M.E. ETC(ELECTRONIC COMMUNICATION & INSTRUMENTATION)

Course Structure and Scheme of Evaluation (Semester-wise, along with curriculum details)

Semester 1

Subject Code	Name of the Subjects	No. of Hrs / Week				Scheme of Examination				
		L	T	P	Theory hours	Credits				
						Theory	IA	Practical	orals	Total
MEECI 1.1	Solid-State Devices & Semiconductor Physics	4	-	0	3	4	2	--	--	6
MEECI 1.2	Control System Analysis and Design	4	-	0	3	4	2	--	--	6
MEECI 1.3	Introduction to MEMS	4	-	0	3	4	2	--	--	6
MEECI 1.4	Fiber Optic Communication	4	-	0	3	4	2	--	--	6
MEECI 1.5	Advance Engineering Mathematics	4	-	0	3	4	2	--	--	6
MEECI 1.6	Fiber Optic lab	0	-	7	--	--	2	2	--	4
MEECI 1.7	Process Control And Instrumentation Lab	0	-	7	--	--	2	2	--	4
	Total	20	-	14	--	20	14	4		38

Semester 2

Subject Code	Name of the Subjects	No. of Hrs / Week				Scheme of Examination				
		L	T	P	Theory hours	Credits				
						Theory	IA	Practical	orals	Total
MEECI 2.1	Biomedical Instrumentation	4	-	0	3	4	2	--	--	6
MEECI 2.2	Digital Signal Processors & Embedded Systems	4	-	0	3	4	2	--	--	6
MEECI 2.3	Information Theory & Coding	4	-	0	3	4	2	--	--	6
MEECI 2.4	Microwave Integrated circuits	4	-	0	3	4	2	--	--	6
MEECI 2.5	Adaptive Signal Processing	4	-	0	3	4	2	--	--	6
MEECI 2.6	Microwave Lab	0	-	7	--	--	2	2	--	4
MEECI 2.7	Biomedical Lab	0	-	7	--	--	2	2	--	4
	Total	20	-	14	--	20	14	4		38

Semester 3

Subject Code	Name of the Subjects	No. of Hrs / Week				Scheme of Examination				
		L	T	P	Theory hours	Credits				
						Theory	IA	Practical	orals	Total
MEECI 3.1	Elective – I	4	-	0	3	4	2	--	--	6
MEECI 3.2	Elective – II	4	-	0	3	4	2	--	--	6
MEECI 3.3	Project	-	-	20	-	-	4	--	8	12
	Total	8	-	20	--	8	8	-	8	24

Electives I:

a) Image processing
b) Error correcting codes
c) Optical computing
d) Radio Frequency Microelectronic chip design
e) Power electronics
f) Industrial design of electronic equipments
g) Electronic system design
h) Wireless Communication

Electives II:

i) Sensors in instrumentation
j) Simulation of circuits and devices
k) Analog VLSI design
l) Virtual instrumentation
m) Wavelet transform & Multi-rate Digital Signal Processing
n) Radio Frequency Design
o) Advance Digital Communication
p) Radar Systems Engineering
q) Electromagnetic Interference And Electromagnetic Compatibility

Semester 4

Subject Code	Name of the Subjects	No. of Hrs / Week				Scheme of Examination				
		L	T	P	Theory hours	Credits				
						Theory	IA	Practical	Orals	Total
MEECI 4.1	Dissertation	-	-	28	-	-	6	-	14	20
	Total	-	-	28	-	-	6	-	14	20

SYLLABUS
M.E. ETC (ELECTRONIC COMMUNICATION & INSTRUMENTATION)

SEMESTER 1

MEECI 1.1:Solid State Devices and Semiconductor Physics:

- *Quantum Mechanics:* Principles of Quantum Mechanics, Schrodinger's wave equation and it's application to particle in free space and infinite well; allowed and forbidden energy bands; propagating electron wave in a periodic lattice; effective mass; density of states;
- *Statistical Mechanics:* The Fermi-Dirac and Maxwell-Boltzmann probability distribution function; the Fermi energy;
- *Equilibrium and non-equilibrium properties:* Carrier Concentration in Intrinsic and Extrinsic semiconductors at equilibrium; compensated semiconductor; carrier transport phenomena- Drift, diffusion; excess carriers in semiconductors- Carrier Generation and Recombination; continuity equation; surface effects.
- *p-n junction:* Energy Band Diagram; zero bias analysis, Forward and Reverse Bias; Linearly graded junction; Abrupt p-i-n junction; Transient Response of P-n junction; Forward bias Diode current (minority and majority carrier current); Generation and recombination current ; Small signal model of the pn junction; Hetero p-n junction, Hetero junction diode current; Reverse bias Diode breakdown.
- *Bipolar junction transistors:* Principle of Operation; Minority Carrier Profiles in a Bipolar Junction Transistor; Current Components and Current Gain; Bias modes and operation of bipolar transistor; Non-ideal effects; Base width modulation; High injection effects; emitter bandgap narrowing and emitter current crowding; Breakdown mechanisms in BJTs; BJT small signal equivalent circuit model- Ebers-Moll Model;
- *MOS Capacitors:* Surface Charge in Metal Oxide Semiconductor Capacitors; Capacitance-Voltage Characteristics of a MIS Structure; Low frequency capacitance; High frequency capacitance ;
- *Metal Oxide Semiconductor Field Effect Transistors (MOSFETs):* Gradual Channel Approximation and Constant Mobility Model*;* Charge sheet approximation*;* Threshold Voltage*;* Onset of Pinchoff and Current Saturation*;* Sub-Threshold Characteristics*;* Substrate Bias Effects; Temperature effects; Effective Mobility concept in MOSFETs*;*
- *Short Channel MOSFETs:* Charge Sharing Model; Drain induced Barrier lowering (DIBL*);* Velocity Saturation, Channel length modulation and narrow channel effect.
- *MOSFET Scaling;* Constant field scalin*g;* Generalized scaling, Constant voltage scaling; Channel Dopant Engineering; Series Resistance in scaled MOSFET*s;* Effective Channel Length*;*
- *Semiconductor devices*: junction diode, zener diode, tunnel diode, Schottky diode, switching diode, UJT, SCR, JFET – characteristics, parameters, equipment circuits and basic application circuits.
- *The region of Nanostructures*: The Complexity problem, The challenge initiated by Nanoelectronics: Technological processes for microminiaturization; Methods and limits of microminiaturization in silicon.

Textbooks / References

1. *Physics of Semiconductor Devices, S.M.Sze, (Wiley Eastern Ltd)*
2. *Solid-State Electronic Devices, B. Streetman and S. K. Banerjee, (Wiley Eastern Ltd)*
3. *Semiconductor Physics and Devices, Donald A. Neaman (Tata McGraw-Hill)*
4. *Fundamentals of Modern VLSI Devices, Yuan Taur and Tak H. Ning (Cambridge University Press)*
5. *Nanoelectronics and Nanosystems by K. Goser, P. Glosekotter and J. Dienstuhl – Springer International Edition.*
6. *Nanotechnology by M. Ratner and D. Tatner, Pearson Education.*
7. *Nanotechnology by M. Wilson ,et al.*
8. *Nanotechnology by R. Booker, E. Boysen, Wiley-dreamtech India Pvt. Ltd.*

MEECI 1.2:Control System Analysis and Design

Review of frequency and time response analysis and specifications of control systems, need for controllers, continues time compensations, continues time PI, PD, PID controllers, digital PID controllers.
Sampling, time and frequency domain description, aliasing, hold operation, mathematical model of sample and hold, zero and first order hold, factors limiting the choice of sampling rate, reconstruction.

Difference equation description, Z-transform method of description, pulse transfer function, time and frequency response of discrete time control systems, stability of digital control systems, Jury's stability test, state variable concepts, first companion, second companion, Jordan canonical models, discrete state variable models, elementary principles.
Review of principle of compensator design, Z-plane specifications, digital compensator design using frequency response plots, discrete integrator, discrete differentiator, development of digital PID controller, transfer function, design in the Z-plane.
Algorithm development of PID control algorithms, software implementation, implementation using microprocessors and microcontrollers, finite word length effects, choice of data acquisition systems, microcontroller based temperature control systems, microcontroller based motor speed control systems.

TEXT BOOK:

1. M.Gopal, "Digital Control and Static Variable Methods", Tata McGraw Hill, New Delhi, 1997.
2. John J. D'Azzo, "ConstantiveHoupios, Linear Control System Analysis and Design", McGraw Hill, 1995.
3. Kenneth J. Ayala, "The 8051 Microcontroller- Architecture, Programming and Applications", Penram International, 2nd Edition, 1996.

MEECI 1.3:Introduction to MEMS

Basic device technology: depletion region and diffusion capacitance, junction breakdown, breakdown voltage enhancement in pn junction. Thermal properties and second breakdown phenomenon, calculation of reverse leakage current. IC technology: Lithography, diffusion, ion implantation, oxidation and epitaxial growth. MEMS and Microsystems – Applications , Multidisciplinary nature of MEMS , The effects of miniaturization and scaling .Working principles of Microsystems : Microsensors -Biomedical sensors and biosensors , Optical sensors , pressure sensors . Microactuation : Actuation using piezoelectric crystals , Actuation using Electrostatic forces , (Parallel plate, Comb drive actuators) MEMS with Microactuators : Micro grippers ,micro motors ,micro valves , micro pumps , micro accelerometers ,Microfluidics .Materials for MEMS – Substrates and wafers, silicon as substrate material, Single crystal silicon and wafers, crystal structure ,The Miller Indices ,Mechanical properties of Silicon , Silicon Compounds, Silicon Piezoresistors ,Gallium Arsenide, Quartz, polymers for MEMS ,Packaging materials.Microsystem fabrication – Environment for Microfabrication , Photolithography ,Ion implantation ,Diffusion, Oxidation ,Chemical vapour deposition ,Sputtering , Epitaxy , Etching .Overview of Micro manufacturing – Bulk micro manufacturing , Surface micro machining Microsystems Design - Design considerations – Selection of signal transduction ,Process design ,Design of a silicon die for a micro pressure sensor, Microsystem packaging ,The three levels of micro system packaging ,interfaces in micro system packaging , Signal mapping and transduction RF MEMS and optical MEMS components.

Texts /References :

1. *Tai-Ran Hsu, "MEMS and Microsystems ,Design and Manufacture", TMH, 2002.*
2. *Mark Madou, "Fundamentals of Micro fabrication", CRC Press, New York, 1997.*
3. *Julian W Gardner, "Microsensors: Principles and Applications", John Wiley & Sons, 1994*
4. *Sze S M, "Semiconductor Sensors", McGraw-Hill, New Delhi, 1994.*
5. *NadimMaluf, " An Introduction to Micro Electro Mechanical System Design", Artech House, 2000.*
6. *Chang Liu, 'Foundations of MEMS', Pearson Education Inc., 2006.*
7. *M.H. Bao, "Micro Mechanical Transducers", Volume 8, Handbook of Sensors and Actuators, Elsevier, 2000.*
8. *Chang C Y and Sze S M, "VLSI Technology", McGraw-Hill, New York, 2000.*

MEECI 1.4:Fiber optic communication

- **Dispersion in Single Mode Fibers:** Group Velocity Dispersion, Material Dispersion, Waveguide Dispersion, Higher Order Dispersion, Polarization Mode Dispersion.
- **Fiber Losses:** Attenuation Coefficient, Material Absorption, Rayleigh Scattering, Waveguide Imperfections.
- **Nonlinear Optical Effects:** Stimulated Light Scattering, Phase Modulation, Four Wave Mixing.
- **Optical Sources:** LED Spectrum and Modulation Response, LED Structures, LASER Rate Equations, LASER Structures, Distributed Feedback LASER, Coupled Cavity Semiconductor LASER, Tunable Semiconductor

LASER, Vertical Cavity Surface Emitting LASER, LASER CW Characteristics, Small Signal and Large Signal Modulation, relative Intensity Noise and Spectrum,

- **Optical Transmitters Design:** Source-Fiber Coupling, Driving Circuitry, Optical Modulators, Optoelectronic Integration.
- **Optical Detectors:** p-i-n, Avalanche and MSM Photodetectors, Detector Responsivity, Rise Time and Bandwidth.
- **Optical Receivers Design:** Front End, Linear Channel, Decision Circuit, Integrated Receivers, receiver Noise, Sensitivity Degradation.
- **Optical Amplifiers:** Semiconductor Optical Amplifier, Raman Amplifier, Erbium Doped Fiber Amplifier, System Applications.
- **Dispersion Management:** Pre and Post Compensation Schemes, Dispersion Compensating Fibers, Otical Filters, Fiber Bragg Gratings.
- **WDM Lightwave Systems:** High Capacity point to point Links, Wide and Metro Area networks, Multiple Access WDM systems.
- **WDM Components:** Tunable Optical Filters, Multiplexers &Demultiplexers, Add-Drop Multiplexers, Star Couplers, Wavelength Routers, Optical Cross Connects, Wavelength Converters, WDM Transmitters & Receivers.

Textbooks / References

1. *G. Agrawal, Fiber Optic Communication Systems, John Wiley and Sons, 3rd Ed 2002*
2. *G. Keiser, Fibre Optic Communication, McGraw-Hill, 2nd Ed. 1992.*
3. *AjoyGhatak and K. Thyagarajan, An Introduction to Fiber Optics, Cambridge Univ, 1998*
4. *G.Agrawal, Nonlinear Fiber Optics, Academic Press, 2nd Ed. 1994.*
5. Optical Fiber Technology, DetlefGloge, IEEE Press, 1975

MEECI 1.5:Advanced Engineering Mathematics:

Random Variables: Specific Random variables, Mean and variances, Moments, binomial distribution, uniform distributions, Gaussian or normal distribution, chi-square distribution, Rayleigh distribution,
Bivariate Distributions, One function of two random variables, two functions of two random variables, Joint Moments, Joint Characteristic functions, Logarithmic and multivariate Gaussian distribution
Sequence of Random Variables: Conditional densities, Mean Square Estimation
***Stochastic Processes*General concepts:** General concepts, Defination, Systems with stochastic inputs, the power spectrum, Spectral Representation: Factorization and innovations, finite order systems and state variables, Fourier series and Karhunen-Loeve Expansions
Spectrum Estimation: Ergodicity, Spectrum Estimation
Mean Square Estimation: Introduction, Prediction and filtering and Prediction
Entropy: Introduction, Basic Concepts, The maximum entropy method, Coding, channel capacity.
Markov Chains: Introduction.
***Linear Algebra*:**
Introduction to matrices, Geometry of linear equations, Gaussian Elimination, Vector space and subspaces, , Linear Independence, basis and dimension, The four fundamental Subspaces, Graphs and networks
Linear Transformation and Algebra of linear Transformation, Rotation P, Projection P and Reflection H
Orthogonality: Orthogonal vectors and subspaces
Cosine inner product and projection onto lines, Schwarz inequality
Eigen Values and Eigen Vectors, Diagonalisation of Matrices, Complex Matrices.
Numerical Methods in Linear Algebra, Numerical Methods for Differential Equations.

Textbooks / References

1. *Athanasios Papoulis " Probability , Random variables and stochastic processes"*

2. *Roy D Yates" Probability and Stochastic Processes" John Wiley*

3. *GilberStrang "Linear algebra and its applications" Thomson*

4. *Hadley "Linear Algebra" Narosa publishing house*

5. *John G.Proakis "Digital Communication " Digital Communication "*

6. *Erwin Kreysig "Advanced Engineering Mathematics", Wiley Eastern*

MEECI 1.6:Fiber Optics - Lab

- To establish optical power profile measurement using Optical Time Domain Reflectometer
- To determine working of Optical Power Splitter
- To determine working of Optical Switch
- To determine working of WDM Coupler/Splitter
- To carry out Fusion Splicing of two single mode fibers
- To determine spectral response of Wavelength Division Multiplexed signal using optical Spectrum Analyzer
- To carry out V-groove splicing of two single mode fibers
- To determine and evaluate LASER power-current characteristics
- To determine VI characteristics of various LED types and establish relationship between cut-in parameters and band-gap energy
- To design and simulate a complete optical network system and evaluate its performance using OPTISYTEM software

MEECI 1.7:Process Control And Instrumentation Laboratory

- Study of Process Control Training plant
- Piping and Instrumentation diagram
- Simulation of coupled parameter and Distributed parameter system.
- Identification of linear dynamic model of a process using non parametric methods.
- Design and implementation PID Control scheme on simulated process.
- PID Implementation issues
- Level and pressure control (with and without Interaction) in process control Test Rig.
- Auto- Tuning of PID controller
- (b) Design and implementation of gain scheduled Adaptive controller on the simulated model of variable area tank process.
- Design and implementation of Feed forward and Cascade control schemes on the simulated model of CSIR process.
- Analysis of MIMO system.
- Design and implementation of Multi-loop PID and Multivariable PID control schemes on the simulated model of two-tank systems.
- Design and implementation of Robust PID control schemes on the simulated
- model of variable area tank process.
- Design and implementation of Self tuning and Model Reference Adaptive
- Control schemes on the simulated model of variable area tank process.

SEMESTER 2

MEECI 2.1:Biomedical Instrumentation

Brief introduction to human physiology. Biomedical transducers: displacement, velocity, force, acceleration, flow, temperature, potential, dissolved ions and gases.
Bioelectrodes and biopotential amplifiers for ECG, EMG, EEG, etc. Measurement of blood temperature, pressure and flow. Impedance plethysmography. Ultrsonic and nuclear imaging.
Sources of bio electric potentials and electrodes
The Cardiovascular system and cardio vascular measurements
Patient care and monitoring and measurements in respiratory system
Bio telemetry and instrumentation for the clinical lab, defibrilla-tors, heart-lung machine, artificial kidney, aids for the handicapped.
X-ray and radio isotope instrumentation and electrical safety of medical equipment.
Prostheses and aids: pacemakers. Safety aspects.
Bio-telemetry; radio telemetry services single and multi-channel telemetry circuits
AMPLITUDE MODULATION AND DEMODULATION CIRCUITS FOR MESURENT SYSTEMS:
Basic configuration for a modular electronical chopper semiconductor modulator balanced modulator basic configuration of a demodulator chopper demodulator semiconductor demodulators balanced demodulator.
MULTIPLEXING IN TELEMETRY SYSTEMS: Block diagram of a multiplexer and its mechanical switch equivalent block diagram of a demultiplexer and its mechanical switch equivalent frequency division multiplexing time division multiplexing sample –and – hold circuit an outline of pulse modulation techniques used in telemetry.

Textbooks / References

1. *W.F. Ganong, Review of Medical Physiology, 8th Asian Ed, Medical Publishers, 1977.*
2. *J.G. Websster, ed., Medical Instrumentation, Houghton Mifflin, 1978.*
3. *A.M. Cook and J.G. Webster, eds., Therapeutic Medical Devices, Prentice-Hall, 1982.*
4. *Biomedical Transducers and Instruments by Tatsuo Togawa, P. Ake Oberg, Toshiyo Tamura, P. ÅkeÖberg*
5. *Signals and Systems Analysis in Biomedical Engineering by Robert B. Northrop*
6. *Bioimpedance and Bioelectricity Basics by SverreGrimnes, OrjanGrottemMartinsen*

MEECI 2.2:Digital Signal Processors & Embedded Systems

Digital signal processors: general and special purpose digital signal processors, computer architecture for signal processing, selecting digital signal processors, architecture and programming of TMSC6713 processor.

Introduction to DSP ASIC Design, Configurable Logic for Digital Signal Processing, Design methodology for DSP, VLSI Implementation of DSP Processors.

Introduction: ARM embedded systems, RISC design philosophy, ARM processor fundamentals, Programmer's model, pipeline, ARM processor families.

ARM Instruction set:Data processing instructions, Branch & load-store instructions, Software interrupt instructions, Program status register instructions, Manipulating bits & bit patterns, Arithmetic operations.

I/O related operations:Input & output, Semi hosting, Serial IO, Input from switches & external events, Timing of IO actions, Programming.

ARM Hardware:ARM hardware, ARM nodes, Exceptions & Exception Handlers, Program structures & testing.Embedded ARM Applications:VLSI Ruby II Advanced communication Processor.VLSI ISDN subscriber processor.Ericsson-Bluetooth baseband controller.ARM 1176 – JZFS in Raspberry Pi.ARM Cortex –A8 (armv7a) in Beagle Bone.

Textbooks/ References:

1. *Steve Furber "ARM System-on-Chip Architecture", Second Edition, Pearson Education, 2000.*
2. *J.R. Gibson "ARM Assembly Language – an Introduction" Dept. of Electrical Engineering and Electronics, The University of Liverpool, 2007.*
3. *Andrew N. Sloss, Dominic Symes, Chris Wright, " ARM System Developer's Guide" Elsevier, 2004.*
4. *Emmanuel C. Ifeachor Barrie W. Jervis, "Digital Signal Processing", Pearson Education Asia*
5. *Manual of TMS320C67XX processor*

MEECI 2.3:Information Theory & Coding:

- Discrete Source of Information, Entropy of an Information Sources, Extension of a zero memory sources.
- Markov information process & its entropy, Information channels, probability relations in a channel.
- A priori & A Posteriori Entropies, Equivocation Mutual information, properties of mutual information.
- Capacity of channels, symmetry channels/uniform channels, BSC, BEC, Noiseless & Deterministic channels, and Cascaded channels.
- Classification of codes: Block codes, bounds & inequalities.
- Instantaneous codes, Average length, Variable length codes for lossless data compression.
- Kraft's Inequality, compact codes, efficiency & redundancy, Huffman & Shannon-fano codes, Adaptive Huffman code encoding & decoding.
- Groups, rings & fields, properties of infinite fields, Primitive Polynomials Construction of GF (2^m), Primitive element, conjugates of an element over GF (2^m)
- Galois Field arithmetic Realization & Implementation.
- Vector Space, Introduction to linear block codes
- Generator and parity check matrices, Implementation of encoder & decoder.
- Hamming code systematic, standard array and syndrome decoding, Non-systematic hamming code.
- Probability of error, Weight Distribution
- Introduction to Cyclic codes, generator and parity check matrices of cyclic codes.
- Determining of transmitted code and error detection of received code.
- Encoding and decoding of cyclic codes, Cyclic hamming codes & implementations.

Textbooks / References

1. *N. Abramson, Information and Coding, McGraw Hill, 1963.*
2. *Shu Lin and D.J. Costello Jr., Error Control Coding, Prentice Hall, 1983.*
3. *Hamming, Richard Wesly, "Coding and Information Theory", Prentice hall,1980.*
4. *McWilliams & Sloane "Error Correcting Codes", North Holland Publishing Co.*
5. *Peterson & Weldon, "Error Correcting Codes", John Wiley.*
6. *M. Mansurpur, Introduction to Information Theory, McGraw Hill, 1987.*
7. *R.B. Ash, Information Theory, Prentice Hall, 1970.*
8. *Berlekamp, "Algebraic Coding Theory", Mc-Graw hill.*

MEECI 2.4:Microwave Integrated Circuits

Introduction to microwave integrated circuits: Active and passive components.Analysis of microstrip lines: variational method, conformal transformation, numerical analysis; losses in microstrip lines; Slot line and Coupled lines; Design of power dividers and combiners, directional couplers, hybrid couplers, filters.Microstrip lines on ferrite and garnet substrates; Isolators and circulators; Lumped elements in

MICs.Technology of MICs: Monolithic and hybrid substrates; thin and thick film technologies, computer aided design.

Textbooks / References

1. *Leo Young and H. Sobol, Ed. Advances in Microwaves, Vol.2, Academic Press Inc., 1974.*
2. *B.Bhatand S. Koul, Stripline-like transmission lines for MICs, John Wiley, 1989.*
3. *T.K. Ishii, Handbook of Microwave Technology*

MEECI 2.5:Adaptive Signal Processing

Discrete Time Random Variables: Ensemble Averages, Joint Distribution, Joint Moments, Independent, Uncorrelated and Orthogonal random Variables, Linear Mean Square Estimation, Bias and Consistency.
Random Processes: Stationary Processes, The Autocovariance and Autocorrelation Matrices, Ergodicity, White Noise and Power Spectrum, Filtering, Spectral factorization, Types of Random Processes: ARMA, AR and MA.
Stochastic Signal Modeling: ARMA models, AR and MA models, Applications in Power Spectrum Estimation.
Wiener Filtering: The FIR Wiener filter, Filtering, Linear Prediction, Noise Cancellation.
Spectrum Estimation: Nonparametric models – The Periodogram, Performance of the Periodogram, The Modified Periodogram, Periodogram Averaging (Bartletts Method).
Adaptive Filtering: FIR Adaptive Filters – The Steepest Descent Adaptive Filter, The LMS Algorithm and its convergence. Normaized LMS.
Applications in Array Processing: Spatial Filtering/ Beamforming, Interference Mitigation in Radar Systems, Sidelobe Canceller.
Other Applications: Channel Equalization, Acoustic Echo Cancellation, Linear Predictive Coding, Active Noise Control.

Textbooks / References

1. *Statistical Digital Signal Processing and Modeling by Monson H. Hayes, Wiley India (2002)*
2. *Adaptive Filter Theory by Simon Haykin, Prentice Hall (1986)*
3. *Statistical and Adaptive Signal Processing by DmitrisManolakis, Vinay Ingle and Stephen Kogon, Artech House (2005)*
4. *Adaptive Signal Processing by Widrow and Stearns, Prentice Hall (1984)*

MEECI 2.6:Microwave Lab

- MIC component characterization, design simulation fabrication of MIC components.
- Measurement of wave length and Frequency, equivalent circuit of cavity wave meters.
- Typical wave meters, Resonant cavities.
- Methods of frequency measurements-Direct measurement – Interpolation method. Measurement of reflection coefficient Low, high, medium VSWR measurements. Standing wave pattern, Slotted line section and its limitation. Impedance measurement techniques. Nodal shift method. Tangent method. Reflectometer.
- Measurement of microwave power: Typical barrater elements, thermistor.
- Bolometer bridge circuits, extending range of bolometer devices, low and high power measurement techniques.
- Measurement of attenuation: insertion loss method. Substitution method.

- Measurement of S- parameters. Network Analyzer principle. Reflection and Transmission measurements using vector network Analyzer.
- Measurements on passive microwave components. Characteristics of directional coupler. Isolator, Circulator. Antenna Measurements.
- Measurements of radiation pattern, Antenna gain measurements. Far field and Near field techniques.

MEECI 2.7: Biomedical Lab

Lab will be based on theory of BIOMEDICAL INSTRUMENTATION and minimum of 08 experiments.

SEMESTER 3

a) Image Processing:

Introduction: Fundamental Steps in Image Processing, Elements of Image Processing Systems.

Digital Image Representation - Gray Scale and Color Images.

Image Sampling and Quantization – Uniform & Non-Uniform.

Relationships between Pixels – Neighbours, Connectivity, Distance Measures, Arithmetic & Logic Operations.

Basic Transformations – Translation, Rotation, Concatenation and Perspective Transformation.

Two Dimensional Orthogonal Transforms - DFT, FFT, WHT, Haar transform, KLT, DCT.

Image Enhancement - Filters in spatial and frequency domains, histogram-based processing, Homomorphic filtering.

Image Restoration - Degradation Model, Discrete Formulation, Circulant and Block Circulant Matrices, Restoration using Inverse Filtering, Removal of blur caused by uniform linear motion, LMS Wiener Filter.

Image Compression – Lossless and Lossy Coding, Transform Coding, JPEG, MPEG.

Edge detection – Detection of point, line, discontinuities. Gradient Operators, Laplacian, LoG Filters, Global Processing via Hough Transform.

Mathematical morphology - Binary Morphology, Dilation, Erosion, Opening and Closing, Duality Relations, Gray Scale Morphology, Hit-and-Miss Transform, Thinning and Shape Decomposition.

Computer Tomography - Radon transform, Back-Projection Operator, Fourier-slice theorem, CBP and FBP methods.

Textbooks / References

1. *Digital Image Processing by Rafael C. Gonzalez and Richard E. Woods, Pearson, 2009*
2. *Fundamentals of Digital Image Processing by Anil K. Jain, Prentice Hall of India, 1989.*
3. *Digital image processing by W. K. Pratt, Prentice Hall, 1989.*
4. *Sonka, Hlavac, Boyle, Image Processing, Analysis and Machine Vision, Thomson, 2001*

b) Error Correcting Codes

Linear block codes : Systematic linear codes and optimum decoding for the binary symmetric channel; Generator and Parity Check matrices, Syndrome decoding on symmetric channels; Hamming codes; Weight enumerators and the MacWilliams identities; Perfect codes.
Introduction to finite fields and finite rings; factorization of (X^n-1) over a finite field; Cyclic Codes. BCH codes; Idempotents and Mattson-Solomon polynomials; Reed-Solomon codes, Justeen codes, MDS codes, Alterant, Goppa and generalized BCH codes; Spectral properties of cyclic codes.
Decoding of BCH codes: Berlekamp's decoding algorithm, Massey's minimum shift register synthesis technique and its relation to Berlekamp's algorithm. A fast Berlekamp - Massey algorithm.
Convolution codes; Wozencraft'ssequential decoding algorithm, Fann's algorithm and other sequential decoding algorithms; Viterbi decoding algorithm.

Textbooks / References

1. *F.J. MacWilliams and N.J.A. Slone, The theory of error correcting codes, North Holland, 1977.*
2. *R.E. Balahut, Theory and practice of error control codes, Addison Wesley, 1983.*

c)Optical Computing

Basic elements of optical systems- mirrors, gratings, lenses. Transducers- spatial light modulators, Holographic elements, Fundamental Limitations on dynamic range, Hybrid optical electronics systems, Dependence between optics and electronics.Image spectral analysis and filtering, pattern recognitions Picture deblurring –synthetic aperture Radar imaging. Radio signal analysis-simple arithmetic, matrix operation- Differential and integration Non –linear effects- optical bistability, Hybrid polarisation devices, optical phase conjugation. Passive and Active integrated optic devices
Digital optical computers – Internal representation, implementation of binary logic elements, implementation of arithmetic units.
Memory – interconnection and communication –Architectures

Textbooks / References

1. *Optical Computing: An Introduction by Mohammad A. Karim, Abdul A. S. Awwal*
2. *A Digital Design Methodology for Optical Computing by Miles Murdocca*
3. *Introduction to Fourier Optics by Joseph W. Goodman*
4. *Optical Computing: A Survey for Computer Scientists, by Feitelson, D. G., (ISBN 0-262-061-120), MIT Press 1988.*

d) RF Microelectronic Chip Design:

Introduction to RF and Wireless Technology: Complexity, design and applications. Choice of Technology. Basic concepts in RF Design: Nonlinearly and Time Variance, intersymbol Interference, random processes and Noise. Definitions of sensitivity and dynamic range, conversion Gains and Distortion. Analog and Digital Modulation for RF circuits: Comparison of various techniques for power efficiency. Coherent and Non coherent defection. Mobile RF Communication systems and basics of Multiple Access techniques. Receiver and Transmitter Architectures and Testing heterodyne, Homodyne, Image-reject, Direct-IF and sub-sampled receivers. Direct Conversion and two steps transmitters. BJT and MOSFET behavior at RF frequencies Modeling of the transistors and SPICE models. Noise performance and limitation of devices. Integrated Parasitic elements at high frequencies and their monolithic implementation. Basic blocks in RF systems and their VLSI implementation : Low Noise Amplifiers design in various technologies, Design of Mixers at GHz

frequency range. Various Mixers, their working and implementations, Oscillators: Basic topologies VCO and definition of phase noise. Noise-Power trade-off. Resonatorless VCO design. Quadrature and single-sideband generators, Radio Frequency Synthesizes: PLLS, Various RF synthesizer architectures and frequency dividers, Power Amplifiers design. Linearisation techniques, Design issues in integrated RF filters. CAD tools for RF VLSI designs.

Texts/References

1. *B.Razavi, RF Microelectronics, Prentice-Hall PTR,1998*
2. *T.H.Lee, The Design of CMOS Radio-Frequency Integrated Circuits", Cambridge University Press, 1998.*
3. *R.JacobBaker,H.W.Li, and D.E. Boyce, CMOS Circuit Design ,Layout and Simulation, Prentice-Hall of India,1998.*
4. *Y.P. Tsividis Mixed Analog and Digital VLSI Devices and Technology, McGraw Hill,1996*

e) Power Electronics:

Review of line commutated converters, inverters, voltage control & Power factor improvement. power Devices : BJT, MOSFET, IGBT & GTOs - operating characteristics and gate drive requirements and circuits. Switched - mode rectifier: various Power circuit configurations & wave shaping techniques. Synchronous link rectifiers: Power circuit configurations, control techniques, application of these converters in load compensation, series compensators, multi level converters. inverters : voltage source inverters:- single phase & Six step inverters, voltage control & PWM strategies,and implementation aspects, Modification of power circuit for Four quadrant operation. Current source inverters: single phase and three phase power circuit configuration and analysis. Load commutated inverters: principle of operation, modification of power circuit configuration for low frequency operation. Phase Controllers.

Texts/References

1. *N.Mohan,T.M. Undeland&W.P.Robbins, Power Electronics: Converter, Applications & Design, John Wiley & Sons, 1989.*
2. *M.H. Rashid, Power Electronics, Prentice Hall of India, 1994.*
3. *B.K.Bose, Power Electronics & A.C. Drives, Prentice Hall, 1986.*
4. *R. Bausiere& G. Seguier, Power Electronic Converters, Springer- Verlag, 1987.*
5. *D.M.Mitchell, DC-DC Switching Regulator Analysis McGraw Hill, 1987.*

f)Industrial Design of Electronic Equipments:

Introduction to industrial design , product design methodology, product planning, data collection , creativity techniques, elements of aesthetics,. Ergonomics, control panel organization, graphic user interface, design structure, materials , processes and product finishers, product detailing anf value engineering.

Texts/References

1. *Industrial Design andEngg. Design council By Flurschiem CH (springer verlag)*
2. *control Panel Design and Ergonomics By Yammiyavar (CEDT/IISC publication)*

g) Electronic System Design:
Signal conditioning, instrumentation and isolation amplifiers, analog filters, analog switches, programmable circuits, switched- capacitor circuits and application. A/D and D/A conversion: sampling and quantisation, antialiasing and smoothening filters , data converters, interfacing with DSP blocks. Signal measurements in the presence of noise: synchronous detection, signal averaging .noise in electronic systems: design of low nise circuits. Interfacing of analog and digital systems. PCB design and layout; system assembly consideration.

Texts/References

1. *S Sedra and KC Smith, Microelectronic circuits, Oxford, 1998.*
2. *S. Soclof, Applications of analog integrated circuits, Prentice Hall1990.*
3. *T. T. Lang, Electronics of measuring systems - practical implementation, Wiley,1987.*
4. *P. Horowitz and W Hill, The art of electronics, Cambridge,1995.*
5. *H.W.Ott, Noise Reduction Techniques in Electronic Systems, Wiley, 1989.*
6. *S. K Mitra, Digital signal processing: a computer based approach, McGraw Hill, 1998.*
7. *W.C. Bosshart, Printed Circuit Boards: Design and Technology, Tata McGraw Hill, 1983.*
8. *G.L. Ginsberg, Printed Circuit Design, McGraw Hill, 1991.*

h) Wireless Communication

Wireless Communications and Diversity: Fast Fading Wireless Channel Modeling, Rayleigh/Ricean Fading Channels, BER Performance in Fading Channels , Diversity modeling for Wireless Communications, BER Performance Improvement with diversity, Types of Diversity – Frequency, Time, Space

Broadband Wireless Channel Modeling, WSSUS Channel Modeling, RMS Delay Spread, Doppler Fading, Jakes Model, Autocorrelation, Jakes Spectrum, Impact of Doppler Fading

Cellular Communications: Introduction to Cellular Communications, Frequency reuse, Multiple Access Technologies, Cellular Processes - Call Setup, Handover, Teletraffic Theory

Code Division Multiple Access: Introduction to CDMA, Walsh codes, Variable tree OVSF, PN Sequences, Multipath diversity, RAKE Receiver, CDMA Receiver Synchronization

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

MIMO Systems: Introduction to MIMO, MIMO Channel Capacity, SVD and Eigen modes of the MIMO Channel, MIMO Spatial Multiplexing – BLAST, MIMO Diversity – Alamouti, OSTBC, MRT, MIMO - OFDM

Ultra Wide Band Communication: UWB Definition and Feature, UWB Wireless Channels, UWB Data Modulation, Uniform Pulse Train, Bit - Error Rate Performance of UWB

3G and 4G Wireless Standards: GSM, GPRS, WCDMA, LTE, WiMAX

References:

1. *Fundamentals of Wireless Communications* by David Tse and PramodViswanath: Cambridge University Press.
2. *Wireless Communications* by Andrea Goldsmith: Cambridge University Press.
3. *Wireless Communications: Principles and Practice* by Theodore Rappaport: Prentice Hall.
4. *MIMO Wireless Communications* by EzioBiglieri:Cambridge University Press.
5. *Digital Communications* by John G Proakis: McGraw Hill Science/Engineering/Math.
6. *Wireless Communications* by Andreas Molisch: Wiley IEEE Press.
7. *Mobile Wireless Communications* by Mischa Schwartz: Cambridge University Press

i) Sensors in Instrumentation:

Sensor characteristics; R, L and C sensors: Hall effect sensors; Piezoelectric sensors; Micro-sensors. Sensors for displacement, pressure, temperature, flow etc. Optical sensors; chemical and bio-sensors. Sensor applications in non-destructive testing. Interfacing sensors with microprocessors and micro controllers.

Texts/References

1. *D. V.S.Murthy,Transducers in instrumentation,Prentice Hall, 1995.*
2. *J. P.Bentley, Principles of measurement systems, Wiley,1989*
3. *J. W.Gardner, Microsensors, principles and applications, Wiley,1996.*
4. *S.M.Sze, Semiconductor Sensors, Wiley,1994*

j) Simulation of Circuits and Devices

Formulation of network equations: Nodal, mesh, modified nodal and hybrid analysis equations.
Sparse matrix techniques; Solution of nonlinear networks through Newton-Raphson technique. Multistep methods: convergence and stability; Special classes of multistep methods: Adams-bashforth, Adams-Moulton and Gear's methods; Solution of stiff systems of equations; Adaptation of multistep methods to the solution of electrical networks; General purpose circuit simulators.
Review of semiconductor equations (Poisson, continuity, drift-diffusion, trap rate). Finite difference formulation of these equations in 1D and 2D. Grid generation.
Physical/empirical models of semiconductor parameters (mobility, lifetime, band gap, etc.).
Computation of characteristics of simple devices (p-n junction, MOS capacitor, MOSFET, etc.); Small-signal analysis.

Texts/References

1. *L.O.Chua and P.M.Lin, Computer aided analysis and electronic circuits, Prentice Hall, 1975.*
2. *S. Selberherr, Analysis and Simulation of Semiconductor Devices, Springer-Verlag, 1984.*
3. *N.J. McCalla, Fundamentals of Computer Aided Circuit Simulation, Kluwer Academic Publishers, 1988.*

k) Analog VLSI Design:

Single-Stage amplifiers:
Basic concepts, Common-Source Stage, Source Follower, Common- Gate Stage, Cascode Stage, Choice of device models.

Differential amplifiers:
Single –ended & differential operations, basic differential pair, Common mode response, Differential pair with MOS loads, Gilbert cell.

Passive & Active Current Mirrors:
Basic current mirrors, Cascode Current mirrors, Active current mirrors,

Frequency Response of Amplifiers:
General Considerations, Common Source Stage, Source Followers, Common-gate Stage, Cascode Stage, Differential Pair.

Noise:
Statistical Characteristics of noise, Types of noise, Representation of noise in circuits, Noise in single stage amplifiers, Noise in differential pairs, Noise Bandwith,

Feedback:
General Considerations, Feedback topologies, Effect of loading, Effect of feedback on Noise.

Operational amplifiers:
General considerations, One stage op amps, Two stage op-amps, Gain boosting, comparison, Common mode feedback, Input range limitations, slew rate, Power supply rejection, Noise in op-amps

Oscillators:
General considerations, Ring oscillators , LC oscillators, Voltage controlled oscillators

Phase locked loops:
Simple PLL, Charge-pump PLL's, Nonlinear effects in PLL, Delay locked loops, Applications.

Text/References

1. *BehzadRazavi, " Design of Analog CMOS Integrated Circuits", Tata Mc-Graw Hill.*
2. *R.* Jacob Baker, *Harry W.* Li, *David E. Boyce,* "CMOS *Circuit Design, Layout, and Simulation"*
3. *Paul R. Gray and Robert G.Meyer, " Analysis and Design of Analog Integrated Circuits", John Wiley & Sons.*
4. *Mohammed Ismail, Terri Fiez, " Analog VLSI signal and Information Processing ", 1994, McGraw-Hill International Editons.*

l) Virtual Instrumentation

Virtual Instrumentation: Historical perspective, advantages, block diagram and architecture of a virtual instrument, data-flow techniques, graphical programming in data flow
Comparison with conventional programming. Development of Virtual Instrument using GUI.
Real-time systems, Embedded Controller, OPC, HMI/SCADA software, Active X programming.

VI programming techniques: VIS and sub-VIS, loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes.
Local and global variables, string and file I/O, Instrument Drivers, Publishing measurement data in web.
Programming examples

Data acquisition basics: Introduction to data acquisition on PC, Sampling fundamentals, Input/Output techniques and buses. ADC, DAC, Digital I/O, counters and timers, DMA, Software and hardware installation, Calibration, Resolution, Data acquisition interface requirements.

VI Chassis requirements. Common Instrument Interfaces: current loop, RS232C/RS485, GPIB, Bus Interfaces: USB, PCMCIA, VXI, SCSI, PCI, PXI, Firewire. PXI system controllers, Ethernet control of PXI. Networking basics for office and Industrial applications, VISA and IVI.

VI toolsets, Distributed I/O modules. Application of Virtual Instrumentation: Instrument Control, Development of process database management system.
Simulation of systems using VI, Development of Control system, Industrial Communication, Image acquisition and processing, Motion control.

TEXTBOOKS

1. *Gary Johnson, LabVIEW Graphical Programming, Second edition, McGraw Hill, Newyork, 1997.*

2. *Lisa k. Wells & Jeffrey Travis, LabVIEW for everyone, Prentice Hall, New Jersy, 1997.*

REFERENCE BOOKS

1. *Kevin James, PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control, Newnes, 2000*

m) Wavelet Transforms and Multirate Digital Signal Processing

Fundamentals of multi-rate systems**:** Basic multi rate operations, interconnection
of building blocks, poly phase representation, multi stage implementation, applications of multi rate systems, special filters and filter banks.

Multirate Filter Banks:
Maximally decimated filterbanks:Errorscreatd in the QMF bank alias free QMF system, power symmetric QMF banks,M channel filter banks, poly phase representation, perfect reconstruction systems, alias free filter banks,tree structured filter banks,trans multiplexers.

Continuous Wavelet Transform:
Introduction, C-T wavelets, Definition of CWT, The CWT as a correlation. Constant Q-Factor Filtering Interpolation and time frequency resolution, the CWT as an operator, inverse CWT.

Introduction To Discrete Wavelet Transform And Orthogonal Wavelet Decomposition**:** Introduction. Approximation of vectors in nested linear vector spaces, (i) example of approximating vectors in nested subspaces of a finite dimensional liner vector space, (ii) Example of approximating vectors in nested subspaces of an infinite dimensional linear vector space. Example MRA. (i) Bases for the approximations subspaces and Harr scaling function, (ii) Bases for detail subspaces and Haar wavelet.

MRA, Ortho Normal Wavelets And Their Relationship To Filter Banks**:** Introduction, Formal definition of an MRA. Construction of a general orthonormal MRA, (i) scaling function and subspaces, (ii) Implication of dilation equation and orthogonality, a wavelet basis for MRA. (i) Two scale relations for (t), (ii) Basis for the detail subspace (iii) Direct sum decomposition, Digital filtering interpolation (i) Decomposition filters, (ii) reconstruction, the signal.

Alternative Wavelet Representations**:** Introduction, Bi-orthogonal wavelet bases, Filtering relationship for bi-orthogonal filters, Examples of bi-orthogonal scaling functions and wavelets.
2-D wavelets.

Non - separable multidimensional wavelets, wavelet packets.
Wavelets Transform and Data Compression:Introduction, transform coding, DTWT for image compression

(i) Image compression using DTWT and run-length encoding.

(i) Embedded tree image coding (ii) compression with JPEG audio compression (iii) Audio masking, (iv) Wavelet based audio coding.

Construction Of Simple Wavelets**:** Construction of simple wavelets like Harr and DB1.

Other Applications of Wavelet Transforms:Introduction, wavelet de-noising, speckle removal, edge detection and object isolation, Image fusions, Object detection by wavelet transforms of projections.

Text books:

1. *Wavelet transforms- Introduction to theory and applications, RaghuveerM.Rao and Ajit S. Bapardikar, Person Education, 2000.*
2. *P.P.Vaidyanahan,"Multirate Systems and Filter Banks,"Pearson Education (Asia)Pte.Ltd,2004.*

Reference Books:

1. *Wavelet transforms, Prasad and Iyengar, Wiley estern, 2001.*
2. *Wave-let and filter banks, Gilbert Strang and Nguyen Wellesley Cambridge press, 1996*
3. *Insight into WAVELETS from theory to practice, K.P. Soman*
4. *and K.L. Ramchandran, Eastern Economy Edition, 2008*

n) RF Design:

- Introduction to RF Electronics.
- Basic concepts in RF design.
- MOS Review
- Path Loss
- Small Signal Model
- Receiver Design
- RF Transreceivers
- Low Noise RF amplifiers and Mixers.
- RF Power amplifiers.
- RF Oscillators.

Text/References

1. *BehzadRazavi, "RF Microelectronics", Pearson Education.*

2. *Reinhold Ludwig, Paul Bretchko,"RF Circuit Design: Theory & Applications "*
3. *Peter b. Kenington, "High Linearity RF Amplifier Design ", Artech House Microwave Library.*
4. *Jeremy Everard, "Fundamentals of RF Circuit Design With Low Noise Oscillators", John Wiley & Sons Ltd.*

o) Advanced Digital Communication

Introduction: Complex baseband representation of signals, Gram-Schmidt orthogonalization procedure. M-ary orthogonal signals, bi-orthogonal signals, simplex signal waveforms.

Continuous phase modulation: QPSK and variants, MSK, GMSK.

Receiver in additive white Gaussian noise channels: Coherent and noncoherent demodulation: Matched filter,Correlator demodulator, square-law, and envelope detection; Detector: Optimum rule for ML and MAP detection Performance: Bit-error-rate, symbol error rate for coherent and non-coherent schemes.

Band-limited channels: Pulse shape design for channels with ISI: Nyquist pulse, Partial response signaling (duobinary and modified duobinary pulses), Channel with distortion: Design of transmitting and receiving filters for a known channel and for time varying channel (equalization); Performance: Symbol by symbol detection and BER, symbol and sequence detection, Viterbi algorithm.

Synchronization: Different synchronization techniques - Early-Late Gate, MMSE, ML and spectral line methods

Communication over fading channels: Characteristics of fading channels, Rayleigh and Ricianchannels, receiver performance-average SNR, outage probability, amount of fading and average bit/symbol error rate.

References:

1. *Fundamentals of Communication Systems* by J. G. Proakis and M. Salehi,: Pearson Education, 2005.
2. *Communication Systems, 5th ed*by SimonHaykins: John Wiley, 2008.
3. *Digital Communication Techniques*: *Signaling and detection* by M. K. Simon, S. M. Hinedi and W. C. Lindsey: Prentice Hall India, N. Delhi, 1995.
4. *Advanced Electronic Communication Systems, 4th Ed.*, by 4. W. Tomasi, Pearson Education, 1998.
5. *Digital Communication over Fading Channels* by M. K. Simon and M. S. Alouini: Wiley 2000.

p) Radar Systems Engineering

The radar range equation: Radar fundamentals. derivation of range equation, the search radar equation, jamming and radar range with jamming, radar clutter and radar range with clutter. radar range with combined interferences sources. The theory of target detection: Noise and false alarms. Detection of one sample of signal with noise, integration of pulse trains, detection of fluctuating targets, CFAR, Optimum and matched filter Theory. loss factors in detection. Targets and interference: Definition of radar cross section . Radar cross section of simple and complex objects, Spatial distribution of cross section. Bistatic cross section. CW and FM Radar: Doppler Effect. CW and FMCW Radar, Airborne Doppler Navigation, Multi frequency CW Radar.

MTI Radar: Delay lines and line cancellors, subclutterVisibility.MTI using range gates and filters, pulse Doppler radar. Non-coherent MTI radar. Application of Digital signal processing to radar system. Tracking Radar: Different types of tracking techniques. Tracking in range. Tracking in Doppler. Search Acquisition radar. Comparision of Trackers. Introduction to pulse compression Radar: Height finding radars. Air traffic control. Radars and data handling . Atmospheric effects of radar. Electromagnetic compatibility aspects. Airborne Radars, synthetic Aperture Radar. Secondary surveillance Radars.

TEXTBOOKS:

1. David barton .k, Modern radar system analysis, Artech house, 1988.
2. Fred nathanson e, Radar design principles signal processing and the environment, McGraw Hill.1969.
3. Cook CE. Bernfield. M, Radar signals. Academic press, 1967.
4. Skolnik, Introduction to radar systems ,Mcgraw hill, 2nd Edition 2003.

q) Electromagnetic Interference and Electromagnetic Compatibility

INTRODUCTION Sources of EMI, Conducted and radiated interference- Characteristics - Designing for electromagnetic compatibility (EMC)- EMC regulation- typical noise path- use of network theory- methods of eliminating interferences.

METHOD OF HARDENING Cabling –capacitive coupling- inductive coupling- shielding to prevent magnetic radiation- shield transfer impedance, Grounding – safety grounds – signal grounds- single point and multipoint ground systems- hybrid grounds- functional ground layout –grounding of cable shields- ground loops-guard shields. balancing, filtering and shielding Power supply decoupling- decoupling filters-amplifier filtering – high frequency filtering- shielding – near and far fields- shielding effectiveness- absorption and reflection loss, Shielding with magnetic material- conductive gaskets, windows and coatings- grounding of shields.

Digital circuit noise and layout Frequency versus time domain- analog versus digital circuits- digital logic noise- internal noise sources- digital circuit ground noise –power distribution-noise voltage objectives-measuring noise voltages-unused inputs-logic families.

Electrostatic discharge,STANDARDS AND LABORATORY TECHNIQUES

Static Generation- human body model- static discharges-ED protection in equipment design- ESD versus EMC, Industrial and Government standards – FCC requirements – CISPR recommendations-Laboratory techniques-Measurement methods for field strength-EMI

TEXTBOOKS

1. Bernhard Keiser, “Principles of Electro-magnetic Compatibility”, Artech House, Inc. (685 canton street, Norwood, MA 020062 USA) 1987.
2. Bridges, J.E Milleta J. and Ricketts.L.W., “EMP Radiation and Protective techniques”, John Wiley and sons, USA 1976.
3. IEEE National Symposium on “Electromagnetic Compatibility”, IEEE, 445, hoes Lane, Piscataiway, NJ 08855.
4. Robertson RF microwave handbook; rohde and Schwarz – Microwave handbook
5. Henry W.Ott, “ Noise reduction techniques in electronic systems”, John Wiley & Sons, 1989.

SEMESTER 4

Thesis work

Thesis work will start from the 3rd semester and will continue in the 4th semester.