broadband Networks, Multihop wireless broadband networks - mesh networks - MANET importance of routing protocols - classification of routing protocols in MANET - routing metrics - packet scheduling algorithms - admission control mechanism.

UNIT-III: Internet: Internet protocol - technology trends in IP networks - IP packet communications in mobile communication networks; TCP and UDP - Internet success and limitation - performance of TCP/ IP networks; Circuits Switched Networks: SONET - DWDM - fiber to home - DSL - intelligent network (IN) scheme - comparison with conventional systems - merits of the IN scheme - CATV and layered network - services over CATV.

UNIT-IV: ATM Networks, ATM reference model - addressing - signaling - routing- ATM Adaptation Layer (AAL) - traffic classes - traffic management and quality of service - traffic descriptor - traffic shaping - management and control - traffic and congestion control - network status monitoring and control - user/ network signaling - internetworking with ATM - IP over ATM - multiprotocol over ATM.

UNIT-V: High Performance Networks,WiMAX overview - competing technologies - overview of the physical layer - PMP mode - mesh mode - multihop relay mode; Introduction: UWB overview - time hopping UWB - direct sequence UWB - multiband UWB; Introduction: LTE and LTE– A overview - system model - specifications - frame structure - comparison with broadband technologies.

Reference Books:

1) Jean Warland and PravinVaraiya, "High Performance Communication Networks", 2nd Edition, Harcourt and Morgan Kanffman Publishers, London, 2008.
2) Leon Gracia and Widjaja, "Communication Networks", Tata McGraw Hill, 2008.
3) LumitKasera and PankajSethi, "ATM Networks: Concepts and Protocols", Tata McGraw Hill, 2007.
4) Jeffrey G. Andrews, Arunabha Ghosh and RiasMuhamed, "Fundamentals of WiMAX Understanding Broadband Wireless Networking", Prentice Hall of India, 2008.
5) Amitabha Ghosh and RapeepatRatasuk, "Essentials of LTE and LTE-A", Cambridge University, 2011.
6) David Tung Chong Wong, Peng-Yong Kong, Ying-Chang Liang, KeeChaing Chua and Jon W. Mark, "Wireless Broadband Networks", John Wiley and Sons, 2009.

MIMO WIRELESS COMMUNICATIONS

Unit-I MIMO Systems

Introduction to MIMO Wireless communications, MIMO System Model, MIMO Zero- Forcing (ZF) Receiver: Properties of the Zero-Forcing Reciver Matrix, Principle of Orthoganality Interpretation of ZF Receiver, MIMO MMSE Receiver, Singular Value Decomposation (SVD) of the MIMO, Examples of SVD.

Unit-II MIMO Capacity and Coding

Introduction to MIMO information theory, Singular value Decomposition and MIMO Capacity, optuimal MIMO Capacity, Asympotic MIMO Capacity, Almouti and Space-Time Codes, Almouti code procedure, Non-linear MIMO Receiver- V-BLAST

Unit-III MIMO Channel Models

Statistical MIMO Model: Spatial Correlation, PAS Model, Statistical Model of Correlated Fading Channel, Generation of correlated MIMO Channel coefficients, I- METRA MIMO Channel Model, 3GPP MIMO Channel Model, SCM Link- Level Channel Parameters, SCM Link- Level Channel Modeling, Spatial Correlation of Ray- based Channel Model

Unit-IV Antenna Diversity and Space- Time Coding Techniques

Antenna Diversity: Receive Diversity, Transmit Diversity, Space- Time Coding (STC): System Model, Pairwise Error Probability, Space- Time Code Design, Almouti Space- Time Code, Generalization of Space- Time Block Coding, Decoding for Space- Time Block Codes, Space- Time Trellis Code.

Unit- V Multi- User MIMO

Mathematical Model for Multi-User MIMO System, Channel Capacity of Multi- User MIMO System: Capacity of MAC, Capacity of BC, Transmission methods for Broadcast Channel: Channel inversion, block diagonalization, Dirty Paper Coding (DPC), Tomlinson – Harashima Precoding

Textbook:

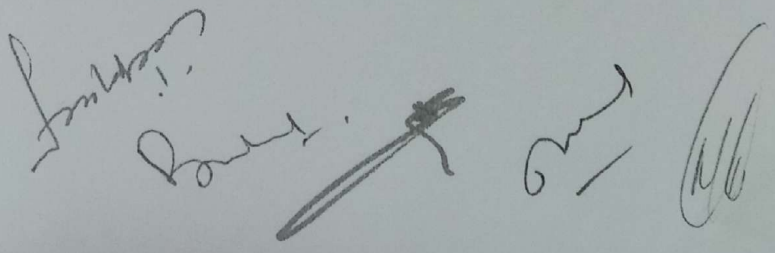
1. R.S. Kshetrimayum, *Fundamentals of MIMO Wireless Communications*, Cambridge University Press, 2017.
2. Yong-Soo Cho Jaekwon King MIMO- OFDM Wireless Communications with MATLAB

References:

A.Chockalingam and B. Sundar Rajan, *Large-MIMO systems,* Cambridge University Press, 2014

Brijesh Kumbhani, Rakhesh Singh Kshetrimayum, *MIMO Wireless Communications over Generalized Fading Channels,* CRC Press, 2017

T.L.Marzetta,, E.G. Larsson, h. Yang and H. Q. Ngo, *Fundamentals of massive MIMO,* Cambridge University Press, 2016



ECEM-912E3
INTERNET OF THINGS

UNIT-I: Introduction to Internet of Things: Definition and Characteristics of IoT, Physical Design of IoT – IoT Protocols, IoT communication models, Iot Communication APIs IoT enabaled Technologies – Wireless Sensor Networks, Cloud Computing, Big data analytics, Communication protocols, Embedded Systems, IoT Levels and Templates, Challenges in IoT Design, Domain specific applications of IoT , Home automation, Industry applications, Surveillance applications, Other IoT applications.

UNIT-II: Network & Communication aspects Wireless medium access issues, MAC protocol survey, Survey routing protocols, Sensor deployment & Node discovery, Data aggregation & dissemination .

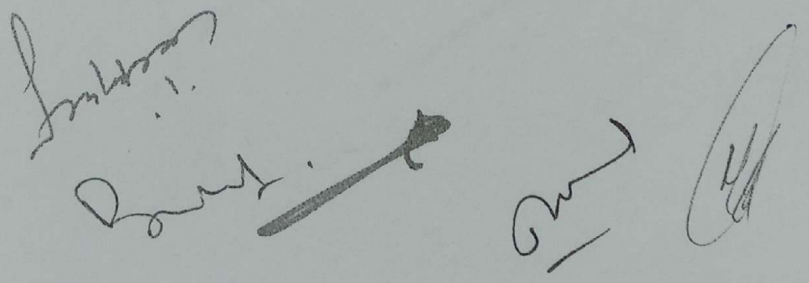
UNIT-III: IoT and M2M : Software defined networks, network function virtualization, difference between SDN and NFV for IoT Basics of IoT System Management with NETCOZF, YANG- NETCONF, YANG, SNMP NETOPEER

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

UNIT-V: IoT Physical Devices and Endpoints: Introduction to Raspberry PI-Interfaces (serial, SPI, I2C) Programming – Python program with Raspberry PI with focus of interfacing external gadgets, controlling output, reading input from pins.**IoT Physical Servers and Cloud Offerings**: Introduction to Cloud Storage models and communication APIs Webserver – Web server for IoT, Cloud for IoT, Python web application framework Designing a RESTful web APIs

Reference Books:

1.Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2014.
2. Waltenegus Dargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice" .
3. Arshdeep Bahga and Vijai Madisetti "Internet of Things: A Hands-on Approach", Bahga & Madisetti, 2014



CEM-913 Project
CEM-914 Seminar-I

Project description

The project work shall be carried out by students individually. In the project work, students shall choose a specific topic/area for the project. The selected areas shall encompass recent and emerging trends in technologies that prove beneficial for society in general. Supervisor will be assigned to each student in the beginning of the 3rd semester of their course. Each student at the end of the course will submit a Project report and the workable prototype/Simulation regarding the project and the same will be evaluated by the external examiner for final award of the course. The student needs to submit a working prototype/Simulation with a project report encompassing full scale work. Moreover, the student needs to present a Seminar of at least thirty minute duration before an audience comprising of the faculty and students of the department concerned.

ECEM-915 Dissertation
ECEM-916 Seminar -II

In the Thesis part, the students are required to carry out the project work on a specific topic/area and conclude with a hardware prototype or a software solution preferably providing a scientific solution to an existing problem feared by the society at large. The dissertation work is to be carried out in the last semester, however can be an execution of the project work. The students need to submit the dissertation report at the end of the programme. These reports will be evaluated by at least one external examiner .A viva voice exam of individual students shall be conducted on the dissertation work by an external examiner in partial fulfillment for the award of the degree of Masters in Technology. Moreover, the student needs to present a Seminar of at least thirty minute duration before an audience comprising of the faculty and students of the department concerned before the last thesis presentation date.