TELECOMMUNICATION ENGINEERING

M.Tech Programme

Electronics and Communication –Telecommunication Engineering

Curriculum and scheme of Examinations

SEMESTER I

Code No.	Name of Subject	Credits	Hrs /week	Exam duration	Marks			Remarks
					Continuous Assessment	University Exam	Total	
TTM 1001	Linear Algebra	3	3	3	40	60	100	Of the 40 marks of internal assessment 25 marks for test and 15 marks for assignment. End semester exam is conducted by the University
TMC 1001	Advanced Digital Signal Processing	3	3	3	40	60	100	Do
TMC 1002	Advanced Digital Communication	3	3	3	40	60	100	Do
TSC 1001	Random Processes and Applications	3	3	3	40	60	100	Do
TTC 1005	Advanced Optical Communication	3	3	3	40	60	100	Do
TTC 1006	Wireless Communication and Networks	3	3	3	40	60	100	Do
TTC 1101	Telecommunication Lab I	1	2	-	100	-	100	No End Semester Examination
TTC 1102	Seminar	2	2	-	100	-	100	Do
	TOTAL	21	22					7 Hours of Departmental Assistance work

SEMESTER II

Code No.	Name of Subject	Credits	Hrs / week	Exam Duration	Marks			Remarks
					Continuous Assessment	End Semester Exam	Total	
TTC 2001	Antenna Theory Analysis and Design	3	3	3	40	60	100	Of the 40 marks of internal assessment 25 marks for test and 15 marks for assignment. End semester exam is conducted by the University
TSC 2001	Estimation and Detection Theory	3	3	3	40	60	100	Do
**	Stream Elective I	3	3	3	40	60	100	Do
**	Stream Elective II	3	3	3	40	60	100	Do
**	Department Elective	3	3	3	40	60	100	Do
TCC 2000	Research Methodology	2	2	3	40	60	100	Of the 40 marks of internal assessment 25 marks for test and 15 marks for assignment. End semester Exam is conducted by the Individual Institutions
TTC 2101	Thesis- Preliminary Part I	2	2	-	100	-	100	No End semester Examination
TTC2102	Telecommunication Lab II	1	2	-	100	-	100	Do
TTC2103	Seminar	2	2	-	100	-	100	Do
	TOTAL	22	23	-				6 hrs of departmental assistance work

** Students can select a subject from the subjects listed under stream/department electives for the second semester as advised by the course coordinator.

STREAM ELECTIVES OFFERED IN TELECOMMUNICATION ENGINEERING FOR SEMESTER II

List of Stream Electives

Stream Elective I:

TTE 2001 RF Circuits and Systems
TTE 2002 Secure Communication
TTE 2003 Multirate Signal Processing and Wavelets
TTE 2004 Adaptive Signal Processing

Stream Elective II:

TTE 2005	Spread Spectrum and CDMA Systems
TTE 2006	Image and Video Processing
TTE 2007	Speech and Audio Processing
TTE 2008	Information Theory

List of Department Electives

TTD 2001	VLSI for Communication
TTD 2002	Wireless Personal Area Networks
TTD 2003	Space Time Coding and MIMO Systems
TTD 2004	High Performance Communication Networks

SEMESTER III

Code No.	Name of Subject	Credits	Hrs / week	Exam duration	Marks			Remarks
					Continuous Assessment	End Semester Exam	Total	
**	Stream Elective III	3	3	3	40	60	100	Of the 40 marks of internal assessment 25 marks for test and 15 marks for assignment. End Semester Exam is conducted by the Individual Institutions
**	Stream Elective IV	3	3	3	40	60	100	Do
***	Non-Dept.(Interdisciplinary) Elective	3	3	-	40	60	100	Do
TTC 3101	Thesis-Preliminary-Part II	5	14	-	200	-	200	No End Semester Examination
	TOTAL	14	23					6 hrs of departmental assistance work

** Students can select a subject from the subjects listed under Stream Electives III and IV as advised by the course coordinator.

***Students can select a subject from the subjects listed under Non-Dept. (Interdisciplinary) Elective as advised by the course coordinator.

Stream Elective III

TTE 3001 Embedded Systems for Communication
TTE 3002 Neuro Fuzzy Systems
TTE 3003 Modelling and Simulation of Communication Systems
TTE 3004 Digital Microwave Communication

Stream Elective IV

TTE 3005 WDM Optical Network and Optical switching
TTE 3006 RF MEMS
TTE 3007 Network Management and Security
TTE 3008 Radio Frequency System Design

SEMESTER IV

Code No	Subject Name	Credits	Hrs/week	Marks					Remarks
				Continuous Assessment		University Exam		Total	
				Guide	Evaluation Committee	Thesis Evaluation	Viva Voce		
TTC 4101	Thesis	12	21	150	150	200	100	600	5 % of the mark is earmarked for Publication in journal/conference
	Total	12	21						8 hrs of departmental assistance work

TTM 1001 LINEAR ALGEBRA

Structure of the Course

Lecture	:	3 hrs/ Week	Credits: 3
Internal Continuous Assessment	:	40 Marks	
End Semester Examination	:	60 Marks	

Course Objectives

- To enhance the knowledge in abstract algebra
- To develop the skills to identify linear transformation and transforms and its role in linear systems
- To develop the skills to formulate linear transformation problems in matrix form

Learning Outcomes

- Understand the formulation of problems in abstract algebra framework
- Understand and represent linear transformations
- Understand the role of matrices in linear transformation representations

Module I

Vector Space: - Group, Ring, Field, Vector spaces. Subspaces, Linear independence, Span, basis, dimension, finite dimensional vector spaces, direct sum. Examples of finite dimensional vector spaces – RN, CN, vector space of matrices.

Linear Transformation: - Linear Transformation, range and null space, rank nullity theorem, Matrix representation of linear transform. Change of basis, projection, transpose, linear functionals and dual spaces. Infinite dimensional vector spaces function space.

Module II

System of Linear equations: - Fundamental subspaces, Existence and uniqueness of solution, Least squares solution.

Inner Product spaces: - Inner Product spaces, norm, orthogonality, Hilbert spaces, orthogonal complements, projection theorem, orthogonal projections, orthonormal basis.

Module III

Nonsingular, Hermitian and Unitary matrices. Diagonalizability: - Eigen values and Eigen vectors. Diagonalizability, Properties of Eigen values and Eigen vectors of Hermitian matrices. Circulant and Toeplitz Matrices, Convolution as a Matrix Operation. Diagonalization of LTI operator, DFT. SVD, Pseudo inverse, QR decomposition, Schur decomposition.

References:

1. Hoffman Kenneth and Kunze Ray: *Linear Algebra*, 2nd edition, Prentice Hall of India.
2. Gilbert Strang: *Linear Algebra And Its Applications*, 4th edition, Thomson Learning.
3. Frazier, Michael W.: *An Introduction to Wavelets Through Linear Algebra.*, 1999, Springer Publications.

Structure of the question paper:

There will be three questions from each module out of which two questions are to be answered by the students

TMC 1001 ADVANCED DIGITAL SIGNAL PROCESSING

Structure of the Course

Lecture	: 3 hrs/ Week	Credits : 3
Internal Continuous Assessment	: 40 Marks	
End Semester Examination	: 60 Marks	

Course Objective

1. To provide an overview of time frequency analysis and hence the significance of wavelet transform.
2. To enable the students to use various wavelet transforms for applications like data compression.
3. To familiarize the students with multirate sampling principles.
4. To enable the students to appreciate various applications of multirate systems.
5. To equip the students to work with various linear prediction algorithms.
6. To familiarize the students with power spectrum estimation of signals using parametric and non-parametric methods.

Learning Outcomes

1. Design multirate systems for applications like sub-band coding.
2. Account for the wavelet transform principles, taking into consideration, time frequency analysis and multi resolution analysis.
3. Implement various wavelet transforms on 1D as well as 2D signals.
4. Use wavelet transforms for applications like image compression.
5. Design linear prediction systems using Levinson-Durbin algorithm.
6. Have a better appreciation of the uses of parametric and non-parametric methods for power spectrum estimation of signals.

Module I

Review of fundamentals of the Discrete Time Systems: Design of FIR Digital filters- Window method, Park-McClellan′s method. Design of IIR Digital Filters ‑ Butterworth, Chebyshev and Elliptic Approximations; Lowpass, Bandpass, Bandstop and High pass filters. Effect of finite register length in FIR filter design. Basics of Multirate systems and its application, up sampling and Down - Sampling, Fractional Sampling rate converter.

Module II

Polyphase decomposition. Efficient realisation of Multirate systems. Uniform filter banks and it's implementation using polyphase decomposition. Two channel Quadrature Mirror Filter Banks, Perfect Reconstruction. Time Frequency Analysis, Heisenberg's uncertinity principle. Short time fourier transform. Continous Wavelet Tranform and it's properties. Multi Resolution Analysis,

Module III

Discrete Wavelet Transform, Orthonormal Wavelet Analysis - Filterbank interpertation. Application of wavelet tranform for data compression. Linear Prediction -Forward and Backward Prediction - Levinson-Durbin Algorithm. Power spectrum estimation of signals: Wide Sense Stationary Random Processes. Power spectral density. Non parametric methods: periodogram,Backman-Tuckey method. Parametric method: ARMA, AR processes, Yule-Walker method.

References:

1) P. P. Vaidyanathan, Multirate Systems and Filterbanks, Prentice Hall
2) Wavelet Transforms - Bopadikar and Rao, Pearson Education
3) Insight into wavelets, K. P. Soman, Prentice Hall India
4) Digital signal Processing, By John G. Proakis, Dimitris G. Manolakis
Pearson Education

Reading:

1) L. Cohen, Time Frequency Analysis, Prentice Hall.
2) Wavelets and Filterbank, G Strang & T Nguyen , Wellesly-Cambridge
3) Wavelets and subband coding, M Vetterli & J Kovacevic, Prentice Hall

Structure of the question paper:

There will be three questions from each module out of which two questions are to be answered by the students. It shall have 60% problem and 40% theory.

TMC 1002 ADVANCED DIGITAL COMMUNICATION

Structure of the Course

Lecture	: 3 hrs/ Week	Credits : 3
Internal Continuous Assessment	: 40 Marks	
End Semester Examination	: 60 Marks	

Course Objectives

- To introduce to various aspects of Digital Communication over various Channels, from design through performance issues to application requirement.
- To have idea on the advances in Multichannel and Multicarrier Systems design.

Learning Outcomes

- Understand the design issues of Digital Communication over Additive Gaussian Noise Channels, over Band limited Channels and Fading Multipath Channels.
- Understand the design issues in spread spectrum and multi user communication systems.
- Understand various digital communication receivers, equalization and diversity techniques.

Module I

Digital Communication over Additive Gaussian Noise Channels- Characterization of Communication Signals and Systems- Signal space representation- Connecting Linear Vector Space to Physical Waveform Space- Scalar and Vector Communication over Memory less Channels- Optimum waveform receiver in additive white Gaussian noise (AWGN) channels - Cross correlation receiver- Matched filter receiver and error probabilities- Optimum Receiver for Signals with random phase in AWGN Channels- Optimum receiver for Binary Signals- Optimum receiver for M-ary orthogonal signals- Optimum waveform receiver for coloured Gaussian noise channels- Karhunen Loeve expansion approach- whitening.

Module II

Digital Communication over Band limited Channels- Optimum pulse shaping- Nyquist criterion for zero ISI- partial response signaling- Optimum receiver for channels with ISI and AWGN- Equalization Techniques- Zero forcing linear Equalization- Decision feedback equalization- Adaptive Equalization- Multichannel and Multicarrier Systems- FFT based multi carrier system- Spread Spectrum Signals- Model of Spread spectrum system- Direct sequence spread spectrum signals- Processing gain and jamming margin- Applications of DS-Spread spectrum- Generation of PN-Sequence- Frequency - Hopped spread spectrum signals- Performance of FH Spread spectrum in an AWGN channel- Synchronization of spread spectrum signals.

Module III

Digital Communication over Fading Multipath Channels- Characterization and model- Frequency-non selective slowly fading channel- Digital signalling over a frequency-selective slowly fading channel- Diversity techniques- Multiuser Communications- Multiple access techniques- Capacity of multiple access methods- Code Division Multiple Access- Multi

User Detectors- Decorrelating Detector- Minimum mean square error detector- Random access methods.

References:

1. John G.Proakis, *Digital Communications*, 4/e, McGraw-Hill
2. Edward. A. Lee and David. G. Messerschmitt, "Digital Communication", Allied Publishers (second edition).
3. Viterbi, A. J., and J. K. Omura. *Principles of Digital Communication and Coding.* NY:McGraw-Hill, 1979. ISBN: 0070675163.
4. Marvin K Simon, Sami M Hinedi, William C Lindsey - *Digital Communication Techniques –Signal Design & Detection*, PHI.
5. MIT OpenCourseWare, Electrical Engineering and Computer Science,Principles of Digital communication II, Spring 2006.
6. A.J.Viterbi, "CDMA- Principles of Spread Spectrum", Addison Wesley, 1995.
7. Simon Haykin, " Digital Communication, 4th Edition.
8. Aazhang B. Digital Communication Systems [Connexions Web site]. 2008.

Structure of the question paper:

There will be three questions from each module out of which two questions are to be answered by the students. It shall have 60% problem and 40% theory.

TSC 1001 RANDOM PROCESSES AND APPLICATIONS

Structure of the Course

Lecture	: 3 hrs/ Week	Credits : 3
Internal Continuous Assessment	: 40 Marks	
End Semester Examination	: 60 Marks	

Course Objectives

- To provide necessary basic concepts in statistical signal analysis.
- To study about random processes and its properties
- Apply the basic concepts to various elementary and some advanced applications.

Learning Outcomes

- Have a fundamental knowledge of the basic probability concepts
- Have a good knowledge of standard distributions which can describe real life phenomena
- Acquire skills in handling situations involving several random variable and functions of random variable.
- Understand and characterize phenomena which evolve with respect to time in probabilistic manner

Module I

Introduction,: Sets, Fields and Events, Definition of probability, Joint, Conditional and Total Probability, Bayes Theorem and applications.

Random Variable :- Definition, Probability Distribution Function, Probability Density function, Common density functions, Continuous, Discrete and Mixed random Variables, Conditional and Joint Distributions and densities, independence of random variables.

Functions of Random Variables: One function of one random variable, One function of two random variables, Two functions of two random variables.

Module II

Expectation: Fundamental Theorem of expectation, Moments, Joint moments, Moment Generating functions, Characteristic functions, Conditional Expectations, Correlation and Covariance, Jointly Gaussian Random Variables.

Random Vector: - Definition, Joint statistics, Covariance matrix and its properties.

Random Processes: -Basic Definitions, Poisson Process, Wiener Process, Markov Process, Birth- Death Markov Chains, Chapman- Kolmogorov Equations, Stationarity, Wide sense Stationarity, WSS Processes and LSI Systems, Power spectral density, White Noise, Periodic and cyclostationary processes.

Module III

Chebyshev and Schwarz Inequalities, Chernoff Bound, Central Limit Theorem.

Random Sequences: Basic Concepts, WSS sequences and linear systems, Markov Random sequences, ARMA Models, Markov Chains, Convergence of Random Sequences: Definitions, Laws of large numbers.

Advanced Topics: Ergodicity, Karhunen- Leove Expansion, Representation of Bandlimited and periodic Processes: WSS periodic Processes, Fourier Series for WSS Processes.

References:

1. Henry Stark and John W. Woods "Probability and Random Processes with Applications to Signal Processing", Pearson Education, Third edition.
2. Athanasios Papoulis and S. Unnikrishna Pillai. Probability, Random Variables and Stochastic Processes, TMH
3. Gray, R. M. and Davisson L. D. ,An Introduction to Statistical Signal Processing. Cambridge University Press, 2004
(Available at: http://www.ee.stanford.edu/~gray/sp.html)

Structure of the question paper:

There will be three questions from each module out of which two questions are to be answered by the students. It shall have 80% problem and 20% theory.

TTC 1005 ADVANCED OPTICAL COMMUNICATION

Structure of the Course

Lecture	: 3 hrs/ Week	Credits : 3
Internal Continuous Assessment	: 40 Marks	
End Semester Examination	: 60 Marks	

Course Objectives

- To introduce the working principles behind different lasers.
- To familiarize the design of optical amplifiers.
- Know the origin of fiber optics losses, including intrinsic and extrinsic loss and know how to calculate link losses.
- Design a basic optical fiber link.
- Understand the concept and conditions for light guidance.
- To familiarize the system architecture of lightwave systems.
- To provide a basic idea about soliton systems.

Learning Outcomes

- Understand the construction and working of different lasers and fiber amplifiers.
- Should be able to design light wave systems.
- Understand soliton systems.

Module I

Rare earth doped fiber fabrication techniques and physical properties, Theory and operation of LASER fiber devices, Neodymium and Erbium doped fiber LASERs, Broadband operation, Narrow line width and tunable fiber lasers, Q switched fiber lasers, Mode locked fiber lasers, Rare earth doped fluride glass fibers, Erbium doped fiber amplifiers, Semiconductor Amplifiers, Semiconductor Optical Amplifiers, Raman Amplifiers

Module II

System Applications, Lightwave Systems: System Architecture , Design guidelines, Long haul systems, computer aided design, Dispersion Managements: Need for Dispersion Management, Precompensation Schemes, Postcompensation schemes, dispersion compensating fibers, Optical filters, fiber Bragg gratings, Long Haul Lightwave Systems, High Capacity Systems, Multichannel Systems: WDM Lightwave Systems, WMD Components, System Performance issues , Time-Division Multiplexing, Subcarrier Multiplexing

Module III

Soliton Systems: Soliton-Based Communications, Los-Managed Solitons, Disperson-Managed Soliton, Impact of Amplifier Noise, Coherent, Lightwave Systems: Modulation Format, Demodulation schemes, Bit-Error Rate, Sensitivity Degradation, system Performance

References:

1. Govind.PAgarwal , Fiber-Optic communication Systems, Wiley India, 2009.
2. Rajappa Pappannareddy, Introduction to Lightwave Communication System, Arctech House,
3. B. E. A. Saleh, M. C. Teich, Fundamentals of photonics, Wiley Inter science, 1991.

4. J. Singh, Optoelectronics: An introduction to materials & devices, McGraw Hill, 1996.
5. J. Wilson & J. F. B. Hawkes, Optoelectronics: An introduction, 2nd ed., Prentice Hall.
6. Digonnet, Rare Earth Doped Fiber LASERS and Amplifiers, Marcel Dekker Inc.,USA, 2005
7. Hussein, Moufab Jaffer : Photonic Switching Technology: System & Networks, John Wiley 1999
8. Raji Ramaswami, Kumar Sivarajan: Optical Networks, Morgan Kaufman 2009

Structure of the question paper:

There will be three questions from each module out of which two questions are to be answered by the students. It shall have 50% problem and 50% theory.

TTC 1006 WIRELESS COMMUNICATION AND NETWORKS

Structure of the Course

Lecture	: 3 hrs/ Week	Credits : 3
Internal Continuous Assessment	: 40 Marks	
End Semester Examination	: 60 Marks	

Course Objectives

- To introduce the concept of radio propagation characteristics.
- To familiarize wireless networks.
- To familiarize wireless data networking.
- To introduce the link design in satellite communication.

Learning outcomes

- Understand the radio propagation characteristics to design fading channels.
- Understand wireless data networking.
- Understand satellite link design.

Module I

Radio Propagation Characteristics: Models for path loss, shadowing and multipath fading (delay spread, coherence band width, coherence time, Doppler spread), Jakes channel model, Digital modulation for mobile radio, analysis under fading channels: diversity techniques and RAKE demodulator, channel coding techniques, multiple access techniques used in wireless mobile communications. Space time propagation, wireless channel, channel as a space time random field, space time channel and signal models, capacity of space time channels, spatial diversity, space time receivers, space time coding with channel knowledge, space time OFDM.

Wireless networks – WLAN Configuration – IEEE 802.11 – Physical layer – media access frame format – systematic exploitation of 802.11b, High throughput WLAN (IEEE 802.11n), Quality of service support (IEEE 802.11e), Security enhancements (IEEE 802.11i). Bluetooth, Bluetooth protocol architecture, Bluetooth security.

Module II

The cellular concept: Frequency reuse, The basic theory of hexagonal cell layout, Spectrum efficiency, FDM / TDM cellular systems, Channel allocation schemes, Handover analysis, Erlang capacity comparison of FDM / TDM systems and cellular CDMA. Discussion of GSM and CDMA cellular standards, Signalling and call control, Mobility management, location tracking. Wireless data networking, packet error modelling on fading channels, performance analysis of link and transport layer protocols over wireless channels: mobile data networking (Mobile IP): wireless data in GSM, IS – 95 and GPRS. Space time Wireless Communications.

Module III

Satellite link – basic link and interference analysis, Rain induced attenuation and cross polarization interference – link design, Frequency Division Multiple Access – FDM – FM – FDMA, Single channel per carrier.

References:

1. Andrea Goldsmith, "Wireless Communication", Cambridge University Press.
2. J.G. Proakis, Digital Communication, McGraw Hill, 2000.
3. T.S. Rappaport, Wireless Communications: Principles and Practice, Prentice Hall, 2002.
4. Tri. T. Ha: , Digital Satellite Communication, 2nd Edn ,McGraw Hill, 2009
5. G.L. Stuber, Principles of Mobile Communications, Kluwer Academic, 1996.
6. Kumar, D. Manjunath and J. Kuri, Communication Networking, an Analytical Approach, Elsever, 2004
7. Paulraj, R. Nabar & D. Gore, Introduction to Space Time Wireless Communications, Cambridge University Press, 2003
8. C Sivarama Murthy and B S Manoj, Ad-Hoc Wireless Networks, Architectures and Protocols, PH, 2004.

Structure of the question paper:

There will be three questions from each module out of which two questions are to be answered by the students. It shall have 50% problem and 50% theory.

TTC1101 TELECOMMUNICATION LAB I

Structure of the Course:

Lab	: 2 hrs/ Week	Credit : 1
Internal Continuous Assessment	: 100 marks	

Pre-requisite: Basic course on MATLAB and Communication Engineering Lab
Tools: Numerical Computing Environments – GNU Octave or MATLAB or any other equivalent tool, NS2/OPNET.

Random Processes – Generation of discrete time i.i.d. random processes with different distributions (Bernoulli, Binomial, Geometric, Poisson, Uniform, Gaussian, Exponential, Laplacian, Rayleigh, Rician) - pmf/pdf estimation, AR, MA and ARMA processes - spectral estimation - Visualization of Central Limit Theorem, Whitening Filter.
Communication system Design for Band limited Channels - Signal Design for Zero ISI and Controlled ISI - Partial Response Signaling.
Carrier Phase Modulation and Quadrature Amplitude Modulation - BER Performance in AWGN channel.
Synchronization in Communication Systems: Carrier and Clock Synchronization- Frequency Offset Estimation and Correction.
Modeling and Simulation of Networks using NS2/OPNET: Unicast Routing Basics - Measurements and Statistics of Delays, Throughput, and Packet Behavior - TCP and Packet Trace Tools - Real-Audio vs. TCP-based Traffic.
TCP Connections- Congestion and Congestion Control Parameters. MAC Protocols: CSMA and CSMA/CD in Ethernet and LAN Environments. Multimedia Networking applications: RTSP and Transport of Video using UDP. OMNEST and OMNET

TTC 1102 SEMINAR

Structure of the Course:

Seminar	: 2 hrs/ Week	Credits: 2
Internal Continuous Assessment	: 100 marks	

The student is expected to present a seminar in one of the current topics in Telecommunication Engineering. The student will undertake a detailed study based on current published papers, journals, books on the chosen subject and submit seminar report at the end of the semester.

Marks:

Seminar Report Evaluation : 50 Marks

Seminar Presentation : 50 marks

TTC 2001 ANTENNA THEORY ANALYSIS AND DESIGN

Structure of the Course

Lecture	: 3 hrs/ Week	Credits : 3
Internal Continuous Assessment	: 40 Marks	
End Semester Examination	: 60 Marks	

Course Objectives

- To give an overview about radiation mechanism.
- Familiarize antenna arrays and array patterns.
- To introduce the concepts of microstrip antennas.
- Familiarize smart antenna systems.

Learning Outcomes

- Should be able to optimize array patterns.
- Understand the radiation mechanism and structure of microstrip antennas.
- Understand smart antenna systems.

Module I

Basic concepts of radiation: Radiation mechanism- Current distribution of antennas, Impedance concept-Balance to Unbalanced transformer. Radiation from apertures: Field equivalence principle, Rectangular and circular apertures, Uniform distribution on an infinite ground plane, Aperture fields of Horn antenna-Babinets principle, Reflector antennas, Slot antennas

Module II

Array Antennas: Types of linear arrays, current distribution in linear arrays. Optimization of Array patterns, Continuous aperture sources, Antenna synthesis techniques. Adaptive arrays and adaptive beam formation – side lobe cancellation.

Micro strip antennas: Radiation mechanisms, Feeding structure, Rectangular patch, Circular patch, Ring antenna. Input impedance of patch antenna, Micro strip dipole, Micro strip arrays, Phased arrays. Micro strip antennas.

Module III

Smart Antennas systems: Generalized array signal processing, Beam forming concepts: DOB, TRB & SSBF, Switched beam, antennas, spatial diversity, and fully adaptive antennas for enhanced coverage, range extension & improvement in frequency refuse, interference Nulling for LOS & Multipath systems, SDMA concepts and Smart antennas implementation issues.

References:

1. C. A. Balanis: "*Antenna Theory Analysis and Design*", 2nd edition, John Wiley and Sons, New York, 2009.
2. John D. Kraus.: "*Antennas*", 3rd Edition,John wiley and Sons, 2001
3. Collin. R. E. and Zucker. F. J: "*Antenna Theory*" Part I, McGraw Hill, New York,1969
4. J. C. Liberti & T.S. Rappaport: *Smart Antennas for Wireless Communication: IS-95 and Third Generation CDMA applications*, 1999, Prentice Hall.
5. John D Kraus: "*Antennas for all Application*", 4th edition, Publishing House of Electronics Industry, 2008.

6. B. Pattan: *Robust Modulation Methods and Smart Antennas in Wireless communications*, 2000, Prentice Hall.
7. J.S. Blogh & L. Hanzo: *Third-Generation Systems and Intelligent Wireless Networking: Smart Antennas and Adaptive Modulation*, April 2002, Wiley-IEEE Press.
8. C. Smith & D. Collins: *3G Wireless Networks*, 2nd edition, McGraw Hill, 2007.

Structure of the question paper:

There will be three questions from each module out of which two questions are to be answered by the students. It shall have 60% problem and 40% theory.

TSC 2001 ESTIMATION AND DETECTION THEORY

Structure of the Course

Lecture	: 3 hrs/ Week	Credits : 3
Internal Continuous Assessment	: 40 Marks	
End Semester Examination	: 60 Marks	

Course Objectives

- Familiarize the basic concepts of detection theory, decision theory and elementary hypothesis testing
- Acquire knowledge about parameter estimation, and linear signal waveform estimation
- Get a broad overview of applications of detection and estimation

Learning Outcomes

- Understand Signal detection in the presence of noise
- Understand the basic concepts of estimation theory
- Ability to apply the concepts of estimation and detection in various signal processing applications

Module I

Detection Theory, Decision Theory, and Hypothesis Testing :Review of Probability Theory, Elementary hypothesis testing, Bayes rule, minimax rule, Neyman-Pearson rule; compound hypothesis testing; generalized likelihood-ratio test; Detection with unknown signal parameters, Signal detection in the presence of noise, Chernoff bound, asymptotic relative efficiency; sequential detection; nonparametric detection, sign test, rank test.

Module II

Parameter Estimation: Minimum Mean Squared error estimator, Maximum a Posteriori estimator, linear estimators, Maximum likelihood parameter estimator, invariance principle; estimation efficiency, Cramer-Rao lower bound, Fisher information matrix; least squares, weighted least squares, best linear unbiased estimation.

Module III

Linear Signal Waveform Estimation: Wiener and Kalman Filtering, Lattice filter structure, Levinson Durbin and innovation algorithms, Applications of detection and estimation**:** Applications in diverse fields such as communications, system identification, adaptive filtering, pattern recognition, speech processing, and image processing

References:

1. S.M. Kay, *Fundamentals of Statistical Signal Processing: Detection Theory*, Prentice Hall, 1998
2. S.M. Kay, *Fundamentals of Statistical Signal Processing: Estimation Theory*, Prentice Hall, 1993
3. H.L. Van Trees, *Detection, Estimation and Modulation Theory, Part I,* Wiley, 1968.
4. H.V. Poor, *An Introduction to Signal Detection and Estimation,* 2nd edition, Springer, 1994.
5. L.L. Scharf , *Statistical Signal Processing, Detection and Estimation Theory* , Addison-Wesley:1990

Structure of the question paper:

There will be three questions from each module out of which two questions are to be answered by the students. It shall have 60% problem and 40% theory.

TCC 2000 RESEARCH METHODOLOGY

Structure of the Course

Lecture	: 2 hrs/ Week	Credits : 2
Internal Continuous Assessment	: 40 Marks	
End Semester Examination	: 60 Marks	

Course Objective

- To formulate a viable research question
- To distinguish probabilistic from deterministic explanations
- To analyze the benefits and drawbacks of different methodologies
- To understand how to prepare and execute a feasible research project

Learning Outcomes

Students are exposed to the research concepts in terms of identifying the research problem, collecting relevant data pertaining to the problem, to carry out the research and writing research papers/thesis/dissertation.

Module I

Introduction to Research Methodology - Objectives and types of research: Motivation towards research - Research methods *vs.*Methodology. Type of research: Descriptive *vs.*Analytical, Applied *vs.* Fundamental, Quantitative *vs.* Qualitative, and Conceptual*vs.* Empirical. Research Formulation - Defining and formulating the research problem -Selecting the problem - Necessity of defining the problem - Importance of literature review in defining a problem. Literature review: Primary and secondary sources - reviews, treatise, monographs, patents.Web as a source: searching the web. Critical literature review - Identifying gap areas from literature review - Development of working hypothesis. (15 Hours)

Module II

Research design and methods: Research design - Basic Principles- Need forresearch design — Features of a good design. Important concepts relating to research design: Observation and Facts, Laws and Theories, Prediction and explanation, Induction, Deduction. Development of Models and research plans: Exploration, Description, Diagnosis, Experimentation and sample designs.Data Collection and analysis: Execution of the research - Observation and Collection of data - Methods of data collection - Sampling Methods- Data Processing and Analysis strategies - Data Analysis with Statistical Packages - Hypothesis-Testing -Generalization and Interpretation. (15 Hours)

Module III

Reporting and thesis writing - Structure and components of scientific reports -Types of report - Technical reports and thesis - Significance - Different steps in the preparation, Layout, structure and Language of typical reports, Illustrations and tables, Bibliography, referencing and footnotes. Presentation; Oral presentation - Planning - Preparation -Practice - Making presentation - Use of audio-visual aids - Importance of effective communication.

Application of results of research outcome: Environmental impacts –Professional ethics - Ethical issues -ethical committees.Commercialization of the work - Copy right - royalty - Intellectual property rights and patent law - Trade Related aspects of Intellectual Property Rights - Reproduction of published material - Plagiarism - Citation and acknowledgement - Reproducibility and accountability. (15 Hours)

References:

1. C.R Kothari, Research Methodology, Sultan Chand & Sons, New Delhi,1990
2. Panneerselvam, “Research Methodology”, Prentice Hall of India, New Delhi, 2012.
3. J.W Bames,” Statistical Analysis for Engineers and Scientists”, McGraw Hill, New York.
4. Donald Cooper, “Business Research Methods”, Tata McGraw Hill, New Delhi.
5. Leedy P D, "Practical Research: Planning and Design", MacMillan Publishing Co.
6. Day R A, *"How to Write and Publish a Scientific Paper"*, Cambridge University Press, 1989.
7. Manna, Chakraborti, “Values and Ethics in Business Profession”, Prentice Hall of India, New Delhi, 2012.
8. Sople,” Managing Intellectual Property: The Strategic Imperative, Prentice Hall of India, New Delhi, 2012.

Structure of the question paper:

There will be three questions from each module out of which two questions are to be answered by the students.

TTC 2101 THESIS PRELIMINARY: PART-I

Structure of the Course

Thesis : 2 hrs/week Credits : 2
Internal Continuous Assessment : 100 Marks

For the Thesis-Preliminary Part-I the student is expected to start the preliminary background studies towards the Thesis by conducting a literature survey in the relevant field. He/she should broadly identify the area of the Thesis work, familiarize with the design and analysis tools required for the Thesis work and plan the experimental platform, if any, required for Thesis work. The student will submit a detailed report of these activities at the end of the semester.

Distribution of marks

Internal assessment of work by the Guide : 50 marks

Internal evaluation by the Committee : 50 Marks

TTC 2102 TELECOMMUNICATION LAB II

Structure of the Course

Lab	: 2 hrs/ Week	Credit : 1
Internal Continuous Assessment	: 100 marks	

Pre-requisite: Nil
Tools: Numerical Computing Environments – GNU Octave, - MATLAB, Communication Blockset, RF Blockset and signal processing Blockset, NS2/OPNET.

Channel Coding: Linear Block code and Convolutional codes -Viterbi Decoding – Majority Logic Decoders- CRC-32.
Modeling and Simulation of Radio Channels - Multipath Fading Channels- Jake‟s Model.
Spread Spectrum Communication Systems
Scheduling and Queuing Disciplines in Packet Switched Networks: FIFO, Fair Queuing, RED- TCP Performance: with and without RED.
Antenna simulation using ANSYS, IE3D and Microsoft office. OMNET++.
Wireless Medium Access Control: MAC layer 802.11: CSMA/CA, RTS/CTS mode.
Simple Ad hoc/Sensor Networks: Simulation and Evaluation.

TTC 2103 SEMINAR

Structure of the Course

Seminar	: 2 hrs/ Week	Credits: 2
Internal Continuous Assessment	: 100 marks	

The student is expected to present a seminar in one of the current topics in Telecommunication Engineering. The student will undertake a detailed study based on current published papers, journals, books on the chosen subject and submit seminar report at the end of the semester.

Marks:

Seminar Report Evaluation	: 50 Marks
Seminar Presentation	: 50 Marks

TTE 2001 RF CIRCUITS AND SYSTEMS

Structure of the Course

Lecture	: 3 hrs/ Week	Credits : 3
Internal Continuous Assessment	: 40 Marks	
End Semester Examination	: 60 Marks	

Course objectives

- Familiarize how to use Smith chart.
- Get an overview about the details of microwave switches and phase shifters.
- Get an idea about microwave filters.

Learning outcomes

- Understand the importance of Smith chart in various design applications.
- Should be able to design microwave filters.

Module I

Review of Basic Transmission Line Theory, Planar Transmission Lines - Stripline, microstrip line, suspended stripline and coplanar line; Parallel coupled lines in stripine and microstrip – Analysis, design and characteristics.

Microwave Network Analysis - Microwave network representation, Impedance and admittance matrices, Scattering parameters, Typical two-port, three port, four port networks; Impedance Matching Techniques - Smith chart, Matching networks using lumped elements, Single- and double-stub matching, Quarter wave transformer, Multisection transformers - Binomial and Chebyshev. Basic Passive Components -Lumped elements in MIC, Discontinuities and resonators in microstrip, Balun. Analysis and design of stripline/microstrip components-Directional couplers, Power divider, Hybrid ring.

Module II

Switches and Phase Shifters - PIN diode– Equivalent circuit and Characteristics, Basic series and shunt switches in microstrip; SPST and SPDT switches, Switched line, branchline coupled and loaded line phase shifters in microstrip. Applications in phased arrays. MIC Filters - Lumped element filter design at RF. Impedance and Low pass scaling.

Module III

Frequency transformation, High impedance/Low impedance low pass filter, Parallel coupled band pass filter, Spur line band stop filter, Realization in microstrip and suspended stripline Basics of MIC, MMIC and MEMS technologies - Substrates used, Fabrication process, Relative advantages. Examples- Realization of lumped elements and filters in MMIC, Realization of planar transmission lines and filters in MEMS.

References:

1. M.M. Radmanesh, Radio Frequency and Microwave Electronics, Pearson Education Asia, 2001.
2. D. M. Pozar, Microwave Engineering, 2nd Edition, John Wiley & Sons, 1998.
3. B. Bhat & S.K. Koul, Stripline-like Transmission Line for Microwave Integrated Circuits, New Age Intl. (P) Ltd.,1989.
4. D. K. Misra, Radio Frequency and Microwave Communication Circuits – Analysis and Design, John Wiley & Sons, 2001;

Structure of the question paper:

There will be three questions from each module out of which two questions are to be answered by the students. It shall have 80% problem and 20% theory.

TTE 2002 SECURE COMMUNICATION

Structure of the Course

Lecture	: 3 hrs/ Week	Credits :3
Internal Continuous Assessment	: 40 Marks	
End Semester Examination	: 60 Marks	

Course Objective

As a graduate level course on secure communication, this course assure to deliver the students, a sound understanding of the number theoretic methods and algorithms used in classical and modern cryptography and their cryptanalysis.

Learning Outcome

1. Learn theorems on the number and abstract algebra and develops the mathematical proof witting skills.
2. Learn mathematics behind the cryptography and the cryptographic standards.
3. Learn the algorithms used in cryptanalysis and their merits.
4. Initiate the talented students to propose and analyze new algorithms and methods in cryptology.

Module I

Introduction to cryptography - stream and block ciphers- symmetric and public keys.
Basics -Mathematical proofs and methods.
Complexity theory: Computational Complexity Classes P, NP- NP-Complete, NP-Hard, BPP.
Number theory: primes, divisibility, linear Diophantine equations, congruences, systems of congruence equation, quadratic congruences. Wilson theorem, Fermat's little theorem, Euler's theorem. Multiplicative functions, Primitive roots, Quadratic residues, Legendre symbol, Continued fractions.
Elementary Algebraic Structures: Groups- subgroups, order, homomorphism, cyclic groups, generators. Rings- characteristics, Finite Fields. Polynomial Rings and their algebra over finite fields, multiplicative inverses. Discrete logarithm over groups.
Elliptic Curves: as a group defined over finite field, number of points, order and algebra of rational points on elliptic curves.

Module II

Classical Cryptography: Affine ciphers, hill ciphers, digraphs, enciphering matrices.; Linear Feedback Shift Registers for PN sequences.
Public key Cryptography: One way functions, Hash functions, Knapsack cryptosystems, RSA, Deffie Helman Key Exchange system, El Gamal's Public key crypto system. Elliptic curve crypto system.
Cryptographic standards: DES, AES, MD5, Digital Signature, Zero Knowledge Protocol.

Module III

Cryptanalysis.Algorithms : Modular exponentiation, Fast group operations on Elliptic curves.
Primality test- Fermat’s pseudo primality test, Strong prime test, Lucas Pseudo prime test, Elliptic curve test.
Integer Factorization- Trial division, Fermat's method, CFRAC. Quadratic and Number Field Sieves.
Algorithms for Discrete Logarithms: Baby-step Giant-step alg. Algorithms for Discrete Logarithm on Elliptic curves.

References:

1. A Course in Number Theory and Cryptography, Neal Koblits, Springer, 2e.
2. Number Theory for Computing, Song Y Yan, Springer, 2e.
3. Elementary Number Theory with Applications, Thomas Koshy, Elsivier, 2e.
4. Fundamentals of Cryptology, Henk CA van Tilborg, Kluwer Academic Publishers.
5. Primality Testing and Integer Factorization in Public Key Cryptography, Song Y Yan, Springer, 2e.
6. Public Key Cryptography, Arto Salomaa, Springer, 2e.
7. An Introduction to Theory of Numbers, I Niven, HS zuckerman etc.., John Wiley and Sons, 5e.
8. How to Prove it- A structured Approach, Daniel J Velleman, Cambridge University Press, 2e.

Structure of the question paper:

There will be three questions from each module out of which two questions are to be answered by the students. It shall have 60% problem and 40% theory.

TTE 2003 MULTIRATE SIGNAL PROCESSING AND WAVELETS

Structure of the Course

Lecture	: 3 hrs/ Week	Credits : 3
Internal Continuous Assessment	: 40 Marks	
End Semester Examination	: 60 Marks	

Course Objectives

- To familiarize digital filter banks.
- To understand the difference between uniform and non-uniform filter bank.
- To get an idea about wavelet transforms.

Learning outcomes

- Understand digital filter bank and have a good knowledge about design issues of filter banks.
- Should have a very good knowledge about wavelet transforms.

Module I

The sampling theorem - sampling at subnyquist rate - Basic Formulations and schemes. Basic Multirate operations- Decimation and Interpolation - Digital Filter Banks- DFT Filter Bank- Identities- Polyphase representation Maximally decimated filter banks: Polyphase representation - Errors in the QMF bank- Perfect reconstruction (PR) QMF Bank - Design of an alias free QMF Bank

Uniform band and non uniform filter bank - tree structured filter bank- Errors created by filter bank system

Module II

Polyphase representation- perfect reconstruction systems

Paraunitary PR Filter Banks- Filter Bank Properties induced by paraunitarity- Two channel FIR paraunitary QMF Bank- Linear phase PR Filter banks- Necessary conditions for Linear phase property- Quantization Effects: -Types of quantization effects in filter banks. - coefficient sensitivity effects, dynamic range and scaling.

Cosine Modulated pseudo QMF Bank- Alas cancellation- phase - Phase distortion- Closed form expression-Polyphase structure- PR Systems

Module III

Wavelet Transform by multiresolution :- Scaling subspaces, Wavelet subspaces, Requirements for MRA (Dialation, Transalation, Basis), Dialation equation, Transalation equation, MRA examples (Piecewise constant functions, Cubic Splines, Daubchies functions) Scaling Functions, Wavelets from filters, Wavelet coefficients by recursion, lowpass iteration and cascade algorithm.

References:

1. P.P. Vaidyanathan: "*Multirate systems and filter banks.*" Prentice Hall. PTR. 2004.
2. N.J. Fliege: "*Multirate digital signal processing .*" John Wiley 1994.
3. M Vetterli & J Kovacevic, *Wavelets and subband coding*, Prentice Hall
4. Sanjith K. Mitra: "*Digital Signal Processing: A computer based approach.*" 4th edition, McGraw Hill, 2004.
5. R.E. Crochiere and L. R. Rabiner: "*Multirate Digital Signal Processing*", Prentice Hall. Inc.1983.

6. J.G. Proakis and D.G. Manolakis: "*Digital Signal Processing: Principles. Algorithms and Applications*", 3rd edition Prentice Hall India, 1999.
7. G Strang & T Nguyen , *Wavelets and Filterbank*, Wellesly-Cambridge

Structure of the question paper:

There will be three questions from each module out of which two questions are to be answered by the students. It shall have 60% problem and 40% theory.

TTE 2004 ADAPTIVE SIGNAL PROCESSING

Structure of the Course

Lecture	: 3 hrs/ Week	Credits : 3
Internal Continuous Assessment	: 40 Marks	
End Semester Examination	: 60 Marks	

Course Objectives

- Introduction of basic concepts of adaptive systems and their applications.
- Get an overall picture about applications of adaptive filters in various fields

Learning Outcomes

- Understand basic concepts of adaptive signal processing
- Understanding of the convergence issues, computational complexities and optimality of different filters
- Ability to develop adaptive systems for various applications

Module I

Adaptive systems - definitions and characteristics - applications - properties-examples - adaptive linear combiner-input signal and weight vectors - performance function-gradient and minimum mean square error - introduction to filtering-smoothing and prediction - linear optimum filtering-orthogonality - Wiener – Hopf equation-performance surface

Module II

Searching performance surface-stability and rate of convergence - learning curve-gradient search - Newton's method - method of steepest descent - comparison - gradient estimation - performance penalty - variance - excess MSE and time constants – mis-adjustments

LMS algorithm convergence of weight vector-LMS/Newton algorithm - properties - sequential regression algorithm - adaptive recursive filters - random-search algorithms - lattice structure - adaptive filters with orthogonal signals.

Module III

Adaptive modelling of Multipath Communication channel, Adaptive equalization of telegraph channels, Adaptive interference cancellation, Application in ECG-maternal ECG in Foetal Electrocardiography, Techniques used in Adaptive removal of noise in speech signals and echoes in long distance telephone circuits.

References:

1. Bernard Widrow and Samuel D. Stearns: "*Adaptive Signal Processing*", Person Education, 2008.
2. Simon Haykin: "*Adaptive Filter Theory*", Pearson Education, 2003.
3. John R. Treichler, C. Richard Johnson, Michael G. Larimore: "*Theory and Design of Adaptive Filters*", Prentice-Hall of India, 2002. (Wiley and sons publications, 1987)
4. S. Thomas Alexander: "*Adaptive Signal Processing - Theory and Application*", Springer-Verlag.
5. D. G. Manolokis, V. K. Ingle and S. M. Kogon: "*Statistical and Adaptive Signal Processing*", McGraw Hill International Edition, 2000.

Structure of the question paper:

There will be three questions from each module out of which two questions are to be answered by the students. It shall have 50% problem and 50% theory.

TTE 2005 SPREAD SPECTRUM AND CDMA SYSTEMS

Structure of the Course

Lecture	: 3 hrs/ Week	Credits : 3
Internal Continuous Assessment	: 40 Marks	
End Semester Examination	: 60 Marks	

Course objectives

- To familiarize fundamentals of Spread Spectrum.
- To get an idea about performance analysis of Spread Spectrum system under various channel conditions.
- To provide an overview of Spread Spectrum multiple access networks.
- To get an overview of CDMA systems.

Learning outcomes

- Generate various spreading sequences and codes.
- Should be able to comment about the feasibility of given SS system from its performance analysis.
- Should be able to provide solutions to various issues present in SS systems.

Module I

Fundamentals of Spread Spectrum **:**Introduction to spread spectrum communication, pulse noise jamming, low probability of detection, direct sequence spread spectrum, frequency-hopping and time-hopping spread spectrum systems, correlation functions, spreading sequences- maximal-length sequences, gold codes, Walsh orthogonal codes- properties and generation of sequences

Synchronization and Tracking: delay lock and tau-dither loops, coarse synchronization-principles of serial search and match filter techniques.

Module II

Performance Analysis of SS system **:** Performance of spread spectrum system under AWGN, multi-user Interference, jamming and narrow band interferences Low probability of intercept methods, optimum intercept receiver for direct sequence spread spectrum, Error probability of DS-CDMA system under AWGN and fading channels, RAKE receiver

Capacity, Coverage and Control of Spread Spectrum Multiple Access Networks : Basics of spread spectrum multiple access in cellular environments, reverse Link power control, multiple cell pilot tracking, soft and hard handoffs, cell coverage issues with hard and soft handoff, spread spectrum multiple access outage, outage with imperfect power control, Erlang capacity of forward and reverse links. Multi-user Detection -MF detector, decorrelating detector, MMSE detector. Interference Cancellation: successive, Parallel Interference Cancellation, performance analysis of multiuser detectors and interference cancellers.

Module III

CDMA Systems: General aspects of CDMA cellular systems, IS-95 standard, Downlink and uplink, Evolution to Third Generation systems, WCDMA and CDMA-2000 standards, Principles of Multicarrier communication, MCCDMA and MC-DS-CDMA.

References:

1. R. L. Peterson, R. Ziemer and D. Borth: "*Introduction to Spread Spectrum Communications*," Prentice Hall, 1995.
2. A. J. Viterbi: "*CDMA - Principles of Spread Spectrum Communications*," Addison-Wesley, 1995.
3. Vijay K. Garg, Kenneth F. Smolik, Joseph E. Wilkes: *Applications of CDMA in Wireless/Personal Communications*, Prentice Hall, 1997
4. S. Verdu: "*Multiuser Detection*" , Cambridge University Press, 1998 (with correction: 2003)
5. Mosa Ali Abu – Rgheff "*Introduction to CDMA Wireless communication*" Else Vier
6. M. K. Simon, J. K. Omura, R. A. Scholtz and B. K. Levitt: "*Spread Spectrum Communications Handbook*", McGraw Hill, New York, 2002.
7. Cooper and McGillem: "*Modern Communications and Spread Spectrum*" McGraw-Hill, 1986.
8. J. G. Proakis: "*Digital Communications*," McGraw Hill, 4th edition, 2001.
9. S. Glisic and B. Vucetic: "*Spread Spectrum CDMA Systems for Wireless Communications*," Artech House, 1997

Structure of the question paper:

There will be three questions from each module out of which two questions are to be answered by the students. It shall have 60% problem and 40% theory.

TTE 2006 IMAGE AND VIDEO PROCESSING

Structure of the Course

Lecture	: 3 hrs/ Week	Credits : 3
Internal Continuous Assessment	: 40 Marks	
End Semester Examination	: 60 Marks	

Course Objectives

- To enhance the knowledge of transform domain and filtering
- To develop the skills for processing of images and videos
- To enhance the knowledge of image and video compression formats

Learning Outcomes

- Understand and compare the performances of different tyes of transforms and filtering operations
- Understand the processing of images and videos
- Understand the different types of compression techniques

Module I

Basics of Image processing, RGB and HSV colour model, 2D sampling theorem and Nyquist criteria, Interpolation, Moire Effect and flat field response. Image transforms - DFT, DCT, Sine, Hadamard, Haar, Slant, KL transform, Wavelet transform.

Image enhancement **:-** Point processing, Spatial filtering, Histogram techniques, Pseudo colouring and false colouring, Frequency filtering. Image Restoration:- Image observation models, Sources of degradation, inverse filtering and wiener filtering.

Module II

Image Segmentation**: -** region growing, region merging and split and merge, watershed segmentation. Image texture analysis - co-occurence matrix, measures of textures, statistical models for textures.

Hough Transform, boundary detection, chain coding, segmentation and thresholding methods.

Image Reconstruction from projections: - Random transform, Back- projection operator, Back projection algorithm, Fan beam and algebraic restoration technique. Image restoration : - in the presence of noise.

Module III

Video processing – display enhancement, video mixing, video scaling, scan rate conversion, Image compression – lossless and lossy compression techniques, standards for image compression – JPEG, JPEG2000. Video compression – motion estimation, intra and interframe prediction, perceptual coding, standards - MPEG, H.264

References:

1. Anil K Jain: "*Fundamentals of Digital Image Processing,"*, PHI, 1989.
2. Gonzalez and Woods: "*Digital Image Processing"*, 3rd edition, PHI, 2008.
3. Bhabatosh Chanda, D. Dutta Majumder: "*Digital Image Processing and Analysis* , PHI, 2004.
4. W Pratt: *Digital Image Processing*, 4th edition, Wiley, 2007.
5. Al Bovik: *Handbook of Image and Video*, 2nd edition, Academic Press, 2005.
6. Keith Jack: *Video Demystified*, 5th edition, LLH, 2007.

Structure of the question paper:

There will be three questions from each module out of which two questions are to be answered by the students. It shall have 60% problem and 40% theory.

TTE 2007 SPEECH AND AUDIO PROCESSING

Structure of the Course

Lecture	: 3 hrs/ Week	Credits : 3
Internal Continuous Assessment	: 40 Marks	
End Semester Examination	: 60 Marks	

Course Objectives

- To enhance the knowledge of speech production models
- To develop the skills to compare different compression and coding techniques
- To develop the skills for speech analysis, synthesis and recognition

Learning outcomes

- Understand the theories and modes of speech production
- Understand speech coding and analysis
- Understand the techniques for speech synthesis and recognition

Module I

Speech Production – human speech production mechanism, acoustic theory of speech production, digital models for speech production. Speech perception – human hearing, auditory psychophysics, JND, pitch perception, auditory masking, models for speech perception. Speech Analysis – Time and frequency domain analysis of speech, speech parameter estimation, Linear prediction.

Module II

Speech compression – quality measures, waveform coding, source coders, Speech compression standards for personal communication systems.

Audio processing – characteristics of audio signals, sampling, Audio compression techniques, Standards for audio compression in multimedia applications, MPEG audio encoding and decoding, audio databases and applications.

Module III

Speech synthesis – text to speech synthesis, letter to sound rules, syntactic analysis, timing and pitch segmental analysis.

Speech recognition – Segmental feature extraction, DTW, HMMs, approaches for speaker, speech and language recognition and verification

References:

1. T.F Quatieri , Discrete-time speech signal processing: Principles and Practise Pearson, Pearson,2002 .
2. 2002Douglas O'Shaugnessy, Speech Communication – Human and Machine, IEEE Press, 2000
3. L R Rabiner, Digital Processing of Speech Signals, Pearson,1978
4. Zi Nian Li, Fundamentals of Multimedia, Pearson Education, 2003

Structure of the question paper:

There will be three questions from each module out of which two questions are to be answered by the students. It shall have 60% problem and 40% theory.

TTE 2008 INFORMATION THEORY

Structure of the Course

Lecture	: 3 hrs/ Week	Credits : 3
Internal Continuous Assessment	: 40 Marks	
End Semester Examination	: 60 Marks	

Course Objectives

- To get an overview about entropy.
- Familiarize the concept of channel capacity and its computation.
- Get an idea about rate distortion theory.

Learning Outcomes

- Understand the importance of entropy calculation.
- Should be able to design channels with different channel capacity.
- Understand rate distortion properties.

Module I

Entropy- Memory less sources- Markov sources- Entropy of a discrete Random variable- Joint, conditional and relative entropy- Mutual Information and conditional mutual information- Chain relation for entropy, relative entropy and mutual Information- Lossless source coding- Uniquely decodable codes- Instantaneous codes- Kraft's inequality - Optimal codes- Huffman code- Shannon's Source Coding Theorem.

Module II

Asymptotic Equipartition Property (AEP) - High probability sets and typical sets- Method of typical sequence as a combinatorial approach for bounding error probabilities. Channel Capacity- Capacity computation for some simple channels- Arimoto-Blahut algorithm- Fano's inequality- Shannon's Channel Coding Theorem and its converse- Channels with feed back- Joint source channel coding Theorem.

Differential Entropy- Joint, relative and conditional differential entropy- Mutual information- Waveform channels- Gaussian channels- Mutual information and Capacity calculation for Band limited Gaussian channels- Shannon limit- Parallel Gaussian Channels-Capacity of channels with colored Gaussian noise- Water filling.

Module III

Rate distortion theory - Introduction, Rate distortion function, properties, continuous sources and rate distortion measure, Rate distortion theorem, converse, information transmission theorem, rate distortion optimization.

References:

1. Robert Gallager: "*Information Theory and Reliable Communication*", John Wiley & Sons.
2. T. Bergu: "*Rate Distortion Theory a Mathematical Basis for Data Compression*" PH Inc. 1971.
3. *Special Issue on Rate Distortion Theory*, IEEE Signal Processing Magazine, Vol. 15, No. 6, November 1998.
4. T. Cover and Thomas: "*Elements of Information Theory*", 2nd edition, John Wiley & Sons 2006.
5. R. J. McEliece: "*The theory of information & coding*", Addison Wesley Publishing Co., 1982.

6. Shu Lin and Daniel. J. Costello Jr.: "*Error Control Coding: Fundamentals and applications*", 2nd edition, Prentice Hall Inc, 2002.
7. ebook by David Mc.

Structure of the question paper:

There will be three questions from each module out of which two questions are to be answered by the students. It shall have 60% problem and 40% theory.

TTD 2001 VLSI FOR COMMUNICATION

Structure of the Course

Lecture	: 3 hrs/ Week	Credits : 3
Internal Continuous Assessment	: 40 Marks	
End Semester Examination	: 60 Marks	

Course Objective

- To give a basic understanding of the theory of MOS devices.
- To facilitate an in depth knowledge in Receiver front end design
- To develop a clear understanding in mixed circuit design,emphasising on Sigma delta modulators
- To give an in depth knowledge in PLL.

Learning Outcome

- To be able to do a receiver front end design
- Understand the basics of different types of mixers.
- To be able to do mixed circuit design

Module I

MOS Transistor Theory - NMOS and PMOS Transistor, Threshold voltage, basic DC equations (no derivation, only final equations), large signal behavior and Small signal Model of MOS transistor-parameters, (final equation and typical values)

Receiver Front End: General Discussion. Filter Design. Rest of Receiver Front End: Nonidealities and Design Parameters. Nonlinearity. Noise. Derivation of NF, Low Noise Amplifier, General Topology, Matching networks, Wideband LNA and Narrowband LNA, Comparison.

Module II

Active Mixer-Balanced and Unbalanced Mixer, Gilbert Mixer, Conversion gain, NF for a mixer

Switching Mixer, Sampling Mixer, Demodulators. A/D Converters Used in a Receiver. Low-Pass Sigma-Delta Modulators, Switch Capacitor based Integrators, 1 bit ADC and DAC, Bandpass Sigma-Delta Modulators .

Module III

PLL-Based Frequency Synthesizer, Phase Detector/Charge Pump, Dividers. VCO: Introduction. LC Oscillators. Ring Oscillator. Phase Noise, Loop Filter: General Description. Loop Filter: Design Approaches

References:

1. Neil H.E. Weste and Kamran Eshraghian: *Principles of CMOS VLSI Design*, LPE Pearson 2004
2. Gray, Hurst Lewis and Meyer: *Analysis and design of Analog Integrated Circuits*, Wiley 4th Edition
3. Bosco Leung: *VLSI for Wireless Communications*, , LPE Pearson 2004

Structure of the question paper:

There will be three questions from each module out of which two questions are to be answered by the students. It shall have 60% problem and 40% theory.

TTD 2002 WIRELESS PERSONAL AREA NETWORKS

Structure of the Course

Lecture	: 3 hrs/ Week	Credits : 3
Internal Continuous Assessment	: 40 Marks	
End Semester Examination	: 60 Marks	

Course Objective

- To get an idea about wireless personal area networks.

Learning Outcome

- To be able to understand deeply about the wireless personal area networks.

Prerequisite: Basic course on Digital Communication at Under Graduate Level.

Module I

Introduction to wireless networks, characteristics of Wireless Networks, WPAN,WLAN, WMAN,IEEE 802.15 standards, IEEE 802.11 standards, IEEE 802.16 standards, Issues and challenges in wireless networks, classification and types of wireless networks, Mobile, IPv4, and Mobile IPv6. Wireless Personal Area Networks (WPANs), Bluetooth, Overview, profiles, Specifications, protocol architecture, piconets and scatter nets, frequency, Bands and channel arrangements, SCO and ACL links, packet types and packet, Format, connection modes, usage scenarios.

Module II

Zigbee: Introduction to Zigbee alliance and standard, advantages and limitations, Zigbee layers, characteristic features, topologies, protocol stack, IEEE 802.15.4PHY, IEEE 802.15.4 MAC, Zigbee alliance defined layers (Network and application layers). Zigbee applications.
IrDA (Infrared Data Association): Introduction, protocol stack, frame format, services, overview and IrDA applications.
UWB (Ultra Wideband), Overview, technology, characteristics, advantages& disadvantages, comparison between UWB & spread spectrum techniques, UWB applications. Comparisons of all the WPAN technologies (Bluetooth, Zigbee, IrDA, UWB).

Module III

Mobile Ad Hoc Networks (MANETs): Introduction to MANETs, characteristics and applications of MANETs, issues and challenges in MANETs, information routing in MANETs, goals for selecting routing protocols for MANETs. Routing protocol classification for MANETss, reactive and proactive protocols, route discovery and maintenance.

References:

1. Kaveh Pahlavan, Prashant Krishnamurthy: “Principles of Wireless Networks”, 2nd edition, Pearson education 2009.
2. William Stallings: “Wireless Communication and Networks”, 1st edition, Pearson education Inc, ISBN, 2002.
3. Dr. Kamilo Feher: "*Wireless Digital Communications*: *Modulation* & *Spread Spectrum* Applications", 5th edition, Prentice-Hall India, 2001.
4. Vijay K. Garg, Joseph E. Wilkes: “Principles and Applications of GSM”: Pearson education Inc, ISBN, 2005.
5. Andreas F. Molisch: “Wideband wireless Digital Communications”: Pearson education Inc, ISBN, 2001.

Structure of the question paper:

There will be three questions from each module out of which two questions are to be answered by the students. It shall have 60% problem and 40% theory.

TTD 2003 SPACE TIME CODING AND MIMO SYSTEMS

Structure of the Course

Lecture	: 3 hrs/ Week	Credits : 3
Internal Continuous Assessment	: 40 Marks	
End Semester Examination	: 60 Marks	

Course objectives

- To introduce MIMO channel models.
- To get an idea about MIMO diversity.
- To provide an overview of space time block codes and trellis codes.

Learning outcomes

- Understand the concept of MIMO systems.
- Understand the effectiveness of communication systems using MIMO diversity and spatial multiplexing.
- Should be able to construct space time block code and trellis code.

Module I

Information theoretic aspects of MIMO: Review of SISO communication - MIMO channel models - Classical i.i.d. and extended channels - Frequency selective and correlated channel models - Capacity of MIMO channels - Ergodic and Outage Capacity - Capacity bounds - Influence of channel properties on capacity.

Module II

MIMO Diversity and Spatial Multiplexing: Space Time Diversity Aspects - Sources and types of diversity - analysis under Rayleigh fading – Diversity and Channel knowledge - MIMO Spatial multiplexing - Space Time receivers - ML - MMSE - ZF – Sphere decoding - BLAST receivers - DMG tradeoff in MIMO systems.

Module III

Space Time Block Codes: Alamouti's code for two transmit antennas - Comparison with dual-branch receive diversity STBC based on real/complex orthogonal designs - Code Design Criteria for quasi-static Channels (Rank, Determinant and Euclidean Distance) - Orthogonal Designs - Generalized Orthogonal Designs - Quasi-Orthogonal Designs - Performance Analysis. Representation of STTC- shift register, generator matrix, state-transition diagram, trellis

Space Time Trellis Codes: Diagram - Code construction. Delay diversity as a special case of STTC- Performance Analysis.

References:

1. Paulraj, R. Nabar & D. Gore: "*Introduction to Space Time Wireless Communications"*, 2nd edition, Cambridge University Press, 2005.
2. B.Vucetic and J. Yuan: *Space-Time Coding*, John Wiley, 2003.
3. E.G. Larsson and P. Stoica: "*Space-Time Block Coding for Wireless communications*", Cambridge University Press,2008.
4. H. Jafarkhani: "*Space-Time Coding: Theory and Practice*", Cambridge University press,2005.
5. D. Tse and P. Viswanath: *"Fundamentals of Wireless Communication"*, Cambridge University press,2005.

Structure of the question paper:

There will be three questions from each module out of which two questions are to be answered by the students. It shall have 60% problem and 40% theory.

TTD 2004 HIGH PERFORMANCE COMMUNICATION NETWORKS

Structure of the Course

Lecture	: 3 hrs/ Week	Credits : 3
Internal Continuous Assessment	: 40 Marks	
End Semester Examination	: 60 Marks	

Course Objectives

- Focuses on the convergence of the telephone, computer networking, cable TV, and wireless industries.
- Explains current and emerging networking technologies.
- To get an overview of fundamental principles to develop a comprehensive understanding of network architectures, protocols, control, performance, and economics.
- Explains the economic factors and technical tradeoffs that guide network development.

Learning Outcomes

- Derives the most important mathematical results of network performance.
- Combines the perspectives of the communications engineer, the computer scientist and the economist to provide a system-level understanding of the core networking principles and technologies.
- Presents essential tools for analyzing, designing, and managing high performance networks.
- It supplies network hardware and software developers with the tools to develop networking solutions and implementation in state-of-the-art technologies such as Internet, high speed LANs and WANs, ISDN, ATM, BISDN, and SONET.

Module I

Basics Of Networks:- Telephone, computer, Cable television and Wireless network, networking principles, Digitalization: Service integration, network services and layered architecture, traffic characterization and QOS, networks, services: network elements and network mechanisms

Module II

Packet Switched Networks:-OSI and IP models: Ethernet (IEEE 802.3); token ring (IEEE 802.5), FDDI, DQDB, frame relay, SMDS: Internet working with SMDS.INTERNET AND TCP/IP NETWORKS:-Overview; internet protocol; TCP and VDP; performance of TCP/IP networks circuit switched networks: SONET; DWDM, Fibre to home, DSL, Intelligent networks, CATV.

Module III

ATM and Wireless Networks:-Main features-addressing, signaling and routing; ATM header structure-adaptation layer, management and control; BISDN; Inter-working with ATM, Wireless channel, link level design, channel access; Network design and wireless networks
Optical Networks and Switching:-Optical links- WDM systems, cross-connects, optical LAN's, optical paths and networks; TDS and SDS: modular switch designs-Packet switching, distributed, shared, input and output buffers

References:

1. Jean Walrand and Pravin Pratap Varaiya: "*High Performance Communication Networks*", 2nd Edition, Harcourt and Morgan Kauffman, London, 2000.

2. Sumit Kasera "*ATM Networks* ", Tata McGraw-Hill, New Delhi, 2006.
3. Behrouz.a. Forouzan: "*Data Communication and Networking* ", Tata McGraw-Hill, New Delhi, 2001.
4. C.Sivaram Murty and M.Guruswamy: "*WDM Optical Networks, Concepts, Design and Algorithms*", PHI,2002.
5. A.Leon Gracia,I. Widjaja: "*Communication networks* ", Tata McGraw-Hill, 2nd edition,New Delhi, 2006.
6. Rajiv Ramaswamy,Kumar Sivarajan: "*Optical Networks:a practical perspective*", 2nd edition,Morgan Kaufmann, 2002

Structure of the question paper:

There will be three questions from each module out of which two questions are to be answered by the students. It shall have 60% problem and 40% theory.

TTC 3101 THESIS PRELIMINARY: PART II

Structure of the Course

Thesis : 14 hrs/week Credits: 5

Internal Continuous Assessment : 200 Marks

The Thesis Preliminary Part - II is an extension of Thesis Preliminary Part - I. Thesis Preliminary Part II comprises preliminary thesis work, two seminars and submission of Thesis - Preliminary report. The first seminar would highlight the topic, objectives and methodology and the second seminar will be a presentation of the work they have completed till the third semester and the scope of the work which is to be accomplished in the fourth semester, mentioning the expected results.

Distribution of marks

Internal assessment of work by the Guide : 100 Marks

Internal evaluation by the Committee : 100 Marks

TTE 3001 EMBEDDED SYSTEMS FOR COMMUNICATION

Structure of the Course

Lecture	: 3 hrs/ Week	Credits : 3
Internal Continuous Assessment	: 40 Marks	
End Semester Examination	: 60 Marks	

Course objectives

- To give a brief introduction to microcontrollers
- To introduce the concept and basics of embedded systems
- To give an overview of the different communication buses and protocols.
- To give an indepth knowledge in RTOS

Learning outcome

- To be able to program a microcontroller
- Understand the basics of embedded systems
- Get an understanding of the different protocols
- To be able to program using RTOS

Module I

Brief review of the microcontrollers – 8051/PIC/ARM - Programming, CPU Block diagram, Memory Organization, Interrupts, ADC, PWM, Timers, Watch Dog Timer, Serial Port, I/O Port.

Introduction to Embedded Systems: Characteristics of Embedded systems, Software embedded into a system - General ideas of Processor and Memory organization - Processor and memory selection, Interfacing to Memory and I/O devices- Devices and Buses- Device Drivers and Interrupt Servicing mechanisms.

Module II

Overview of Communication Buses and protocols – Serial Bus Communication Protocols, Parallel Bus Protocols, Internet Embedded Systems - Network Protocols, Wireless and Mobile System Protocols

Hardware Software Co-design and Program Modeling – Program Models, Multiprocessor Systems, UML Modeling, Inter-process Communication and Synchronization of Processes, Tasks and Threads Multiple Processes in an Application - Data sharing by multiple tasks and routines- Inter Process Communication.

Module III

Real Time Operating Systems - Operating System Services, I/O Subsystems- Network Operating Systems - Real Time and Embedded System Operating systems -Interrupt routines in RTOS Environments - RTOS Task Scheduling models, Interrupt Latency and response Times - Standardization of RTOS - Ideas of Embedded Linux.

Study of VX works, MicroC/OS-II RTOS, Case Studies of programming with RTOS and Case study /design using 8051/PIC microcontroller/ARM processor for applications in Telecommunications.

References:

1. Ajay V. Desh Mukh: "*Microcontrollers -Theory and Applications*", Tata Mc Graw Hill Publications, 2005

2. Rajkamal: "*Embedded Systems Architecture; Programming and Design*", 2nd Edition; Tata McGraw Hill Publications,2008.
3. Michael Predko, Myke Predko: *Programming and Customizing the 8051 microcontroller*, 1st Edition; McGraw Hill International ,1999.
4. Ayala, Kenneth J: *8051 microcontroller: Architecture, Programming & Applications*, 3rd Edition, Cengage Learning, 2004
5. J.R.Gibson,: *ARM Assembly Language –An Introduction*, Lulu Press, 2007
6. Jane.W.S. Liu: *Real-time Systems*, PHI 2000
7. Phillip A Laplante: *Real-Time Systems Design and Analysis : An Engineer's Handbook , 3rd edition, Wiley-IEEE,2004*
8. Paul T Ward & Stephen J Mellor: *Structured Development for Real - Time Systems V1 : Introduction and Tools*, 9th edition,Yourdon Press, 1985
9. David E.Simon: *Embedded Software Primer*, Addison-Wesley, 1999.
10. Tornado API Programmer's guide2.0, Wind River Systems, 1999
11. VxWorks Programmers guide, Wind River Systems
12. VxWorks References manual, Wind River Systems

Structure of the question paper:

There will be three questions from each module out of which two questions are to be answered by the students. It shall have 60% problem and 40% theory.

TTE 3002 NEURO FUZZY SYSTEMS

Structure of the Course

Lecture	: 3 hrs/ Week	Credits : 3
Internal Continuous Assessment	: 40 Marks	
End Semester Examination	: 60 Marks	

Course Objectives

- Explore the basic principles underlying the analysis and synthesis of fuzzy neural integrated systems with models and case studies.
- Focuses on the usage of heuristic learning strategies derived from the domain of neural network theory to support the development of a fuzzy system.
- Deals with the fundamentals of genetic algorithms for neural-net training and structure optimization, issues involved and their applications in a variety of different areas of engineering and science

Learning Outcomes

- Provides a framework for unification, construction and development of neuro-fuzzy systems.
- As it reflects theoretical and practical issues in a balanced way, effective development of models in any field can be made.
- Enables to implement and experiment with genetic algorithms on their own for any problems.

Module I

Learning processes-Single layer and Multi layer Perceptrons-Principal Component Analysis-Independent Component Analysis-Stochastic Machines.
Introduction to Neurodynamics and Neuroprogramming.

Module II

Fuzzy systems-Crisp sets and fuzzy sets – operation on fuzzy sets – fuzzy relations – fuzzy control systems – Case studies. Neural networks and fuzzy systems – Models-Case studies.

Module III

Genetic Algorithms and Fuzzy Logic- Basics-Design issues-Convergence rate-Genetic Algorithm methods-Case studies.

References :

1. Simon Haykin, *Neural Networks, a comprehensive foundation,* 2/e, Pearson Education.
2. Timothy J Ross, *Fuzzy logic with Engineering Applications*" 2/e, McGraw Hill
3. John Yen, Reza Langari, *Fuzzy Logic-Intelligence, Control and Instrumentation*, Pearson Education, 2002

Reading:

1. Yegna Narayana B, *Artificial Neural Networks*– PHI
2. Ahamad M.Ibrahim, *Introduction to Applied Fuzzy Electronics*, PHI
3. S.Rajasekharan,G.A Vijayalakshmi Pai , *Neural Networks,Fuzzy Logic and Genetic Algorithams,* PHI

4. Martin T.Hagan, Howard B.Demuth, Mark Beale *Neural Network Design*, Vikas Thomson Learning.

Structure of the question paper:

There will be three questions from each module out of which two questions are to be answered by the students. It shall have 60% problem and 40% theory.

TTE 3003 MODELLING AND SIMULATION OF COMMUNICATION SYSTEMS

Structure of the Course

Lecture	: 3 hrs/ Week	Credits : 3
Internal Continuous Assessment	: 40 Marks	
End Semester Examination	: 60 Marks	

Course Objectives

- Introduce to the main ideas underlying the simulation of communication systems (links).
- Focuses on the modeling, performance evaluation techniques, and the role of simulation in the systems engineering of actual systems with various issues such as discrete-time representation of waveforms, random number generation, Monte Carlo simulation, and validation.

Learning Outcomes

- Developing a simulation of a communication system, using simulation program for the design or analysis of a communication system, or considering the application of these tools to their own design and analysis problems.

Module I

Modelling and Simulation Approach : Review of stochastic process and their properties. Univariate and multivariate models, Transformation of random variables, Bounds and approximation, Random process models - Markov and ARMA Sequences, Sampling rate for simulation.

Methods of performance evaluation-simulation approach - Advantages and limitations. System model steps and its types involved in simulation study. Basic concepts of modelling – modelling of systems, devices, random process and hypothetical systems. Error sources in simulation. Validation, simulation environment and software issues. Role of simulation in communication system and random process. Steps involved in simulation study.

Generation and Parameter Estimation : Monte Carlo simulation, properties, random number Generation, Generating independent and correlated random sequences. Testing of random number generators. Parameter estimation: Estimating mean, variance, confidence interval, Estimating the Average Level of a Waveform, Estimating the Average power of a waveform, Power Spectral Density of a process, Delay and Phase.

Module II

Modelling of Communication Systems : Information sources, source coding, base band modulation, channel coding, RF and optical modulation, filtering, multiplexing, detection/demodulation- carrier and timing recovery for BPSK and QPSK. Modeling considerations for PLL.

Communication Channel Models : Fading and multipath channels- statistical characterization of multipath channels and time-varying channels with Doppler effects, models for multipath fading channels. Finite state channel models – channels with and without memory. Methodology for simulating communication systems operating over fading channels.

Module III

Performance Estimation and Evaluation : Estimation of Performance Measures - Estimation of SNR, Performance Measures for Digital Systems, Importance sampling method, Efficient Simulation using Importance Sampling, Quasianalytical Estimation.

Analysis of simulation Results: Model Verification Techniques, Model Validation Techniques, Transient Removal, Terminating Simulations, Stopping Criteria, Variance Reduction.

Case Studies: (1) Performance of 16-QAM equalized Line of Sight Digital Radio Link, (2) performance evaluation of CDMA Cellular Radio System.

References:

1. M.C. Jeruchim, Philip Balaban and K.Sam shanmugam, "Simulation of communication systems," Plemum press, New York, 2007.
2. M.Law and W. David Kelton ," Simulation Modelling and analysis" ,Tata McGraw Hill, New York, 2008.
3. K.Hayes, "Modelling and Analysis of computer communication networks," Plenum press, NewYork.
4. Raj Jain, The Art of Computer Systems Performance Analysis, John Wiley and Sons.
5. Jerry Banks and John S.Carson, "Discrete-event system Simulation", Prentice Hall, Inc., New Jersey.

Structure of the question paper:

There will be three questions from each module out of which two questions are to be answered by the students. It shall have 60% problem and 40% theory.

TTE 3004 DIGITAL MICROWAVE COMMUNICATION

Structure of the Course:

Lecture	: 3 hrs/ Week	Credits : 3
Internal Continuous Assessment	: 40 Marks	
End Semester Examination	: 60 Marks	

Course Objectives

- Familiarize digital microwave systems and their structures.
- Understanding multiplexing techniques.
- To get an overview about different waveguide components and accessories.

Learning Outcomes

- Understand the structure of digital microwave systems.
- Understand digital transmission systems.
- Understand the working of waveguide components and accessories

Module I

Digital Microwave Communication systems - general block diagram, interconnections, 34+2Mb Digital microwave radio equipment – arrangement of modules – DMR 770, signal flow, modules and sub modules, Transmitter – Receiver sub system, Channel Primary MUX – Data frame.

Structure of 30 channel Primary MUX, Signaling in Telecommunication, R2 Signaling, PDM 30B exchange. III order multiplexing equipment – 2/34 MUX equipment, overview of 2/8 card, 8/34 card (No detailed functional description), alarms and consequent action.

Module II

Equalization techniques in DMR-770 Digital Microwave radio – Delay equalizer, Transversal equalizer, line equalizer. Bit Stream integration in Digital Transmission systems – Multiplexing of synchronous data signals, multiplexing asynchronous signals, retiming by justification, perforated clock, Integration of 2Mb streams in II order digital MUX, Integration of digital streams of different data rates.

Module III

Waveguide components and accessories – bands, corners, taper, twist, flexible wave guide, loading elements, ferrite devices. Ac cessories – clamps, earthing pit, flanges and coupling, bending tools, Precautions while hoisting waveguide

References:

1. P V Sreekanth: *Digital Microwave Communication Systems*, Universities Press, 2003
2. Robert E. Collin: *Foundation for Microwave Engineering,2nd edition,* McGraw Hill,1992
3. David M. Pozar: *Microwave Engineering,3rd* Edition, John Wiley & Sons,2004.

Structure of the question paper:

There will be three questions from each module out of which two questions are to be answered by the students. It shall have 60% problem and 40% theory.

TTE 3005 WDM OPTICAL NETWORK AND OPTICAL SWITCHING

Structure of the Course

Lecture	: 3 hrs/ Week	Credits : 3
Internal Continuous Assessment	: 40 Marks	
End Semester Examination	: 60 Marks	

Course Objectives

- To familiarize about components of optical network.
- To familiarize different optical networks.
- To familiarize control management.

Learning Outcomes

- Understand WDM optical network and its features.

Module I

Introduction to Optical Networks: The Optical Layer, Transparency and All-Optical Networks.

Optical Packet Switching, Transmission Basics, Propagation of Signals in Optical Fiber: Nonlinear Effects

Components: Isolators and Circulators, Multiplexers and Filters, Optical Amplifiers, Transmitters, Detectors, Switches, Wavelength Convertors, Transmission System Engineering: System Model.

Module II

Networks; Client Layers of the Optical Layer: SONET / SDH, ATM, IP, Storage Area Networks.

WDM Network Elements: Optical Cross connect, WDM Network Design, LTD and RWA Problems, Dimensioning Wavelength Rooting Networks, Statistical Dimensioning Models, Maximum Load Dimensioning Model, DWDM networks

Module III

Control Management: Optical Layer services and Interfacing, Performance and Fault Management, Configuration Management.

Network Survivability: Protection in SONET / SDH, Protection in IP Network, Optical Layer Protection Scheme.

Access Network: Photonic Packet Switching, Optical TDM, Synchronisation, Header Processing, Buffering, Burst switching, Deployment considerations, Designing transmission Layer.

References:

1. Ramaswami, Sivarajan Optical Networks, Elsevier – 2004
2. C.Sivaramamurthy & M.Gurusamy: *WDM optical Networks*, PHI, 2002.
3. E.A.Saleh, M.C.Teich, Fundamentals of photonocs, Wiley Interscience, 1991.
4. J.Singh, Optoelectronics: an introduction to materials and devices, McGraw Hill, 1996.
5. J.Wilson and J.F.B.Hawkes, Optoelectronics: an introduction, Prentice Hall India,1998

Structure of the question paper:

There will be three questions from each module out of which two questions are to be answered by the students. It shall have 60% problem and 40% theory.

TTE 3006 RF MEMS

Structure of the Course

Lecture	: 3 hrs/ Week	Credits : 3
Internal Continuous Assessment	: 40 Marks	
End Semester Examination	: 60 Marks	

Course Objectives

- To enhance the knowledge of Microelectromchanical systems
- To impart the knowledge of RF MEMS passive, active devices
- To develop the skills to design and model and analyse systems like RF MEMS switches

Learning Outcomes

- Understand the processes in MEMS fabrication
- Understand RF MEMS design, modelling issues
- Understand the working of different types of RF MEMS devices

Module I

Introduction to RF MEMS, application in wireless communications; Overview of RF MEMS fabrication, design and testing; Introduction to Microfabrication Techniques- Materials properties, Bulk and surface micromachining, Wet and dry etching, Thin-film depositions; Actuation Mechanisms in MEMS- Piezoelectric, Electrostatic, Thermal, Magnetic.

Module II

RF MEMS switches and applications, Integration and biasing issues for RF switches; MEMS switch design, modeling and analysis- Electromechanical finite element analysis, RF design;

Module III

Inductors and capacitors - micromachined inductors, variable inductors, polymer based inductors, gap-tuning and area tuning capacitors, dielectric tunable capacitors; Resonators – applications in oscillators and filters; Micromachined antennas;
RF NEMS-overview

References:

1. "RF MEMS: Theory, Design, and Technology", Gabriel M. Rebeiz, Wiley, 2003
2. "RF MEMS Circuit Design for Wireless Applications", Hector J. De Los Santos, Artech House, 2002
3. "RF MEMS and Their Applications", Vijay Varadan, K. J. Vinoy, K. A. Jose, Wiley, 2003.

Structure of the question paper:

There will be three questions from each module out of which two questions are to be answered by the students. It shall have 50% problem and 50% theory.

TTE 3007 NETWORK MANAGEMENT AND SECURITY

Structure of the Course

Lecture	: 3 hrs/ Week	Credits : 3
Internal Continuous Assessment	: 40 Marks	
End Semester Examination	: 60 Marks	

Course objectives

- To give a basic knowledge on different network management.
- To give an in depth knowledge on the different network threats
- To make aware of the need and methods of network security

Learning outcome

- Understand OSI Network management model and internet management
- Understand the concept of Broadband network management and ATM network management.
- Understand the threats and the different levels of security in network.

Module I

OSI Network management: OSI Network management model-Organizational model-Information model, communication model. Abstract Syntax Notation - Encoding structure, Macros Functional model CMIP/CMIS
Internet management (SNMP): SNMP-Organizational model-System Overview, The information model, communication model-Functional model, SNMP proxy server, Management information, protocol remote monitoring.

Module II

Broadband network management: Broadband networks and services, ATM Technology-VP,VC,ATM Packet, Integrated service, ATMLAN emulation, Virtual LAN. ATM Network Management-ATM Network References model, Integrated local management Interface. ATM Management Information base, Network management applications:Configuration management, Fault management, performance management, Event Correlation Techniques . Management, Accounting management, Report Management, Policy Based Management Service Level Management.

Module III

Network Security Threats: Virus, Worm, Spam, Trojans.
Network Security – Electronic Mail Security- Pretty Good Privacy – S/MIME – IP security – overview and architecture – authentication header – encapsulating security payload – combing security associations – web security requirements Secure Socket Layer and Transport Layer Security – secure electronic transactions, Authentication applications: X-509, Kerberos, RADIUS.

References:

1. William Stallings: *SNMP*, 3rd Edition, *Addison Wesley , 1999*.
2. Mani Subramanian: *Network Management Principles and practice*, Addison Wesley New York, 2000.
3. Peterson Davie: *Computer Networks – A systems approach*, Morgan Kauffman, Harcourt Asia, 4th edition, 2007.
4. Stallings: "*Network security essentials applications and standards*",2nd edition, Pearson education, 2003.

5. Salah Aiidarous, Thomas Plevayk: *Telecommunications Network Management Technologies and Implementations*, Eastern Economy Edition IEEE Press, New Delhi, 1997.
6. Lakshmi G. Raman: *Fundamentals of Telecommunication Network Management*, Eastern Economy Edition IEEE Press, New Delhi, 1999
7. Menezes, A. J., Van Oorschot, P. C., Vanstone, S. A.: "*Handbook of applied cryptography*", Boca Ratón [etc.]: CRC Press, 1997. ISBN 0-8493-8523-7.
8. Stallings, W.: "*Cryptography and network security: principles and practice*". 4th ed. Upper Saddle River: Prentice Hall, 5th edition,2010. ISBN 0-13-187316-4.

Structure of the question paper:

There will be three questions from each module out of which two questions are to be answered by the students. It shall have 60% problem and 40% theory.

TTE 3008 RADIO FREQUENCY SYSTEM DESIGN

Structure of the Course

Lecture	: 3 hrs/ Week	Credits : 3
Internal Continuous Assessment	: 40 Marks	
End Semester Examination	: 60 Marks	

Course objectives

- To familiarize how to use Smith chart for impedance matching.
- To get an overview of two-port networks
- To provide an overview of RF filter design.
- To familiarize high frequency equivalent circuits of various diodes.
- To get an overview about the microwave oscillators.

Learning outcomes

- Design transmission lines with impedance matching.
- Design various RF filters.
- Design BJT and MESFET amplifiers.
- Should be able to design microwave oscillators.

Module I

Review of transmission lines-Binomial and Chebyshev transformer. Return loss and Insertion loss. Smith chart -Impedance matching using smith chart. ABCD parameters of simple Two Port Networks- Impedance Element, T networks, Transmission line section (analysis not required). Scattering parameters – Chain scattering matrix, Signal flow analysis using S parameters.

RF Filter Design- First order low pass, high pass and band pass filter circuits. Frequency transformation and Impedance Transformation. Higher order filter design concepts.

Module II

Review of BJT and MESFET. V-I Characteristics and High Frequency equivalent circuits. High Frequency equivalent circuits of Tunnel Diode, Gunn Diode, Varactor Diode. PIN Diode as an attenuator, Computation of transducer loss.

Design of simple matching and biasing networks. Power relations for RF transistor and MESFET Amplifiers, Stabilization methods. Simple BJT and MESFET Amplifier Design Examples.

Module III

Microwave Oscillators –High frequency Oscillator configuration, Design of MESFET based Oscillator, Dielectric resonator Oscillator, Gunn Oscillator, YIG Oscillator. Mixers-Design of simple RF Mixer Circuit based on BJT and MESFET.

References:

1. Reinhold Ludwig, Pavel Bretchko: "*RF Circuit Design-Theory and Application* ", Pearson Education, New Delhi, 2000.
2. Matthew M Radmanesh, "*Radio Frequency and Microwave Electronics*", Pearson Education, Asia 2006.
3. Collins, “Foundation for Microwave Engineering”, 2nd edition. Mc Graw Hill,Inc, 1992.
4. David M Pozar,”Microwave Engineering” 3rd edition. Wiley, 2009.

Structure of the question paper:

There will be three questions from each module out of which two questions are to be answered by the students. It shall have 60% problem and 40% theory.

TTC 4101 **THESIS**

Structure of the Course

Thesis	: 21 hrs/week	Credits: 12
Internal Continuous Assessment	: 300 Marks	
End Semester Examination	: 300 Marks	

The student has to continue the thesis work done in second and third semesters. There would be an interim presentation at the first half of the semester to evaluate the progress of the work and at the end of the semester there would be a pre-Submission seminar before the Evaluation committee for assessing the quality and quantum of work. This would be the qualifying exercise for the students for getting approval from the Department Committee for the submission of Thesis. At least once technical paper is to be prepared for possible publication in Journals/Conferences. The final evaluation of the Thesis would be conducted by the board of examiners constituted by the University including the guide and the external examiner.

Distribution of marks

Internal evaluation of the Thesis work by the Guide : 150 Marks

Internal evaluation of the Thesis by the Evaluation Committee : 150 Marks

Final evaluation of the Thesis Work by the Internal and External Examiners:

[Evaluation of Thesis: 200 marks *+ Viva Voce: 100 marks (**5% of the marks is ear marked for publication in Journal/Conference*)] TOTAL – 300 Marks