MICROWAVE AND TV ENGINEERING

M.Tech. Programme

Electronics and Communication – Microwave and TV Engineering

Curriculum and Scheme of Examinations

SEMESTER I

Code No.	Name of Subject	Credits	Hrs / week	Exam duration	Marks			Remarks
					Continuous Assessment	University Exam	Total	
TMM 1001	Mathematical Methods For 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
TMC 1001	Advanced Digital Signal Processing	3	3	3	40	60	100	Do
TMC 1002	Advanced Digital Communication	3	3	3	40	60	100	Do
TMC 1003	Optical Communication Systems	3	3	3	40	60	100	Do
TSC 1001	Random Processes & Applications	3	3	3	40	60	100	Do
TMC 1005	Antenna Theory & Design	3	3	3	40	60	100	Do
TMC 1101	Communication Systems & Optics Lab	1	2	-	100	-	100	No End semester Examination
TMC 1102	Seminar	2	2	-	100	-	100	Do
	TOTAL	21	22					7 Hours of Departmental Assistance work

SEMESTER II

Code No.	Name of Subject	Credits	Hrs / week	Exam duration	Marks			Remarks
					Continuous Assessment	End Semester Exam	Total	
TSC 2001	Estimation and Detection Theory	3	3	3	40	60	100	Of the 40 marks of internal assessment 25 marks for test and 15 marks for assignment. End semester exam is conducted by the University
TMC 2002	RF Circuit Design	3	3	3	40	60	100	Do
**	Stream Elective I	3	3	3	40	60	100	Do
**	Stream Elective II	3	3	3	40	60	100	Do
**	Department Elective	3	3	3	40	60	100	Do
TCC 2000	Research Methodology	2	2	3	40	60	100	Of the 40 marks of internal assessment 25 marks for test and 15 marks for assignment. End Semester Exam is conducted by the Individual Institution
TMC 2101	Thesis-Preliminary Part I	2	2		100		100	No End Semester Examination
TMC 2102	RF Design & Simulation Lab	1	2	-	100	-	100	Do
TMC 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.

<u>STREAM ELECTIVES OFFERED IN MICROWAVE AND TV ENGINEERING FOR SEMESTER II</u>

List of Stream Electives

Stream Elective I:

TME 2001 Computational Electromagnetics
TME 2002 Microwave Integrated Circuits
TME 2003 Smart Antennas

Stream Elective II:

TME 2004 Digital Techniques in Television Engineering
TME 2005 Secure Communication
TME 2006 Microwave Imaging

List of Department Electives (Common for all streams)

TCD 2001 Design of VLSI Systems
TCD 2002 Soft Computing
TCD 2003 Optimization Techniques
TCD 2004 Information Hiding & Data Encryption

SEMESTER III

Code No.	Name of Subject	Credits	Hrs / week	Exam duration	Marks			Remarks
					Continuous Assessment	End Semester Exam	Total	
**	Stream Elective III	3	3	3	40	60	100	Of the 40 marks of internal assessment 25 marks for test and 15 marks for assignment. End Semester Exam is conducted by the Individual Institutions
**	Stream Elective IV	3	3	3	40	60	100	Do
*	Non-Dept (Interdisciplinary) Elective	3	3	3	40	60	100	Do
TMC 3101	Thesis – Preliminary Part II	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 for the third semester as advised by the course coordinator.

*Students can select a subject from the subjects listed under non department (Interdisciplinary) electives for the third semester as advised by the course coordinator.

STREAM ELECTIVES OFFERED IN MICROWAVE AND TV ENGINEERING FOR SEMESTER III

List of Stream Electives

Stream Elective III

TME 3001 Electromagnetic Interference and Compatibility
TME 3002 Modeling and Simulation of Communication Systems
TME 3003 Wireless Communication

Stream Elective IV

TME 3004 Advanced Coding Theory
TME 3005 Multi Carrier and Spread Spectrum Systems
TME 3006 Radar Signal Processing

SEMESTER IV

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

TMM 1001 MATHEMATICAL METHODS FOR 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 provide an overview of vector spaces, groups ,rings and fields
- To familiarize the students with linear algebra techniques and its applications.
- To enable the students to use special functions.
- To familiarize with basics of Number Theory.

Course Outcomes:

- By the end of the course, the student will be able to understand the advanced concepts about's vector spaces, rings , special differential equations and Number Theory Basics.

Module I

Algebraic structures**:** Sets-relations-Groups-subgroups-co-sets and Lagranges Theorem, Rings Integral domain and Fields-Definition and examples.
Linear Algebra**:-** Vector space-subspace-linear dependence-basis-dimension-Interpolation and wronskian-Linear Transformation-change of bases-diagonalization.
Eigen values and eigen vectors-diagonalization of matrices--exponential matrices-of linear recurrence relations

Module II

Special Functions: Hyper geometric functions- Pochhammer notation. Basis properties of Hyper geometric series. Integral formula for hypergeometric functions . Solutuion of Hyper geometric functions. Bessel Functions -Properties . Generating function , recurrance formula, orthoganilty property. Fourier Bessel Expansion, Legendre Functions - Properties . Generating function , recurrance formula orthoganiity and Fourier Legendre Series.

Module III

Number Theory: Basics of Number theory. Prime numbers. Divisibility, Greatest Common Divisor. Euclidean algorithm. Arithmetic functions Mobius and Euler totient function. Dirchlet covolution and Mobius inversion forumula. Linear Congruence , Chinese Remainder Theorem. Farey fractions and properties. Quadratic residues – Legendre symbol. Euler fermat theorem and primitive roots. Introduction to theory of partition of numbers – Generating functions for p(n) – Ferrer's diagram. Goldbache's conjecture.

References:

1. C.L.Liu,*Elements of Discrete Mathematics*, Tata McGraw Hill
2. Fraleigh, *A first course in abstract algebra*, Narosa
3. Jin Ho Kwak and Sungpyo Hong, *Linear Algebra-*, 2/e, Springer.
4. Strang and Gilbert, *Introduction to Linear Algebra*, 3/e, Cambridge.
5. Erwin Kreyszig- Advanced Engineering Mathematics – 9'th edition , Wiley India
6. S.S Sastry – Advanced Engineering Mathematics , PHI
7. Thoimas Koshy-Elementary Number Theory and it's applications- Elsevier
8. Tom M Apostol Introduction to Analytic Number Theory – Springer

9. *Hardy, G. H.;* Wright, E. M. *(2008) [1938]. In Heath-Brown, D. R.; Silverman, J. H.* An Introduction to the Theory of Numbers *(6th ed.). Oxford: Oxford University Press*
10. *M.R. Schroeder – Number Theory in Science and Communication – Springer.*

Structure of the Question paper:

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

TMC 1001 ADVANCED DIGITAL SIGNAL PROCESSING

Structure of the Course

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

Course Learning Objectives:

- To provide an overview of time frequency analysis and hence the significance of wavelet transform.
- To enable the students to use various wavelet transforms for applications like data compression.
- To familiarize the students with multirate sampling principles.
- To enable the students to appreciate various applications of multirate 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 multirate 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

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

Module II

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

Module III

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

References:

1. P. P. Vaidyanathan, Multirate Systems and Filterbanks, Prentice Hall
2. Wavelet Transforms - Bopadikar and Rao, Pearson Education
3. Insight into wavelets, K. P. Soman, Prentice Hall India
4. Digital signal Processing, By John G. Proakis, Dimitris G. Manolakis Pearson Education
5. L. Cohen, Time Frequency Analysis, Prentice Hall.
6. Wavelets and Filterbank, G Strang & T Nguyen , Wellesly-Cambridge
7. Wavelets and subband coding, M Vetterli & J Kovacevic, Prentice Hall

Structure of the Question paper:

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

TMC 1002 ADVANCED DIGITAL COMMUNICATION

Structure of the Course

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

Course Objectives

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

Learning Outcomes

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

Module I

Digital Communication over Additive Gaussian Noise Channels-Characterization of Communication Signals and Systems- Signal space representation- Connecting Linear Vector Space to Physical Waveform Space- Scalar and Vector Communication over Memory less Channels- Optimum waveform receiver in additive white Gaussian noise (AWGN) channels - Cross correlation receiver- Matched filter receiver and error probabilities- Optimum Receiver for Signals with random phase in AWGN Channels- Optimum receiver for Binary Signals- Optimum receiver for M-ary orthogonal signals- Optimum waveform receiver for coloured Gaussian noise channels- KarhunenLoeve 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 OpenCourseWare, Electrical Engineering and Computer Science,Principles of Digital communication II, Spring 2006.
6. A.J.Viterbi, "CDMA- Principles of Spread Spectrum", Addison Wesley, 1995.
7. Simon Haykin, " Digital Communication, 4th Edition.
8. Aazhang B. Digital Communication Systems [Connexions Web site]. 2008.

Structure of the Question paper:

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

TMC 1003 OPTICAL COMMUNICATION SYSTEMS

Structure of the Course

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

Course Objectives:

- Understand the basic concepts and advantages of fiber optics communication.
- Calculate pulse spread in optical fiber and use it to calculate the bandwidth and data rate of an optical fiber link.
- Be able to solve the wave equation and apply it in the analysis of symmetric slab waveguide.
- Understand the concept and conditions for light guidance.
- Understand the difference between single mode/multimode fibers as well as step index and graded index fibers and perform relevant calculations.
- Know the origin of fiber optics losses, including intrinsic and extrinsic loss and know how to calculate link losses.
- Design a basic optical fiber link.
- To understand various optical amplifiers, WDM systems and Soliton systems

Learning Outcomes :

- Understand various principles of optical communications system operating characteristics
- Knowledge of the basic design rules and trade-offs of modern optical transmitters and receivers
- understand various optical amplifiers
- Know about multiplexing techniques
- Understand Soliton systems

Module I
Lightwave system components-Optical Transmitters and receivers–concepts, components. Design of Optical transmitters- Hetrostructures- VCSEL- Modulation - Detectors- Noise and sensitivity. BER-Sensitivity degradation- Receiver Design.

Module II
Architecture and Design of Light wave systems- Loss limited and Dispersion limited lightwave systems. Link budget analysis. Optical amplifiers-Various types-Design of EDFAs- Various Techniques for Dispersive management: WDM systems –Components and performance issues.

Module III
Soliton based systems- Impact of amplifier noise-Timing Jitter, Gordon – Hauss Effect, Bit Error Rate Performance.
Coherent light wave systems-Concepts, Modulation Formats and Bit Error Rate Performance.

References:
1. Govind P. Agrawal: Fiber Optic Communication System, John Wiley and Sons, 2003
Reading:

2. W J Diggonet, Rare earth Doped Fiber Lasres and Amplifiers
3. Hasegawa, Solitons in Optical Communications
4. Govind P. Agrawal: Nonlinear Optics, Academic press 2nd Ed.

Structure of the Question paper:

There will be three questions from each module out of which two questions are to be answered by the students. It shall have 50% problems and 50% 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 Bandlimited and periodic Processes: WSS periodic Processes, Fourier Series for WSS Processes.

References:

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

Structure of the Question paper:

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

TMC 1005 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 Objectives:

- To give idea about analysis and design of antennas and antenna arrays.

Learning Outcomes:

- Understand the analysis of practical antennas
- Understand the design antennas
- Understand general antenna arrays and array design method.

Module I

Review of Antenna Parameters- Polarization, Input impedance, Gain . Relation between radiation fields with magnetic vector potential and magnetic vector potential – Helmholtz equation and Lorentz conditions.

Review of dipole antennas (short dipole and arbitrary length), Monopole antennas, Vee and rhombic antennas. Folded dipole and it's properties. Analysis of Circular Loop and Biconical Antenna. Helical Antennas (normal mode and axial mode) – relation for far fields, radiation resistance and gain. Antenna matching –T match, baluns, gamma and omega match. Frequency independent antenna antennas – Rumsey Principle – Spiral Antennas. Design of log periodic dipole arrays .

Module II

Current induced in a dipole antenna – Pocklington and Hallen's integral equations. Solution of Hallen's integral equation for current induced in a dipole antenna for delta gap model. Near fields of linear antennas, self and mutual impedance, arrays of parallel dipoles, Yagi-Uda antennas. Aperture antenna – Field equivalence principle. Radiation from open-ended wave-guides, horn antennas, horn radiation fields, horn directivity, optimum horn design, rectangular micro-strip antennas – Filed analysis and design, parabolic reflector antennas, gain and beam width of reflector antennas, aperture-field and current-distribution methods, radiation patterns of reflector antennas, dual-reflector antennas, lens antennas -hyperbolic lens and zoned lens.

Module III

Antenna arrays – General expression for array factor. Grating lobes. One dimensional arrays- Broad side , end fire and Chebyshev arrays. Concept of beam steering. Design of array using Schelkunnof's zero placement method, and Fourier series method. Woodward-Lawson frequency-sampling design , Narrow beam design and Butler matrix beam former. Adaptive Beam forming.2D arrays – Rectangular and Circular array.

References:

1.Sopholes J. Orfanidis – Electromagnetic waves and antennas. Available at:
http://eceweb1.rutgers.edu/~orfanidi/ewa/

2. Consrantive A Balanis -Antenna Theory - Analysis and Design – 2/e John Wiley & Sons.
3. John D. Krans, Ronald J. Marhefka : Antennas for all Applications , 3/e, TMH
4. Thomas A Milligan – Modern Antenna Design ,2/e John Wiley & Sons.

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.

TMC 1101 COMMUNICATION SYSTEMS & OPTICS LAB

Structure of the Course:

Lab	: 2 hrs/ Week	Credits: 1
Internal Continuous Assessment	: 100 Marks	

Course Objectives:

- Attain ability to do projects for digital communication
- Familiarize the use of matlab for simulation of optical communication.
- Familiarize with microwave bench setup and measurements

Learning Outcomes:

- Familiarization of Microwave measurements
- Familiarization of digital and optical communication experiments.

<u>COMMUNICATION EXPERIMENTS: (MATLAB)</u>

(1) Simulation of Digital communication system.
(2) Simulation of fading and multipath channels.
(3) BER curves and eye patterns.
(4) Simulation Of a RADAR System
(5) Simulation Of Mobile Network using.

<u>FIBER OPTICS EXPERIMENTS:</u>

(1) Characteristics of optical transmitters and receivers.
(2) Study of Optical Spectrum Analyser.
(3) Design and setting up a WDM system.
(4) Link Analysis Using OTDR .

<u>MICROWAVE EXPERIMENTS:</u>

(1) Calibration & Trouble shooting Of Microwave measurement set up
(2) Crystal Index measurement
(3) Parameter measurements of H-plane , E-plane & Magic T.
(4) Measurement Of Dielectric Constant

TMC 1102 SEMINAR

Structure of the Course:

Duration	: 2 hrs/ Week	Credits : 2
Internal Continuous Assessment	: 100 Marks	

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

Marks:

Seminar Report Evaluation	: 50 Marks
Seminar Presentation	: 50 Marks

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.

TMC 2002 RF CIRCUITS DESIGN

Structure of the course

Lecture	: 3 hrs/week	Credits: 3
Internal continuous assessment	: 40 Marks	
End Semester Examination	: 60 Marks	

Course objective:

- should be to use Smith chart
- should be able to design matching and biasing networks
- should be able to design microwave oscillators and amplifiers

Learning outcomes:

- understand the importance of Smith chart and ABCD parameters in RF circuit design
- should be able to design microwave oscillators and amplifiers
- understand the importance of stability circle

Module I

Quarter wave transformer- Theory of small reflections, Multi section transformer , Binomial and Chebyshev transformer. Return loss and Insertion loss. Smith Chart - Impedance Matching Using smith Chart, Finding unknown impedance and input impedance using Smith chart. ABCD parameters of simple Two –Port Networks - Impedance Element, T networks , Transmission line section (Analysis – Not required).Scattering Parameters - Chain Scattering Matrix , Signal Flow analysis using S-Parameters.

Module II

RF filter design - First order low pass, high pass and band pass filter circuits. Frequency transformation and impedance transformation. Higher order filter design. Filter implementation –Unit elements, Kuroda's Identities, examples of Microstrip filter design. Coupled filter-Odd and even mode excitation, Band pass filter section. Cascading band pass filter elements, Design examples. RF power divider circuit – Wilkinson's power divider. Theory of PIN diode - Design of PIN switches and attenuators.

Module III

Design of simple matching and biasing networks -Power Relations for RF transistor and MESFET amplifiers, Stabilization Methods. Simple BJT and MESFET amplifier design examples. Microwave oscillators - High frequency oscillator configuration, Design of MESFET based oscillator Dielectric resonator Oscillator, gunn Oscillator, YIG Oscillator. Mixers - Design of simple RF mixer circuits based on BJT and MESFET.

References:

1. Reinhold Ludwig, Pavel Bretchko, RF Circuit Design-Theory and Application, - Pearson Education.
2. Matthew M. Radmanesh, "Radio Frequency and Microwave electronics", Pearson Education. Asia 2001
3. Collins, "Foundation for Microwave Engineering", 2ndEd. McGraw Hill, Inc.

4. David M.Pozar , “Microwave Engineering” , 2ndEd.Wiley Equations for K , Δ, Power gain e , radius and centre of gain and noise figure circles, will be provided along with the Question paper for design purpose.

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.

TCC 2000 RESEARCH METHODOLOGY

Structure of the Course

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

Course Objective

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

Learning Outcomes

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

Module I

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

Module II

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

Module III

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

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

References:

1. C.R Kothari, Research Methodology, Sultan Chand & Sons, New Delhi,1990

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

Structure of the question paper:

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

TTC 2101 THESIS PRELIMINARY: PART-I

Structure of the Course

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

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

Distribution of marks

Internal assessment of work by the Guide	: 50 marks
Internal evaluation by the Committee	: 50 Marks

TMC 2102 RF DESIGN AND SIMULATION LAB

Structure of the Course:

Duration	: 2 hrs/ Week	Credits: 1
Internal Continuous Assessment	: 20 Marks	
Mini Project, End Semester Examination	: 30 Marks	

Course Objectives:

- Attain ability to do measurements using network analyzer and spectrum anlyzer
- Familiarize the use of CAD methods for RF circuit and antenna analysis.

Course outcome:

- Familiarization of network analyzer and spectrum analyzer
- Familiarization of CAD softwares for RF circuit design and antenna analysis.

<u>Experiments</u>

1) Use of Spectrum Analyzer for studying spectrum of analog and digital modulated signals.
2) S ¨C Parameter measurement of 2 PORT RF circuits using Network Analyzer.
3) Simulation of Dipole, Yagi and Log Periodic Antenna using 4NEC2
4) Design of RF amplifier , Oscillators and FILTERS using Microwave CAD packages (Microwave Office / HFSS)
5) Design and simulation of Patch Antenna using HFSS.
6) Design and Simulation of 1D and 2D arrays using Matlab / HFSS.

TMC 2103 SEMINAR

Structure of the Course:

Duration	: 2 hrs/ Week	Credits : 2
Internal Continuous Assessment	:100 Marks	

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

Marks:

Seminar Report Evaluation	: 50 Marks
Seminar Presentation	: 50 Marks

TME 2001 COMPUTATIONAL METHODS FOR ELECTROMAGNETICS

Structure of the Course:

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

Course Objectives:

- To give idea about Numerical methods for solving complex Electromagnetic problems.

Learning Outcomes:

- Understand the Numerical methods for Electromagnetic problems
- Understand the Finite Difference Method and Finite Difference Time Domain Method for Electromagnetic Analysis.
- Understand Finite Element Method for Electromagnetic Problems.

Understand use of Method of Moments and Spectral Analysis

Module I

Introduction to Numerical Methods for solution of partial differential equation, Richardson's extrapolation formula. Green's Function and it's Numerical Integration and use of Richardson's extrapolation. Finite Difference Method. Solution of one dimensional two dimensional differential equations with simple example. Application to waveguides.

Module II

Finite Difference Time Domain (FDTD) method -Yee 's Algorithm - Solution of Maxwell's Equation in 1 ,2 and 3 dimension .Method of Moments - Application of Method of Moments to waveguides and Microstrip transmission lines.

Module III

Application of Method of moments for analysis of antenna characteristics - Radiation Pattern , Antenna Impedance, Mutual Coupling and antenna arrays. Spectral Analysis of Microstrip circuits.

References:

1. Richard C . Booton , Computational Methods for Electro Magnetics and Microwaves. Wiley Series in Microwave and Optical Engineering.
2. R.F Harrington, Time Harmonic Electromagnetic Fields, McGraw Hill, Newyork 1961
3. Andrew F. Peterson, Computational Methods for Electromagnetics, IEEE press.
4. Anders Bondeson , Thomas Rylander ,Computational Electromagnetics, Par ngelström Springer 2005, 1/e

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.

TME 2002 MICROWAVE INTEGRATED CIRCUITS

Structure of the course:

Lecture	: 3 hrs/week	Credits: 3
Internal continuous assessment	: 40 Marks	
End Semester Examination	: 60 Marks	

Course objective:

- should be to design microwave transmission lines
- should be able to design filters ,phase shifters, circulators
- should be familiarize with microwave integrated assemblies

Learning outcomes:

- understand design microwave transmission lines
- should be able to design microwave phase shifters circulators and isolators
- understand the of design and fabrication of microwave circuits

Module I

Planar Transmission line – strip line, Microstrip line, suspended line, slot line, coplanar wave guide, coupled strip-lines, microstrip coupled lines, Distributed and lumped elements of integrated circuits – capacitors, inductors, resistors, terminations, attenuators, resonators and discontinuities.

Module II

Filters – LPF, BPF, Diode control devices – switches, attenuators, limiters, phase shifters diode phase shifter, ferrite and differential phase shifters, circulators and isolators.

Module III

Microwave integrated subassemblies – L band multifunctional Transmit/Receive MODULE, Electrically tunable L band pre selector balanced amplifier, C band multichannel receiver.
Design and fabrication – RF/Microwave packages, 3 dimensional design, fabrication aspects.

References:

1. Leo Maloratsky*: Passive RF and Microwave Integrated Circuits*, Elsevier, 2006
2. Bharathi Bhat and Shiban K. Koul: *Stripline-like Transmission Lines for MIC*, New Age International (P) Ltd, 1989
3. Yoshihiro Konishi: *Microwave Integrated Circuits*, CRC Press 1991
4. Ivan Kneppo*: Microwave Integrated Circuits*, Springer, 1994

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.

TME 2003 SMART ANTENNAS

Structure of the Course:

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

Course Objectives:

- To give idea about theoretical methods for smart antenna technology.

Learning Outcomes:

- Understand the basics of smart antennas and it's applications
- Understand the theory of beam forming and adaptive beam forming.
- Understand the use of smart antennas for wireless application.

Module I

Introduction to Smart Antenna benefits and smart antenna arrays for Mobile Communications: Antenna arrays and spatial filters – Frequency wave number response of the array. Narrow beam former. Uniform linear array (ULA) – visible range . Beam pattern parameters and Grating lobes. Concept of co -array , redundancy and holes – relationship with side lobe level. Minimum redundancy and minimum holes arrays. Beam pattern design algorithm. Array steering , array polynomial and array design using Schelkunoff's method. Review of beam forming using Fourier series and Butler matrix beam forming.

Module II

Adaptive antenna arrays: Optimum beam forming using MVDR beam former- Interference cancellation performance. Implementation of adaptive beam forming using sample matrix inversion (SMI). Linearly Constraint Minimum variance beam former. The generalized side lobe canceller. Linear .Survey of Various Propagation Models for Mobile Communication.- Lee cell model , time varying vector channel model, Gaussian wide sense stationary model and time varying vector channel model. Smart antenna arrays using diversity combining techniques. Direction of Arrival (DOA) estimation using MUSIC algorithm.

Module III

Channel model and the Vector Channel Impulse Response of the array . Brief survey of channel models – Lee's model and Rayleigh model. Smart antenna array design using Diversity Combining. antenna arrays fixed Beamforming Networks and Switched Beam forming. Introduction to Wideband Smart Antennas

References:

1) Harry L Van Trees, Optimum Array Processing , Part IV of Detection ,Estimation and Modulation Theory, Wiley Interscience.
2) Dimitris .G.Manolakis, Vinay.K.Ingle, Stephen M Kogan , Statistical and Adaptive Signal Processing, Artech House.
3) T.S. Rappaport and J.C. Liberti, Smart Antennas for Wireless Communications, Prentice Hall, NJ: Prentice Hall,1999

4) Rajeswari Chatterjee - Antennas For Information Super Skyways. PHI – 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.

TME 2004 DIGITAL TECHNIQUES IN TELEVISION ENGINEERING

Structure of the Course:

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

Course Objectives:

- To understand the various technical components in digital television broadcasting.

Learning Outcomes:

- Understand audio and video compression standards used for digital TV.
- Understand the different digital television systems.
- Understand the modulation schemes used in digital TV.

Module I

Basic principles of Digital TV broadcasting - Review of current television standards, Digitization of video signals - Digitization formats. Digital television systems – ATSC, DVB-T, ISDB, DTMB.

Module II

Compression of video signals – MPEG-2, H.264/MPEG-4 Part 10 AVC, AVS standards. Compression artifacts. Compression of audio signals –AC-3, AAC, HE- AAC standards. Source multiplexing, Conditional access, Conditional access management systems, DVB common scrambling algorithm.

Module III

ATSC 8-VSB Modulation, ATSC Data Framing, ATSC Concatenated Channel Coder, ATSC Channel Capacity, DVB Modulation, DVB Channel Coding, DVB Channel Capacity, DVB teletext, DVB subtitling system.

References:

1. Understanding Digital Television: An Introduction to DVB Systems with Satellite, Cable, Broadband and Terrestrial TV, Lars-Ingemar Lundström, Focal Press – Elsevier
2. Coding and Modulation for Digital Television (Multimedia Systems and Applications Volume 17) Gordon M. Drury, Garik Markarian, Keith Pickavance, 2002 Kluwer Academic Publishers
3. Digital Television: Technology and Standards. John F. Arnold , Michael R. Frater , Mark R. Pickering, 2007 ,John Wiley & Sons
4. Digital Television Satellite, Cable, Terrestrial,IPTV, Mobile TV in the DVB Framework, Third Edition by Hervé Benoit, Focal Press – Elsevier
5. Digital video broadcasting: technology, standards, and regulations, Ronald de Bruin, Jan Smits. Artech house, inc.

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.

TME 2005 SECURE COMMUNICATION

Structure of the Course:

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

Course Objective:

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

Learning Outcome:

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

Module I

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

Module II

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

Module III

Cryptanalysis. Algorithms : Modular exponentiation, Fast group operations on Elliptic curves.

Primality test- Fermat’s pseudo primality test, Strong prime test, Lucas Pseudo prime test, Elliptic curve test. Integer Factorization- Trial division, Fermat's method, CFRAC. Quadratic and Number Field Sieves.

Algorithms for Discrete Logarithms: Baby-step Giant-step alg. Algorithms for Discrete Logarithm on Elliptic curves.

References:

1. A Course in Number Theory and Cryptography, Neal Koblits, Springer, 2e.
2. Number Theory for Computing, Song Y Yan, Springer, 2e.

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

Structure of the Question paper:

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

TME 2006 MICROWAVE IMAGING

Structure of the Course:

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

Course Objectives:

- Awareness regarding the important fundamentals of image processing
- Enable students to understand the concepts of electromagnetics with reference to imaging
  Enable students to understand applications of microwave imaging and its use the in designs of practical systems

Learning Outcomes:

- Understand various image processing systems
- Understand concepts of electromagnetics with reference to imaging
- Understand designs of practical microwave imaging systems

Module I

Fundamentals of image processing: Elements of virtual perception. Image sensing and acquisition, Image sampling and quantization: Image enhancement ,image restoration, image segmentation and Image recognition

Module II

Electromagnetic radiation and electromagnetic spectrum: Radiation principles, Planck law, Stephan Boltzman law. interaction of electromagnetic radiation with earth's surface, Wien's displacement law, spectral signature, reflectance characteristics of earths surface types. Remote sensing systems. Principles of microwave remote sensing

Module III

Airborne and spaceborne radar systems: system parameters: wavelength, polarisation, resolution. Target parameters :back scattering, volume scattering. Radar image analysis. Synthetic Aperture Radar, SAR Interferometry. SAR applications. Principles of thermal imaging. Applications of microwave imaging in medicine.

References:

1. Floyd.M.Handerson and Anthony,J.Lewis "Principles and applications of Imaging RADAR", Manual of Remote sensing, Third edition, vol.2, ASPRS, Jhumurley and sons, Inc,1998.
2. Philippe Lacomme,Jean clande Marchais,Jean-Philippe Hardarge and Eric Normant, Air and spaceborne radar systems-An introduction, Elsevier publications 2001.
3. Iain H.woodhouse, Introduction to microwave remote sensing, 2004.
4. Roger J Sullivan, Knovel, Radar foundations for Imaging and Advanced

Concepts, SciTech Pub, 2004.
5. Ian Faulconbridge, Radar Fundamentals, Published by Argos Press, 2002.
6. Eugene A. Sharkov,Passive Microwave Remote Sensing of the Earth: Physical Foundations, Published by Springer, 2003.
7. Digital Image Processing (3rd Edition) Rafael C. Gonzalez , Richard E. Woods Prentice Hall, 2007.
8. Margaret Cheny,Brett Borden,Fundamentals of radar imaging Society for Industrial and Applied Mathematics. (SIAM),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.

TCD 2001 DESIGN OF VLSI SYSTEMS

Structure of the Course

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

Course Objectives

- Understand the basics of CMOS Inverter and other Logic Design Techniques
- Get a feel of current design technology
- In-depth knowledge about various memory elements

Learning Outcomes

- Understand the basics of VLSI Design
- Understand the working of high speed adders and multipliers
- Understand , various methods in the design of memory elements

Module I

CMOS Inverter - Static Behaviour, Performance of CMOS Inverter - Dynamic Behaviour, Power Energy and Energy Delay, CMOS Circuit and Logic Design-CMOS Logic structures. Advanced techniques in CMOS Logic Circuits-Mirror circuits, Pseudo nMOS, Tri-state circuits, Clocked CMOS, Dynamic CMOS Logic circuits, Dual Rail Logic Networks.

Module II

Arithmetic Circuits in CMOS VLSI-Bit Adder Circuits, Ripple Carry Adder, Carry Look Ahead Adders, Other High speed adders-Multiplexer based fast binary adders, Multipliers-Parallel multiplier, Wallace Tree and Dadda multiplier, Low power design- Scaling Versus Power consumption, Power reduction techniques

Module III

Designing Memory and Array Structures - Memory classification, Memory Core - Read Only Memories, Non-volatile Read Write Memories, Read Write Memories, Content - Addressable or Associative Memories, Memory Peripheral Circuits - Address Decoders, Sense Amplifiers.

References:

1. John P. Uyemura, Introduction to VLSI Circuits and Systems, John Wiley & Sons 2002
2. Kesshab K. Parthi, VLSI DIGITAL SIGNAL PROCESSING SYSTEMS, John Wiley & Sons 2002
3. Neil H. E. Weste, Kamran Eshranghian, Principles of CMOS Design, Pearson Education Asia 2000
4. Jan M. Rabaey and et al, DIGITAL INTEGRATED CIRCUITS, Pearson Edn. Inc. 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.

TCD 2002 SOFT COMPUTING

Structure of the Course

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

Course Objectives

- To familiarize various components of soft computing.
- To give an overview of fuzzy Logic
- To give a description on artificial neural networks with its advantages and application.

Learning Outcomes

- Identify and describe soft computing techniques and their roles in building intelligent machines
- Recognize the feasibility of applying a soft computing methodology for a particular problem
- Apply fuzzy logic and reasoning to handle uncertainty and solve engineering problems

Module I

Basics of Fuzzy Sets: Fuzzy Relations – Fuzzy logic and approximate reasoning – Design. Methodology of Fuzzy Control Systems – Basic structure and operation of fuzzy logic control systems. Concepts of Artificial Neural Networks: Basic Models and Learning rules of ANN's. Single layer perceptron networks – Feedback networks – Supervised and unsupervised learning approaches – Neural Networks in Control Systems.

Module II

Integration of Fuzzy and Neural Systems: Neural Realization of Basic fuzzy logic operations – Neural Network based fuzzy logic inference – Neural Network based Fuzzy Modelling – Types of Neural Fuzzy Controllers. Data clustering algorithms - Rule based structure identification-Neuro-Fuzzy controls - Simulated annealing.

Module III

Survival of the Fittest - Fitness Computations - Cross over - Mutation -Reproduction - Rank method– Rank space method AI search algorithm - Predicate calculus - Rules of interference – Semantic networks - Frames - Objects - Hybrid models - Applications.

References:

1. Jyh Shing Roger Jang,Chuen-Tsai Sun, Eiji Mizutani, (1997), *Neuro-Fuzzy and Soft Computing*: A Computational Approach to Learning and Machine, Prentice Hall,.
2. Chin –Teng Lin and C.S. George Lee,(1996) "*Neural Fuzzy Systems*" – A neuro fuzzy synergism to Intelligent systems, Prentice Hall International
3. Yanqing Zhang and Abraham Kandel (1998), *Compensatory Genetic Fuzzy Neural Network and Their Applications*, World Scientific.
4. T. J. Ross (1995)- *Fuzzy Logic with Engineering Applications*, McGraw-Hill, Inc.
5. Nih J.Nelsson, "*Artificial Intelligence - A New Synthesis*", Harcourt Asia Ltd., 1998.
6. D.E . Goldberg, "*Genetic Algorithms: Search, Optimization and Machine Learning*", Addison Wesley,N.Y, 1989

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 2003 OPTIMIZATION TECHNIQUES

Structure of the Course

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

Course Objectives

- To familiarize the students with the need of optimization in engineering.
- To introduce the students with the different types of optimization algorithms
- To enable the students to select the suitable optimization technique for the particular problem.

Learning Outcomes

- Understand the role of optimization in engineering design.
- Understand the working principle of optimization algorithms.
- Understand the formulation of the problem and usage of optimization algorithms.

Module I

One dimensional – necessary and sufficient conditions, Search methods- Fibonacci search, golden section search, Gradient methods- Newton- Raphson method, cubic search. Multivariable- necessary and sufficient conditions, Search methods- Evolutionary method, Hook-Jeevs pattern search, Gradient based methods- steepest descent, Newton's method, conjugate gradient method.

Module II

Linear Programming - Systems of linear equations & inequalities, Formulation of linear programming problems, Theory of Simplex method, Simplex Algorithm, Two phase method-Duality, Dual Simplex method.Non Linear Programming- Kuhn-Tucker conditions- Necessary and Sufficiency theorem – transformation method – penalty function method, search method –random search method, linearized search - Frank-Wolf method.

Module III

Meta-heuristic optimization Techniques- (Principle and implementation steps for examples related to engineering (signal processing, communication, control system) optimization of the following) Differential Evolution(DE), Harmony Search Algorithm(HSA), Artificial Bee Colony Algorithm(ABC).

References:

1. Optimization for Engineering Design, Algorithms and Examples. -PHI, ISBN -978-81-203-0943-2, Kalyanmoy Deb, IIT Kanpur.
2. Unit - 4 Corresponding publications .

Structure of the Question paper:

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

TCD 2004 INFORMATION HIDING & DATA ENCRYPTION

Structure of the Course

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

Course Objectives

- The ability to do Cryptography, watermarking and Steg analysis
- Should be able to use various Data Hiding techniques
- Ability to apply encryption techniques in data for various applications

Learning Outcomes

- Understand Cryptography, watermarking and Steg analysis
- Understand capabilities of encryption techniques in data for various applications
- Understand, Analyse various Data Hiding techniques

Module I

Introduction to Complexity theory, Elementary Number theory, Algebraic Structures- Groups, Rings and Finite Fields, Polynomials over Finite Fields (Fq). Classical Cryptography, Stream Ciphers, Public Key Cryptography: based on Knapsack problem, AES. Digital Signature, Zero Knowledge Proofs.

Module II

Information Hiding: Watermarking, Steganography. Objectives, difference, requirements, types (Fragile and robust).Parameters and metrics (BER, PSNR, WPSNR, Correlation coefficient, MSE, Bit per pixel). LSB, additive, spread spectrum methods. Applications: Authentication, annotation, tamper detection and Digital rights management. Hiding text and image data, mathematical formulations.

Module III

Hiding in 1D signals: Time and transform techniques-hiding in Audio, biomedical signals, HAS Adaptive techniques. Hiding in 2D signals: Spatial and transform techniques-hiding in images, ROI images, HVS Adaptive techniques. Hiding in video: Temporal and transform domain techniques, Bandwidth requirements. Steg analysis: Statistical Methods, HVS based methods, SVM method, Detection theoretic approach.

Reference:

1. Neal Koblitz, *A Course in Number Theory and Cryptography*, 2nd Edition, Springer
2. Stefan Katzenbeisser, Fabien A. P. Petitcolas, *Information Hiding Techniques for Steganography and Digital Watermarking*,Artech House Publishers, 2000.
3. Neil F Johnson et al Kluwer, *Information hiding: steganography and watermarking attacks and countermeasures*Academic Publishers London.
4. Ingmar J Cox eta al *Digital Watermarking*,Morgan Kaufman Series, Multimedia information and system.
5. Ira S Moskowits, Proceedings, *4th international workshop*,IH 2001, Pitts burg, USA April 2001 Eds:2. AVISPA package homepage, http:/ www.avispaproject.org/
6. Handbook of Applied Cryptography, AJ Menezesetc al, CRC 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.

TMC 3101 THESIS PRELIMINARY: PART II

Structure of the Course

Thesis	: 14 hrs/week	Credits: 5
Internal Continuous Assessment	: 200 Marks	

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

Distribution of marks

Internal assessment of work by the Guide : 100 Marks

Internal evaluation by the Committee : 100 Marks

TME 3001 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 Objectives:

- The ability to identify the sources of Electro-magnetic Interference.
- Should be able to design EMC circuits and systems.
- Ability to apply EMI detection circuits.

Module I

Introduction to Electro-magnetic Interference (EMI) - Definitions, Different Sources of EMI, Electro-static discharge (ESD), Electro-magnetic pulse (EMP), Lightning, and Mechanism of transferring Electro-magnetic Energy: Radiated emission, radiated susceptibility, conducted emission, and conducted susceptibility, Differential & common mode currents.

Introduction to EMC - Concepts of EMC, EMC units. EMC requirements for electronic systems - World regulatory bodies- FCC, CISPR etc. Class-A devices, class-B devices.

Different Mitigation Techniques for preventing EMI. Grounding: Fundamental grounding concepts, Floating ground, Single-point & Multi-point ground, advantages & disadvantages of different grounding processes.

Shielding: Basic concepts of shielding, Different types of shielding, Shielding effectiveness(S.E), S.E of a conducting barrier to a normal incident plane wave, multiple reflection within a shield, mechanism of attenuation provided by shield, shielding against magnetic field & Electric field, S.E for Electronic metal & Magnetic metal, Skin-depth, S.E for far-field sources, shield seams. Cross-talks & Coupling, Measurement set for measuring Cross-talk. Filtering & decoupling.

Module II

Non-ideal behaviour of different electronic components - Examples: Communication equipment, Microwave oven, Personal Computers, Health Hazards limits, EMC in healthcare environment.

Antennas - Characteristics of antennas, fields due to short electric dipole & small magnetic pole, near field & Far-field sources & their characteristics. Broadband antenna measurements, antenna factor.

Time-domain & Frequency-domain Analysis of Different Signals - identifying the frequency, phase & power spectrum of different signals. Time-domain Reflectrometry (TDR) basics for determining the properties of a transmission line.

System Design For EMC - Simple susceptibility models for wires & PCB, Simplified lumped model of the pick-up of incident field for a very short two-conductor line.

Module III

Cables, connectors, components: EMI suppression cables, EMC connectors, EMC gaskets, Isolation transformers, optoisolators. Choice of capacitors, inductors, transformers and resistors.

Digital and Analogue circuit design: Design for emission control and design for immunity, Radiation from logic circuits, analogue circuits and SMPS. Microprocessor watchdog, defensive programming.

Radiated and conducted interference measurements and ESD: Anechoic chamber, TEM cell, GH TEM Cell, characterization of conduction currents / voltages, conducted EM noise on power lines, conducted EMI from equipment, Immunity to conducted EMI detectors and measurements. ESD, Electrical fast transients / bursts, electrical surges. Measurements of radiated emission in open test range & in Anechoic chamber, Conducted emission testing by Line Impedance Stabilization network (LISN).

References:

1. Engineering Electromagnetic Compatibility - V. Prasad Kodali, IEEE Publication, Printed in India by S. Chand & Co. Ltd., New Delhi, 2000.
2. EMC for Product Designers –Tim Williams, B-H Newnes, Oxford.
3. EMC Analysis Methods & Computational Models-Frederick M Tesche, Michel V.Ianoz,Torbjorn Karlsson (John Willey & Sons, Inc)
4. Introduction to Electromagnetic compatibility - Clayton R. Paul (John wiley & Sons)
5. EMI/EMC Computational modelling Hand Book- by Archambelt.
6. Applied Electromagnetic Compatibility- Dipak L Sengupta & Valdis V Liepa (John Wiley & Sons Inc).
7. Bernhard Keiser, Principles of Electromagnetic Compatibility, Artech house, 3rd Edn, 1986.

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.

TME 3002 MODELLING AND SIMULATION OF COMMUNICATION SYSTEMS

Structure of the Course:

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

Course Objectives:

- The ability to model and simulate communication systems.
- Should be able to estimate and simulate communication systems.
- Ability to analysis the simulation Results.

Module I

Modeling and Simulation Approach: Review of stochastic process and their properties. Univariate and multivariate models, Transformation of random variables, Bounds and approximation, Random process models - Markov and ARMA Sequences, Sampling rate for simulation.
Methods of performance evaluation-simulation approach - Advantages and limitations. System model steps and its types involved in simulation study. Basic concepts of modeling – modeling of systems, devices, random process and hypothetical systems. Error sources in simulation. Validation, simulation environment and software issues. Role of simulation in communication system and random process. Steps involved in simulation study.
Generation and Parameter Estimation: Monte Carlo simulation, properties, random number Generation, Generating independent and correlated random sequences. Testing of random number generators. Parameter estimation: Estimating mean, variance, confidence interval, estimating the Average Level of a Waveform, Estimating the Average power of a waveform, Power Spectral Density of a process, Delay and Phase.

Module II

Modeling of Communication Systems: Information sources, source coding, base band modulation, channel coding, RF and optical modulation, filtering, multiplexing, detection/demodulation- carrier and timing recovery for BPSK and QPSK. Modeling considerations for PLL.
Communication Channel Models: Fading and multipath channels- statistical characterization of multipath channels and time-varying channels with Doppler effects, models for multipath fading channels. Finite state channel models – channels with and without memory. Methodology for simulating communication systems operating over fading channels.

Module III

Performance Estimation and Evaluation : Estimation of Performance Measures - Estimation of SNR, Performance Measures for Digital Systems, Importance sampling method, Efficient Simulation using Importance Sampling, Quasianalytical Estimation.
Analysis of simulation Results: Model Verification Techniques, Model Validation Techniques, Transient Removal, Terminating Simulations, Stopping Criteria, Variance Reduction.
Case Studies: (1) Performance of 16-QAM equalized Line of Sight Digital Radio Link, (2) performance evaluation of CDMA Cellular Radio System.

References:

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

Structure of the Question paper:

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

TME 3003 WIRELESS COMMUNICATIONS

Structure of the Course:

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

Course Objectives:

• To give idea about modern digital communication methods and systems.

Learning Outcomes:

• Understand the modern digital communication systems.
• Understand multicarrier and multiuser communication systems and their performance.
• Understand spread spectrum systems and their performance.

Module I

Fading and Diversity Wireless Channel Models- Path loss and Shadowing models, Statistical fading models, Narrow band and wideband fading models, Review of performance of digital modulation schemes over wireless channels

Diversity- Time diversity, Frequency and Space diversity, Receive diversity, Concept of diversity branches and signal paths, Performance gains, Combining methods- Selective combining, Maximal ratio combining, Equal gain combining, performance analysis for Rayleigh fading channels, Transmit Diversity-Alamouti Scheme

Module II

Spread spectrum and CDMA: Motivation- Direct sequence spread spectrum (DS-SS), Frequency hopping spread spectrum (FH-SS), ISI and Narrow band interference rejection, Code design- Maximal length sequences, Gold codes- Walsh codes, Diversity in DS-SS systems- Rake Receiver- Performance analysis, CDMA Systems- Interference Analysis for Broadcast and Multiple Access Channels, Capacity of cellular CDMA networks, Reverse link power control.

Capacity of Wireless Channels- Capacity of flat and frequency selective fading channels

Module III

Cellular Wireless Communication : Cellular concept, Interference, Trunking and grade of service, Improving coverage and capacity in cellular systems.

Overview of second generation cellular wireless systems: GSM and IS-95 standards, 3G systems: UMTS & CDMA 2000 standards and specifications, vision of 4G standards.

OFDM: Introduction to OFDM, Multicarrier Modulation and Cyclic Prefix, Channel model and SNR performance, OFDM Issues – PAPR, Frequency and Timing Offset Issues

References:

1. T.S. Rappaport, “Wireless Communication, principles & practice”, PHI, 2002.
2. Simon Haykin and Michael Moher, “ Modern Wireless Communications”, Person Education, 2007.
3. G.L Stuber, “Principles of Mobile Communications”, 2nd edition, Kluwer Academic Publishers, 2001.

4. R.L Peterson, R.E. Ziemer and David E. Borth, "Introduction to Spread Spectrum Communication", Pearson Education, 1995.
5. A.J.Viterbi, "CDMA- Principles of Spread Spectrum", Addison Wesley, 1995.
6. Andrea Goldsmith, "Wireless Communications", Cambridge University press, 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.

TME 3004 ADVANCED CODING THEORY

Structure of the Course:

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

Course Objectives:

- To systematically builds up the coding theory aspects from mathematical fundamentals to the state of the art methods.

Learning Outcomes:

- Understand the algebraic aspects to the coding theory.
- Understand to the level of state of the art methods and algorithms in coding.
- Enable the students to take up coding theory problems for their thesis work.

Module I

Review of modern algebra. Galois fields. Construction and basic properties of Finite fields, Vector Space. Linear block codes; properties, minimum distance, error detection and correction. Standard Array, syndrome decoding. Cyclic codes, encoding and decoding, Non-binary codes.

Module II

Convolutional codes. Generator sequences. Structural properties. ML decoding. Viterbi decoding. Sequential decoding. Practical applications of convolutional codes.
Modulation codes. Trellis coded modulation. Lattice type Trellis codes. Geometrically uniform trellis codes. Decoding of modulation codes.

Module III

Turbo codes. Turbo decoder. Interleaver. Turbo decoder. MAP and log MAP decoders. Iterative turbo decoding. Optimum decoding of turbo codes.
Space-time codes. MIMO systems. Space-time block codes (STBC) – decoding of STBC.

References:

1. S.Lin & D.J.Costello, Error Control Coding, Prentice-Hall
2. R. E. Blahut, Theory and Practice of Error Control coding Addison-Wesley Pub. Co.
3. Stephen B.Wicker, Error Control System for Digital Communication & Storage, PHI4
4. S. Sklar, Digital Communication, Pearson Education

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.

TME 3005 MULTI CARRIER AND SPREAD SPECTRUM SYSTEMS (MTV)

Structure of the Course:

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

Course Objectives:

- To introduce the student to the various aspects of multicarrier communication
- Important aspects related to OFDM and CDMA are discussed
- Receiver structures for CDMA and MC-CDMA systems are discussed.

Learning Outcomes:

- Understand the concepts of multicarrier communication
- Understands the important aspects of OFDM and CDMA systems
- Understand the working of receiver structures for CDMA and MC-CDMA systems.

Module I

The concept of multicarrier transmission**:** OFDM as a multicarrier transmission, Implementation by FFT, OFDM with guard interval, Spectral shaping for OFDM Systems, Sensitivity of OFDM signals against nonlinearities, Time and frequency synchronisation for OFDM Systems, OFDM with pilot symbols for channel estimation. Requirement of the mobile Radio Channel, Time and frequency interleavers, OFDM system with convolutional coding and QPSK

Module II

General Principles of of CDMA: The concept of spreading, Cellular mobile radio networks, Spreading codes and their properties – Pseudonoise sequences, Gold codes, Kasami codesand Barker codes. Methods for handling interference in CDMA Mobile radio networks – Power control, Soft handover. Representation of CDMA signals, The discrete channel model for synchronous transmission in a frequency flat channel, The discrete channel model for synchronous wideband MC-CDMA transmission

Module III

Receiver Structures for Synchronous Transmission: The single user matched filter receiver, Optimal receiver structures, Suboptimal linear receiver structures, Suboptimal nonlinear receiver structures. Receiver Structures For MC-CDMA and Asynchronous Wideband CDMA Transmission – The RAKE receiver, Optimal receiver structures. Example of a CDMA System – Wireless LAN.

References:

1. Theory and applications of OFDM and CDMA ; Henrik Schulze ; John Wiley & Sons, Ltd
2. OFDM for Wireless Communications Systems ; Ramjee Prasad ; Artech House
3. Introduction to CDMA Wireless Communication ; Mosa Ali Abu-Rgheff ; Elsevier

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.

TME 3006 RADAR SIGNAL PROCESSING (MTV)

Structure of the Course:

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

Course Objectives:

- To introduce the student to the various aspect of radar signal processing
- Various aspects related to Doppler and MTI Radar signal processing are discussed.
- Narrow band Direction of Arrival Estimation techniques are also dealt in detail.

Learning Outcomes:

- Understand the fundaments of radar signal processing
- Understand the working of Doppler and MTI Radar processing .
- Understand the various aspects of Narrow Band Direction of Arrival Estimation.

Module I

Introduction to radar signal Processing : Systems Fundamentals and Definitions, Signal Integration , Correlation , Convolution , Spectrum Analysis, Fast Algorithms : FFT, Fast Convolution, Fast Correlation, Windows and Resolution, Recovery from Samples – Interpolation,
Synthesis of Complex Data From Magnitude Only, Digital Filter Fundamentals

Module II

Radar Detection – Introduction , Detection in Noise , Signal Integration and Target Fluctuation, Coherent Integration , Target Fluctuation and coherent Integration . Doppler and Moving Target Indicator (MTI) Fundamentals, MTI Principles and Methods , Blind Doppler Shifts and PRF Stagger, De-Staggering and Processing, MTI and MTD with Moving Radars and Moving Clutter, CW, High PRF, and Medium PRF Doppler Processing.

Module III

Array Processing in Radars: General Arrays, Linear Arrays, Uniformly Weighted Linear Arrays , Conventional Beam former , Narrowband Direction of Arrival Estimation – Classical Methods – Delay and Sum Method, Capons Minimum Variance Distortionless Response Method Subspace Methods for DOA Estimation – MUSIC, Min Norm and ESPIRIT technique

References:

1.Radar : Principles, Technology and Applications ; Byron Edde ; PEARSON
2.Radar signal analysis and processing using MATLAB ; Bassem R Mahafza ; CRC Press
3.Optimum Array Processing ; Harry L Van Trees ; Wiley - Interscience

Structure of the Question paper:

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

TMC 4101 **THESIS**

Structure of the Course

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

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

Distribution of marks

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

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

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

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