DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Curriculum M.E. (COMMUNICATION SYSTEMS)

Full Time

Semester – I										
Sl. No.	**Category**	**Course Code**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
1	PC-I	CSYC 101	Mathematics for Engineers	4	-	-	25	75	100	3
2	PC-II	CSYC 102	Advanced Digital Communication Techniques	4	-	-	25	75	100	3
3	PC-III	CSYC 103	RF Engineering	4	-	-	25	75	100	3
4	PC-IV	CSYC 104	Advanced Digital Signal Processing	4	-	-	25	75	100	3
5	PE – I	CSYE 105	Professional Elective - I	4	-	-	25	75	100	3
6	PE - II	CSYE 106	Professional Elective - II	4	-	-	25	75	100	3
7	PC-I Lab	CSYP 107	Design and Simulation of Communication Systems Lab - I	-	-	3	40	60	100	2
			Total	**24**	**-**	**3**	**190**	**510**	**700**	**20**

Semester –II										
Sl. No.	**Category**	**Course Code**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
1	PC-V	CSYC 201	Advanced Radiation Systems	4	-	-	25	75	100	3
2	PC-VI	CSYC 202	Advanced Wireless Communication Engineering	4	-	-	25	75	100	3
3	PC-VII	CSYC 203	Optical Networks	4	-	-	25	75	100	3
4	PC-VIII	CSYC 204	Wireless Sensor Networks	4	-	-	25	75	100	3
5	PE – III	CSYE 205	Professional Elective - III	4	-	-	25	75	100	3
6	PE - IV	CSYE 206	Professional Elective - IV	4	-	-	25	75	100	3
7	PC-II Lab	CSYP 207	Design and Simulation of Communication Systems Lab - II	-	-	3	40	60	100	2
8.	Semi	CSYP 208	Seminar				100	-	100	1
			Total	**24**	**-**	**3**	**290**	**510**	**800**	**21**

Semester –III										
Sl. No.	**Category**	**Course Code**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
1	OE - I	CSYE 301	Open Elective - I	4	-	-	25	75	100	3
2	OE – II	CSYE 302	Open Elective - II	4	-	-	25	75	100	3
3	Thesis	CSYT 303	Thesis Phase - I	-	4	-	40	60	100	4
4	Ind.Train	CSYT 304	Industrial Training		*		100	-	100	2
			Total	**8**	**4**	**-**	**190**	**210**	**400**	**12**

*** four weeks during the summer vacation at the end of second semester**

Semester –IV										
Sl. No.	**Category**	**Course Code**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
1	Thesis	CSYT 401	Thesis Phase - II	-	8	-	40	60	100	12
			Total	**-**	**8**	**-**	**40**	**60**	**100**	**12**

L – Lecture; P – Practical; T – Thesis; CA – Continuous Assessment;
FE – Final Examination

Part Time

Semester – I											
Sl. No.	**Category**	**Course Code**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**	**Equivalent Course Code in B.E. Full Time**
1	PC - I	PCSYC 101	Mathematics for Engineers	4	-	-	25	75	100	3	CSYC 101
2	PC – II	PCSYC 102	Advanced Digital Communication Techniques	4	-	-	25	75	100	3	CSYC 102
3	PC – III	PCSYC 103	RF Engineering	4	-	-	25	75	100	3	CSYC 103
			Total	**12**	**-**	**-**	**75**	**225**	**300**	**9**	

Semester – II											
Sl. No.	**Category**	**Course Code**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**	**Equivalent Course Code in B.E. Full Time**
1	PC – IV	PCSYC 201	Advanced Radiation Systems	4	-	-	25	75	100	3	CSYC 201
2	PC – V	PCSYC 202	Advanced Wireless Communication Engineering	4	-	-	25	75	100	3	CSYC 202
3	PC – VI	PCSYC 203	Optical Networks	4	-	-	25	75	100	3	CSYC 203
			Total	**12**	**-**	**-**	**75**	**225**	**300**	**9**	

Semester – III											
Sl. No.	**Category**	**Course Code**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**	**Equivalent Course Code in B.E. Full Time**
1	PC – VII	PCSYC 301	Advanced Digital Signal Processing	4	-	-	25	75	100	3	CSYC 104
2	PE – I	PCSYE 302	Professional Elective - I	4	-	-	25	75	100	3	CSYE 105
3	PE - II	PCSYE 303	Professional Elective – II	4	-	-	25	75	100	3	CSYE 106
4	PC Lab - I	PCSYP 304	Design and Simulation of Communication Systems Lab - I	-	-	3	40	60	100	2	CSYP 107
			Total	**12**	**-**	**3**	**115**	**285**	**400**	**11**	

Semester – IV											
Sl. No.	**Category**	**Course Code**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**	**Equivalent Course Code in B.E. Full Time**
1	PC – VIII	PCSYC 401	Wireless Sensor Networks	4	-	-	25	75	100	3	CSYC 204
2	PE – I	PCSYE 402	Professional Elective - III	4	-	-	25	75	100	3	CSYE 205
3	PE - II	PCSYE 403	Professional Elective – IV	4	-	-	25	75	100	3	CSYE 206
4	PC Lab - II	PCSYP 404	Design and Simulation of Communication Systems Lab - II	-	-	3	40	60	100	2	CSYP 207
5	Semi	PCSYP 405	Seminar	-	-	-	100	-	100	1	CSYP 208
			Total	**12**	**-**	**3**	**215**	**285**	**500**	**12**	

Semester – V											
Sl. No.	**Category**	**Course Code**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**	**Equivalent Course Code in B.E. Full Time**
1	OE - I	PCSYE 501	Open Elective - I	4	-	-	25	75	100	3	CSYE 301
2	OE – II	PCSYE 502	Open Elective - II	4	-	-	25	75	100	3	CSYE 302
3	Thesis	PCSYT 503	Thesis Phase - I	-	-	4	40	60	100	6	CSYT 303
			Total	**8**	**-**	**4**	**90**	**210**	**300**	**12**	

*** four weeks during the summer vacation at the end of second semester**

Semester – VI											
Sl. No.	**Category**	**Course Code**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**	**Equivalent Course Code in B.E. Full Time**
1	Thesis	PCSYT 601	Thesis Phase - II	-	-	8	40	60	100	13	CSYT 401
			Total	**-**	**-**	**8**	**40**	**60**	**100**	**13**	

L – Lecture; P – Practical; T – Thesis;
CA – Continuous Assessment; FE – Final Examination

LIST OF PROFESSIONAL ELECTIVES

1. Speech Processing
2. Spread Spectrum Communication
3. Microwave Antennas and Integrated Circuits
4. RF MEMS for Wireless Communication
5. OFDM for Wireless Communication Systems
6. Mobile Ad Hoc Networks
7. High Speed Networks
8. Virtual Private Networks
9. Electromagnetic Interference and Compatibility in System Design
10. Advanced Electromagnetic Theory
11. RF Communication
12. Advanced Digital Image Processing
13. Digital Video Processing
14. Wireless Communication Networks
15. VLSI for Wireless Communication
16. FPGA based Wireless Communication System Design

LIST OF OPEN ELECTIVES

1. Wireless Intelligent Networks
2. System Management and Security
3. Embedded System Design
4. Multimedia Communication
5. Soft Computing Techniques
6. Cloud Computing
7. Cryptography Systems
8. Research Methodology

CSYC 101	MATHEMATICS FOR ENGINEERS	L	T	P
		4	0	0

COURSE OBJECTIVES

- This course will provide the state of the art knowledge about the theoretical background for modeling the real problems of construction management.

Basic Concepts of Probability

Theory of Probability - Random variables - Moments - Moment Generating Function - Standard distributions - Functions of Random variables - Two dimensional random variables - Correlation – Regression.

Estimation Theory

Principles of least squares - Multiple and partial Correlation – Regression - Estimation of parameters – Maximum likelihood Estimates - Method of moments.

Testing of Hypothesis

Sampling distributions - Tests based on Normal, t, Chi-square and F distributions - Analysis of variance - One way and Two way classifications.

Design of Experiments

Completely Randomised Design - Randomised Block Design - Latin Square Design – 22 Factorial Design

Queueing Theory

Single and Multiple server- Markovian Queueing models - Customer impatience – M/G/1 Queueing system - Queueing applications.

REFERENCES

1. Taha, H.A., Operations Research - An Introduction, Prentice Hall of India Ltd. 1997.
2. Irwin Miller, John E Freund, Probability and Statistics for Engineers, Englewood Cliffs, Prentice-Hall, 1994.
3. S C Gupta, V K Kapoor, Fundamentals of Mathematical Statistics-A Modern Approach, New Delhi, Sultan Chand, 1999.
4. Goel, Brahms, Operations research, 4th ENL and revised edition pragatiprakashan, 2000

COURSE OUTCOMES

At the completion of the course students will be able to

1. Determinate probability and estimation of variables.
2. Determine the statistics value of each variable by using sampling techniques
3. Find the block design by using various design of Experiment method.
4. Determine the queue system using queuing theory.

Mapping Course Outcomes(COs) with Programme Outcomes(POs)										
Course Outcomes(COs)	Programme Outcomes(POs)									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✓	✓				✓	✓			
CO2			✓		✓			✓	✓	✓
CO3	✓	✓			✓				✓	✓
CO4		✓		✓		✓				✓

CSYC 102	ADVANCED DIGITAL COMMUNICATION TECHNIQUES	L	T	P
		4	0	0

COURSE OBJECTIVES

- To enable the student to understand advanced modulation and Coding Techniques.
- To learn the Optimum receivers for digital communication schemes.
- To have a knowledge on base band signal conditioning methods for exploiting the channel.

Digital Modulation Techniques

Digital Modulation, an Overview, Factors that Influence the Choice of Digital Modulation, Bandwidth and Power Spectral Density of Digital Signals, Line Coding and Pulse Shaping Techniques, Linear Modulation Techniques: BPSK, DPSK, QPSK, Offset QPSK, $\pi/4$ QPSK, QPSK Transmission and Detection Techniques, Combined Linear and Constant Envelope Modulation: MPSK, QAM, MFSK and OFDM, Spectral Characteristics of Digitally Modulated Signals.

Optimum Receivers

Optimum Receiver for Signals Corrupted by Additive White Gaussian Noise, Performance of the Optimum Receiver for Memory less, Modulation Optimum Receiver for CPM Signals, Optimum Receiver for Signals with Random Phase in AWGN Channel, Performance Analysis for Wire line and Radio Communication Systems,

Modulation Performance in Fading and Multipath Channels: Performance of Digital Modulation in Slow Flat Fading Channels, Frequency Selective Channels, Performance of $\pi/4$ DQPSK in Fading and Interference.

Equalization

Fundamentals of Equalization, Generic Adaptive Equalizer, Equalizers in Communication Receivers, Survey of Equalization Techniques, Linear Transversal and Filter Equalizer, Non Linear Equalizers: Decision Feedback and Maximum Likelihood Sequence Equalizer, Algorithms for adaptive Equalization, Fractional Spaced Equalizers.

Trellis Coded Modulation

Modulation and Coding for Band Limited Channels, Coded Modulation for Bandwidth-Constrained Channels-Trellis Coded Modulation; Set Partitioning, Four –State Trellis Coded Modulation with 8-PSK Signal Constellation, Eight-State Trellis Code for Coded 8-PSK Modulation, Eight-State Trellis for Rectangular QAM Signal Constellations, Decoding Methods.

Turbo Coding
Introduction-Turbo Encoder, Turbo Decoder, Iterative Turbo Decoding Principles; Modifications of the MAP Algorithm-The Soft-Output Viterbi Algorithm (SOVA); Turbo Coded BPSK Performance over Gaussian channels, Turbo Coding Performance over Rayleigh Channels.

REFERENCES

1. Theodore S.Rappaport., "Wireless Communications", 2nd edition, Pearson Education, 2002.
2. John G. Proakis., "Digital Communication", 4 th edition, Mc Graw Hill Publication, 2001
3. Bernard Sklar., "Digital Communications", second edition, Pearson Education, 2001.
4. Stephen G. Wilson., "Digital Modulation and Coding", First Indian Reprint, Pearson Education, 2003.
5. M.K.Simon, S.M.Hinedi and W.C.Lindsey, "Digital communication techniques; Signalling and detection", Prentice Hall India, New Delhi, 1995.

COURSE OUTCOMES
The student would be able
1. To demonstrate various digital modulation techniques
2. To design basic and advanced coding for a digital communication system
3. To use base band signal conditioning methods involved for exploiting channel.

Mapping Course Outcomes(COs) with Programme Outcomes(POs)										
Course Outcomes(COs)	Programme Outcomes(POs)									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✓	✓	✓		✓					
CO2			✓	✓	✓	✓				
CO3	✓	✓	✓	✓		✓				

CSYC 103	RF ENGINEERING	L	T	P
		4	0	0

COURSE OBJECTIVES
- To learn the fundamental concepts of RF wireless communications.
- To explore the students about the protocols and modulation techniques.
- To introduce transmitter and receiver system design techniques and analysis.
- To understand the basics of radio system design and applications.

RF Passive Components and Transmission Line Analysis
High Frequency Resistors: Capacitors and inductors - transmission line analysis – line equation - microstrip line - SWR voltage reflection co-efficient propagation constant – phase constant - phase velocity - Smith chart - parallel RL and RC circuits - ABCD parameters and S parameters.

RF Active Components and RF Amplifier Design
RF Diode: PIN diode - Gunn Diode - RF bipolar junction transistor - RF field effect transistor - modeling of diode - transistor and FET; RF Amplifier: Characteristics – power relational and

stability considerations - LNA - power amplifiers - differential amplifiers - distributed power amplifiers and broadband amplifiers.

RF Circuits Design

RF Oscillator Design: Fixed frequency oscillator - dielectric resonant oscillator – voltage controlled oscillator - sun element oscillator; RF Mixer Design: Single ended mixer – double ended mixer; RF Filter Resonator and Filter Configuration: Butterworth and Chebyshev filters - design of microstrip filters.

RF IC Design

Introduction to RFIC: Analog and microwave design versus RFIC design – noise performance estimation - RF technology - receiver with single IF stage metallization – sheet resistance - skin effect -parasitic capacitance and inductance - current handling – metal capacitors - spiral inductors - quality factor - layout in IC - mutual inductance - multilevel - measurement - packaging.

RF System Design

Link Design: Fading design - protected and non protected microwave systems – path calculation - spread spectrum microwave system - compatibility - safety coordinate systems - Datam's and GPS - receiver design - receiver architecture dynamic range – Frequency conversion and filtering; Examples of Practical Receivers: FM broadcast - digital cellular - multimeter wave point to point - Direct conversion GSM receiver; RF MEMS: Concept - implementation and applications.

REFERENCES

1. Reinhold Ludwig and Pavel Bretchko, "RF Circuit Design", Pearson Education, 2007.
2. David Pozar, "Microwave and RF Design of Wireless Systems", John Wiley, 2008.
3. Josn Rogers and Calvin Plett, "Radio Frequency Integrated Circuit Design", Artech House, 2002.
4. Ferri Losee, "RF systems, Components and Circuits Handbook", Artech House, 2002.
5. Joseph J. Carr, "Secrets of RF Circuit Design", Tata McGraw Hill, 2004.
6. Vivek Varadhan, K J. Vinoy and Jose, "RF MEMS and Their Applications", Wiley Eastern Edition, 2003.

COURSE OUTCOMES

On completion of this course, the students will be able to

1. Understand the basic concepts of RF wireless communications
2. Acquire the detail view of communication protocol
3. Analyze and design various transmitters and receivers
4. Understand the basics of radio system design and applications

Mapping Course Outcomes(COs) with Programme Outcomes(POs)										
Course Outcomes(COs)	Programme Outcomes(POs)									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✓	✓								
CO2	✓	✓	✓							
CO3	✓		✓	✓		✓			✓	
CO4	✓		✓	✓		✓				

CSYC 104	ADVANCED DIGITAL SIGNAL PROCESSING	L	T	P
		4	0	0

COURSE OBJECTIVES

- To provide in-depth treatment on methods and techniques in discrete-time signal transforms, digital filter design, optimal filtering power spectrum estimation, multi-rate digital signal processing.
- To estimate the spectrum using parametric methods and non parametric methods and prediction using wiener FIR & IIR filters.
- To study adaptive filtering techniques using LMS algorithm and to study the applications of adaptive filtering.
- To apply multirate signal processing fundamentals.

Discrete Random Signal Processing

Discrete Random Processes, Expectations, variance, Co-variance, energy of discrete signals - Parseval's theorem. Wiener Khintchine relation - Power spectral density -Periodogram- Sample autocorrelation-sum decomposition theorem, spectral factorization theorem – Discrete random signal processing by linear systems – Simulations of white noise.

Spectrum Estimation

Non-parametric methods-correlation method- co-variance estimator - performance analysis of estimators-unbiased, consistent estimators- Periodogram Estimator - Barlett spectrum estimation - Welch estimation - Model based approach- AR, MA, ARMA Signal Modeling - Parameter estimation using Yule-Walker method.

Linear Estimation and Prediction

Maximum likelihood criterion- efficiency of estimator - least mean squared error criterion- Wiener filter - Discrete Wiener-Hoff equations - Recursive estimators - Kalman filter- linear prediction, prediction error- whitening filter, inverse filter - Levinson recursion and Levinson recursion algorithm for solving Toeplitz system of equations. Lattice recursion, Lattice realization.

Adaptive Filters

FIR adaptive filters - Newton's Steepest Descent method - adaptive filter based on steepest descent method Widrow-Hoff LMS adaptive algorithm - Adaptive channel equalization- Adaptive Echo Canceller- Adaptive noise cancellation- RLS adaptive filters-Exponentially weighted RLS- sliding window RLS-simplified IIR LMS adaptive filter.

Multirate Signal Processing and Wavelet Transform

Review of Decimation and Interpolation Process. Sub band filter theory – Perfect Reconstruct (PR) condition – Cosine modulated filters – Para-unitary filters. Application of wavelet transform with Sub band filter theory. Wavelet transform as a correlator- Multiresolution theory – Heisenberg uncertainty principle – Two dimensional wavelet transform.

REFERENCES

1. John G. Proakis, Dimitris G. Manolakis, "Digital Signal processing", Prentice Hall of India, Fourth Edition 2006.
2. Manson H.Hayes, "Statistical Digital Signal Processing and Modelling", John Wiley and sons, Inc., New York, 1996.
3. Sopocles J. Orfanidis, "Optical Signal Processing", McGraw Hill, 1990.
4. Fliege N. J ,Multirate, "Digital Signal Processing", John Wiley & Sons, 2000.

COURSE OUTCOMES

On completion of this course, the students will be able to

1. Acquire in-depth treatment on methods and techniques in discrete-time signal transforms, digital filter design, optimal filtering power spectrum estimation, multi-rate digital signal processing.
2. Estimate the spectrum using parametric methods and non parametric methods and prediction using wiener FIR & IIR filters.
3. Analyse adaptive filtering techniques using LMS algorithm and to study the applications of adaptive filtering.
4. Understand clearly about multi rate signal processing fundamentals.

Mapping Course Outcomes(COs) with Programme Outcomes(POs)										
Course Outcomes(COs)	Programme Outcomes(POs)									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✓	✓	✓	✓	✓	✓				
CO2	✓	✓	✓	✓	✓	✓			✓	
CO3	✓	✓	✓		✓	✓			✓	
CO4	✓	✓								

CSYC 107	DESIGN AND SIMULATION OF COMMUNICATION SYSTEMS LAB – I	L	T	P
		0	0	3

COURSE OBJECTIVES

- To understand underlying concepts in signal processing
- To have a complete understanding of error–control coding.
- To understand encoding and decoding of digital data streams.
- To provide a comprehensive analysis of spread spectrum systems
- To have a knowledge of the basics of OFDM.

List of Experiments

1. Simulation of Convolutional Coding Techniques.
2. Simulation of Linear Block Coding Techniques.
3. Simulation of Arithmetic Coding Techniques.
4. Simulation of Huffman Coding.
5. Simulation of Turbo Coding.
6. Simulation of Direct Sequence Spread Spectrum System.
7. Simulation of Frequency Hopping Spread Spectrum System.
8. Study of QPSK and QAM Modulation Technique.
9. Simulation of Pulse Radar Parameter on Detection Range.
10. Simulation of OFDM System.

COURSE OUTCOMES

1. Able to learn about signal processing concepts.
2. Able to understand the practical implementation issues, such as Error control coding, source coding.
3. Learn about design and simulation of modulation and coding techniques using software.
4. Understanding of application of OFDM for communication systems.

Mapping Course Outcomes(COs) with Programme Outcomes(POs)										
Course Outcomes	Programme Outcomes									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✓		✓		✓					
CO2		✓				✓			✓	
CO3	✓	✓				✓				
CO4			✓			✓			✓	

CSYC 201	ADVANCED RADIATION SYSTEMS	L	T	P
		4	0	0

COURSE OBJECTIVES

- To introduce the fundamental principles of antenna and to apply them to the design and analysis of antenna systems.
- To study the various antenna array.
- To learn the antenna polarization.
- Different types of antennas and their applications will be introduced, with focus on Frequency independent antenna, Travelling Wave antennas, microstrip patch antennas, V-antenna, Reflector antenna, antenna arrays, and the design considerations of using antennas in wireless communication systems.

Concepts of Radiation

Physical Concept of Radiation: Radiation from surface and line current distributions - radiation pattern - near and far field regions - reciprocity - directivity and gain – effective aperture - polarization - input impedance - efficiency - Friss transmission equation – radiation integrals and auxiliary potential functions.

Aperture and Reflector Antennas
Huygens's principle - radiation from rectangular and circular apertures – design considerations - Babinets principle - radiation from sectoral - pyramidal - conical and corrugated horns - design concepts of parabolic reflectors and cassegrain antennas.

Broadband Antennas
Principles - design and properties of log periodic - yagi-uda - frequency independent antennas - loop antenna - helical antennas - biconical antennas - broadcast antenna - spiral antenna and slot antennas.

Microstrip Antennas
Microstrip Antennas: Radiation mechanism - parameters and applications - feeding methods - method of analysis - design of rectangular and circular patch - impedance matching of microstrip antennas.

Applications
Antennas for biomedical applications - smart antennas for mobile communications – antenna for infrared detectors - marine applications - plasma antennas.

REFERENCES

1. Jordan E.C, "Electromagnetic Waves and Radiating Systems", Prentice Hall of India,2003.
2. Balanis C.A, "Antenna Theory", 2nd Edition, Wiley, 2003.
3. J.D. Krauss, "Antennas", Tata McGraw Hill, 2006.
4. Elliot, "Antenna Theory and Design", IEEE press, 2003.

COURSE OUTCOMES
On completing this course the students should be able to:
1. Understand the basic concepts and characteristics of antennas in the transmit and receive mode.
2. Understand the concepts of array antennas such as analysis and synthesis of radiation patterns.
3. Design and analyze frequency independent antenna, Travelling Wave antennas, microstrip patch antennas, V-antenna, Reflector antenna.
4. Analyze and design aperture antennas such as horns, slots, and microstrip patches.
5. Design and analyze reflector antennas using geometrical optics or physical optics techniques.

Mapping Course Outcomes(COs) with Programme Outcomes(POs)										
Course Outcomes(COs)	Programme Outcomes(POs)									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✓	✓								
CO2	✓	✓								
CO3	✓	✓	✓	✓		✓				
CO4	✓	✓	✓	✓		✓				
CO5	✓	✓	✓	✓		✓				

CSYC 202	ADVANCED WIRELESS COMMUNICATION ENGINEERING	L	T	P
		4	0	0

COURSE OBJECTIVES

- To introduce various wireless channel models
- To compare different diversity and combining technique
- To make channel capacity for multiple antennas.

Mobile Radio Propagation: Path Loss and Shadowing

Radio Wave Propagation, Transmit and Receive Signal Models, Free-Space Path Loss, Ray Tracing: Two-Ray Model, Dielectric Canyon (Ten-Ray Model), General Ray Tracing, Simplified Path Loss Model, Empirical Path Loss Models: Okumura's Model, Hata Model, Walfisch / Bertoni Model, Piecewise Linear (Multi-Slope) Model, Indoor Propagation Models, Shadow Fading, Combined Path Loss and Shadowing, Outage Probability under Path Loss and Shadowing, Cell Coverage Area.

Statistical Multipath Channel Models

Time-Varying Channel Impulse Response, Narrowband fading models: Autocorrelation, Cross Correlation, and Power Spectral Density, Envelope and Power Distributions, Level Crossing Rate and Average Fade Duration, Finite State Markov Models, Wideband Fading Models: Power Delay Profile, Coherence Band width, Doppler Power Spectrum and Channel Coherence Time, Transforms for Autocorrelation and Scattering Functions, Discrete-Time Model, Spatio-Temporal Models.

Capacity of Wireless Channels

Introduction, Capacity in AWGN, Capacity of Flat-Fading Channels : Channel and System Model, Channel Distribution Information (CDI) Known, Channel Side Information at Receiver, Channel Side Information at the Transmitter and Receiver, Capacity with Receiver Diversity, Capacity Comparisons, Capacity of Frequency-Selective Fading: Time-Invariant Channels, Time-Varying Channels.

Diversity

Realization of Independent Fading Paths, Diversity System Model, Selection Combining, Threshold Combining Maximal Ratio Combining, Equal-Gain Combining, Moment Generating Functions in Diversity Analysis: Diversity Analysis for MRC, Diversity Analysis for EGC and SC Diversity Analysis for Non coherent and Differentially Coherent Modulation, Transmitter Diversity.

MIMO Communications

Narrow Band MIMO Model, Parallel Decomposition of the MIMO Channel, MIMO Channel Capacity, MIMO Diversity Gain: Beam forming, Diversity Multiplexing Trade Off, Space Time Modulation and Coding: STBC, STTC, Spacial Multiplexing and BLAST Architecture.

REFERENCES

1. Andrea Goldsmith, "Wireless Communications", Cambridge University Press, 2007.
2. Theodore S. Rappaport , "Wireless Communications Principles and Practices", Second Edition, Pearson Education, Asia, 2002.
3. David Tse and PramodViswanath, "Fundamentals of Wireless Communication", Cambridge University Press, 2005.

4. A.Paulraj, R.Nabar, D.Gore, “Introduction to Space Time Wireless Communications”, Cambridge University Press, 2003.

COURSE OUTCOMES

1. The student would have the diverse knowledge in wireless communication.

Mapping Course Outcomes(COs) with Programme Outcomes(POs)										
Course Outcomes (COs)	Programme Outcomes(POs)									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✓	✓	✓			✓				

CSYC 203	OPTICAL NETWORKS	L	T	P
		4	0	0

COURSE OBJECTIVES

- To develop an in-depth understanding, in terms of architecture, protocols and applications, of major optical networking technologies.
- To provide an exposure to solve numerical or analytical problems pertaining to the optical networking technologies
- To initiate the necessary background to perform projects involving optical networks.

WDM Technology and Issue in WDM Optical Networks

Introduction – Optical Networks – WDM – WDM Optical Networking Evolution - Enabling Technologies for WDM Optical Networks – WDM Optical Network – Architecture – Issues in Wave Length Routed Networks – Next Generation Optical Internet Networks.

Wavelength Routing Algorithms

Introduction – Classification of RWA Algorithms Fairness and Admission Control – Disturbed Control Protocols – Permutation Routing and Wavelength Requirements - Wavelength rerouting algorithms - Introduction – Benefits of Wavelength Routing- Issues in Wavelength Routing – Light Path Migration – Rerouting Schemes – Algorithm AG – Algorithm MWPG Rerouting in WDM Networks With Sparse Wavelength Conversion – Rerouting in Emulsifier Networks – Rerouting in Multifiber Unidirectional Ring Networks.

Wavelength Convertible Networks

Introduction – Need For Wavelength Converters - Wavelength Convertible Architecture – Routing in Convertible Networks – Performance Evaluation of Convertible Networks – Networks With Sparse Wavelength Conversion – Converter Placement Problem – Converter Allocation Problem.

Virtual Topology Design

Introduction – Virtual Topology Design Problem – Virtual Topology Design Sub Problems – Virtual Topology Design Heuristics – Regular Virtual Topology Design – Predetermined Virtual Topology and Light Path Routes – Design of Multifiber Networks -Virtual Topology

Reconfiguration - Introduction – Need for Virtual Topology Reconfiguration – Reconfiguration due to Traffic Changes, Reconfiguration for Fault Restoration.

Network Survivability and Provisioning

Failures and Recovery – Restoration Schemes – Multiplexing Techniques – Distributed Control Protocols. Optical Multicast Routing – Next Generation Optical Internet Networks.

REFERENCES

1. Siva Ram Murthy.C and Mohan Gurusamy., "WDM Optical Networks", Concepts, Design and Algorithms . Prentice Hall India, 2002.
2. Rajiv Ramasami and Kumar N. Sivarajan, "Optical Networks" A Practical Perspective, A Harcourt publishers international company, 2000.
3. Jun Zheng and Hussein T Mouftah, "Optical WDM Networks Concepts and Design Principles", Wiley IEEE Press, 2004.
4. Hemani Kaushal, V K Jain and Subrat Kar, "Free Space Optical Communication", Springer, 2017.

COURSE OUTCOMES

On completion of this course the students will be able to

1. To got an in-depth understanding, in terms of architecture, protocols and applications, of major optical networking technologies.
2. Able to solve numerical or analytical problems pertaining to the optical networking technologies.
3. To understand the necessary background to perform projects involving optical networks.

Mapping Course Outcomes(COs) with Programme Outcomes(POs)										
Course Outcomes(COs)	Programme Outcomes(POs)									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✓	✓	✓	✓		✓			✓	
CO2	✓	✓		✓		✓				
CO3			✓	✓	✓	✓			✓	

CSYC 204	WIRELESS SENSOR NETWORKS	L	T	P
		4	0	0

COURSE OBJECTIVES

- To study the characteristics of access mechanisms in wireless networks and Mobile IP and TCP routing protocols.
- To obtain a broad understanding of the technologies and applications for the emerging and exciting domain of wireless sensor networks.
- To study the challenges and latest research results related to the design and management of wireless sensor networks.
- To focus on network architectures, energy management and security related issues.

Networks Fundamentals

Introduction to wireless network and M-computing –Fading and shadowing communication – Mobile IP – overview – Network elements - packet delivery – registration – Tunneling and

encapsulation – optimization –Traditional TCP and inspection on Mobility – indirect and snooping TCP – 2G/3G – Beyond 3G Networks.

Architecture

Introduction to sensor networks – Architectures – design factor – sensor network classifications - characteristics – Modeling of sensor network - WSN as Embedded system – Tiered architectures in sensor network – Forming of tiered network - Draw backs - Power efficient topology in WSN- Issues – Assumptions.

Protocols

MAC- Hidden/Exposed terminals – Near/Far terminals – SDMA, FDMA, TDMA and CDMA – infrared transmission – MAC Layer synchronization –power management – roaming – SMACS and EAR algorithm – CSMA –Hybrid TDMA/FDMA – Adhoc networks – Clustering Algorithm – Leach – Teen – Peach Technique.

Security System

Security Protocols –Authentication – Network layer – Security techniques – Security in WSN – Adhoc network – Search Technique – Security management technique - Reliability issues in WSN – Distributed sensor systems – Distributed services – Dynamic adaption – Fault tolerance - pre limiters – classic fault.

Energy Management

Introduction – Different power management technology – Design in EEMAC – Reduce communication – Node level energy management – Node Level Processor Oriented Energy Management – Node level I/O device oriented Energy Management – Energy aware routing.

REFERENCES

1. Mohammed Ilyas and Imadmahgoub, “Handbook of sensor networks, compact wireless and wired sensing systems”, CRC press, 2005.
2. Rappaport T.S, “Wireless Communication Principles and Practice”, Prentice Hall,1996.
3. Jon S.Wilson, Elsevier , “Sensor technology handbook,”
4. Taub H. and .Schilling D.L, “Principle of Communication”, McGraw-Hill; 1989.
5. Simon Haykin, “Communication Systems”, John Wiley; 1995.

COURSE OUTCOMES

On completion of this course the students will be able to

1. Understand the concepts of wireless communication.
2. Acquire knowledge about the various propagation methods and Channel models.
3. Have an enhanced understanding of various transceivers and its multiple access schemes.

Mapping Course Outcomes(COs) with Programme Outcomes(POs)										
Course Outcomes(COs)	Programme Outcomes(POs)									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✓	✓	✓		✓	✓				
CO2	✓	✓	✓							
CO3	✓		✓	✓		✓				

CSYP 207	DESIGN AND SIMULATION OF COMMUNICATION SYSTEMS LAB – II	L	T	P
		0	0	3

COURSE OBJECTIVES

- To learn about the adaptive filtering algorithms.
- To study the basics of pitch estimation in speech signal and formulation of Linear Prediction.
- To learn the short term power spectrum of sound using MFC.
- To generate binary sequence using Gold Code, Kasami code.
- To study the concepts of micro strip patch antenna.
- To analyze the spectral characteristics of AWGN noise and Colored noise.

List of Experiments

1. Simulation of Adaptive Filters using LMS and RLS algorithm.
2. Pitch Estimation for Speech.
3. Linear Prediction Analysis of Speech Signal.
4. Mel Frequency Spectral Coefficients.
5. Simulation of Gold Cold Technique.
6. Simulation of Kasami Code Sequence.
7. Measurement of Frequency Response Directivity and Radiation Efficiency of Microstrip Square Patch Antenna.
8. Simulation of Spectral Analysis of AWGN and Colored Noise.
9. Spectral Characterization of communication signals (using Spectrum Analyzer).
10. Wireless Channel simulation and characterization

COURSE OUTCOMES

1. Ability to design LMS and RLS adaptive filters for signal enhancement, channel equalization.
2. The ability to analyze speech signal using of Linear Prediction.
3. Able to extract features speech using MFC.
4. Able to generate binary sequence for digital applications.
5. Able to handle the noise in any system.

Mapping Course Outcomes(COs) with Programme Outcomes(POs)										
Course Outcomes	Programme Outcomes									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1		✓	✓	✓		✓				
CO2			✓		✓				✓	
CO3				✓	✓	✓			✓	
CO4						✓			✓	
CO5		✓			✓					

CSYP 208	SEMINAR	L	T	P
		0	0	2

COURSE OBJECTIVES

- To work on a technical topic related to Communication and acquire the ability of written and oral presentation
- To acquire the ability of writing technical papers for Conferences and Journals

The students will work for two periods per week guided by student counsellor. They will be asked to present a seminar of not less than fifteen minutes and not more than thirty minutes on any technical topic of student's choice related to Communication and to engage in discussion with audience. They will defend their presentation. A brief copy of their presentation also should be submitted. Evaluation will be done by the student counsellor based on the technical presentation and the report and also on the interaction shown during the seminar.

COURSE OUTCOMES

1. The students will be getting the training to face the audience and to interact with the audience with confidence.
2. To tackle any problem during group discussion in the corporate interviews.

Mapping Course Outcomes(COs) with Programme Outcomes(POs)										
Course Outcomes	Programme Outcomes									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1		✓	✓	✓		✓	✓		✓	
CO2		✓	✓	✓	✓	✓			✓	

CSYT 303	THESIS PHASE I	L	T	P
		0	0	3

COURSE OBJECTIVES

- To apply the relevant knowledge and skills, which are acquired within the technical area, to the relevant problems in the area of communication.

A thesis work on a specialized topic in the area of communication should be taken at the beginning of the third semester in consultation with the Head of the Department. A report must be submitted n the end of the third semester and there will be a viva-voce examination on the thesis.

COURSE OUTCOMES

On completion of this course the students will be able to

1. Do the projects related to communication engineering.
2. Handle larger problems on the advanced level within the technical area.

Mapping Course Outcomes(COs) with Programme Outcomes(POs)										
Course Outcomes	Programme Outcomes									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1		✓	✓	✓		✓			✓	
CO2		✓	✓	✓	✓	✓			✓	

CSYT 304	INDUSTRIAL TRAINING	L	T	P
		0	*	0

COURSE OBJECTIVES

- To train the students in the field work related to communication systems and to have a practical knowledge in carrying out related works.
- To train and develop skills in solving problems during execution of certain works related to communication.

The students individually undergo a training program in reputed concerns in the field of communication during the summer vacation (at the end of second semester for full – time / fourth semester for part – time) for a minimum stipulated period of four weeks. At the end of the training, the student has to submit a detailed report on the training they had, within ten days from the commencement of the third semester for Full-time / fifth semester for part-time. The students will be evaluated, by a team of staff members nominated by Head of the department, through a viva-voce examination.

COURSE OUTCOMES

1. The students can face the challenges in the field with confidence.
2. The students will be benefited by the training with managing the situation that arises during the execution of works related to communication.

Mapping Course Outcomes(COs) with Programme Outcomes(POs)										
Course Outcomes	Programme Outcomes									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1		✓	✓		✓	✓	✓	✓		
CO2		✓	✓		✓	✓	✓			

CSYT 401	THESIS PHASE II	L	T	P
		0	0	3

COURSE OBJECTIVES

- To apply the relevant knowledge and skills, which are acquired within the technical area, to the relevant problems in the area of communication.

A thesis work on a specialized topic in the area of communication selected in the third semester will be continued in the fourth semester. A report must be submitted at the end of the fourth semester and there will be a viva-voce examination on the thesis.

COURSE OUTCOMES

On completion of this course the students will be able to

1. Prepare the final report of project work in standard format for satisfactory completion of the work.

Mapping Course Outcomes(COs) with Programme Outcomes(POs)										
Course Outcomes	Programme Outcomes									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1		✓	✓	✓	✓	✓			✓	

CSYE X0X	SPEECH PROCESSING	L	T	P
		4	0	0

COURSE OBJECTIVES

- To understand the mathematical foundations needed for speech processing.
- To highlight the basic concepts and algorithms of speech processing and synthesis.
- To familiarize the students with the various speech signal representation, coding and recognition techniques.
- To appreciate the use of speech processing in current technologies and to expose the students to real– world applications of speech processing.

Fundamentals of Digital Speech Processing

Introduction – Discrete Time Signals and Systems – Transform Representation of Signals and Systems – Z-transform – Fourier Transform – Discrete Fourier Transform.

Digital Models for Speech Signal: The Process of Speech Production – Acoustic Theory of Speech Production – Lossless Tube Models – Digital Models for Speech Signals.

Time Domain Models for Speech Processing

Time-Dependent Processing of Speech – Short Time Average Zero Crossing Rate – Short Time Autocorrelation Function - Pitch Period Estimation using Autocorrelation Function – median Smoothing and Speech Processing.

Speech Coding

Introduction-Quantization-Speech quality measure-time-domain waveform coding-Linear predictive coding – Linear Delta Modulation-Adaptive Delta Modulation-Adaptive differential Pulse Code Modulation-Linear Predictive Coders- Synthesis Based Linear Predictive Analysis-Spectral coders – Sub Band Coders-Adaptive Transform Coders - Vocoders - Vector quantization coders-Code Excited Linear prediction.

Automatic Speech Recognition

Introduction – Basis Pattern Recognition Approach – Preprocessing – Parametric Representation Dynamic time warping – Networks for Speech Recognition - Hidden Markov model - Language models -Artificial neural network - Expert-System approach to Automatic Speech Recognition.

Speech Synthesis
Introduction - Principles of Speech Synthesis - Synthesizer Methods – Articulatory Synthesis – Formant Synthesis – Linear Predictive Coding Synthesis – Excitation Modeling – Synthesis of Intonation – Speech Synthesis for Different Speakers – Speech Synthesis in Other Languages – Evaluation of TTS Systems.

REFERENCES

1. D. O'Shaughnessy, "Speech communications", Human and Machine, Second Edition, UniversityPress (India), 2001.
2. L. R. Rabiner and R.W. Schafer, "Digital Processing of Speech Signals", Pearson Education, 2007.
3. L. Rabiner and R.H. Juang, "Fundamentals of Speech Recognition", Pearson education, 2003.
4. Claudio Becchetti and Lucio Prina Ricotti, "Speech Recognition", John Wiley and Sons, 1999.

COURSE OUTCOMES
On completion of this course, the students will be able to
1. Understand speech processing fundamentals.
2. Understand algorithms of speech processing and synthesis.
3. Represent various speech signals, coding and recognition techniques
4. Use speech processing in current applications.

Mapping Course Outcomes(COs) with Programme Outcomes(POs)										
Course Outcomes(COs)	Programme Outcomes(POs)									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✓	✓	✓	✓	✓	✓				
CO2	✓	✓								
CO3	✓	✓	✓							
CO4	✓		✓	✓		✓				

CSYE X0X	SPREAD SPECTRUM COMMUNICATION	L	T	P
		4	0	0

COURSE OBJECTIVES
- To introduce the basic concepts of spread spectrum communications.
- To familiarize with several spread spectrum techniques and its performance in jamming environments.
- To gain knowledge on spread spectrum receivers.
- To understand various applications of spread spectrum techniques.

Introduction
Origin of Spread Spectrum communications - advantages of spectrum spreading - Types of techniques used for spread spectrum - processing gain and other fundamental parameters - jamming methods - linear feedback, shift register and sequence generation - M-sequence and

their statistical properties - correlation properties - non-linear sequences - gold codes - Kasami sequences.

Direct Sequence Spread Spectrum System
Coherent direct sequence systems-model of a DS/BPSK system - uncoded bit error probability for arbitrary jammer waveforms - Cheruoff bound-performance under constant power broadband noise jammer - pulse jammer - partial band jammer-multitone jammer - coded DS/BPSK system.

Frequency Hopping Spread Spectrum System
Non-coherent FH system model - coherent FH systems - frequency synthesis -performance of FH/QPSK and FH/DPSK systems in partial band jamming - time hopping SS technique.

Synchronization of Spread Spectrum Receivers
Acquisition and tracking in DS SS receivers and FH SS receivers – Sequential estimation – Matched filter techniques of acquisition and tracking – Delay locked loop – Tau-Dither loop.

Applications
Code division multiple access - satellite communication – anti-jam military communication - low probability of intercept communication - mobile communication.

REFERENCES

1. R.C.Dixion, “Spread spectrum systems”, John Wiley, 1984.
2. M.K.Simon, J.K.Omura, R.A.Schiltz and B.K.Levitt, “Spread Spectrum Communication”, Vol-I, II & IV, Computer Science Press, USA, 1985.
3. G.R.Cooperand, CD.Mc.Gillem, “Modern communications and spread spectrum”, McGraw Hill, 1986.
4. Roger L Peterson, Rodger E Ziemer and David E Borth, “Introduction to Spread Spectrum Communication”, Pearson Publication,

COURSE OUTCOMES
On completion of this course, the students will be able to
1. Describe the types and advantages of spread spectrum modulation formats.
2. Perform analysis on the performance of spread spectrum modulation formats.
3. Describe the differences and benefits of different types of spreading codes.
4. Analyze the performance of spread spectrum systems in the presence of interference.
5. Analyze the performance of spreading code acquisition and tracking circuits.

Mapping Course Outcomes(COs) with Programme Outcomes(POs)										
Course Outcomes(COs)	Programme Outcomes(POs)									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✓	✓	✓							
CO2	✓	✓	✓			✓				
CO3	✓	✓	✓			✓				
CO4	✓	✓	✓			✓				
CO5	✓	✓		✓		✓				

CSYE X0X	MICROWAVE ANTENNAS AND INTEGRATED CIRCUITS	L	T	P
		4	0	0

COURSE OBJECTIVES

- To understand signal propagation at Radio frequencies & to study aperture and reflector antennas.
- To have a knowledge on the concept of Microstrip antennas.
- To introduce to the students the basics of Microstrip Patch Antennas and its analysis
- To learn about the solid state active devices for MICs.

Aperture and Horn Antennas

Huygen's Equivalence Principle - Radiation from Rectangular and Circular Apertures E-Plane And H-Plane Sectoral Horns – Design Aspects- Radiation From E-Plane Sectoral Horn-Over View of Pyramidal Horn, Conical, Corrugated Horn –Gain Measurement By Standard Horn Antennas.

Satellite Antennas

Radiation and Impedance Properties of Parabolic Reflector Antenna And Cassegrain Antenna - Spillover Loss - Corner Reflector - Lens Antenna.

Antenna Arrays**:** Linear Array With Non-Uniform Current Distribution (Dolph-Tchebyscheff Distribution - Taylor Distribution- Design Considerations)-Planar Array - Phased Array - Adaptive Antenna Array.

Planar Transmission Lines - Fabrication Aspects of MMIC

Planar Transmission Lines For MICS- Different Types- Micro Strip Line – CPW- CPS, FIN Line-Analysis- Comparison of Micro Strip Line, Fin Lines And Coplanar Lines - Analysis of Fin Lines- Conductor Loss In Fin Lines- Design Of Microstrip Lines. Introduction To Coplanar Wave Guide And Coplanar Strips - MMIC Fabrication Techniques.

Microstrip Antennas

Radiation From Micro Strip Patch - Electric And Magnetic Current Distributions - Feeding Techniques - Cavity Model Analysis Of Rectangular And Circular Microstrip Antennas - Design Of Rectangular, Circular Microstrip Patch Antennas-Dual-Frequency Micro Strip Antennas - Circularly Polarized Micro Strip Antennas - Broadband And Ultra Wide Band Micro Strip Antennas - Basic Characteristics Of Stacked - Electromagnetic Coupled And Aperture Coupled Micro Strip Antennas - Aperture Coupled Stacked Micro Strip Antennas.

Microwave Solid – State Active Devices for MICS

Thick and Thin Film Technologies and Materials - Encapsulation and Mounting of Active Devices. Micro Strips on Semiconductor Substrates. Applications of Mics Phased Array Radar System - Satellite T.V. System

REFERENCES

1. Balanis C. A., "Antenna Theory -Analysis & Design", Harper & Row Publisher
2. Collin R. E. , "Antennas & Radiowave Propagation", Mcgraw-Hill Intnl.
3. Garg, R. Bhartia P., Bhal. I & Ittipiboon A. "Microstrip Antenna Design", Handbook

4. Samuel Y. Liao.Microwave Devices & Circuits *3/E*
5. Gupta. K.C. Microwave Integrated Circuits
6. Bhat B. Koul S. K. Stripline-Like Transmission Lines For Microwave Integrated Circuits, Wiley Eastern Ltd., New Delhi.

COURSE OUTCOMES

At the end, the student would be able to

1. Understand signal propagation at Radio frequencies
2. Acquire the knowledge about the Microstrip antennas
3. Get the foundation about solid state active devices

Mapping Course Outcomes(COs) with Programme Outcomes(POs)										
Course Outcomes(COs)	Programme Outcomes(POs)									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✓	✓								
CO2		✓	✓							
CO3			✓	✓		✓			✓	

CSYE X0X	RF MEMS FOR WIRELESS COMMUNICATION SYSTEMS	L	T	P
		4	0	0

COURSE OBJECTIVES

- To provide knowledge on Microsystems fabrication process and Micromachining.
- To understand the fundamentals of RF MEMS circuit elements, MEMS based circuit design and its applications to wireless communications.

Introduction to RF MEMS Technologies

Need for RF MEMS Components in Communications - Space and Defense Applications - Materials and Fabrication Technologies - Special Consideration in RF MEMS Design.

Fabrication Process and Micromachining

Markets for Microsystems and MEMS**,** Substrates and material properties -Doping– Oxidation – Concepts of Bulk Micro machining and Surface Micro machining- Additive Processes- Evaporation and sputtering – Chemical vapor deposition (CVD)- Lithography- Wet etching: Isotropic– Anisotropic – Etch stops- Dry etching: Vapour – Plasma / RIE –DRIE- Other processing techniques and materials: LIGA– Lift-off– Chemical Mechanical Polishing (CMP)– Soft Lithography and polymers – Wafer Bonding - Design rules and Mask making.

RF MEMS Components

MEMS Inductors and Capacitors: Micromachined Inductor, Effect of Inductor Layout – Modeling and Design Issues of Planar Inductor – Gap Tuning and Area Tuning Capacitors – Dielectric Tunable Capacitors.

MEMS Phase Shifters: Types – Limitations – Switched Delay Lines – Micromachined Transmission Lines – Coplanar Lines – Micromachined Directional Coupler and Mixer.

RF MEMS Circuit Elements

Enabled Circuit Elements – Capacitors – Inductors – Varactors – MEM Switch- Shunt MEM Switch – Low Voltage Hinged MEM Switch Approaches – Push-Pull Series Switch – Folded – Beam – Springs – Suspension Series Switch – Resonators – Transmission Line Planar Resonators – Cavity Resonators – Micromechanical Resonators – Film Bulk Acoustics Wave Resonators – MEMS Modeling – Mechanical Modeling – Electromagnetic Modeling.

Advanced RF MEMS Circuits

Enabled Circuit – Reconfigurable Circuits – The Resonant MEMS Switch – Capacitors – Inductors – Tunable CPW Resonator – MEMS Micro switch Arrays – Reconfigurable Circuits – Double – Stub Tuner – nth Stub Tuner – Filter- Resonator Tuning System – Massively Parallel Switchable RF Front Ends – True Delay Digital Phase Shifters- Reconfigurable Antennas – Tunable Dipole Antennas – Tunable Microstrip Patch – Array Antenna.

RF MEMS based Circuit Design

Phase Shifters – Fundamentals- X-Band RF MEMS Phase Shifter For Phased Array Applications – Ka-Band and RF MEMS Phase Shifter For Radar Systems Applications- RF MEMS Filters – Ka-Band, Millimeter Wave Micro Machined Tunable Filter – High-Q 8MHz MEM Resonators Filter- RF MEMS Oscillators – Fundamentals - 14GHz MEM Oscillators - Ka-Band Micro Machined Cavity Oscillator- 2.4 GHz MEMS Based Voltage Controlled Oscillator.

REFERENCES

1. Hector J. De Los Santros, "RF MEMS Circuit Design for Wireless Communication" ,Artech House, 2002.
2. Vijay K. Varadan, Vinoy K.J, Jose k.A., "RF MEMS and their Applications" , John Wiley and Sons., Ltd., 2002.
3. Gabriel M.Rebeiz, "RF MEMS theory, Design and Technology", Wiley Interscience, 2002.
4. Tai-Ran-Hsu, "MEMS & Microsystems Design and Manufacture", Tata McGraw Hill, New Delhi, 2002.

COURSE OUTCOMES

At the end, the student would be able to

1. Familiarize with Microsystems fabrication process and Micromachining.
2. Understand physical aspects of RF circuit design.
3. Acquire knowledge on RF MEMS elements such as switches, resonators, antennas etc.,
4. Design Practical RF MEMS devices.

Mapping Course Outcomes(COs) with Programme Outcomes(POs)										
Course Outcomes(COs)	Programme Outcomes(POs)									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✓	✓								
CO2	✓	✓	✓			✓				
CO3	✓	✓	✓			✓				
CO4			✓	✓						

CSYE X0X	OFDM FOR WIRELESS COMMUNICATION	L	T	P
		4	0	0

COURSE OBJECTIVES

- To impart knowledge about OFDM principles and its Implementation.
- To understand coding and interleaving techniques to reduce channel effects.
- To study various synchronization procedures in OFDM.
- To understand various channel estimation techniques and PAPR reduction schemes in OFDM system.
- To gain knowledge on OFDM multiple access schemes and applications of OFDM.

Introduction

Wireless channel fundamentals - Multicarrier transmission scheme– OFDM Principles – System Model – Generation of Sub Carrier Using IFFT – Guard Time and Cyclic Extension, Choice of OFDM Parameters – OFDM Signal Processing.

Coding, Modulation and Synchronization Techniques

Introduction – Forward Error Correction Coding – Interleaving – Quadrature Amplitude Modulation – Coded Modulation – Synchronization – Sensitivity to Phase Noise , Frequency Offset and Timing Errors – Synchronization Using Cyclic Extension and Special Training Symbols.

Channel Estimation and PAPR Reduction in OFDM System

Coherent Detection : One and Two Dimensional Channel Estimators , Special Training Symbols, Decision Directed Channel Estimation – Differential Detection : Differential Detection in the Time and Frequency Domain-Peak to Average Power Ratio (PAPR) reduction in OFDM system: Clipping and peak windowing, PAPR reduction codes, Selective Mapping and Partial Transmit Sequence.

Orthogonal Frequency Division Multiple Access

Frequency Hopping in OFDMA – Difference between OFDMA and MC-CDMA, OFDMA System Description – Channel Coding – Modulation – Time and Frequency Synchronization, Initial Modulation Timing and Frequency Offset Synchronization Accuracy – Power Control – Random Frequency Hopping Operation – Dynamic Channel (Simple and Fast) – Capacity of OFDMA.

Application of OFDM

Digital Audio Broadcasting –Terrestrial Digital Video Broadcasting. Wireless LAN Standards: IEEE 802.11 - Hyper LAN and MMAC –Difference between IEEE 802.11, Hyper LAN/2 and MMAC- Magic wand (Wireless ATM project). IEEE 802.11, Hyper LAN/ 2 and MMAC Wireless LAN standards – OFDM parameters, Channelization, OFDM signal processing, Training, Difference between IEEE 802.11, Hyper LAN/ 2 and MMAC.

REFERENCES

1. Richard Van Nee and Ramjee Prasad, “OFDM for Wireless Multimedia Communication”, Artech House, 2000.
2. Mare Engels, “Wireless OFDM systems”, Klumer Academic publishers, 2002.

3. Ye (Geoffrey) Li, Gordon L. Stiiber ." Orthogonal Frequency Division Multiplexing for Wireless Communications", Springer 2006.
4. Yong SooCho, Jaekwon Kim,Won Young Yang, Chung G. Kang, "MIMO-OFDM Wireless Communications with MATLAB", John wiley and sons 2010.
5. Ahmad R. S. Bahai, Burton R. Saltzberg, Mustafa Ergen, "Multi carrier Digital communication Theory and applications of OFDM", Second Edition, Springer 2004.

COURSE OUTCOMES

On completion of this course the students will be able to

1. Describe the principles of OFDM and its Implementation.
2. Implement the coding and interleaving procedure to mitigate the channel effects.
3. Analyze synchronization techniques, channel estimation techniques and PAPR reduction techniques in OFDM.
4. Describe multiple accesses in OFDM and various applications of OFDM.

Mapping Course Outcomes(COs) with Programme Outcomes(POs)										
Course Outcomes(COs)	Programme Outcomes(POs)									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✓	✓	✓	✓						
CO2				✓		✓				
CO3	✓		✓	✓		✓				
CO4	✓	✓		✓		✓			✓	

CSYE X0X	MOBILE AD HOC NETWORKS	L	T	P
		4	0	0

COURSE OBJECTIVES

- To introduce the characteristic features of Adhoc wireless networks and their applications to the students.
- To enable the students to understand the functioning of different access and routing protocols that can be used for Adhoc networks.
- To make the students to realize the need for security and challenges and also the role of cross layer design in enhancing the network performance.

Introduction

Introduction to Ad Hoc networks – definition, characteristics features, applications. Characteristics of Wireless channel, Adhoc Mobility Models: - entity and group models.

Medium Access Protocols

MAC Protocols: design issues, goals and classification. Contention based protocols, reservation based protocols, scheduling algorithms, protocols using directional antennas. IEEE standards: 802.11a, 802.11b, 802.11g, 802.15. HIPERLAN.

Network Protocols

Addressing issues in ad hoc network, Routing Protocols: Design issues, goals and classification. Proactive Vs reactive routing, Unicast routing algorithms, Multicast routing algorithms, hybrid

routing algorithm, Power/ Energy aware routing algorithm, Hierarchical Routing, QoS aware routing.

End -to - End Delivery and Security
Transport layer: Issues in designing- Transport layer classification, adhoc transport protocols. Security issues in adhoc networks: issues and challenges, network security attacks, secure routing protocols.

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, Co-operative networks:- Architecture, methods of co-operation, co-operative antennas, Integration of ad hoc network with other wired and wireless networks.

REFERENCES

1. C.Siva Ram Murthy and B.S.Manoj, "Ad hoc Wireless Networks Architectures and protocols", 2nd edition, Pearson Education. 2007
2. Charles E. Perkins, "Ad hoc Networking", Addison – Wesley, 2000.
3. Stefano Basagni, Marco Conti, Silvia Giordano and Ivan Stojmenovic, "Mobile adhoc networking", Wiley-IEEE press, 2004.
4. T. Camp, J. Boleng, and V. Davies "A Survey of Mobility Models for Ad Hoc Network Research," Wireless Communication and Mobile Comp., Special Issue on Mobile Ad Hoc Networking Research, Trends and Applications, vol. 2, no. 5, 2002, pp. 483–502.
5. V.T. Raisinhani and S. Iyer "Cross layer design optimization in wireless protocol stacks", Computer communication, vol 27 no. 8, 2004.

COURSE OUTCOMES
On completion of this course the students will be able to
1. Understand the basics of mobile ADHOC networks
2. Got the knowledge of MAC and network protocols
3. Realize the need for security and challenges and also the role of cross layer design in enhancing the network performance.

Mapping Course Outcomes(COs) with Programme Outcomes(POs)										
Course Outcomes(COs)	Programme Outcomes(POs)									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✓	✓				✓				
CO2	✓	✓								
CO3			✓	✓		✓			✓	

CSYE X0X	HIGH SPEED NETWORKS	L	T	P
		4	0	0

COURSE OBJECTIVES
- To learn about the ATM backbone and advanced network architecture for high performance communication networks.

- To acquire knowledge about MPLS architecture, signaling and routing protocols.
- To study the types of VPN and tunneling protocols for security.
- To learn about Recent Trends In High Speed Networks

Introduction

Evolution of high speed networking – Synchronous Digital Hierarchy (SDH), Fibre Optic Network, Synchronous Optical Network (SONET) standards – Wave length division multiplexed (WDM) LAN – Basics of networking technologies – Fast Ethernet, Gigabit Ethernet, Frame relay DSL, ATM, MPLS, wireless networks such as 802.11,802.16,WiMax, 3G & 4G networks. Design considerations in high performance networking.

ATM

ATM Protocol architecture – core aspects, ATM Layers- ATM Adaptation layer-synchronous fast packet switching techniques and VP/VC encapsulation- ATM cells – ATM traffic Management - Connection management – Discrete time queue analysis and application to Connection Admission Control (CAC) – Peak Cell rate algorithm – Leaky Bucket algorithm.

MPLS

Introduction to MPLS, considerations in the choice of cells VS frames, IP over MPLS architecture &terminology, MPLS forwarding operations, MPLS encapsulation standards, MPLS signaling and routing protocols, research areas in MPLS.

Advanced Networks Concepts

VPN - Remote Access VPN, site-to-site VPN, Tunneling to PPP, Security in VPN, MPLS-operation, Routing, tunneling and use of FEC, Traffic Engineering, MPLS based VPN, overlay networks-P2P Connections.

Recent Trends in High Speed Networks

Enabling Differentiated Services Using Generalized Power Control Model in Optical Networks - Adaptive Quality of Service Based Power Management - New Worm Exploiting IPV6 and IPV4 - IPV6 - Dual stack Networks - Methodologies and Tools for Exploring Transport Protocols in the Context of High speed Networks - End-to-end Congestion Control for High Speed Networks Based on Population Ecology Models.

REFERENCES

1. W.Stallings, “High Speed Networks and Internet”, Pearson ed., 1999.
2. R.O.Onvural, “ATM Networks-Performance Issues”, Artech House, 1995.
3. David E. McDysan, Dave Paw. “ATM & MPLS Theory & Application: Foundations of Multi Service Networking” DOI:10.1036 0072228377;McGraw-Hill publication.
4. Walrand J. Varatya, High performance communication network Morganb Kaufmann – Harcourt Asia Pvt. Ltd. 2nd Edition, 2000
5. Jeffrey G. Andrews. AnuradhaGhosh. RiasMUhamed, “Fundamentals of WiMAX understanding broadband Wireless Networking”,Prentice Hall,ISBN:0-13-222552-2
6. Fred Halsall and Lingana Gouda Kulkarni, “Computer Networking and the Internet” fifth edition, Pearson education.

COURSE OUTCOMES

On completion of this course the students will be able to

1. Understand various High speed networks.
2. Understand ATM Protocol architecture and Traffic Management.
3. Understand clearly the working of MPLS
4. Acquire the basics of Advanced Network Concepts and Recent trends in High Speed Networks.

Mapping Course Outcomes(COs) with Programme Outcomes(POs)										
Course Outcomes(COs)	Programme Outcomes(POs)									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✓	✓								
CO2	✓	✓							✓	
CO3		✓				✓				
CO4	✓	✓							✓	

CSYE X0X	VIRTUAL PRIVATE NETWORKS	L	T	P
		4	0	0

COURSE OBJECTIVES

- To study the types of VPN and tunneling protocols for security.
- To learn about network security in many layers and network management.
- To impart knowledge on VPN protocols and MPLS VPN.

Introduction

Introduction to VPN, VPN devices, Types of VPN - Access VPN, Intranet VPN, Extranet VPN, Overlay and Peer-to-peer VPNs, Connection-oriented and connectionless VPNs, Trusted and Secure VPNs-VPN Provisioning - Service provider and customer provisioned VPNs.

Layer 2 and Layer 3 VPN

Layer 2 Internetworking, VPN Service, - Benefits of L2VPN, Inter-AS L2VPN, Supported IETF Standards-Technology Overview-Intranet Corporate-Internet Access-Scaling MPLS VPNs to Multi-AS, Multi-Provider, and Hierarchical Networks-Heterogeneous Networks-Managed Central Services.

VPN and Firewalls

Secure VPN Technologies, Trusted VPN Technologies, VPN/Firewall Architecture, VPN/Firewall Security Policy, Advanced Security Policy and System Management Hybrid VPN Technologies, Site-to-Site VPN, Remote Access VPN.

MPLS and MPLS VPN

WAN Topologies- Standard IP based Switching – CEF based Multi-Layer switching-MPLS Characteristics- Frame Mode MPLS Operation – MPLS VPN.

VPN Protocols

VPN Protocols, Layer 2 Tunneling Protocol, Internet Protocol Security, Internet Key Exchange (IKE) Protocol, VPN Hacking, Voice over IP Attack – Authentication Header-Encapsulation Security Payload (ESP)- IPSEC Protocol Suite – Generic Routing Encapsulation(GRE).

REFERENCES

1. Ruixi Yuan and Timothy Strayer W., "Virtual Private Networks: Technologies and Solutions", Addison-Wesly, 2001.
2. Thaddeus Fortenberry, "Windows 2000 Virtual Private Networking", Macmillan Technical Pub, 2007.
3. Roger J. Sutton, "Secure Communications: Applications and Management", WILEY, 2002.
4. Don J. Torrieri, "Principles of secure communication systems", 2nd Eedition, Artech House Publishers, 1992.

COURSE OUTCOMES

On completion of this course the students will be able to

1. Understand the types of VPN and tunneling protocols for security.
2. Familiarize about network security in many layers and network management.
3. Acquire knowledge on VPN protocols and MPLS VPN.

Mapping Course Outcomes(COs) with Programme Outcomes(POs)										
Course Outcomes(COs)	Programme Outcomes(POs)									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✓	✓				✓				
CO2	✓	✓							✓	
CO3		✓	✓	✓						

CSYE X0X	ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY IN SYSTEM DESIGN	L	T	P
		4	0	0

COURSE OBJECTIVES

- To understand the concepts related to Electromagnetic interference in PCBs
- To provide solutions for minimizing EMI in PCBs
- To learn EMI standards in the design of PCBs
- To learn various EMI coupling principles, EMI standards and measurements
- To provide knowledge on EMI control techniques and design procedures to make EMI compatible PCBs

EMI/EMC Concepts

EMI-EMC definitions and Units of parameters; Sources and victim of EMI; Conducted and Radiated EMI Emission and Susceptibility; Transient EMI, ESD; Radiation Hazards.

EMI Coupling principles
Conducted, radiated and transient coupling; Common ground impedance coupling ; Common mode and ground loop coupling ; Differential mode coupling ; Near field cable to cable coupling, cross talk ; Field to cable coupling ; Power mains and Power supply coupling.

EMI Control Techniques
Shielding, Filtering, Grounding, Bonding, Isolation transformer, Transient suppressors, Cable routing, Signal control.

EMC Design of PCBs
Component selection and mounting; PCB trace impedance; Routing; Cross talk control; Power distribution decoupling; Zoning; Grounding; VIAs connection; Terminations.

EMI Measurements and Standards
Open area test site; TEM cell; EMI test shielded chamber and shielded ferrite lined anechoic chamber; Tx /Rx Antennas, Sensors, Injectors / Couplers, and coupling factors; EMI Rx and spectrum analyzer; Civilian standards-CISPR, FCC, IEC, EN; Military standards.

REFERENCES

1. V.P.Kodali, Engineering EMC Principles, Measurements and Technologies, IEEE Press, Newyork, 1996.
2. Henry W.Ott., Noise Reduction Techniques in Electronic Systems, A Wiley Inter Science Publications, John Wiley and Sons, Newyork, 1988.
3. Bemhard Keiser, Principles of Electromagnetic Compatibility, 3rd Ed, Artech house, Norwood, 1986.
4. C.R.Paul, Introduction to Electromagnetic Compatibility, John Wiley and Sons, Inc, 1992.
5. Don R.J.White Consultant Incorporate, Handbook of EMI/EMC, Vol I-V, 1988.

COURSE OUTCOMES
1. Analyze Electromagnetic interference effects in PCBs
2. Propose solutions for minimizing EMI in PCBs
3. Analyze Electromagnetic environment, EMI coupling, standards, measurement and control techniques

Mapping Course Outcomes(COs) with Programme Outcomes(POs)										
Course Outcomes(COs)	Programme Outcomes(POs)									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✓	✓	✓			✓				
CO2	✓	✓	✓	✓		✓			✓	
CO3	✓	✓	✓			✓				

CSYE X0X	ADVANCED ELECTROMAGNETIC THEORY	L	T	P
		4	0	0

COURSE OBJECTIVES

- To introduce the students about the transmission lines and wave guides.
- To discuss about the theory of micro strips and strip lines.
- To obtain a broad understanding of surface waveguides and microwave cavities.

Transmission Lines

General solutions for TEM, TE and TM waves obtained from reduced Maxwell's Equations. In homogeneously filled parallel plate transmission-line: Derivation of E.M. fields for the dominant E-mode followed by low-frequency and high frequency solutions.

Waveguides

General solutions for E_{nm} and H_{nm} modes in a rectangular waveguide; including waveguide parameters. Anisotropic dielectrics -Power for H_{nm} modes. Derivation of the attenuation constant for the H_{io} or H_{10}mode.TE_{mo} modes of a partially loaded waveguide, TE_{nm} andTM_{nm} modes in a circular waveguide, TE_{nm} modes in a coaxial transmission line.

Microstrips and Strip Lines

Vector and scalar potential function formulation for microstrip transmission line with anisotropic substrate material - Low frequency solutions; inductance per unit length; capacitance per unit length; propagation constant; and the characteristic impedance - An approximate electrostatic solution for Microstrip Transmission line with perfectly conducting walls; equivalent dielectric constant - Microstrip attenuation - An approximate electrostatic solution for an enclosed strip-line.

Surface Waveguides

TE_n and TM_n modes of a grounded dielectric slab surface waveguide. Phase, group and energy flow velocities. An introduction to Ridge Waveguides and FIN lines. E.M. fields: Resonant frequencies and Q for TE_{10l} modes of a rectangular cavity.

Microwave Cavities

Electromagnetic fields; resonant frequencies and Q for TE_{nml} modes of a circular cavity.$TE_{01\delta}$ mode of the cylindrical dielectric resonator.Farby-Perot resonators - A general microwave cavity - Cavity field expansion in terms of short circuit modes.Electric field expansion in a general cavity; Orthogonality properties.Magnetic field expansion in a general cavity; Orthogonality properties.

REFERENCES

1. Prof. Robert E. Collin, "Foundations for Microwave Engineering", Second Edition; McGraw Hill International Edition, Second Edition, 2000.
2. Prof. David M. Pozar "Microwave Engineering "; Second Edition; John Wiley & Sons; Inc. Third Edition, 2004.
3. Rakhesh Singh Kshetrimayum, "Electromagnetic Field Theory", Cengaga Learning India, 2012.

4. Rohit Khurana, “Electromagnetic Field Theory”, ITL ESL Vikas Publishing, 2015.

COURSE OUTCOMES

On completion of this course the students will be able to

1. Understand clearly about the transmission lines and wave guides
2. Familiarize about the theory of micro strips and strip lines
3. Understand broadly about surface waveguides and microwave cavities

Mapping Course Outcomes(COs) with Programme Outcomes(POs)										
Course Outcomes(COs)	Programme Outcomes(POs)									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✓	✓	✓			✓				
CO2	✓	✓	✓			✓				
CO3	✓	✓	✓			✓				

CSYE X0X	RF COMMUNICATION	L	T	P
		4	0	0

COURSE OBJECTIVES

- To learn the fundamental concepts of RF wireless communications.
- To explore the students about the protocols and modulation techniques.
- To introduce transmitter and receiver system design techniques and analysis.
- To understand the basics of radio system design and applications.

Introduction

Elements of Wireless communications – Mechanism of Radio wave propagation-Open field propagation – Diffraction – Scattering – Path loss - Multipath Phenomena – Flat fading - Diversity technique – Noise.

Antennas and Transmission Lines -Antenna characteristics-Types of antennas- Impedance matching – Measuring techniques.

Communication Protocols and Modulation

Base band data format & protocol – Base band coding – RF frequency & Bandwidth – Modulation and Demodulation: Phase shift keying - Nyquist bandwidth - QPSK constellation diagram and 16- QAM constellation diagram-Spread spectrum: Frequency hopping spread spectrum & direct sequence spread spectrum– RFID.

Transmitters and Receivers

Transmitters -RF Source: Saw resonators & oscillators, Crystal oscillators, Synthesizer control – Modulation: ASK & FSK of Saw oscillators – Amplifiers – Filtering – Antenna Receivers - Tuned radio frequency – Super regenerative receiver – Super heterodyne receiver – Direct conversion receiver – Digital receivers – Repeaters.

Radio System Design
Range of radio system – Sensitivity – Finding range from sensitivity - Super heterodyne image & spurious response – Inter modulation distortion and dynamic range – Demodulation – Internal receiver noise – transmitter design – Bandwidth – Antenna Directivity – Power source.

Applications and Technologies
Wireless local area network (WLAN): Wi-Fi, Network architecture, IEEE 802.11 a, b, HIPERLAN – Bluetooth: Transceiver and timing – Zigbee: Architecture, characteristics, Frame structure, applications, comparison of Bluetooth with Zigbee – Conflict and Compatibility – Ultra wideband technology.

REFERENCES

1. Alan Bensky, "Short Range Wireless Communication Fundamentals of RF System Design and Application", II edition, 2004.
2. T.S. Rappaport, "Wireless Communications", Pearson Education, 2003.
3. Jon B. Hagen, "Radio Frequency Electronics", Cambridge University press, Cambridge, 1996.
4. Ian Hickman, "RF HandBook", Butter Worth Heinemann Ltd., Oxford, 1993.

COURSE OUTCOMES
On completion of this course, the students will be able to
1. Understand the basic concepts of RF wireless communications
2. Acquire the detail view of communication protocol
3. Analyze and design various transmitters and receivers
4. Understand the basics of radio system design and applications

Mapping Course Outcomes(COs) with Programme Outcomes(POs)										
Course Outcomes(COs)	Programme Outcomes(POs)									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✓	✓								
CO2	✓	✓	✓							
CO3	✓		✓	✓		✓			✓	
CO4	✓		✓	✓		✓				

CSYE X0X	ADVANCED DIGITAL IMAGE PROCESSING	L	T	P
		4	0	0

COURSE OBJECTIVES
- To understand the image fundamentals and mathematical transforms necessary for image processing and to study the image enhancement techniques.
- To understand the image segmentation and representation techniques.
- To understand how image are analyzed to extract features of interest.
- To introduce the concepts of image registration and image fusion.
- To analyze the constraints in image processing when dealing with 3D data sets.

Fundamentals of Digital Image Processing
Elements of visual perception, brightness, contrast, hue, saturation, mach band effect, 2D image transforms DFT, DCT, KLT, and SVD. Image enhancement in spatial and frequency domain, Review of morphological image processing.

Segmentation
Edge detection, Thresholding, Region growing, Fuzzy clustering, Watershed algorithm, Active contour methods, Texture feature based segmentation, Model based segmentation, Atlas based segmentation, Wavelet based Segmentation methods.

Feature Extraction
First and second order edge detection operators, Phase congruency, Localized feature Extraction detecting image curvature, shape features Hough transform, shape skeletonization, Boundary descriptors, Moments, Texture descriptors Autocorrelation, Co-occurrence features, Run length features, Fractal model based features, Gabor filter, wavelet features.

Registration and Image Fusion
Registration Preprocessing, Feature selection points, lines, regions and templates Feature correspondence Point pattern matching, Line matching, region matching Template matching, Transformation functions Similarity transformation and Affine Transformation. Resampling Nearest Neighbour and Cubic Splines Image Fusion Overview of image fusion, pixel fusion, Multiresolution based fusion discrete wavelet transform, Curvelet transform. Region based fusion.

3D Image Visualization
Sources of 3D Data sets, Slicing the Data set, Arbitrary section planes, The use of color, Volumetric display, Stereo Viewing, Ray tracing, Reflection, Surfaces, Multiply connected surfaces, Image processing in 3D, Measurements on 3D images.

REFERENCES

1. Rafael C. Gonzalez, Richard E. Woods, “Digital Image Processing”, Pearson, Education, Inc., Second Edition, 2004.
2. Anil K. Jain, Fundamentals of Digital Image Processing', PearsonEducation,Inc., 2002.
3. Rick S.Blum,Zheng Liu,“ Multisensor image fusion and itsApplications“,Taylor& Francis,2006.
4. S Sridhar, “ Digital Image Processing” Second Edition, Oxford Publications, 2000.

COURSE OUTCOMES
On completion of the course, the students will be able to
1. To understand image formation and the role human visual system play in perception of gray and color image data.
2. To apply image processing techniques in both the spatial and frequency domains.
3. To design image analysis techniques in the form of image segmentation and to evaluate the methodologies for segmentation.
4. To understand the concepts of image registration and image fusion.

Mapping Course Outcomes(COs) with Programme Outcomes(POs)										
Course Outcomes(COs)	Programme Outcomes(POs)									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✓	✓								
CO2	✓	✓	✓			✓				
CO3			✓	✓	✓	✓				
CO4	✓		✓						✓	

CSYE X0X	DIGITAL VIDEO PROCESSING	L	T	P
		4	0	0

COURSE OBJECTIVES

- To introduce the fundamentals of video processing.
- To study the concepts of motion estimation and its general methodologies..
- To learn the basics of video coding and its methods.
- To understand the error control techniques in video processing and its applications in the wireless networks.

Introduction to Video Processing

Principles of colour video processing - Video display - Composite versus component video - Progressive and interlaced scan - Sampling of video signals.

Motion Estimation

Two dimensional - Optical flow - General methodologies - Pixel based motion estimation - Block matching algorithm - Deformable block matching algorithm - Mesh based motion - estimation - Global motion estimation - Region based motion estimation - Multiresolution - motion estimation - Three dimensional - Feature based Motion Estimation - Direct motion – Estimation - Iterative model.

Basic of Video Coding

Categorization of video coding schemes - Information Theory for source coding - Binary encoding - Scalar quantization - Vector quantization - Wave form based coding - Block-based transform coding - Predictive coding - Temporal prediction and transform coding.

Error Control in Video Communications

Overview of approaches - Video applications and communication – networks - Transport level error control - Error resilient encoding - Decoder error concealment - Encoder-decoder interactive error control - Error resilience Tools in H.263 and MPEG-4.

Streaming Video over the Internet and Wireless IP Networks

Architecture for video streaming systems - Video compression - Application layer QoS control for streaming – video Continuous media Distribution services - Streaming servers - Media synchronization - Protocols for streaming video - Streaming video over wireless IP networks.

REFERENCES

1. Yao Wang, Jorn Ostermann, Ya-Qin Zhang, ‘Video Processing and Communications’, Prentice Hall, 2002.

2. Alan C. Bovik, 'The Essential Guide to Video Processing', Elsevier Science, second edition, 2009.
3. Jens R. Ohm, 'Multimedia Communication Technology: Representation, Transmission and Identification of Multimedia Signals , Springer, 2004.
4. M. E. Al-Mualla, C. N. Canagarajah and D. R. Bull, "Video Coding for Mobile
5. Communications: Efficiency, Complexity and Resilience", Elsevier Science, Academic Press, 2002.
6. A. Murat Tekalp, 'Digital Video Processing', Prentice Hall, edition 1, 1996.

COURSE OUTCOMES

On completing this course the students should be able to:

1. Understand the basic concepts and characteristics of video processing.
2. Understand the concepts of motion estimation and basics of video coding.
3. Analyze the error control in video communications and its applications.
4. Understand the basics of video compression and its applications in the wireless networks.

Mapping Course Outcomes(COs) with Programme Outcomes(POs)										
Course Outcomes(COs)	Programme Outcomes(POs)									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✓	✓								
CO2	✓	✓								
CO3	✓	✓	✓	✓		✓				
CO4	✓	✓	✓	✓		✓				

CSYE X0X	WIRELESS COMMUNICATION NETWORKS	L	T	P
		4	0	0

COURSE OBJECTIVES

- To understand the various terminologies, principles used in wireless communication networks.
- Overview of wireless communication networks area and its application.
- To appreciate the contribution of wireless communication networks to technological growth.

Physical and Wireless MAC Layer Alternatives

Wired transmission techniques- design of wireless modems, power efficiency, out of band radiation, applied wireless transmission techniques, short distance base band transmission, UWB pulse transmission, broad Modems for higher speeds, diversity and smart receiving techniques, random access for data oriented networks, integration of voice and data traffic.

Wireless Network Planning and Operation

Wireless networks topologies, cellular topology, cell fundamentals signal to interference ratio calculation, capacity expansion techniques, cell splitting, use of directional antennas for cell sectoring, micro cell method, overload cells, channels allocation techniques and channel

borrowing techniques, DCA, mobility management, radio resources and power management securities in wireless networks.

Wireless Personal Area Networks

Introduction to Bluetooth, WPAN Device Architecture, Protocol Stack, Network Connection Establishment, Topology Applications, Low Rate and High Rate WPAN, Wireless Sensor Network, Protocol Stack, IEEE 802.15.3Zig bee Technology – IEEE 802.15.4 Ultra Wideband.

Wireless Local Area Networks

Introduction to Wireless LANs, LAN Equipment, Topologies, Technologies, Architecture and Services, MAC Sub Layer – IEEE 802.11Standards, Interference between Bluetooth and IEEE 802.11, HIPERLAN, Introduction to IEEE 802.16, 802.22, Rural Area Networks – Wi-Max Protocols.

Ad-Hoc Wireless Networks

Characteristics of Ad-hoc Networks, Classifications of MAC Protocols-Table driven and Source initiated On Demand routing protocols, DSDV, AODV, DSR, Hybrid Protocols, TCP over Ad-hoc Wireless Networks.

REFERENCES

1. KavehPahlavan, PrashantKrishnamoorthy, "Principles of Wireless Networks", A United Approach – Pearson Education, 2002.
2. X.Wang and H.V.Poor, "Wireless Communication Systems", Pearson education, 2004.
3. M.Mallick, "Mobile and Wireless design essentials", Wiley Publishing Inc. 2003.
4. P.Nicopolitidis, M.S.Obaidat, G.I. papadimitria, A.S. Pomportsis, "Wireless Networks", John Wiley & Sons, 2003.
5. T.S. Rappaport, "Wireless Communications", Pearson Education, 2003.

COURSE OUTCOMES

On completion of this course, the students will be able to

1. Analyze the design considerations of wireless MAC layer.
2. Formulate wireless network planning and operation techniques.
3. Discuss various WLAN and WWAN standards.
4. Analyze the design considerations of wireless networks.

Mapping Course Outcomes(COs) with Programme Outcomes(POs)										
Course Outcomes(COs)	Programme Outcomes(POs)									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✓	✓	✓	✓		✓				
CO2	✓	✓		✓		✓			✓	
CO3	✓		✓	✓						
CO4	✓		✓	✓		✓				

CSYE X0X	VLSI FOR WIRELESS COMMUNICATION	L	T	P
		4	0	0

COURSE OBJECTIVES

- To study the design concepts of low noise amplifiers.
- To study the various types of mixers designed for wireless communication.
- To study and design PLL and VCO.
- To understand the concepts of CDMA in wireless communication.

Components and Devices

Integrated inductors, resistors, MOSFET and BJT AMPLIFIER DESIGN: Low Noise Amplifier Design - Wideband LNA - Design Narrowband LNA - Impedance Matching - Automatic Gain - Control Amplifiers – Power Amplifiers.

Mixers

Balancing Mixer - Qualitative Description of the Gilbert Mixer - Conversion Gain – Distortion – Low Frequency Case: Analysis of Gilbert Mixer – Distortion - High-Frequency Case – Noise – A Complete Active Mixer. Switching Mixer - Distortion in Unbalanced Switching Mixer – Conversion Gain in Unbalanced Switching Mixer - Noise in Unbalanced Switching Mixer – A Practical Unbalanced Switching Mixer. Sampling Mixer - Conversion Gain in Single Ended Sampling Mixer - Distortion in Single Ended Sampling Mixer - Intrinsic Noise in Single Ended Sampling Mixer - Extrinsic Noise in Single Ended Sampling Mixer.

Frequency Synthesizers

Phase Locked Loops - Voltage Controlled Oscillators - Phase Detector – Analog Phase Detectors – Digital Phase Detectors - Frequency Dividers - LC Oscillators - Ring Oscillators - Phase Noise - A Complete Synthesizer Design Example (DECT Application).

Sub Systems

Data converters in communications, adaptive Filters, equalizers and transceivers.

Implementations

VLSI architecture for Multitier Wireless System - Hardware Design Issues for a Next generation CDMA System.

REFERENCES

1. B.Razavi ,"RF Microelectronics" , Prentice-Hall ,1998.
2. Bosco H Leung "VLSI for Wireless Communication", Pearson Education, 2002.
3. Thomas H.Lee, "The Design of CMOS Radio –Frequency Integrated Circuits', Cambridge University Press, 2003.
4. Emad N Farag and Mohamed I Elmasry, "Mixed Signal VLSI Wireless Design - Circuits and Systems", Kluwer Academic Publishers, 2000.
5. Behzad Razavi, "Design of Analog CMOS Integrated Circuits" McGraw-Hill, 1999.
6. J. Crols and M. Steyaert, "CMOS Wireless Transceiver Design," Boston, Kluwer Academic Pub., 1997.

COURSE OUTCOMES

Upon completion of the course the students will be able to

1. Know the basics of MOSFET and BJT design.
2. Understand the types of mixtures and its characteristics.
3. Understand frequency synthesizers and sub systems.
4. Understand the hardware implementation in wireless systems.

Mapping Course Outcomes(COs) with Programme Outcomes(POs)										
Course Outcomes(COs)	Programme Outcomes(POs)									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✓	✓	✓	✓	✓	✓				
CO2	✓	✓								
CO3	✓	✓	✓							
CO4	✓		✓	✓		✓				

CSYE X0X	FPGA BASED WIRELESS COMMUNICATION SYSTEM DESIGN	L	T	P
		4	0	0

COURSE OBJECTIVES

- To enable the students to learn about the FPGA architecture and the programming technologies.
- To introduce to the students the modeling techniques of VHDL.
- To evaluate the performance using simulation and testing of systems.
- To study the concept behind software radio and the design of digital signal processing blocks.

FPGA Architecture and Programming Technologies

Field Programmable gate arrays- Logic blocks, routing architecture, Design flow technology - mapping for FPGAs, Xilinx XC4000 - ALTERA's FLEX 8000/10000, ACTEL's ACT-1,2,3 and their speed performance Case studies: Altera MAX 5000 and 7000 - Altera MAX 9000 – Spartan II and Virtex II FPGAs - Apex and Cyclone FPGAs. Programming Technologies: Antifuse – static RAM – EPROM and EEPROM technology.

Verilog HDL

Data types and operators – Gate Level Modeling – Data Flow Modeling – Behavioral Modeling-structural modeling –Design of combinational logic and sequential logic circuits-Design of Memory module and Finite state machines-test benches.

Logic Synthesis, Simulation and Testing

Design systems - Logic Synthesis - types of simulation -boundary scan test - fault simulation - automatic test pattern generation.

Software Radio

Block Diagram of Software Radio –Numerically controlled oscillator – Digital Up converters / Down Converters – Sampling schemes-Coherent Modulator and Demodulator - Incoherent

Demodulation – digital approach for I and Q generation- Filter design (CIC) - baseband processing techniques.

System Design

Design of Digital signal processing blocks- FFT, IFFT, FIR filters – crest factor reduction, digital pre distortion blocks - Turbo coders - OFDM modulators/demodulators, Network security - AES encryption - decryption modules - SOC DESIGN - Design Methodologies – Processes and Flows.

REFERENCES

1. M.J.S .Smith, "Application Specific Integrated Circuits", Addison -Wesley Longman Inc., 1997.
2. Parag.K.Lala, Digital System Design using Programmable Logic Devices , BSP, 2003.
3. Samir Palnitkar, " Verilog HDL: A Guide to Digital Design and Synthesis", Prentice Hall, 2003.
4. Jeffrey H Reed, "Software Radio: A Modern Approach to Radio Engineering", Prentice Hall , 2002.
5. Uwe Meyer Baese, "Digital Signal Processing with Field Programmable Gate Arrays", Springer, 2007.

COURSE OUTCOMES

On completion of the course the students will be able to

1. Familiarize about the FPGA architecture and the programming technologies.
2. Understand syntax and semantics of Verilog HDL.
3. Evaluate the performance using simulation and testing of systems
4. Acquire the concept behind software radio and the design of digital signal processing blocks.

Mapping Course Outcomes(COs) with Programme Outcomes(POs)										
Course Outcomes(COs)	Programme Outcomes(POs)									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	✓	✓								
CO2	✓	✓								
CO3	✓	✓	✓		✓	✓				
CO4	✓	✓	✓	✓		✓				

CSYE X0X	WIRELESS INTELLIGENT NETWORKS	L	T	P
		4	0	0

COURSE OBJECTIVES

- To enable the students to study the fundamentals of mobile communication concepts and wireless intelligent networking standards.
- To introduce the concept of intelligent networking and migration from point solutions to network based solutions.
- To expose the students to WIN services, architectures and applications.

Fundamentals of Mobile Communications
Fundamental Mobile Communication Concepts – Wireless System Architecture – Mobile Network Standards – Wireless Intelligent Networking Standards – Evolution to Third – Generation Wireless Standards – Overview of SS7 Network Signaling – Signaling in a Wireless Network – Intelligent Networking.

Introduction to Cellular Mobile Systems
Spectrum Allocation, basic Cellular Systems, performance Criteria, Operation of cellular systems, analog cellular systems, digital Cellular Systems. Frequency Reuse, channel assignment strategies, handoff Strategies, Interference and system capacity, tracking and grade off service, improving coverage and capacity.

Wireless Intelligent Networking
Origins of Intelligent Networking – Wireless Intelligent Networking, WIN, CAMEL – Relationship of wireless Intelligent Networking Standards – Migration from Point solutions to Network- Based Solutions – Impetus for Migration, Advantages and Operational Challenges of Network – Based Solutions.

WIN Capabilities
Intelligence in Telecommunication Networks – Fixed Network Intelligence – Mobile Network Intelligence– Standardized Intelligence for Mobile Networks (WIN, CAMEL) – Phased Development of Standards- Pre WIN, WIN Phase – I, II, III, CAMEL – Phase I, II, Trigger detection points – WIN and CAMEL operational Issues.

WIN Services
Intelligent Networking solutions to Wireless Fraud – Pre call Validation – Cloning Fraud – Roamer Verification and Reinstatement – Network Based HLR – Long term Strategic Advantages – Wireless and Wire line Services – Emulation of Basic Wireless Features – Emulation of Wire line IN Services – Integration of Wire line and Wireless Services – Emergence of Wireless Specific Services – Emergence of Data Prominence – Access to Web Information.

REFERENCES

1. Jochen schiller, "Mobile Communication",Second Edition ,Pearson Education 2012.
2. Theodre S Rappaport , “Wireless Communications: Principles and Practices”, Pearson India ,2009.
3. Gerry Christensen, Paul G.Florack, Robert Duncan, “Wireless Intelligent Networking”, Artech House Publishers 2001.
4. Johan Zuidweg, “Next generation Intelligent Networks”, Artech House Communication Library, Edition I, August 15, 2002.

COURSE OUTCOMES
On completion of this course the students will be able to
1. Acquire knowledge about fundamentals of mobile communication
2. Understand the basic concepts in wireless intelligent networks
3. Acquire the concepts in WIN capabilities, services and architecture

CSYE X0X	SYSTEM MANAGEMENT AND SECURITY	L	T	P
		4	0	0

COURSE OBJECTIVES

- To discuss about the various models for defining the systems.
- To understand the concepts and terminology associated with SNMP.
- To learn to the concepts and architecture behind standards based network management.
- To explore the different encryption methods and security based mechanisms.

Network Management

Organisational Model – Information Model – Communication Model – Encoding Structure – Macros Functional Model – Configuration management - Fault management - Performance management – Event Correlation techniques – Security Management – Accounting Management – Report Management – Policy based Management - Service Level management.

Internet Management

SNMP – Organisational Model – System overview – Information Model – Communication model - Functional Model – SNMP Proxy Server – Management Information – Protocol Remote Monitoring.

Broad Band Network Management

Broad band Networks and Services – ATM technology – VP,VC, ATM Packet – Integrated services – ATM LAN simulation – Virtual LAN – ATM network management – ATM network references Model – Integrated local management interface – ATM management information base – ATM management interface – ATM digital Exchange interface management.

Key Encryption

Conventional Encryption Model – Stegnography – Block Cipher – Encryption algorithms – key distribution – RSA algorithm – Diffie – Hellman Key exchange – Elliptic curve Cryptology – Message Authentication – Digital Signatures – Key management.

System Security

IP Security – Security Architecture – Security Pay load – Web Security requirement – Secure electronic transaction – Dual Signature – Intruders – Viruses – Worms – Trusted Systems – Antivirus Techniques – Digital Immune Systems.

REFERENCES

1. Mani Subramanian, “Network Management Principles and Practice” Addison Wesley Newyork – 2000.
2. Salah Alidarous, Thomas Plevayk, “Telecommunications network management technologies Implementations “, Eastern Economy Edition, IEEE Press New Delhi 1998.
3. Lakshmi G. Raman “Fundamentals of Telecommunication network Management”, Eastern Economy Edition, IEEE Press New Delhi 1999.
4. William Stallings, “Cryptology and network security” 2nd edition PHI New Delhi 1999.

COURSE OUTCOMES

On completion of this course the students will be able to

1. Understand about the various models for defining the systems.
2. Understand the concepts and terminology associated with SNMP.
3. Acquire the concepts and architecture behind standards based network management.
4. Analyze the different encryption methods and security based mechanisms

CSYE X0X	EMBEDDED SYSTEM DESIGN	L	T	P
		4	0	0

COURSE OBJECTIVES

- To make the students to understand the issues and challenges in embedded system design.
- To know the concepts of embedded processor architecture and memory models.
- To explore the software platform for implementing the embedded system and different types of peripherals and bus devices.

Introduction

Introduction to Embedded Computing, Issues and Challenges in Embedded System Design, Trends: SoC, custom designed chips, configurable processors and multi-core processors.

Embedded Processor Architecture

General concepts – Instruction Set Architecture, Levels in architecture, Functional description – hardware/software trade-off Introduction to RISC architecture, pipelining, Instruction issue and execution, Instruction formats, Addressing modes, Data alignment and byte ordering, Introduction to VLIW and DSP processors.

Memory and Cache

Memory model – hierarchy and management - virtual memory concepts, protection, cache and SPM, Introduction to the cache coherency problem. Programming with HCS12**:** C Programming examples for interrupts, UART, Input and Output in HCS12 processor.

Embedded System Software

Components of an embedded software system, system boot up and downloading code, System memory map (allocating sections through linker command file), Programming peripherals and ISRs, Embedded tool chain Mixing C and Assembly- concurrent software- memory management and system initialization.

Peripherals and Bus Devices

SRAM, DRAM, SDRAM, DDR, NOR and NAND Flash, Ethernet, TPU, UART, USB, I2C bus, SPI bus, CAN bus. C Programming examples for Interrupts, I2C, CAN, TPU and Ethernet in ColdFire processor Embedded Operating Systems: OS-less system, Introduction to RTOS-Special considerations in an RTOS, CPU management.

REFERENCES

1. John. L.Hennessy and David.A.Patterson, “Computer Architecture”, Morgan Kaufmann publisher, Fourth Edition, 2007

2. Sinha, Muthukumar and Darshak, "Embedded System Design – A Practical Approach.
3. Frank Vahid and Tony Givargis, "Embedded system design", John Wiley & Sons, International Edition 2003.
4. Han-Way Huang, An Introduction to Hardware and Software Interfacing," The HCS12/9S12.Delmar cengage Learning, First Edition 2005.
5. Michael Barr and Anthony Masasa, "Programming Embedded Systems". O'relly & Associates Inc. 2006.

COURSE OUTCOMES

On completion of the course the students will be able to

1. Understand the issues and challenges in embedded system design.
2. Acquired the concepts of embedded processor architecture and memory models.
3. Analyze the software platform for implementing the embedded system and different types of peripherals and bus devices.

CSYE X0X	MULTIMEDIA COMMUNICATION	L	T	P
		4	0	0

COURSE OBJECTIVES

- To study the image fundamentals and mathematical transforms necessary for image processing.
- To know about the image enhancement techniques and the image compression procedures.
- To understand the basic concepts of VoIP technology and multimedia networking.

Multimedia Components

Introduction - Multimedia skills - Multimedia components and their characteristics - Text, sound, images, graphics, animation, video, hardware.

Audio and Video Compression

Audio compression–DPCM-Adaptive PCM –adaptive predictive coding-linear Predictive coding-code excited LPC-perpetual coding, MP3; Video compression – principles-H.261-H.263-MPEG 1, 2, 4.

Lossless Compression

Compression principles-source encoders and destination encoders—entropy encoding –source encoding -text compression –static Huffman coding dynamic coding –arithmetic coding –Lempel Ziv-Welch Compression.

VOIP Technology

Basics of IP transport, VOIP challenges, H.323/ SIP –Network Architecture, Protocols, Call establishment and release, VoIP and SS7, Quality of Service- CODEC Methods-VOIP applicability.

Multimedia Networking

Multimedia networking -Applications-streamed stored and audio-making the best Effort service-protocols for real time interactive Applications-distributing multimedia beyond best effort service-secluding and policing Mechanisms-integrated services differentiated Services-RSVP.

REFERENCES

1. Fred Halshall, "Multimedia communication - applications, networks, protocols and standards", Pearson education, 2007.
2. Tay Vaughan, "Multimedia: Making it work", 7/e, TMH, 2007.
3. Kurose and W.Ross, "Computer Networking –A top down approach", Pearson education, 3rd edition, 2005.
4. KR. Rao,Z S Bojkovic, D A Milovanovic, "Multimedia Communication Systems: Techniques, Standards, and Networks", Pearson Education 2007.

COURSE OUTCOMES

On completion of this course, the students will be able to

1. Understand clearly about the fundamentals of image processing
2. Gain knowledge of image enhancement techniques and the image compression procedures.
3. Understand about VOIP technology and multimedia networking.

CSYE X0X	SOFT COMPUTING TECHNIQUES	L	T	P
		4	0	0

COURSE OBJECTIVES

Upon completion of this course, the student should be able to get an idea on

- Artificial Intelligence, Various types of production systems, characteristics of production systems.
- Neural Networks, architecture, functions and various algorithms involved.
- Fuzzy Logic, Various fuzzy systems and their functions.
- Genetic algorithms, its applications.

Soft Computing and Artificial Intelligence

Introduction To Soft Computing, Soft Computing Vs. Hard Computing, Various Types of Soft Computing Techniques, Applications of Soft Computing.

Introduction to Artificial Intelligence, Various Types of Production Systems, Characteristics of Production Systems, Breadth First Search, Depth First Search Techniques, Other Search Techniques Like Hill Climbing, Best First Search, A* Algorithm, AO* Algorithms and Various Types of Control Strategies. Knowledge Representation Issues, Prepositional and Predicate Logic, Monotonic and Non Monotonic Reasoning, Forward Reasoning, Backward Reasoning, Weak & Strong Slot & Filler Structures, NLP.

Neural Network

Structure and Function of a Single Neuron: Biological Neuron, Artificial Neuron, Definition of ANN, Taxonomy of Neural Net, Difference B/W ANN and Human Brain, Characteristic and Applications of ANN, Single Layer Network.

Perceptron and Counter Propagation Network

Perceptron Training Algorithm, Linear Separability, Widrow and Hebb's Learning Rule/Delta Rule, ADALINE, MADALINE, AI V/S ANN. Counter Propagation Network- Architecture, Functioning and Characteristics of Counter Propagation Network.

Fuzzy Logic Controller

Functional Diagram - Fuzzification - Membership Value Assignments Using Intuition - Membership Functions - Defuzzification: Max-Membership Principle - Centroid Method - Weighted Average Method - Inference Engine – Knowledge Base -Rule Base - Case Studies.

Genetic Algorithm, Hybrid Soft Computing Techniques and Applications

Optimization – Traditional Optimization Methods – Concept of Evolutionary Algorithm – Genetic Algorithm – Encoding and Decoding of Variables – GA Operators – Reproductions – Cross Over – Mutation – Fitness Function –Fitness Scaling.

Neuro-Fuzzy Hybrid Systems – Genetic Neuro Hybrid Systems – Genetic Fuzzy Hybrid and Fuzzy Genetic Hybrid Systems – Simplified Fuzzy ARTMAP – Applications: A Fusion Approach of Multispectral Images With SAR, Optimization of Traveling Salesman Problem Using Genetic Algorithm Approach, Soft Computing Based Hybrid Fuzzy Controllers.

REFERENCES

1. S.N. Sivanandam and S.N. Deepa, Principles of Soft Computing, Wiley Publications, 2nd Edition, 2011.
2. S, Rajasekaran and G.A. Vijayalakshmi Pai, Neural Networks, Fuzzy Logic & Genetic Algorithms, Synthesis & applications, PHI Publication, 1st Edition, 2009.
3. George J Klir, Bo Yuan, Fuzzy sets & Fuzzy Logic,Theory & Applications, PHI Publication.
4. N.K.Bose, Ping Liang, Neural Network fundamental with Graph, Algorithms & Applications,TMH, First Edition, 1998.
5. Bart Kosko, Neural Network & Fuzzy System, PHI Publication, First Edition, 2009.
6. Rich E, Knight K, Artificial Intelligence, TMH, Third Edition, 2012.
7. Martin T Hagen, Neural Network Design, Nelson Candad, Second Edition, 2008.

COURSE OUTCOMES

At the end of the course the students can able to

1. Learn about soft computing techniques and their applications.
2. Analyze various neural network architecture.
3. Define the fuzzy systems
4. Analyze the genetic algorithms and their applications.

CSYE X0X	CLOUD COMPUTING	L	T	P
		4	0	0

COURSE OBJECTIVES

- Gives the idea of evolution of cloud computing
- Provides knowledge about its services available today
- Helps to the design and development of simple cloud service.
- Focused on some key challenges and issues around cloud computing.

Introduction

Cloud-Definition, Benefits, Usage Scenarios, History of Cloud Computing - Cloud Architecture - Types of Clouds - Business Models Around Clouds – Major Players in Cloud Computing - Issues in Clouds - Eucalyptus - Nimbus - Open Nebula, Cloud Sim.

Cloud Services

Types of Cloud Services: Software as a Service - Platform as a Service – Infrastructure as a Service - Database as a Service - Monitoring as a Service – Communication as Services. Service Providers - Google, Amazon, Microsoft Azure, IBM, Sales Force.

Collaborating using Cloud Services

Email Communication over the Cloud - CRM Management - Project Management-Event Management - Task Management – Calendar - Schedules - Word Processing – Presentation – Spreadsheet - Databases – Desktop - Social Networks and Groupware.

Virtualization for Cloud

Need For Virtualization – Pros And Cons of Virtualization – Types of Virtualization –System Vm, Process VM, Virtual Machine Monitor – Virtual Machine Properties - Interpretation And Binary Translation, HLL VM - Hypervisors – Xen, KVM , Vmware, Virtual Box, Hyper-V.

Security, Standards and Applications

Security in Clouds: Cloud Security Challenges – Software as a Service Security, Common Standards: The Open Cloud Consortium – The Distributed Management Task Force – Standards for Application Developers – Standards for Messaging – Standards For Security, End User Access to Cloud Computing, Mobile Internet Devices and The Cloud.

REFERENCES

1. John Rittinghouse & James Ransome, Cloud Computing, Implementation, Management and Strategy, CRC Press, 2010.
2. Michael Miller, Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Que Publishing, August 2008.
3. David E.Y. Sarna Implementing and Developing Cloud Application, CRC press 2011.
4. Lee Badger, Tim Grance, Robert Patt-Corner, Jeff Voas, NIST, Draft cloud computing synopsis and recommendation, May 2011.
5. Anthony T Velte, Toby J Velte, Robert Elsenpeter, Cloud Computing : A Practical Approach, Tata McGraw-Hill 2010.

COURSE OUTCOMES

Upon Completion of the course, the students will be able to

1. Understand clearly about the introduction of cloud computing
2. Acquired knowledge about its services
3. Design and development of simple cloud service.
4. Implement Practical applications using cloud
5. Gain knowledge on some key challenges and issues around cloud computing

CSYE X0X	CRYPTOGRAPHY SYSTEMS	L	T	P
		4	0	0

COURSE OBJECTIVES

- To explore the use of developments in cryptography systems for effective data transfer.
- To deal with the underlying principles of cryptography and network security.
- To provide an extensive coverage of the techniques and methods needed for the proper functioning of the ciphers.
- To study the concept of the construction and cryptanalysis of block ciphers, stream ciphers and hash functions.
- To describe the IP security architecture and methods to overcome the ill effects of attacks.

Network Security Concepts

Classical security - Techniques and Computer Network Security Concepts - Confidentiality and Security, Security Policy and Operations Life Cycle, Security System Development and Operations - The Attack Process - Attacker Types - Vulnerability Types - Attack Results - Attack Taxonomy.

Encryption

Basic encryption techniques - Concept of cryptanalysis - Shannon's theory - Perfect secrecy - Block ciphers - Cryptographic algorithms - Features of DES - Stream ciphers - Pseudo random sequence generators – linear complexity - Non-linear combination of LFSRs - Boolean functions.

Crypto Systems

Private key and Public key crypto systems - One way functions - Discrete log problem - Factorization problem - RSA encryption - Diffie Hellmann key exchange - Message authentication and hash functions –Digital signatures - Secret sharing - features of visual cryptography - other applications of cryptography.

Crypt Analysis

Hash functions and message digests, public key encryption, authentication, digital signatures, zero knowledge interactive protocols, elliptic curve cryptosystems, formal verification, hard problems.

IP Security
Overview, IP security architecture, authentication, header, security payload, security associations, key management, web security requirement, secure sockets layer, transport layer security, secure electronic transaction, dual signature, intruders, viruses, worms, firewall design, trusted systems, antivirus techniques, digital immune systems.

REFERENCES

1. Douglas A. Stinson, "Cryptography, Theory and Practice", 2nd edition, Chapman & Hall, CRC Press Company, Washington.
2. William Stallings, "Cryptography and Network Security", 4th edition, Prentice Hall of India, New Delhi, 2005.
3. Koblitz N, "A Course on Number Theory and Cryptography", Springer Verlag, 1986.
4. Menezes A. et. al, "Handbook of Applied Cryptography", CRC Press, 1996.

COURSE OUTCOMES
On completion of this course the students will be able to
1. Implement the use of developments in cryptography systems for effective data transfer.
2. Work with the principles of cryptography and network security.
3. Design an extensive coverage of the techniques and methods needed for the proper functioning of the ciphers.
4. Understand the concept of the construction and cryptanalysis of block ciphers, stream ciphers and hash functions.

CSYE X0X	RESEARCH METHODOLOGY	L	T	P
		4	0	0

COURSE OBJECTIVES
- To understand some basic concepts of research and its methodologies
- To identify appropriate research topics and define appropriate research problem and parameters.
- To organize and conduct research in a more appropriate manner
- To write a research report and thesis

Objectives and types of research
Motivation and objectives - Research methods vs Methodology. Types of Research - Descriptive vs Analytical, Applied vs Fundamental, Quantitative vs Qualitative, Conceptual vs Empirical - steps involved in research process criteria of good research, Research problem - selecting the problem - defining the problem

Literature review
Primary and secondary sources - web as a source - searching the web -Critical literature review - Identifying gap areas from literature review.
Research Design: need - features of a good design - concepts relating to research design-research design for exploratory research, descriptive and diagnostic research.
Hypothesis testing: basis concepts- procedure for hypothesis testing - tests of hypothesis - testing based on means proportions, variance.
Fundamentals of design of experiments - Taquchi's methods - response surface methodology.

Quantitative Methods for problem solving:
Tabular and graphical representation of data.
Statistical Modeling and Analysis: Probability Distributions - Binomial, Poisson, Norma; Exponential, Weibull, Fundamentals of Statistical Analysis and Interface - measures of central tendency, dispersion, asymmetry.
Multivariate methods - Factor analysis - methods of factor analysis - centroid method, principal components method, maximum likehood criteria
Concepts of single and multiple correlation and regression.

Algorithmic research problems: Types of solution procedure - complete enumeration method, Metaheuristics for combinatorial problems - Simulated annealing algorithm, Genetic algorithm, Tabu search, neural networks - basic concepts.

Report writing: Structure and components of Research Report, significance of report writing steps in writing report - Types of Report, Layout of Research Report, Mechanism of writing a research report, referencing in academic writing.

REFERENCES

1. Kothari, C.R. Research Methodology Methods and Techniques 2/e, New Age International (P) Limited Publishers, New Delihi,2010.
2. Panneerselvam, R. Research Methodology, Prentice Hall of India Private Limited, New Delhi,2007.
3. Besterfield, Total quality Managemen, Pearson Education Pte.Ltd., New Delhi, 2003.
4. McBurney, D.H.and White,T.L. Research Methods, Cengage Learning, 2010.

COURSE OUTCOMES

On completion of this course the students will be able to

1. Identify the different types of research and recognize the importance of literature review
2. Develop mathematical models for different problems.
3. Analyze the results using statistical methods
4. Prepare technical reports