COMMUNICATION SYSTEMS

M.Tech. Programme

Electronics and Communication - Communication Systems

Curriculum and Scheme of Examinations

SEMESTER I

Code No.	Name of the Subject	Credits	Hours/ Week	Exam Duration	Marks			Remarks
					Continuous Assessment	University Exam	Total	
TCM1001	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
TSC 1001	Random Processes and Applications	3	3	3	40	60	100	Do
TMC 1002	Advanced Digital Communication	3	3	3	40	60	100	Do
TCC 1004	Advanced Optical Communication Systems	3	3	3	40	60	100	Do
TCC 1005	Communication Networks	3	3	3	40	60	100	Do
TCC 1006	Advanced Digital signal Processing	3	3	3	40	60	100	Do
TCC 1101	Advanced Communication Lab I	1	2	-	100	-	100	No End Semester Examination
TCC 1103	Seminar	2	2	-	100	-	100	Do
	TOTAL	21	22					7 Hours of Departmental Assistance work

SEMESTER II

Code No.	Name of the Subject	Credits	Hours/ Week	Exam Duration	Marks			Remarks
					Continuous Assessment	University Exam	Total	
TCC 001	Wireless Communication	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
TCC2000	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 Institution
TCC 2101	Thesis Preliminary part I	2	2	-	100	-	100	No End Semester Examination
TCC 2102	Advanced Communication Lab II	1	2	-	100	-	100	Do
TCC 2103	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 COMMUNICATION SYSTEMS FOR SEMESTER II

List of Stream Electives

Stream elective I

TCE 2001 R F System Design
TCE 2002 Theory of Error control coding
TCE 2003 Secure Communication
TCE2004 Wavelets theory and Construction

Stream elective II

TCE 2005 Advanced Antenna Theory and Design
TCE 2006 Information Theory
TCE 2007 Optical Networks and Photonic switching.
TCE 2008 Multimedia Compression Techniques

List of Department Electives
TCD 2001 Optimization Techniques
TCD 2002 Electromagnetic Interference and Compatibility
TCD 2003 High Speed Digital Systems
TCD 2004 Embedded System Design

SEMESTER III

Code No.	Name of the Subject	Credits	Hours/ Week	Exam Duration	Marks			Remarks
					Continuous Assessment	University 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	3	40	60	100	Do
TCC 3101	Thesis – Preliminary Part 2	5	14	-	200	-	200	No End Semester Examinations
	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 ELECTIVES OFFERED IN COMMUNICATION SYSTEMS FOR SEMESTER III

List of Stream Electives

Stream Elective III

TCE 3001 Multicarrier and Spread Spectrum Communication
TCE 3002 RF Integrated Circuit Design
TCE 3003 Opportunistic Communication and Cognitive Radio
TCE 3004 MIMO Communication Systems

Stream Elective IV

TCE 3005 Modeling and Simulation of Communication System
TCE 3006 Wireless Systems and Standards
TCE 3007 Digital Microwave Communication
TCE 3008 Ad-hoc Networks

SEMESTER IV

Code No	Subject Name	Credits	Hrs/week	Marks					Remarks
				Continuous Assessment		University Exam		Total	
				Guide	Evaluation Committee	Thesis Eva.	Viva Voce		
TCC 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

TCM 1001 LINEAR ALGEBRA

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

Course Learning Objectives:
- To provide an overview of algebraic structures
- To have an idea of different spaces
- To understand the concept of lebesgue measure

Course Outcomes:
- Better appreciation on the concepts of spaces
- Should be able to identify the different spaces
- Should know about the importance of lebesgue integral

Module I
Algebraic structures : Groups, Subgroups, Lagrange's theorem, Rings, Integral domain, Fields and Finite Fields, Vectors Spaces, Subspaces, Basis and dimensions, Normed Spaced, L^p spaces, Linear operator on normed linear spaces, Linear functional, Inner product spaces.

Module II
Hilbert spaces, Orthogonal complements and direct sum, Orthogonal projection, Orthonormal sets and sequences, Total orthonormal sets and Hilbert dimension, Separable Hilbert spaces, Representation of Functional on Hilbert spaces, Riesz's theorem (Functional on Hilbert spaces), Spectral theory in finite dimensional normed spaces.

Module III
Metric spaces, Examples, Open sets, closed sets, Neighborhood, Convergence, Cauchy sequence, Completeness.
Lebesgue measure: Outer measure, Measurable sets, Lebesgue measure, measurable functions, Limit theorem, Lebesgue integral, Riemann integral, integral of a non negative function, Fatou's lemma and monotone convergence theorem.

References:

1. Erwin Kreizig, Introductory Functional analysis with applications, John Wiley and sons, 1989
2. H.L Royden, Real analysis, Third Edition, PHI, 1988
3. C.L.Liu, Elements of Discrete Mathematics, Second Edition, Tata McGraw-Hill, 1977
4. I.N Herstien, Topics in algebra, Second Edition, John Wiley and sons, 2006
5. L.Debnath and P.Mikusinsiki, Introduction to Hilbert spaces with applications, 3/e, Academic 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% problems 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 variables
- 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 Band limited 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. UnnikrishnaPillai. 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% problems and 20% 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-nonselective 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 Open Courseware, Electrical Engineering and Computer Science,Principles of Digital communication II, Spring 2006.

6. J.Viterbi, "CDMA- Principles of Spread Spectrum", Addison Wesley, 1995.
6. Simon Haykin, "Digital Communication, 4th Edition.
7. 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 % problems and 40% theory.

TCC 1004 ADVANCED OPTICAL COMMUNICATION SYSTEMS

Structure of the course:
Lecture: 3 Hrs./ Week Credits: 3
Internal Continuous Assessment: 40 Marks
End Semester Examination : 60 Marks

Course Learning Objectives:

- To provide an overview of the various components used in a fiber optical communication system
- To give an idea about WDM system and components
- To study coherent light wave systems and components

Course Outcomes:

- Understand the functionality of each of the components that comprise a fiber-optic communication system: transmitter, fiber, amplifier, and receiver.
- Understand how semiconductor lasers work, and differentiate between direct modulation and external electro-optic modulation.
- Understand basic optical amplifier operation and its effect on signal power and noise in the system.
- Apply concepts listed above to the design of a basic communication link.

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 fluoride glass fibers, Erbium doped fiber amplifiers, Semiconductor Amplifiers, Semiconductor Optical Amplifiers,types, Raman Amplifiers, System Applications

Module II

Light wave Systems: System Architecture, Design guidelines, Long haul systems, computer aided design. Dispersion Managements: Need for Dispersion Management, Pre-compensation Schemes, Post-compensation schemes, dispersion compensating fibers, Optical filters, fiber Bragg gratings, Long Haul Light wave Systems, High Capacity Systems

Module III

Multichannel Systems: WDM Light wave Systems, WMD Components, System Performance issues , Time-Division Multiplexing, Subcarrier Multiplexing, Soliton Systems: Soliton-Based Communications, Los-Managed Solitons, Dispersion-Managed Soliton, Impact of Amplifier Noise.Coherent Light wave Systems: Modulation Format, Demodulation schemes, Bit-Error Rate, Sensitivity Degradation, system Performance

References:

1. Govind.PAgarwal , Fiber-Optic communication Systems, Wiley India, 2009.
2. RajappaPappannareddy, Introduction to Light wave Communication System, Arctech House, 2009
3. B. E. A. Saleh, M. C. Teich, Fundamentals of photonics, Wiley Inter science, 1991.
4. J. Wilson & J. F. B. Hawkes, Optoelectronics: An introduction, 2nd ed., Prentice Hall, 1998
5. RajiRamaswami, 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 60% problems and 40% theory.

TCC 1005 COMMUNICATION NETWORKS

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

Course Learning Objectives:
- To gain an understanding of the fundamentals of data communications networks
- To give an idea about the different queuing models used in data networks
- To study the different protocol stacks (OSI and TCP/IP) and to understand the functions and protocols within a layer
- To provide an overview of QoS issues in Internet

Course Outcomes:
- Understand layering in computer networks
- Understand the protocols, architectures and implementation issues
- Appreciate the use of queuing models for analyzing data networks

Module I

Traffic measurements, arrival distribution, Poison process, Queuing model for datagram networks, holding/ service time distribution, Little's Theorem, Erlang B formula, Erlang C formula, M/M/1 queuing system, M/M/m/m queuing models, M/G/1 queue – mean value analysis, time reversibility, closed queuing networks.

Module II

Protocol Layers and their service model, Application Layer – The web and HTTP, Telnet, FTP, e-mail, DNS, Content distribution, Transport Layer – UDP, TCP, Flow control, Congestion control – TCP Tahoe, TCP Reno, Fairness, TCP delay modeling, Network Layer – link state routing algorithm, Dijkstra's algorithm, IPv4 addressing, ICMP, DHCP, Network Address translator (NAT), IPv6, multicast routing.

Module III

Link Layer – multiple access protocol, LAN address and ARP, Ethernet, CSMA/CD, CSMA/CA, QoS issues in networks, queuing disciplines – weighted fair queuing, random early detection, Protocols for QoS support, resource reservation – RSVP, MPLS.

References:

1. James. F. Kurose and Keith. W. Ross, "Computer Networks: A top-down approach featuring the Internet", Addison Wesley publications, 3/e, 2004.
2. D. Bertsekas and R. Gallager, "Data Networks", Prentice Hall of India, 2/e, 2000.
3. Anurag Kumar, D. Manjunath, and Joy Kuri, "Communication Networking: An Analytical Approach", Morgan Kaufman Publications, India, 2004.
4. L. L. Peterson & B. S. Davie, "Computer Networks: A System Approach", Morgan Kaufman publishers, 4/e, 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% problems and 40% theory.

TCC 1006 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 Learning Objectives:

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

Course Outcomes:

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

Module I

Multidimensional Discrete signals and Multidimensional systems:Frequency domain characterization of multidimensional signals and systems, sampling two dimensional signals, processing continuous signals with discrete systems, Discrete Fourier analysis of multidimensional signals:Discrete Fourier series representation of rectangular periodic sequences, Multidimensional DFT, definition an properties, Calculation of DFT, Vector radix FFT, Discrete Fourier transforms for general periodically sampled signals, relationship between M dimensional and one dimensional DFTs.

Module II

Multi-rate Signal processing, Basic Sampling alteration schemes:Time-Domain Representation of Down-Sampling and Up-Sampling, Frequency-Domain Characterization of Down-Sampling and Up-Sampling, Decimation and Interpolation-Identities, Cascading, Sampling-Rate Alteration Devices, Poly-phase Decomposition, Multistage Systems, Filters in Multi-rate Systems:Spectral Characteristics of Decimators and Interpolators, Filter Specifications forDecimators and Interpolators, Computation of Aliasing Characteristics, Sampling Rate Alteration of Band pass Signals, FIR and IIR Filters for Sampling Rate Conversion**,** Direct Implementation Structures for FIR and IIR Decimators and Interpolators

Module III

Lth-band FIR digital filters,Ith-band linear-phase FIR filters: definitions and properties, poly-phase implementation of FIRIth-band filters, separable linear-phase Ith-band FIR filters, minimum-phase and maximum-phase transfer functions, half band FIR filters, complementary FIR filter pairs,definitions of complementary digital filter pairs, constructing high pass FIR filters, analysis and synthesis filter pairs, FIR complementary filter pairs

References:

1. Multidimensional Digital Signal Processing - Dan E Dudgeon and R M Mersereau, Prentice Hall, 1995
2. Two dimensional signal and Image Processing- J S Lim, Prentice Hall, 1990
3. Multi-rate filtering for Digital Signal processing- MATLAB applications, LjiljanaMilic, Information Science References:, Hershey- New York, 2009
4. Multi-rate systems and filter banks. P.P. Vaidyanathan, Prentice Hall of India, 1993.
5. Multi-rate Digital Signal Processing, R.E. Crochiere. L. R Prentice Hall. Inc.1983

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% problems and 40% theory.

TCC 1101 ADVANCED COMMUNICATION LAB I

Structure of the course:

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

All the students are expected to do laboratory experiments based on a minimum three courses that they have undergone in that semester. The PG course coordinator, in consultation with the faculty who are offering the various subjects, and the faculty in-charge of the PG laboratory should frame syllabus with a minimum of five experiments covering fundamental concepts, design, and implementation of simple applications based on the theory papers the students have undergone during that semesters.

TCC 1103 SEMINAR

Structureof the course:
Duration : 2 hrs/ Week Credits : 2
Continuous Assessment : 100 Marks

The student is expected to present a seminar in one of the current topics in Communication systems. 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

TCC 2001 WIRELESS COMMUNICATION

Structure of the course:
Lecture: 3 Hrs. / Week Credits: 3
Internal Continuous Assessment: 40 Marks
End Semester Examination : 60 Marks

Course Learning Objectives:
- To introduce about various wireless channel models
- To know about the performance of digital modulation over fading channels
- To have idea about multi carrier modulations

Course Outcomes:
- Understand the design issues of time varying impulse response of the channel.
- Understand various diversity techniques
- Understand MIMO channel capacity and multi carrier modulations

Module I

Wireless channel models: Path loss and shadowing- Transmit and receive signal models, free space path loss, ray tracing, Empirical path loss model-HATA model, simplified path loss model, shadow fading combined path loss and shadowing, outage probability under path loss and shadowing.
Stastical multipath channel models: Time varying channel impulse response, Narrow band fading models, Wide band fading model, discrete time models, Space time channel models.

ModuleII

Performance of digital modulation over fading channels:
Fading: Combined outage and average error probability, Diversity: Time diversity, Frequency and Space Diversity, Receiver Diversity performance gains, Combining methods- Selective combining, Maximal ratio combining, Equal gain combining, Performanceof diversity combining method over Rayleigh fading channel. Transmit diversity- Alamouti scheme.

ModuleIII

MIMO Communication narrow and MIMO model Parallel decomposition of the MIMO channel. MIMO channel capacity- MIMO Diversity gain, Diversity multiplexing trade off, multi carrier modulations: Multi carrier modulation with overlapping subcarrier, mitigation of subcarrier fading , Discrete implementation of multicarrier modulation-Cyclic prefix, OFDM, .

References:

1. Andrea Goldsmith, “ Wireless communication”, Cambridge University press,2006

2. T.S Rappaport, “Wireless communication”; principle and practice PHI, 2006
3. David Tsc and PramodViswanath “Fundamentals of Wireless communication”, Cambridge University press, 2005
4. Hamid Jatakarni, “Space time coding: Theory and practice”, Cambridge University press,2005
5. Vijay Garg ,”Wireless Communication Networking”, Elsevier,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. It shall have 60% problems 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% problems and 40% theory.

TCC2000 RESEARCH METHODOLOGY

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

Course Learning Objectives:

- 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

Course 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.

ModuleII

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.

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.

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,1996
4. Donald Cooper, “Business Research Methods”, Tata McGraw Hill, New Delhi, 2001
5. Leedy P D, "Practical Research: Planning and Design", MacMillan Publishing Co,1995
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. It shall have 60% problems and 40% theory.

TCC 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

TCC 2102 ADVANCED COMMUNICATION LAB II

Structure of the course:
Practical: 2 Hrs. / Week   Credits: 1
Internal Continuous Assessment: 100 Marks

All the students are expected to do laboratory experiments based on a minimum three courses that they have undergone in that semester. The PG course coordinator, in consultation with the faculty who are offering the various subjects, and the faculty in-charge of the PG laboratory should frame syllabus with a minimum of five experiments covering fundamental concepts, design, and implementation of simple applications based on the theory papers the students have undergone during that semesters.

TCC2103 SEMINAR

Structure of the course:
Presentation: 2 Hrs. / Week Credits: 2
Internal Continuous Assessment: 100 Marks

The student is expected to present a seminar in one of the current topics inCommunication systems. 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

TCE 2001 R F SYSTEM DESIGN

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

Course Learning 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.

Course Outcomes:

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

ModuleI

Transmission Line Theory Review of Transmission Line Theory: Lumped Element Model, Field Analysis of Transmission Lines, Terminated Lossless Lines, SWR, and Impedance Mismatches. Planar Transmission-Lines: Strip-line, Micro-strip, Coplanar-Line. Smith Chart: Reflection Coefficient, Load Impedance, Impedance Transformation, Admittance Transformation, Parallel and Series Connection. Revision of S-Parameters. RF Filter Design Overview; Basic Resonator and Filter Configuration, Special Filter Realizations, Filter Implementations, Coupled Filter.

Module II

Impedance Matching Networks Impedance Matching using Discrete Components, Micro-strip line Matching Networks, Single Stub Matching Network, Double Stub Matching Network,Quarter-Wave Transformers, Multi-Section and Tapered Transformers.

Module III

RF Amplifiers, Oscillators, Mixers and their Characteristics, Amplifier PowerRelations, Stability Considerations, Constant Gain Circles, Noise Figure Circles, Constant VSWR Circles, Low Noise Circuits; Broadband, High Power and Multistage Amplifiers. Basic Oscillator Model, High Frequency Oscillator Configurations, Basic Characteristics of Mixers.

References:

1. Reinhold Ludwig & Powel Bretchko, “RF Circuit Design – Theory and Applications”, IEd., Pearson Education Ltd., 2004.
2. David M. Pozzar , “ Microwave Engineering”, 3r Ed., Wiley India, 2007.
3. Mathew M. Radmanesh, “Advanced RF & Microwave Circuit Design-The Ultimate Guide to System Design”, Pearson Education Asia, 2009
4. Davis W. Alan, “Radio Frequency Circuit Design”, Wiley India, 2009.
5. Cotter W. Sayre, “Complete Wireless Design”, 2edEd., McGraw-Hill, 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% problems and 40% theory.

TCE 2002 THEORY OF ERROR CONTROL CODING

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

Course Learning Objectives:

- To introduce to various aspects of error controlling and coding techniques for communication.
- To have idea on the different coding techniques.

Course Outcomes:

- Understand the idea of groups, rings, field, and codes.
- Understand the different error codes for communication systems.
- Understand various turbo codes and its applications

Module I

Introduction, Groups- Rings- Fields- Arithmetic of Galois Field-Integer Ring- Polynomial Rings- Polynomials and Euclidean algorithm, primitive elements, Construction and basic properties of Finite Fields- Computations using Galois Field arithmetic- sub fields- Minimal polynomial and conjugates- Vector space- Vector Subspace- Linear independence Block codes- Properties- Minimum Distance- Error detection and correction- Standard Array and Syndrome decoding- Hamming codes- Perfect and Quasi-perfect codes- Extended codes-Hadamardcodes, Hamming Bound ,GibatVarshamov Bound

Module II

Basic theory of Cyclic codes- Generator and Parity check matrices - Cyclic encoders- Error detection & correction- decoding of cyclic codes- Cyclic Hamming codes- Binary Golay codes- BCH codes- Decoding of BCH codes-The Berlekamp- Massey decoding algorithm. Reed Solomon codes- Generalized Reed Solomon codes- MDS codes, Convolutional Codes - Generator matrices and encoding- state, tree and trellis diagram- Transfer function -- Maximum Likelihood decoding Hard versus Soft decisiondecoding- The Viterbi Algorithm- Free distance-Catastrophic encoders. Soft Decision and Iterative Decoding Soft decision, Viterbi algorithm- Two way APP decoding-

Module III

Low density parity check codes- Turbo codes- Turbo decoding,Turbo Coding: Turbo Encoder, Interleaving, High rate turbo codes, Performance upper bound on turbo codes, Interleaving performance gain, Effective free distance, Turbo codes performance evaluation, Turbo code design, Applications of turbo codes

References:

1.R.E. Blahut, “Theory and Practice of Error Control Coding”, MGH 1983.
2.W.C. Huffman and Vera Pless, “Fundamentals of Error correcting codes”, Cambridge University Press,2003.
3.Shu Lin and Daniel. J. Costello Jr., “Error Control Coding: Fundamentals and applications”, Prentice Hall Inc, 1983.

4.Sklar, ‘ Digital Communication’, Pearson Education, 2009
5.BrankaVucetic, Jinhong Yuan,Turbo Codes: Principles and Applications, The Springer International Series in Engineering and Computer Science, 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 60% problems and 40% theory.

TCE 2003 SECURE COMMUNICATION

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

Course Learning Objectives:

- To introduce to various aspects of Communication over the Channels, for providing security.
- To have idea about the security issues for communication.

Course Outcomes:

- Understand the design issues of secure communication for encryption techniques.
- Understand the design issues in various security problems and its encryptions.
- Understand various secure communications for cryptography.

Module I

Introduction,Rings and fields - Homomorphism- Euclidean domains - Principal Ideal Domains - Unique Factorization Domains -- Field extensions- Splitting fields - Divisibility- Euler theorem - Chinese Remainder Theorem – Primality, Encryption Techniques,Basic encryption techniques - Concept of cryptanalysis - Shannon's theory – Perfect secrecy - Block ciphers - Cryptographic algorithms - Features of DES - Stream ciphers

Module II

Pseudo random sequence generators – linear complexity - Non-linear combination of LFSRs - Boolean functions, Cryptography,Private key and Public key cryptosystems - One way functions - Discrete log problem – Factorization problem - RSA encryption - Diffie Hellmann key exchange – Message authentication and hash functions

Module III

Digital signatures - Secret sharing - features of visual cryptography - other applications of cryptography, Elliptic Curve Cryptography,Elliptic curves - Basic theory - Weirstrass equation - Group law - Point at Infinity –Elliptic curves over finite fields - Discrete logarithm problem on EC - Elliptic curve cryptography - Diffie Hellmann key exchange over EC - Elgamal encryption over EC – ECDSA

References:

1. Douglas A. Stinson, “Cryptography, Theory and Practice”, 2nd Edition, Chapman & Hall, CRC Press Company, Washington, 2005.
2. William Stallings, “Cryptography and Network Security”, 4th Edition, Dorling Kindersley (India) Pvt. Ltd., 2009.
3. Lawrence C. Washington, “ Elliptic Curves: Theory and Cryptography”, Chapman & Hall, CRC Press Company, Washington, 2008.
4. David S. Dummit& Richard M Foote, “ Abstract Algebra”, 2nd Edition, Wiley India Pvt. Ltd., 2008.
5. EvangelosKranakis, “ Primality and Cryptography”, John Wiley & Sons, 1991.

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% problems and 40% theory.

TCE 2004 WAVELETS THEORY AND CONSTRUCTION

Structure of the course:
Lecture: 3 hrs. / Week   Credits: 3
Internal Continuous Assessment: 40 Marks
End Semester Examination   : 60 Marks

Course Learning Objectives:

- To introduce various aspects of wavelets for communication.
- To have idea on the advances in wavelet design.
- To provide an overview of time frequency analysis and hence the significance of wavelet transform

Course Outcomes:

- Understand the fundamentals of spaces, frames and wavelet.
- Understand the design issues in scaling functions, wavelets and filtering schemes.
- Account for the wavelet transform principles, taking into consideration, time-frequency analysis and multi resolution analysis.
- Understand various designs of basis and about the wavelet packets.

Module I

Mathematical preliminaries, Spaces: Linear spaces, Metric spaces, Euclidian spaces and Hilbert spaces. Fourier Theory: Generalized Fourier theory, Fourier transform, Short time Fourier transform, Time-frequency analysis, Theory of frames, Wavelets: The basic functions, Specifications, Admissibility condition, Continuous wavelet transform (CWT), Discrete wavelet transform (DWT).

Module II

The multi-resolution analysis (MRA) of L^2 (R), The MRA axioms, Construction of an MRA from scaling functions - The dilation equation and the wavelet equation, Compactly supported orthonormal wavelet bases - Necessary and sufficient conditions for orthonormality of wavelets, Smoothness and approximation order - Analysis in Soboleve space.Construction of wavelets, Splines, Cardinal B-spline MRA, Sub-band filtering schemes, compactly supported orthonormal wavelet bases.

Module III

Wavelet transforms, Wavelet decomposition and reconstruction of functions in L2 (R). Fast wavelet transforms algorithms - Relation to filter banks.
Construction of wavelets, Bi-orthogonality, and bi-orthogonal basis, Bi-orthogonal system of wavelets - construction, The Lifting scheme.
Wavelet packets, Representation of functions, Basis selection, Criteria for wavelet selection with examples.

References:

1.M. Vetterli, J. Kovacevic, “Wavelets and sub-band coding" Prentice Hall Inc, 1995
2.L. Prasad and S. S. Iyengar, “Wavelet analysis with applications to image processing" CRCPress, 1997.
3.J. C. Goswami and A. K. Chan, “Fundamentals of wavelets: Theory, Algorithms

and Applications" Wiley-Interscience Publication, John Wiley & Sons Inc., 1999.
4.R. M. Rao and A. Bopardikar, “Wavelet transforms: Introduction to theory and applications" Addison-Wesley, 1998.
5.P. P. Vaidyanathan, “Multirate systems and filter banks" Prentice Hall P T R, 1993.

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% problems and 40% theory.

TCE 2005 ADVANCED ANTENNA THEORY AND DESIGN

Structure of the course:
Lecture: 3 Hrs. / Week   Credits: 3
Internal Continuous Assessment: 40 Marks
End Semester Examination   : 60 Marks

Course Learning Objectives:

- To provide an overview of the different antennas and its design
- To get an idea on antenna arrays
- To understand various antenna systems and implementation issues

Course Outcomes:

- Design antennas for various applications
- Have a better appreciation on the concept of antenna arrays
- Assess the various antenna systems

Module I

Planar Antennas: Micro-strip rectangular and circular patch antennas – Analysis and design, feeding methods.Circularly polarized micro-strip antenna, Broadbanding techniques, Printed slot antennas.Array Theory – Linear array, Broad side and end fire arrays, Self and mutual impedance between linear elements, grating lobe considerations.

Module II

Planar array: array factor, beam width, directivity, example of micro-strip patch arrays and feed networks Electronic scanning. Broadband antennas – folded dipole, Sleev dipole, Bi-conical antenna, analysis, characteristics, matching techniques. Yagi array of linear elements, and printed version, Log periodic dipole array.

Module III

Frequency impedance antennas, Planar spiral antennas.Aperture antennas – Field equivalence principle, Babinet's principles, and Rectangular waveguide horn antenna, parabolic reflector antenna.Antennas for mobile communication systems: Handset antennas. Base station antenna.Adaptive antenna algorithms, MIMO antenna systems, Performance and implementation issues

References:

1. A.Balanis, Antenna theory and Design II edition, John Wiley& Sons, 1997
2. J.D.Kraus, Antennas, McGraw – Hill, 1988.
3. R.A.Sainati, CAD of Microstrip Antennas for Wireless Applications, Artech House, 1996
4. S.Chandran, Adaptive antenna arrays, Springer, 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% problems and 40% theory.

TCE2006 INFORMATION THEORY

Structure of the course:
Lecture: 3 hrs. / Week Credits: 3
Internal Continuous Assessment: 40 Marks
End Semester Examination : 60 Marks

Course Learning Objectives:

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

Course Outcomes:

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

Module I

Entropy and Loss less Source coding , 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)- Weak AEP, Source Coding theorem Efficient Source Coding, Shannon-McMillan-Bramman Theorem , Strong AEP , High probability sets and typical sets, Strong typicality versus Weak typicality, Joint typicality- 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.Continuous Sources and Channels

Module III

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.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.Thomas M. Cover and Joy A.Thomas, "Elements of Information Theory", John Wiley & Sons 2006.
2.RobertGallager, "Information Theory and Reliable Communication", John Wiley

&Sons, 1968
3.R. J. McEliece, “The theory of information & coding”, Addison Wesley Publishing Co., 1977.
4.T. Bergu, “Rate Distortion Theory, A Mathematical Basis for DataCompression” PH Inc. 1971.
5.TriT.Ha “Theory and Design of Digital Communication systems”, Cambridge University Press, 2011

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% problems and 40% theory.

TCE2007 OPTICAL NETWORKS AND PHOTONIC SWITCHING

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

Course Learning Objectives:
- To provide students with the knowledge of optical networks
- To get an idea about the client layers of the optical layer
- To get an idea of various optical components
- To familiarize with the optical layer protection schemes

Course Outcomes:
- Understand the importance of optical networks
- Should be able to design WDM networks
- Understand the optical layer protection schemes

Module I

Introduction ton Optical Networks: The Optical Layer, Transparency and All-Optical Networks.Optical Packet Switching, Transmission Basics, Propagation of Signals in Optical Fiber: Nonlinear EffectsComponents: Isolators and Circulators, Multiplexers and Filters, Optical Amplifiers, Transmitters, Detectors, Switches, Wavelength Convertor

Module II

Transmission System Engineering: System Model. Networks; Client Layers of the Optical Layer: SONET / SDH, ATM, IP, Storage Area Networks.WDM Network Elements ,Optical Components, WDM Network Design, LTD and RWA Problems, Dimensioning Wavelength Rooting Networks, Statistical Dimensioning Models, Maximum Load Dimensioning Model

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, Synchronization, Header Processing, Buffering, Burst switchingDeployment considerations, Designing transmission Layer.

References:

1. Ramaswami, Sivarajan, Optical Networks, Elsevier, 2009
2.E.A.Saleh, M.C.Teich, Fundamentals of photonics, Wiley Interscience, 1991.
3.J.Singh, Optoelectronics: An introduction to materials and devices, McGraw Hill, 1996.
4J.Wilson and J.F.B.Hawkes, Optoelectronics: an introduction, Prentice Hall India, 1998
5 Uyless Black Optical Networks, Pearson, 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% problems and 40% theory.

TCE2008 MULTIMEDIA COMPRESSION TECHNIQUES

Structure of the course:
Lecture: 3 hrs./ Week Credits: 3
Internal Continuous Assessment: 40 Marks
End Semester Examination : 60 Marks

Course Learning Objectives:

- To understand various text compression techniques
- To familiarize with audio compression techniques
- To equip student to work with various image compression algorithms

Course Outcomes:

- Understand the importance of data, audio and image compression
- Implement various audio and image compression algorithms

Module I

Introduction:Brief history of data compression applications, Overview of information theory, redundancy. Human audio, visual systems, Taxonomy of compression techniques, Source coding, source models, scalar quantization theory, rate distribution theory, vector quantization, structure of quantizer's, Evaluation techniques-error analysis and methodologies, Text compression:Compact techniques-Huffman coding-arithmetic coding-Shannon-Fano coding and dictionary techniques-LZW family algorithms. Entropy measures of performance-Quality measures.

Module II

Audio compression: Audio compression techniques-frequency domain and filtering-basic sub-band coding-application to speech coding-G.722-application to audio coding-MPEG audio, progressive encoding for audio—silence compression, speech compression techniques-Vocoders.

Module III

Image compression:Predictive techniques-PCM, DPCM, DM. Contour based compression-quad trees, EPIC, SPIHT, Transform coding, JPEG, JPEG-2000, JBIG, Video compression:Video signal representation, Video compression techniques-MPEG, Motion estimation techniques-H.261. Overview of Wavelet based compression and DVI technology, Motion video compression, PLV performance, DVI real time compression

References:

1. SayoodKhaleed, Introduction to data compression, Morgan Kauffman, London,1995
2. Mark Nelson, Dta compression book, BPB Publishers, New Delhi, 1998
3. Watkinson,J. Compression in video and audio, Focal press,London.1995
4. Jan Vozer, Video compression for multimedia, AP profes, NewYork,1995.

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% problems and 40% theory.

TCD2001 OPTIMIZATION TECHNIQUES

Structure of the course:
Lecture: 3 hrs. / Week Credits : 3
Internal Continuous Assessment: 40 Marks
End Semester Examination : 60 Marks

Course Learning Objectives:
- To introduce to methods of unconstrained optimization
- To provides the student with a collection of optimization modeling and solution tools that can be useful in a variety of industries and functions

Course Outcomes:
- Translate a verbal or graphical description of a decision problem into a valid optimization model, by identifying variables, constraints, and an objective function.
- Interpret the meaning and assess the validity of a particular optimization model.
- Find solutions to optimization problems using the most appropriate algorithm.
- Perform sensitivity analysis by tracing the effects of varying a parameter on the optimal decision variables and the objective function.

Module I

Unconstrained optimization: - Necessary and sufficient conditions for local minima, one dimensional search methods, gradient methods - steepest descent, Inverse Hessian, Newton's method, conjugate direction method, conjugate gradient algorithm, quasi Newton methodsLinear Programming : - Convex polyhedra, standard form of linear programming

Module II

Basic solutions, Simplex algorithm, Matrix form of the simplex algorithm, Duality, non-simplexmethods:Khachiyan method, Karmarkar's method.
Nonlinear Constrained Optimization: - equality constraints – Lagrange multipliers, inequality constraints – Kuhn-Tucker conditions, Convex optimization, Geometric programming, Projected gradient methods, Penalty methods

Module III

Introduction to graph theory and combinatorial optimization:Routing-traveling salesman; Assignment – satisfiabilty, constraint saisfiabilty, graph coloring; Subsets-set covering, partitioning; Scheduling; Shortest path and Critical path algorithms

References:

1. Edwin K. P. Chong, Stanislaw H. Zak**, An** Introduction to Optimization, 2nd Ed,Wiley India,2010.
2. Stephen Boyd, LievenVandenberghe, Convex Optimization, CUP, 2004.
3. R. Fletcher, Practical methods of Optimization, Wiley, 2000
4. Jonathan L Grosss, Jay Yellen,Graph theory and its Applications. Chapman and Hall,2006.

5. Alan Tucker, Applied Combinatorics, John Wiley and Sons, 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% problems and 40% theory.

TCD2002 ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY

Structure of the course:
Lecture: 3 hrs. / Week Credits: 3
Internal Continuous Assessment: 40 Marks
End Semester Examination : 60 Marks

Course Learning Objectives:

- To provide an overview of electromagnetic interference and compatibility.
- To learn the different noise coupling mechanisms
- To have an idea about EMI standards and specification.
- To learn about the different EMI control techniques
- To familiarize with EMC design of PCB

Course Outcomes:

- Should be able to assess the effects of electromagnetic interference
- Understand the EMI standards and specification
- Should be able to do EMC design PCB
- Understand circuit board layout and mechanical packaging considerations for EMI/EMC complaint designs

Module 1

EMI Environment – Sources of EMI, conducted and radiated EMI, Transient EMI, EMI-EMC definitions, units, parameters. EMI coupling principles-Conducted, Radiated and Transient Coupling, Common Impedance Ground Coupling, Radiated Common Mode and Ground Loop Coupling, Radiated Differential Mode Coupling, Near field cable to cable coupling. Power mains and power supply coupling.

Module II

EMI specifications: standards, limits - units of specifications, Civilian and Military standards. EMI measurements – EMI test instruments, systems, EMI test, EMI shielded chamber, Open area test site, TEM cell Antennas, conductors, sensors, injectors, couplers, Military test methods and procedures, calibration procedure

Module III

EMI control techniques – shielding, filtering, grounding, bonding, transient suppressors, Isolation transformer, Cable routing, signal control, component selection and mounting. EMC design of PCB – PCB traces cross talk, impedance control, power distribution decoupling, zoning, motherboard designs.

References:

1.Bernhard Keiser, Principles of Electromagnetic Compatibility, ArTech house, 3rd Edn, 2001.
2.Henry W. Ott, Noise reduction Techniques in Electronics Systems, John Wiley & Sons, 1988.
3. Paul, C.R., Introduction to Electromagnetic Compatibility, Wiley Interscience.2010

4. Kodali, V.P., Engineering Electromagnetic Compatibility: Principles, Measurement and Technologies,IEEE Press.2001
5. David A Weston, Electromagnetic Compatibility, Marcel Decar, 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% problems and 40% theory.

TCD2003 HIGH SPEED DIGITAL SYSTEMS

Structure of the course:
Lecture: 3 hrs. / Week Credits: 3
Internal Continuous Assessment: 40 Marks
End Semester Examination : 60 Marks

Course Learning Objectives:

- To acquaint the students with the problems associated with high-speed digital devices
- To provide an overview of power distribution and noise
- To study about timing and synchronization

Course Outcomes:

- Understand the design issues in high speed digital devices
- Consider the different noise sources while designing a power distribution network
- Appreciate the significance of timing and synchronization

Module I

Introduction to high speed digital design.Frequency, time and distance - Capacitance and inductance effects - High seed properties of logic gates - Speed and power -Modeling of wires -Geometry and electrical properties of wires - Electrical models of wires - transmission lines - lossless LC transmission lines - lossy LRC transmission lines - special transmission lines

Module II

Power distribution and noise, Power supply network - local power regulation - IR drops - area bonding - on chip bypass capacitors - symbiotic bypass capacitors - power supply isolation - Noise sources in digital system - power supply noise - cross talk – inter-symbol interference Signaling convention and circuits, Signaling modes for transmission lines -signaling over lumped transmission media - signaling over RC interconnect

Module III

Driving lossy LC lines - simultaneous bi-directional signaling - terminations - transmitter and receiver circuits Timing convention and synchronization, Timing fundamentals - timing properties of clocked storage elements - signals and events - open loop timing level sensitive clocking - pipeline timing - closed loop timing - clock distribution - synchronization failure and meta-stability - PLL and DLL based clock aligners

References:

1. Howard Johnson and Martin Graham, "High Speed Digital Design: A Handbook of BlackMagic”, 3rd Edition, Prentice Hall Modern Semiconductor Design Series' Sub Series: PH Signal Integrity Library, 2006

2. Stephen H. Hall, Garrett W. Hall, and James A. McCall “High-Speed Digital System Design: A Handbook of Interconnect Theory and Design Practices by ", Wiley, 2007

3. Kerry Bernstein, K.M. Carrig, Christopher M. Durham, and Patrick R. Hansen “High Speed CMOS Design Styles”,Springer Wiley 2006

4. Ramesh Harjani “Design of High-Speed Communication Circuits (Selcted Topics inElectronics and Systems)” World Scientific Publishing Company, 2006

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% problems and 40% theory.

TCD 2004 EMBEDDED SYSTEM DESIGN

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

Course Learning Objectives:

- Students will understand current applications, trends and new directions in embedded systems
- The ability to identify the configuration of hardware and software for an embedded system.
- The understanding of embedded systems using modular design and abstraction.
- To familiarize with the different inter process standards

Course Outcomes:

- Understand the basics of an embedded system and its architecture
- Design an embedded system

Module I

Introduction to Embedded system- characteristics of embedded system- categories of embedded system- requirements of embedded systems- challenges and design issues of embedded system- trends in embedded system- system integration- hardware and software partition- applications of embedded system- control system and industrial automation biomedical-data communication system-network information appliances- IVR systems- GPS systems. Software architecture for Embedded Systems: simple round robin architecture- design and implementation of digital multi meter - round robin with interrupt architecture- implementation of communication bridge- function queue scheduling architecture- RTOS architecture.

Module II

Hardware architecture- block schematic of a typical hardware architecture- CPU-memory-I/O Devices- designing with microprocessor/ microcontrollers based ADC/DAC interfacing LED/LCD interfacing. Case studies of embedded processors: 16 bit and 32bit processors – General concepts, DSP Processors and applications.

Module III

Inter process communication: UART - IEEE 1394-IRDA-USB-PCI development tools and their applications. EPROM ERASER-signature Validator- accelerated design for video accelerator. Design methodologies and tools for embedded systems: designing hardware and software components- system analysis and architecture design- system integration- structural and behavioral description smart cards.

References:

1. Wayne wolf, “Computers as components”, Morgan Kaufmann publishers, 2nd Edition, 2008.

2. Jean J.Labrosse, “Embedded system building blocks”, CMP books, 2nd Edition, 1999.
3. Arnold berger, “Embedded system design”, CMP books, 1st Edition, 2001.
4. Narayan and gong, “Specifications and design of embedded systems”, Pearson education, 2nd Edition, 1999.
5. Rajkamal, “Embedded Systems”, Tata McGraHill, 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. It shall have 60% problems and 40% theory.

TCC3101 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

TCE3001 MULTICARRIER AND SPREAD SPECTRUM COMMUNICATION

Structure of the course:
Lecture: 3 Hrs. / Week Credits: 3
Internal Continuous Assessment: 40 Marks
End Semester Examination : 60 Marks

Course Learning Objectives:

- A detailed study on various aspects of fading &spread spectrum communication.
- To have idea on the advances in Multichannel and Multicarrier Systems design.

Course Outcomes:

- Understand the design issues in spread spectrum and multi user communication systems.
- Understand various digital communication receivers, equalization and diversity techniques.

ModuleI

Review of fading channels and modeling. Multi-Carrier Transmission, Orthogonal Frequency Division Multiplexing (OFDM), Applications and Standards, Spread Spectrum Techniques, Spread Spectrum Signals for Digital Communications, Model of a Spread Spectrum Communications System, Direct Sequence Spread spectrum Signals, Rake Receivers, Multi-user Detection, Frequency Hopped Spread Spectrum Signals, Other types of Spread Spectrum Signals, Spread Spectrum in multipath channels, Applications of Spread Spectrum, Multi-Carrier Spread Spectrum, MC-CDMA- Signal Structure, Spreading Techniques, Detection Techniques, Pre-Equalization, Combined Equalization, Soft Channel Decoding, Performance Analysis: MC-DS-CDMA- Signal Structure, Spreading Techniques, Detection Techniques, Performance Analysis

Module II

Multi-Carrier Modulation and Demodulation, Pulse Shaping in OFDM Digital Implementation of OFDM, D/A and A/D Conversion, I/Q Generation; Synchronization Effects of Synchronization ErrorsMaximum Likelihood Parameter estimation, Time Synchronization, Frequency Synchronization, Automatic Gain Control (AGC): Channel Estimation - Two-Dimensional Channel Estimation, One-Dimensional Channel Estimation, Time Domain Channel Estimation, Decision Directed Channel Estimation, Blind and Semi-Blind Channel, Channel Estimation in MC-SS Systems, Channel Estimation in MIMO-OFDM Systems: Channel Coding and Punctured Convolutional Coding, Concatenated Convolutional and Reed

Solomon Coding, Turbo Coding, Low Density Parity Check (LDPC) Codes, OFDM with Code Division Multiplexing:

Module III

Introduction to3GPP Long Term Evolution (LTE) and Wi-MAX , Techniques for Capacity and Flexibility Enhancement, MIMO Overview, BLAST Architecture, Space–Time Coding, Achievable Capacity, Diversity Techniques for Multi-Carrier Transmission-Transmit Diversity, Receive Diversity, Transmit/Receive Diversity Performance Analysis, Space–Frequency Block Codes (SFBC), Spatial Pre-Coding for Multi-Carrier Transmission, Selection Diversity (SD) Equal Gain Transmission (EGT) ,Maximum Ratio Transmission (MRT), Software-Defined Radio, MC-CDMA-Based Software-Defined Radio

References:

1. K. Fazel, S. Kaiser,``Multi-Carrier and Spread Spectrum Systems,” Wiley, 2009.
2. R. L. Peterson, R. Ziemer and D. Borth, “Introduction to Spread Spectrum Communications,” Prentice Hall, 1995.
3. A.J. Viterbi, “CDMA - Principles of Spread Spectrum Communications,” Addison-Wesley, 1997.
4. Cooper and McGillem, “Modern Communications and Spread Spectrum” McGraw- Hill, 1985.
5. J. G. Proakis, “Digital Communications,” McGraw Hill, 4th ed,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% problems and 40% theory.

TCE3002 RF INTEGRATED CIRCUIT DESIGN

Structure of the course:
Lecture: 3 Hrs. / Week Credits: 3
Internal Continuous Assessment: 40 Marks
End Semester Examination : 60 Marks

Course Learning Objectives:

- To introduce the concept of Low noise amplifiers, Active Mixer
- A detailed study on ADC & DAC

Course Outcomes:

- Understand design & working of Low noise amplifiers, Active Mixer.
- Able to design ADC & DAC

Module I

Low Noise Amplifiers in Design Perspective: General philosophy, Matching networks, Wideband LNA Design, Narrow band LNA-Impedance matching, Narrow band LNA-Core amplifier-noise figure, power dissipation, tradeoff between noise figure and power dissipation, gain and other real life design problems

Module II

Active Mixer: Balancing-Unbalanced, single balanced and double balanced mixer, Qualitative Description of Gilbert Mixer, Conversion Gain, low frequency and high frequency , Noise analysis, Passive Mixer:Switching Mixer-unbalanced and balanced types, Distortion in unbalanced mixer, conversion gain in unbalanced mixer, noise in unbalanced switching mixer, Practical unbalanced switching mixer, conversion gain in sampling mixer

Module III

Analog to Digital Converters: ADC used in a receiver, Low Pass Sigma Delta modulator and its implementation-type 1 switched capacitor based integrator, non ideal integrator, 1 bit ADC and DAC, Low pass and band pass sigma delta modulators, Frequency Synthesizer: PLL-based frequency synthesizer, Charge pump, VCO-positive feedback theory

References:

1.Bosco Leung and Charles G.Sodini, "VLSI for Wireless Communication", Pearson Education,2009.
2.BehzadRazavi, "Design of Analog CMOS Integrated Circuits", TMH,2002.
3.BehzadRazavi. "RF Microelectronics", PHI2011.
4. Gonzalez," Microelectronic Transistor Amplifiers-Analysis and Design", PHI 2^{nd} Edition, 1996

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% problems and 40% theory.

TCE3003 OPPORTUNISTIC COMMUNICATION & COGNITIVE RADIO

Structure of the course:
Lecture: 3 hrs. / Week Credits: 3
Internal Continuous Assessment: 40 Marks
End Semester Examination : 60 Marks

Course Learning Objectives:
- To introduce concept of parameter estimation & receiver algorithm
- Detailed study on Cooperative and Cognitive Networks

Course Outcomes:
- To understand the concept of parameter estimation & receiver algorithm
- Understand various Techniques for Cooperative and Cognitive Networks

Module I

Multi-antenna basics: Propagation aspects of MIMO channel modeling,Beamforming techniques, Diversity in wireless systems, Fundamentals of MIMO channel capacity, Multi-antenna capacity. Space-time modulation and coding:Introduction to space-time codes, Perspectives on the diversity-multiplexing trade-off in MIMO systems,Linear pre-coding for MIMO channels, Space-time coding for non-coherent channels, Space-time coding for time- and frequency-selective MIMO channels

Module II

Receiver algorithms and parameter estimation:Array signal processing, optimal subspace techniques for DOA estimation, Blind and semi-blind MIMO channel estimation, MIMO receive algorithms, Space-time turbo coding, Training for MIMO communications.

Module III

Cooperative and Cognitive Networks; The Social Qualities of Pervasive Wireless Networks, Competition and Cooperation in Wireless Multi-Access Networks, Architectures and Protocols for Next Generation Cognitive Networking, Spectrum Awareness, Robust Spectrum Sensing Techniques for Cognitive Radio Networks, Marrying Cooperation and Cognition in Wireless Networks.

References:

1. Opportunistic communication: a system viewFrom Array Processing to MIMO CommunicationsByPramodViswanath, Cambridge University press, 2006.
2. Cognitive Wireless Networks Concepts, Methodologies and Visions Inspiring the Age of Enlightenment of Wireless Communications ByFrank Fitzek (Edited by), Marcos D. Katz (Edited by) Springer-Verlag New York Inc.
3. Opportunistic Communication for Wireless Networks: A Practical Approach by Waqar Ahmad Malik, Lambert publishers,2011.
4. Andreas Heinemann, “Collaboration in opportunistic network: Rethinking mobile ad-hoc communication”, VDM publishing ,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% problems and 40% theory.

TCE3004 MIMO COMMUNICATION SYSTEM

Structure of the course:
Lecture: 3 hrs. / Week Credits: 3
Internal Continuous Assessment: 40 Marks
End Semester Examination : 60 Marks

Course Learning Objectives:

- To study the need of multiple antenna in wireless communication systems, MIMO Channel models

Course Outcomes:

- To understand the need of multiple antenna in wireless communication systems, MIMO Channel models

Module I

Need for MIMO systems, multiple antennas in wireless communication systems, MIMO Channel models Capacity and Information rates in MIMO channels: Capacity and Information rates in AWGN and fading channels, Capacity of MIMO channels.
Space-Time Block Codes**:** Transmit Diversity with Two Antennas: The Alamouti Scheme Transmission Scheme, Optimal Receiver for the AlamoutiScheme, Performance Analysis of the AlamoutiScheme,Orthogonal Space-Time Block Codes, And Linear Orthogonal Designs. Decoding of Linear Orthogonal Designs Performance Analysis of Space-Time Block Codes, Quasi-Orthogonal Space-Time Block Codes, Linear Dispersion Codes

Module II

MIMO Channel models, Single user MIMO Capacity, Single user capacity metrics, Multi-user capacity metrics, and Transceivertechniques: Linear receivers, MMSE-SIC, V-BLAST, D-BLAST, and Closed loop MIMO, Space time coding, Code book pre-coding.

Module III

Antenna Selection in MIMO system: MIMO System Model, Spatial Multiplexing, SIMO Systems. Antenna Selection: Criteria and Algorithms, Performance with Non-Idealities Antenna Selection with Spatial Correlation.
Suboptimal Multi User MIMO techniques: Suboptimal techniques for Multiple Access Channel, Suboptimal techniques for Broadcast channel, MAC-BC duality for linear transceivers

References:

1. MIMO Communication for Cellular Networks by Howard Huang, Constantinos B. Papadias, SivaramaVenkatesan – Springer,2011
2. Coding for MIMO Communication Systems by Tolga M. Duman, Ali Ghrayeb – Wiley,2007
3. MIMO System Technology for Wireless CommunicationsElectrical Engineering & Applied Signal Processing Series, CRC Press Editor(s):GeorgeTsoulos, University of Peloponnese, Greece

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% problems and 40% theory.

TCE3005 MODELING & SIMULATION OF COMMUNICATION SYSTEM

Structure of the course:
Lecture: 3 hrs. / Week Credits: 3
Internal Continuous Assessment: 40 Marks
End Semester Examination : 60 Marks

Course Learning Objectives:

- To model & simulate various communication networks,estimate their parameters,performance issues
- To study Uniform random number generation

Course Outcomes:

- Able to design various communication networks
- Solve issues related to design to communication networks

Module I

Introduction, Aspects of simulation methodology, Performance Estimation, Simulation sampling frequency, Low pass equivalent simulation models for band pass signals, Multicarrier signals, Non-linear and time-varying systems, Post processing – Basic graphical techniques and estimations

Module II

Uniform random number generation, mapping uniform random variables to an arbitrary pdf, Correlated and Uncorrelated Gaussian random number generation, PN sequence generation, Random signal processing, testing of random number generators.Monte Carlo simulation, Fundamental concepts, Application tocommunication systems, Monte Carlo integration, Semi analytic techniques, Case study: Performance estimation of a wireless system.

Module III

Modeling and simulation of non-linearity's: Types, Memory-less non-linearities, Nonlinearities with memory, Modeling and simulation of Time varying systems : Random process models, Tapped delay line model, Modeling and simulation of waveform channels, Discrete memory-less channel models, Markov model for discrete channels with memory. Efficient simulation techniques, Tail extrapolation, pdf estimators, Importance sampling methods, Case study: Simulation of a Cellular Radio System.

References:

1.William.H.Tranter, K. Sam Shanmugam, Theodore. S. Rappaport, Kurt L. Kosbar, Principles of Communication Systems Simulation, Pearson Education (Singapore)Pvt. Ltd, 2004.
2. M.C. Jeruchim, P.Balaban and K. Sam Shanmugam, Simulation of Communication Systems: Modeling, Methodology and Techniques, Plenum Press, New York, 2001.
3. Averill.M.Law and W. David Kelton, Simulation Modeling and Analysis, McGeaw Hill Inc., 2000.
4. Geoffrey Gorden, System Simulation, Prentice Hall of India, 2ndEdition, 1992.

5. Jerry Banks and John S. Carson, Discrete Event System Simulation, Prentice Hall of India, 1984.

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% problems and 40% theory.

TCE3006 WIRELESS SYSTEMS & STANDARDS

Structure of the course:
Lecture: 3 hrs. / Week Credits: 3
Internal Continuous Assessment: 40 Marks
End Semester Examination : 60 Marks

Course Learning Objectives:

- To study various regulations & standards of wireless systems

Course Outcomes:

- To understand various regulations & standards of wireless systems

Module I

Regulation of wireless: Licensed Frequencies, Unlicensed Frequencies, categorizing wireless services, Broadcast Radio, Two-way Radio Communications, Mobile telephone service, Analog Cellular (First Generation), Digital Cellular and PCS (Second Generation), Wideband Cellular (3rd Generation), Aircraft Telephones, Mobile Satellite, Wireless Office Cordless, land mobile radio, Specialized Mobile Radio (SMR), Enhanced SMR (ESMR) , wireless data, fixed wireless, Wireless Cable, Wireless Local Loop (WLL), remote control, point to point communications links, broadcast radio, wireless local area network (WLAN), wirelesspersonal area network (WPAN), Bluetooth, ZigBee

Module II

Analog Cellular , Digital Mobile Radio , Packet Based Digital Cellular (2.5 Generation) , Wideband Digital Cellular (3rd Generation) , analog systems (1ST GENERATION) , Advanced Mobile Phone Service (AMPS) , Total Access Communication System (TACS) , Nordic Mobile Telephone (NMT) , Narrowband AMPS (NAMPS) , Japanese Mobile Cellular System (MCS) , CNET , MATS-E , digital cellular systems (2ND GENERATION) , Global System for Mobile Communication (GSM) , North American TDMA (IS-136 TDMA) , Extended TDMA (E-TDMA)TM , Code Division Multiple Access (IS-95 CDMA) , upgraded digital cellular system (2 1/2 GENERATION) , General Packet Radio Service (GPRS) , Enhanced Data Rates for Global Evolution (EDGE) , Evolution Data Only (EVDO) , Evolution Data and Voice (EVDV) , wideband digital cellular systems (3RD GENERATION) , Wideband Code Division Multiple Access (WCDMA) , Code Division Multiple Access 2000 (CDMA2000) , services , Voice , Messaging , Data , future enhancements , Software Defined Radios , Spatial Division Multiple Access (SDMA)

Module III

IEEE Wireless LAN , technologies , Ethernet , Spread Spectrum , Information Security , Access Control , commercial systems , 802.11A , 802.11B , 802.11G , Hyper-LAN , future enhancements , Ultra Wide Band (UWB) , Software Defined Radios
Mobile IP, WAP, IP in Mobile Adhoc network, Adhoc Mobile networking, Cognitive radio for WPAN, WLAN and WMAN.

References:

1. Rappaport, Communication, 2nd Edition, Pearson Publication,2002
2. W. Stallings, Wireless Communications & Networks, Prentice Hall, 2001.
3. Y. B. Lin and I. Chlamtac, Wireless and Mobile Network Architectures, John Wiley & Sons, 2001.
4. HwaChen,M.Guizani, Next generation wireless systems and networks, Wiley, 2006.

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% problems and 40% theory.

TCE3007 DIGITAL MICROWAVE COMMUNICATION

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

Course Learning Objectives:
- To study various Digital Microwave Communication Systems
- To introduce the concept of Synchronization.

Course Outcomes:
- To understand various Digital Microwave Communication Systems
- To understand the concept of Synchronization

Module I
Introduction: - Overview of Digital Transmission Systems, Pulse – code modulation, Hierarchy of digital transmission systems, Hierarchy of digital modulation techniques- FSK,PSK, DPSK MSK,QPSK, and QAM, Basics of Microwave Communication: - Radio fundamentals, structure and characteristics of earth's atmosphere, Radio propagation, Digital Microwave point-point systems, and other microwave systems.

Module II
Digital Microwave Communication Systems: 34 and 2Mb traffic, arrangement of Modules, signal flow in 34+2Mb equipment, Transmitter receiver subsystems, and various data rates in 34+2Mb digital MW radio.
Data frame structure of 30 Channel primary MUX, Signaling in communication, R2 signaling, and description of 2/34 MUX equipment.

Module III
Synchronization on Passband digital transmission:- Synchronization concept, carrier synchronization, symbol synchronization, carrier and symbol synchronization in DMR 770.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 with selected topics in Mobile Communications," Universities Press, 2009.
2. Harvey Lahpamer, "Microwave Transmission Networks: Planning, design, and development," 2ndEdn, Tata McGraw-Hill.
3. Richard C, Kirby, FerdoIvanek, "Terrestrial Digital Microwave Communication", Artech House Publishers,1989
4. KamiloFeher, " Digital Communication –Microwave Applications", 2ndEdn,Scitech Publishers,1997.
5. George Kizer, "Digital Microwave Communication: Engineering Point –to – Point Microwave Systems," Wiley –IEEE Press.

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% problems and 40% theory.

TCE 3008 AD-HOC NETWORKS

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

Course Learning Objectives:
- To study the issues related to ad-hoc networks
- To study QoS in Ad Hoc Wireless Networks
- To introduce Recent Advances in Wireless Networks

Course Outcomes:
- Able to understand Architectures and Protocols for ad-hoc networks
- Understand various Technologies and standards of ad-hoc networks

Module I

Ad Hocwireless networks: Issues in Ad Hoc Wireless Networks. Ad Hoc Wireless Internet
MAC Protocols for Ad Hoc Wireless Networks: Issues in Designing a MAC Protocol for Ad Hoc Wireless Networks. Design Goals of a MAC Protocol for Ad Hoc Wireless Networks. Classifications of MAC Protocols.Contention-Based Protocols.Contention-Based Protocols with Reservation Mechanisms.Contention-Based MAC Protocols with Scheduling Mechanisms.MAC Protocols That Use Directional Antennas.Other MAC Protocols.Routing Protocols for Ad Hoc Wireless Networks: Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks.Classifications of Routing Protocols.Table-Driven Routing Protocols. On-Demand Routing Protocols. Hybrid Routing Protocols.Routing Protocols with Efficient Flooding Mechanisms.Hierarchical Routing Protocols.Power-Aware Routing Protocols.

Module II

Transport Layer and Security Protocols for Ad Hoc Wireless Networks: Introduction. Issues in Designing a Transport Layer Protocol for Ad Hoc Wireless Networks. Design Goals of a Transport Layer Protocol for Ad Hoc Wireless Networks. Classification of Transport Layer Solutions. TCP Over Ad Hoc Wireless Networks. Other Transport Layer Protocols for Ad Hoc Wireless Networks.Security in Ad Hoc Wireless Networks.Network Security Requirements. Issues and Challenges in Security Provisioning. Network Security Attacks.Key Management. Secure Routing in Ad Hoc Wireless Networks.
Quality of Service in Ad Hoc Wireless Networks: Issues and Challenges in Providing QoS in Ad Hoc Wireless Networks. Classifications of QoS Solutions.MAC Layer Solutions.Network Layer Solutions.QoS Frameworks for Ad Hoc Wireless Networks

Module III

Wireless Sensor Networks: Sensor Network Architecture. Data Dissemination.Data Gathering.MAC Protocols for Sensor Networks.Location Discovery.
Hybrid Wireless Networks: Next-Generation Hybrid Wireless Architectures. Routing in Hybrid Wireless Networks.Pricing in Multi-Hop Wireless Networks.Power Control

Schemes in Hybrid Wireless Networks.Load Balancing in Hybrid Wireless Networks Recent Advances in Wireless Networks.
Introduction.Ultra-Wide-Band Radio Communication.Wireless Fidelity Systems. Optical Wireless Networks. The Multimode 802.11 -IEEE 802.11a/b/g.The Meghadoot Architecture.

References:

1. Siva Ram Murthy, B.S Manoj, Ad Hoc Wireless Networks:Architectures and Protocols,Prentice Hall,2004.
2. PrasanthMohapathra, S. Krishnamurthy, AdhocNetworks: Technologies and standards, Springer, 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% problems and 40% theory.

TCI3001 MULTIMEDIA COMMUNICATION

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

Course Learning Objectives:

- To introduce the concept of multimedia communication systems
- To have an idea on various Computer and Multimedia Networks
- To study various Compression techniques & Standards

Course Outcomes:

- Understand the issues related to various Computer and Multimedia Networks
- Understand various Compression techniques & Standards

Module I

Introduction to multimedia systems, Definition of terms and concepts related to multimedia. Trends in the development and the use of multimedia, Tools, techniques, and guidelines facilitating the planning, design, production, and implementation of multimedia products.

Module II

Introduction to Compression techniques - Lossless Compression, Lossy Compression. Entropy coding, SourceEncoding. Text Compression – Static Huffman coding, Arithmetic Coding, LZ Coding, LZW Coding. ImageCompression- JPEG. Audio Compression- Differential Pulse code modulation (DPCM), Adaptive DPCM,MPEG audio coders, Dolby audio coders Video Compression- Video Compression Principle, frame types, Motion estimation and compensation,MPEG-1, MPEG-2, MPEG-4,MPEG-7

Module III

Computer and Multimedia Networks: Basics of Computer and Multimedia NetworksMultiplexing Technologies, LAN and WAN, Access Networks, Common Peripheral Interfaces. . Multimedia networking: ATM, RTP, RSVP, RTSP, multicasting: storage and server issues, Multimedia processors, mobile multimedia, watermarking, Multimedia systems: Video on Demand (VoD), Video conferencing, HDTV Multimedia Systems

References:

1. Raghavan S.V and Tripathi S.K: Networked Multimedia systems: Concept, Architecture and Design, Prentice Hall, 1998.
2. Ze-Nian Li and M. S. Drew, “Fundamental of Multimedia”, Pearson Education,2004.
3. R. Parekh. Principles of Multimedia, TMH,2006
4. Khalid Sayood Introduction to Data Compression, Second Edition, Morgan Kaufmann Publishers,2005
5. S. Pandey and M. Pandey. Multimedia : System, Technology a Communication, Katharia and Sons publishing,2010

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% problems and 40% theory.

TCI3002 FUZZY SYSTEM

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

Course Learning Objectives:

- To introduce the concept of fuzzy systems.
- To study various operations in fuzzy sets.
- To study design of various fuzzy logic system.

Course Outcomes:

- Able to design various fuzzy logic systems and Fuzzy control systems.
- Able to do various operations in a fuzzy set.

Module I

Introduction to Fuzzy sets and systems. Basics of fuzzy sets, membership function, support of a fuzzy set, height - Normalised fuzzy set, α - cuts (decomposition of a fuzzy set), set theoretic definitions on fuzzy sets, complement, intersection and union equality, subsethood - basic definition based on membership functions. The law of the excluded middle and law of contradiction on fuzzy sets.Properties of fuzzy sets operations (logical proof only). Extension of fuzzy sets concepts - type-2 and level 2 fuzzy sets - examples.

Module II

Operations on fuzzy sets - intersection, algebraic sum - product, bounded sum - product, drastic sum product, Extension principle and its applications. Fuzzy relation.Resolution form of a binary fuzzy relation.Operations on fuzzy relations - projection, max.-min. and min and max, compositions cylindric extension.Similarity relations - Reflexivity, symmetry, transitivity.Further operations on fuzzy sets, concentration, dilation, contrast intensification, linguistic hedges. Logical operations on fuzzy sets – Negation – Conjunction, disjunction, implication, fuzzy inference.

Module III

Block diagram of a fuzzy logic system. Fuzzy rule base – simplification of compound rule base – fuzzy inference – max. – min, max product, max drastic product, max bounded product. Defuzzification – Centre of gravity, center of sums, weighted average etc. Fuzzy pattern recognition-Feature analysis, Partitions, of the feature space,Single sample identification, Multifeature recognition. Fuzzy control systems- Review of control theory for fuzzy controls, Simple controllers, General controllers, Stability, Models, Inverted pendulum, Aircraft landing control, Air conditioner control.

References:

1. Timothy J. Ross, Fuzzy Logic with Engineering Applications, Wiley India,2011
2. Ahamad M. Ibrahim : Introduction to Applied Fuzzy Electronics, PHI.1996
3. S. Rajasekharan, G A VijayalakshmiPai: Neural Networks, Fuzzy logic and Genetic Algorithms, PHI.2009

4. Klir and Yuan: Fuzzy Sets and Fuzzy Logic- Theory and Applications, Prentice Hall of India.2009
5. Yen: Fuzzy Logic: Intelligence, Control and Instrumentation , Pearson Education, 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% problems and 40% theory.

TCI3003 MICROCONTROLLER BASED SYTEM DESIGN

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

Course Learning Objectives:

- To study the architecture &programming of 8051 micro controller
- To introduce the architecture &programming of PIC microcontroller

Course Outcomes:

- Able to design various micro controller based systems .
- Able to solve issues related to various micro controller systems

Module I

An introduction to embedded systems: Concepts of RISC & CISC. An Embedded System, Processor in The System, Other Hardware Units, Software Embedded into a System.8051 MICROCONTROLLER: Architecture of 8051 - Signals - Operational features - Memory and I/O addressing, Instruction set – Programming

Module II

Programming timer/counter. Interrupts- handling and programming. Serial communication using 8051- Interfacing with RS232. 8051 interfacing - keyboard, stepper motor, ADC , DAC, and LCD Module interface. Applications - square wave and rectangular wave generation, frequency counter and temperature measurement. Development & Debugging tools for microcontroller based system design: software and hardware tools like {cross assembler, compiler, debugger, simulator, in-circuit emulator and logic analyser

Module III

PIC microcontroller: PIC microcontrollers: History and features Comparison of PIC with other CISC & RISC based systems and Microprocessors, 16f877 architecture and pin details ARM CONTROLLER: Architecture – Memory Organization – Pipeline and cache concepts – ARM (32 bit) Architecture , Study of ARM CPU Cores-ARM710T, ARM 720T, ARM 740T.

References:

1. Muhammad Ali Mazidi, *The 8051 microcontroller and Embedded System*, 2006, Pearson Education.
2. Kenneth Ayala, The 8051 Microcontroller, 3/e, Thomson Publishing, New Delhi,2000.
3. PIC 16F877 data book &ARM processor Data book.
4.Andrew N Sloss,DominicSymes,Chris Wright, *ARM Developer's Guide*, Elsevier , 2004
5.Wayne Wolf, Computers as Components: Principles of Embedded Computing system design, ElseVier,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% problems and 40% theory.

TCC4101 THESIS – FINAL

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