Revised Syllabus for M.E. IN MICROELECTRONICS

1. 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 Credits				
		L	T	P	Theory hours	Theory	IA	Practical	orals	Total
MEM1.1	Solid-State Devices & Semiconductor Physics	4	-	0	3	4	2	--	--	6
MEM1 .2	Digital VLSI Design	4	-	0	3	4	2	--	--	6
MEM1.3	Analog VLSI Design	4	-	0	3	4	2	--	--	6
MEM1.4	VLSI Technology	4	-	0	3	4	2	--	--	6
MEM1.5	Advanced Engineering Mathematics	4	-	0	3	4	2	--	--	6
MEM1.6	HDL –LAB	0	-	7	--	--	2	2	--	4
MEM1.7	VLSI CAD – 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 Credits				
		L	T	P	Theory hours	Theory	IA	Practical	orals	Total
MEM 2.1	ASIC Design & FPGA	4	-	0	3	4	2	--	--	6
MEM 2.2	Digital Signal Processors & Embedded Systems	4	-	0	3	4	2	--	--	6
MEM 2.3	Design for Testability & E-Waste Management	4	-	0	3	4	2	--	--	6
MEM 2.4	Processor Architecture & Parallel Processing	4	-	0	3	4	2	--	--	6
MEM 2.5	Memory Design	4	-	0	3	4	2	--	--	6
MEM 2.6	Parallel Processing - LAB	0	-	7	--	--	2	2	--	4
MEM 2.7	FPGA and Embedded Systems – 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				
						Credits				
		L	T	P	Theory hours	Theory	IA	Practical	orals	Total
MEM 3.1	Elective – I	4	-	0	3	4	2	--	--	6
MEM 3.2	Elective – II	4	-	0	3	4	2	--	--	6
MEM 3.3	Project	-	-	20	-	-	4	--	8	12
	Total	8	-	20	-	8	8	-	8	24

List of Electives

Elective -I

E1 System on Chip (SOC)
E2 Process and Device Characterization and Measurements
E3 Sensor Technology and MEMS
E4 Optical Communication
E5 Microwave Integrated Circuits
E6 Design for Reliability
E7 Mobile Phone Programming
E8 Image Processing
E9 Industrial Design of Electronic Devices

Elective - II

E10 Integrated Optics
E11 TCP/IP and Implementation of a Network IP on FPGA
E12 Electronic Systems Design
E13 Sensors in Instrumentation
E14 Simulation of circuits & devices
E15 Nanoelectronics
E16Compound Semiconductors: Properties & Applications
E17 RF Microelectronic Chip Design
E18 Electromagnetic Interference and Electromagnetic Compatibility

Semester 4

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

SYLLABUS

M.E. IN MICROELECTRONICS

SEMESTER 1

MEM1.1 SOLID-STATE DEVICES &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, Heterojunctiondiode 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 scaling; Generalized scaling, Constant voltage scaling; Channel Dopant Engineering; Series Resistance in scaled MOSFETs; 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.*

MEM1.2 DIGITAL VLSI DESIGN:

- Introduction To MOS Circuits: MOS Transistors, MOS Transistor Switches, CMOS Logic, Circuit and System Representations, MOS Transistor Theory - Introduction MOS Device Design Equations, The Complementary CMOS Inverter-DC Characteristics, Static Load MOS Inverters, The Differential Inverter, The Transmission Gate, The Tri State Inverter, Bipolar Devices.

- Circuit Characterization And Performance Estimation: Introduction, Resistance Estimation Capacitance Estimation, Inductance, Switching Characteristics CMOS-Gate Transistor Sizing, Power Dissipation, Sizing Routing Conductors, Charge Sharing, Design Margining, and Reliability.

- Graphs: representation of graphs using matrices; Paths, connectedness; circuits, cutsets, trees; Fundamental circuit and cutset matrices; Voltage and current spaces of a directed graph and their complementary orthogonality. Stick Diagrams & Layouts.

- CMOS Circuit and Logic Design: CMOS Logic Gate Design, Basic Physical Design of Simple Gate, CMOS Logic Structures, Clocking Strategies, I/O Structures.

- Systems Design And Design Method: Design Strategies, CMOS Chip Design Options, Design Methods, Design Capture Tools, Design Verification Tools, CMOS Testing - Manufacturing Test Principles, Design Strategies for Test, Chip Level Test Techniques, System Level Test Techniques.

- Syntax and Semantics of Verilog: Variable types, arrays and tables.Operators, expressions and signal assignments.Modules, nets and registers,Concurrent and sequential constructs.Tasks and functions.
- Examples of design using Verilog.

Texbooks / References

1. *N. Weste and K. Eshranghian, "Principles of CMOS VLSI Design", Addison Wesley, 1998.*
2. *Jacob Backer, Harry W. Li and David E. Boyce, " CMOS Circuit Design, Layout and*
3. *Simulation ", Prentice Hall of India, 1998.*
4. *L.Glaser and D. Dobberpuhl, "The Design and Analysis of VLSI, Circuits", Addison Wesley 1993.*
5. *C.Mead and L. Conway, "Introduction to VLSI Systems", Addison Wesley, 1979.*
6. *Randel & Geiger, " VLSI Analog and Digital Circuit Design Techniques" McGraw-Hill,1990.*
7. *Sahib H.Gerez, "Algorithms for VLSI design automation ",1998.*
8. *William M. Penny, Lillian Lau, " MOS Integrated Circuits- Theory, Fabrication, Design and System Applications of MOS LSI", Van Nostrand Reihold Company.*
9. *Sung Ms Kang, Yusuf Lablebici, "CMOS Digital Integrated Circuits Analysis & Design", Tata Mc-Graw Hill.*
10. *S. Palnitkar, "Verilog HDL: A Guide to Digital Design and Synthesis", Prentice Hall (NJ, USA), 1996.*
11. *J. Bhaskar, "Verilog HDL Synthesis - A Practical Primer", Star Galaxy Publishing, Allentown, PA) 1998.*

MEM1.3 <u>ANALOG VLSI DESIGN:</u>

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.

Textbook/References

1. *Behzad Razavi, " 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.*

MEM1.4 <u>VLSI TECHNOLOGY:</u>

- Environment for VLSI technology: clean room and safety requirements, Wafer cleaning process and wet chemical etching techniques

- Impurity incorporation: solid-state diffusion modeling and technology, Ion implantation: modeling, technology and damage annealing; Characterization of impurity profiles

- Oxidation: kinetics of silicon dioxide growth for thick, thin and ultra-thin films. Oxidation technologies in VLSI and ULSI; Characterization of oxide films; high K and low K dielectrics for ULSI.

- Lithographic techniques: Photolithography techniques for VLSI/ULSI; Mask generation.

- Chemical Vapour deposition techniques: CVD techniques for deposition of polysilicon, silicon dioxide, silicon nitride and metal films; epitaxial growth of silicon; modeling and technology.

- Metalisation techniques: evaporation and sputtering techniques. Failure mechanisms in metal interconnects; multilevel Metalisation schemes.

- Masking Sequence and Process flow for MOS and BIPOLAR Devices

- Topological Design rules

Textbooks/References

1. *S.M.Sze (Ed), "VLSI Technology", 2nd Edition, McGraw-Hill, 1988.*
2. *Streetman," VLSI Technology".*
3. *C.Y. Chang and S.M. Sze (Ed), "ULSI Technology", McGraw-Hill Companies Inc., 1996.*
4. *S.K.Gandhi, "VLSI fabrication Principles",John Wiley Inc., New York, 1983.*
5. *Sorab K. Gandhi, "The Theory and Practice of Microelectronics", John Wiley & Sons*
6. *B.G Streetman, "VLSI Technology" , Prentice Hall, 1990.*
7. *A.S Grove, "Physics and Technology of semiconductor devices", John Wiley & Sons, 1967.*

MEM1.5 **<u>ADVANCED ENGINEERING MATHEMATICS:</u>**

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, Definations, 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. *Gilber Strang "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 Easstern*

MEM1.6 **<u>HDLLAB:</u>**
Lab will be based on theory of hardware descriptive languages (VHDL/Verilog)and minimum of 08 experiments

MEM1.7 **<u>VLSI CAD – LAB</u>**
Lab will be based on theory of VLSI Design and minimum of 08 experiments having layout and spice design components.

<u>**SEMESTER 2**</u>

MEM 2.1 ASIC Designand FPGA:

- Introduction To ASICS, CMOS Logic And ASIC Library Design
  Types of ASICs - Design flow - CMOS transistors CMOS Design rules - Combinational Logic Cell – Sequential logic cell - Data path logic cell - Transistors as Resistors - Transistor Parasitic Capacitance- Logical effort -Library cell design - Library architecture.

- Programmable Asics, Programmable ASIC Logic Cells And Programmable ASIC I/O Cells
  Anti fuse - static RAM - EPROM and EEPROM technology - PREP benchmarks - Actel ACT - Xilinx LCA - Altera FLEX - Altera MAX DC & AC inputs and outputs - Clock & Power inputs - Xilinx I/O blocks.

- Programmable ASIC Interconnect, Programmable ASIC Design Software And Low Level Design Entry
  Actel ACT -Xilinx LCA - Xilinx EPLD - Altera MAX 5000 and 7000 - Altera MAX 9000 - Altera FLEX - Design systems - Logic Synthesis - Half gate ASIC -Schematic entry - Low level design language - PLA tools - EDIF- CFI design representation.

- ASIC Construction, Floor Planning, Placement And Routing
  System partition - FPGA partitioning - partitioning methods - floor planning - placement - physical design flow - global routing - detailed routing - special routing - circuit extraction - DRC.
- Introduction to IPR laws , licensing and copyright issues, VLSI Supply chain Management, Time to Market

Text/References

1. *M.J.S .Smith, - " Application - Specific Integrated Circuits " - Addison -Wesley Longman Inc., 1997*
2. *Skahill, Kevin," VHDL for Programmable Logic", Addison-Wesley, 1996*
3. *John F. Wakherly, " Digital Design: Principles and Practices", 2nd Edn 1994, Prentice Hall International Edn*
4. *Charles W. Mckay, "Digital Circuits a proportion for microprocessors", Prentice Hall*

MEM 2.2 Digital Signal Processors & Embedded System

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*
6. Keshab K. Parhi, " VLSI DSP Systems; Design & implementation" , Wiley InterScience Publishers.

MEM 2.3 **Design For Testability And E-Waste Management:**

- Physical Faults and their Modeling.
- Stuck-at Faults, Bridging Faults
- Fault Collapsing; Fault Simulation
- Deductive, Parallel, and Concurrent Fault Simulation Critical Path Tracing
- ATPG for Combinational Circuits: D- Algorithm, Boolean Difference, Podem
- Random, Deterministic and Weighted Random Test Pattern Generation Aliasing and its Effect on Fault Coverage
- PLA Testing, Cross Point Fault Model and Test Generation
- Delay Faults; ATPG for Sequential Circuits
- Time Frame Expansion; Controllability and Observability Scan Design, BILBO, Boundary Scan for Board Level Testing
- BIST and Totally Self checking Circuits
- System level Diagnosis; Introduction
- Yield Modelling Reliability and effective area utilization.
- E-Waste Management, RoHS Compliance
- EMI- EMC Testing

Text/References

1. *Hideo Fujiwara, " Logical testing & design for testability", The MIT Press.*
2. *Mike Tien Chienlee, " High level Test Synthesis of Digital VLSI circuits", Artech House Boston London.*
3. *Viswani D.Agarval Michael L.Bushnell, " Essentials of Electronic Testing for Digital*
4. *Memory & Mixed Signal VLSI Circuit ", Kluwer Academic Publications, 1999.*

MEM 2.4 **Processor Architecture & Parallel Processing**

Architecture of Advanced Microprocessors, memory hierarchies, memory management, pipelining Superscalar architecture, Multiprocessing and Multithreading, Vector Processing, Pipelining in Vector Processors

Introduction: GPUs as Parallel Computers, Architecture of a Modem GPU, Why More Speed or Parallelism, Parallel Programming Languages and Models Overarching Goals, Evolution of Graphics Pipelines; the Era of Fixed-Function

Graphics Pipelines, Evolution of Programmable Real-Time Graphics, Unified Graphics and Computing Processors, GPGPU, An Intermediate Step, GPU Computing Scalable GPUs Recent Developments, Future Trends

Introduction to CUDA: Data Parallelism CUDA Program Structure, A Matrix-Matrix Multiplication Example, Device Memories and Data Transfer, KernelFunctions and Threading; Function declarations, Kernel launch, Predefined variables, Runtime API.CUDA Thread Organization, Using block Id x and thread Id x, Synchronization and Transparent Scalability, Thread Assignment, Thread Scheduling and Latency Tolerance

CUDA Memories: Importance of Memory Access Efficiency, CUDA Device Memory Types, A Strategy for Reducing Global Memory Traffic Memory as a Limiting Factor to Parallelism, Global Memory Bandwidth, Dynamic Partitioning of SM Resources, Data Perfetching, Instruction Mix, Thread Granularity, Measured Performance

Introduction to OPENCL: Introduction to OPENCL Background, Data Parallelism Model, Device Architecture, Kernel Functions, Device Management and Kernel Launch, Electrostatic Potential Map in OpenCL.

Text Books/ References

1. *V.Carl Hamacher, Z.Vranesic and S.Zaky, Computer Organisation, fourth edition, McGraw Hill International Edition, Computer Science series 1987*
2. *David B Kirk and Wen Mei W Hwu: Programming Massively Parallel Processors: A Hands- On Approach, Elsevier India Private Limited, 2010*
3. *"Introduction to Parallel Computing " by Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar, Pearson Education, 2nd Edition 2009.*
4. *"Parallel Programming- Techniques and applications using networked workstations and parallel computers" by Barry Wilkinson, Michael Allen Pearson Education, 2nd Edition 2007.*
5. *5."Multi Core Programming – Increasing Performance through Software Multi-threading" by Shameem Akhter and Jason Roberts, Intel Press 2006*
6. *Computer Architecture: A Quantitative Approach, 4th Edition [Paperback] John L. Hennessy (Author), David A. Patterson (Author)*

MEM 2.5 **Memory Design:**

- Random Access Memory Technologies
  Static Random Access Memories (SRAMs):
  SRAM Cell Structures-MOS SRAM Architecture-MOS SRAM Cell and Peripheral Circuit Operation-Bipolar SRAM Technologies-Silicon On Insulator (SOl) Technology-Advanced SRAM Architectures and Technologies-Application Specific SRAMs.
  Dynamic Random Access Memories (DRAMs):
  DRAM Technology Development-CMOS DRAMs-DRAMs Cell Theory and Advanced Cell Strucutures-BiCMOS DRAMs-Soft Error Failures in DRAMs-Advanced DRAM Designs and Architecture-Application Specific DRAMs.

- Nonvolatile Memories
  Masked Read-Only Memories (ROMs)-High Density ROMs-Programmable Read-Only Memories (PROMs)-Bipolar PROMs-CMOS PROMs-Erasable (UV) - Programmable Road-Only Memories (EPROMs)-Floating-Gate

EPROM Cell-One-Time Programmable (OTP) EPROMS-Electrically Erasable PROMs (EEPROMs)- EEPROM Technology And Arcitecture-Nonvolatile SRAM-Flash Memories (EPROMs or EEPROM)-Advanced Flash Memory Architecture.

- Semiconductor Memory Reliability And Radiation Effects
  General Reliability Issues-RAM Failure Modes and Mechanism-Nonvolatile Memory Reliability-Reliability Modeling and Failure Rate Prediction-Design for Reliability-Reliability Test Structures-Reliability Screening and Qualification.
  Radiation Effects-Single Event Phenomenon (SEP)-Radiation Hardening Techniques-Radiation Hardening Process and Design Issues-Radiation Hardened Memory Characteristics-Radiation Hardness Assurance and Testing - Radiation Dosimetry-Water Level Radiation Testing and Test Structures.

- Advanced Memory Technologies And High-Density Memory Packaging Technologies
  Ferroelectric Random Access Memories (FRAMs)-Gallium Arsenide (GaAs) FRAMs-Analog Memories-Magnetoresistive Random Access Memories (MRAMs)-Experimental Memory Devices. Memory Hybrids and MCMs (2D)-Memory Stacks and MCMs (3D)-Memory MCM Testing and Reliability Issues-Memory Cards-High Density Memory Packaging Future Directions.

Textbooks /References

1. *A.K Sharma, " Semiconductor Memories Technology, Testing and Reliability", IEEE Press.*
2. *Luecke Mize Care, " Semiconductor Memory design & application", Mc-Graw Hill.*
3. *Betty Prince, " Semiconductor Memory Design Handbook"*

MEM 2.6 <u>PARALLEL PROCESSING LAB</u>

Lab will be based on theory of Parallel Processing and minimum of 08 experiments having CUDA and OPENCL Concepts.

MEM 2.7 <u>FPGA AND EMBEDDED SYSTEMS LAB:</u>

Lab will be based on theory of FPGA and Embedded System and minimum of 08 experiments having Xilinx's FPGAs and ARM processors.

SEMESTER 3

E1:System On Chip (SOC):

- System on Chip Technology Challenges
- System On a Chip (SOC) components.
- SoC Design Methodology
- Parameterized Systems-on-a-Chip
- System-on-a-chip Peripheral Cores
- SoC and interconnect centric Architectures
- System level design representations and modeling languages.
- Target architecture models.
- Intra-chip communication.
- Graph partitioning algorithms.
- Task time measurement.
- Interconnect latency modeling.
- Back annotation of lower level timing to high-level models.
- Synthesis of SOC components.
- System Level, Block Level and Hardware/Software Co-verification
- SOC components: emulation, co-simulation, Physical Verification.

Textbooks/References

1. *Wayone Wolf," Modern VLSI Design: SOC Design"*
2. *Prakash Rashnikar, Peter Paterson, Lenna Singh" System-On-A-Chip Verification methodlogy & Techniques", Kluwer Academic Publishers.*
3. *Alberto Sangiovanni Vincentelli," Surviving the SOC Revolution: A Guide to Platform-based Design", Kluwer Academic Publishers.*

E2:Process And Device Characterization & Measurements:

- Physical Characterization: Thin Film Thickness- Measurements-ellipsometry, surface profiling, spectrophotometry, FTIR
- Critical Dimension Measurements: Optical microscope, Scanning Electron Microscope, Transmission Electron Microscope
- Material and Impurity Characterization: SIMS, XRD, EDAX
- Electrical Characterization:
- Our-probe technique, Hall effect, sheet resistance C-V measurements, DLTS, Carrier lifetime, impurity profiling, I-V measurements
- Process and SPICE model parameter Extraction.

Textbooks /References

1. *W.R. Reunyan, " Semiconductor Measurements And Instrumentation", Mc-Graw Hill.*
2. *Schroder, "Semiconductor Material And Device Characterization"*
3. *Philips F. Kare and Greydon B. Lauabee, " Characterization of semiconductor Materials", Mc-Graw Hill.*
4. *K.V. Ravi, "Imperfections And Impurities In Semiconductor Silicon", John Wiley And Sons.*

E3: Sensor Technologies And MEMS:

Sensors types and classification – mechanical, acoustic, magnetic, thermal, chemical, radiation and biosensors. Microsensors.Sensors based on surface-acoustic wave devices.Micromachining techniquesMEMS for automative, communication and signal processing applications.Modeling and simulation of microsensors and actuators.Sensors and smart structures.Micro-opto-electro-mechanical sensors and system.

Textbooks /References

1. *Ristic L (ed), "Sensor Technology and Devices", Artech House, London, 1994.*
2. *Sze S.M. (ed), "Semiconductor Sensors", John Wiley, New York, 1994 Wise*
3. *K.D. (Guest Editor) "Integrated Sensors, Microp-actuators and micro-systems*
4. *(MEMS)", Special Issue of proceedings of IEEE, Vol. 86, No.8, August 1998.*

E4: Optical Communication:

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. *Feitelson, D. G., Optical Computing: A Survey for Computer Scientists., (ISBN 0-262-061-120), MIT Press 1988.*

E5: 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.Bhat and S. Koul, Stripline-like transmission lines for MICs, John Wiley, 1989.*
3. *T.K. Ishii, Handbook of Microwave Technology*

E6: Design For Reliability

Review of probability theory, nature of reliability problems in electronics equipments, reliability modeling, fault analysis technique, reliability predictions, software reliability, introduction to state space analysis.

Textbooks/References

1. *Design Reliability: Fundamentals and Applications - by Balbir S. Dhillon*
2. *Reliability: Modeling, Prediction, and Optimization by Wallace R. Blischke, D. N. Prabhakar Murthy*
3. *Reliability: Modeling, Prediction, and Optimization*

E7: Mobile Phone Programming

- Introduction to Mobile Phone Programming **:**
- Evolution of Mobile Phones, Networks and Services, Wireless Technologies and Architecture, Mobile Application Deployment.
- Service Discovery : Service Discovery in Real Life, Service Discovery in Computer Networks

- The Walkie Talkie Application : Introduction, The Software, Bluetooth IP Integration.
- Cooperative Wireless Networking: Introduction , Challenges, Cooperative Principles in Wireless Networks, Cooperation in Heteregenous Networks.
- Cross Layer Protocol Design for Wireless Communication: Introduction, Crosslayer Protocol design,
- Cross Layer Examples for Multimedia Services over Bluetooth: Introduction, Adaptive Header Compression for Bluetooth
- Convergence of Mobile Devices and Wireless Sensor Networks : Introduction, Classification of Different Convergence forms, First Demonstrator
- Using In-built RFID/NFC, Cameras, and 3D Accelerometers as Mobile Phone Sensors
- Using RFID/NFC on Mobile Phones, Using Cameras on Mobile Phones, Motion Interfaces using 3D Sensors
- Energy Efficiency of Video Decoder Implementations: Introduction, Mobile Video Applications, Software Interfacing Issues
- Optimizing Mobile Software with Built-in Power Profiling **:** S60 Power Profiling Application, Carbide.c++ Power-Performance Profiling, Energy-Efficient Design Guidelines
- Google Android:
- Background , An Open Platform for Mobile Development , Native Android Applications, Android SDK Features ,Introducing the Open Handset Alliance, Introducing the Development Framework
- Android Development :Developing for Android, Developing for Mobile Devices, Android Development Tools
- Creating Applications and Activities :What Makes an Android Application?, Introducing the Application Manifest, Using the Manifest Editor, The Android Application Life Cycle, Understanding Application Priority and Process States, Externalizing Resources , A Closer
- Look at Android Activities
- Intents, Broadcast Receivers, Adapters, and the Internet:
- Introducing Intents, Introducing Adapters, Using Internet Resources, Introducing Dialogs, Creating an Earthquake Viewer
- Data Storage, Retrieval, and Sharing :
- Saving Simple Application Data, Saving and Loading Files, Databases in Android, Introducing Content Providers.
- Maps, Geocoding, and Location-Based Services : Using Location-Based Services, Setting up the Emulator with Test Providers, Finding Your Location, Using the Geocoder, Creating MapBased Activities, Mapping Earthquakes Example
- Peer-to-Peer Communication: Introducing Android Instant Messaging, Introducing SMS

TEXT BOOKS/ REFERENCES:

1. *Mobile Phone Programming and its Application to Wireless Networking by Frank H.P. Fitzek, Frank Reichert, Springer*
2. *Professional Android Application Development by Reto Meier, Wiley Publishing Inc.*
3. *Android : A Programmer's Guide by Jerome DiMarzio, McGraw Hill Inc.*
4. *Mobile Phone Programming by Saurabh Jain, BPB Publications*
5. *Mobile Phones and Mobile Communication by Rich Ling, Polity Press*
6. *Hello, Android: Introducing Google's Mobile Development Platform by Ed Burnett, Pragmatic Bookshelf*
7. *Android Application Development: Programming with the Google SDK by Rick Rogers, John Lombardo, Zigurd Mednieks, O'Reilly Media*
8. *Pro Android: Developing Mobile Applications for G1 and Other Google Phones by Sayed Y Hashimi, Satya Komatineni, Apress Publications*
9. *Android Essentials by Chris Haseman, Apress Publications*

E8: 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*

E9: 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.

TEXT BOOKS/ REFERENCES:

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

E10: Integrated Optics:

Symmetric and asymmetric waveguides, Planar waveguide (Step index), Strip waveguides, Graded Index 2D waveguide, Ray analysis and WKB analysis of inhomogeneous planar waveguides. 3D waveguide structures, marcatilis method, effective index method.Losses in optical waveguides: Scattering Losses, Absorption Losses, Radiation losses. Guided Wave control: Electro optic control: Electro optic effect, Bulk and integrated optic modulators,Acousto optic control: Acousto optic effect, bulk and integrated optic modulators, Non-linear optic control. Passive waveguide devices: Optical path bending components, power dividers, polarizers, Wavelength Mux and demux.Electro optic couplers and switches. Semiconductor laser sources: Basic laser source, DFB lasers, Quantum well lasers, Direct modulation of lasers.Integrated optics Detectors: Depletion layer photodiodes, specialized photodiode structures, Factors limiting performance. Examples of Integrated optic and opto electronic integrated circuits: Spectrum analysers, wavelength meters, chemical sensors, transceivers.

TEXT BOOKS/ REFERENCES:

1. *Optical Electronics: Ajoy Ghatak and K. Thyagarajan (Cambridge University Press)*
2. *Integrated Optics Theory and Technology: Robert Hunsperger (Springer)*
3. *Optical Integrated circuits: Hiroshi Nishihara, Masamitsu haruna and Toshiaki suhara (Mc Graw Hill)*

4. *Gray and Meyer: Analysis and Design of Analog Integrated Circuits*
5. *Non-linear optics: Ghatak*
6. *Fundamentals of photonics: Saleh and Teich*
7. *Introduction to fiber optics : ghatak and thyagrajan*

E11:TCP/IP and Implementation of a Network IP on FPGA:

Introduction to TCP/IP and other basic Networking Protocols;
Link Layer, Internet Protocol, ARP, TCP, TFTP, UDP;
Telnet & Rlogin, FTP. Implementation of models of various protocols learnt in class on FPGA.
Designing a customized Network IP design.

TEXT BOOKS/ REFERENCES:

1. *TCP/IP Illustrated, Vol.1: The Protocols (Addison-Wesley Professional Computing Series) by W. Richard Stevens*
2. *Douglas Perry, " VHDL", McGraw Hill International (NY), 1993, The Institute of Electrical and Electronics Engineers.*

E12: 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.

TEXT BOOKS/ REFERENCES:

1. *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.*

E13: 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.

TEXT BOOKS/ 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*

E14: 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.

TEXT BOOKS/ 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.*

E15: Nanoelectronics

The region of Nanostructures; The Complexity problem, The challenge initiated by Nanoelectronics: Technological processes for microminiaturization; Methods and limits of microminiaturization in silicon; Microelectronics and Mechanical Systems (MEMS): Integrated Optoelectronics.
Basics of Nanoelectronics, quantization of Action, Charge and Flux; Schrodinger Equation, Electrons in Potential Wells, Photons interacting with electrons in solids. Diffusion Processes.
Basics of Information theory, Biology-inspired concepts; Biological Networks, Neuronal cells on silicon, Modelling of neuronal cells by VLSI, Neuronal networks with local adaptation and Distributed data processing.
Biochemical and quantum – mechanical computers: DNA computer, Quantum Computer.
Parallel Architectures for Nanosystems: Architectural principles, Mono and multiprocessor systems, parallel data processing; Influece of delay time; power dissipation and parallelism.
Architectures for parallel processing in nanosystems
Soft computing in Nanoelectronics: Methods of soft computing; characteristics of Neural Networks in Nanoelectronics.
Complex Integrated Systems and their properties; Nanosystems as Information – Processing machines, System Design and Interfaces; Evolutionary Hardware, Requirements of Nanosystems.
Integrated switches and Basic circuits: Switches and wiring; Classic Integrated switches and their Basic circuits
Quantum Electronics: QEDs; examples of QEDs.
Bioelectronics and Molecular Electronics.
Nanoelectronics with Tunneling Devices: Tunneling Element; Technology of RTD; Digital circuit design based on RTDs; Digital circuit design based on RTBT.
Single Electron Transistor (SET): Principle and circuit design of SET; Comparison between FET and SET circuit designs.
Nanoelectronics with Superconducting Devices: Basics, Superconducting switching Devices, Elementary circuits, Flux Quantum Device, Applications.
Limits of Integrated Electronics: A survey about the limits, Replacement of Technologies; Energy supply and Heat Dissipation; Parameter spread as limiting Effect; Limits due to thermal particle motion, Reliability as limiting Factor; Physical limits.
Final objectives of Integrated Electronic Systems: removal of uncertainties by

Nanomachines, uncertainties in Nanosystems, uncertainties in the development of Nanoelectronics.

TEXT BOOKS/ REFERENCES

1. *Nanoelectronics and Nanosystems by K. Goser, P. Glosekotter and J. Dienstuhl –*
2. *Nanotechnology by M. Ratner and D. Tatner, Pearson Education.*
3. *Nanotechnology by M. Wilson ,et al.*
4. *Nanometer Structures by A. Lakhtakia (ed.), Prentice Hall of India.*
5. *Nanotechnology by R. Booker, E. Boysen, Wiley-dreamtech India Pvt. Ltd.*

E16: Compound Semiconductors: Properties & Applications

Important parameters governing the high speed performance of devices and circuits: Transit time of charge carriers, junction capacitances, ON-resistances and their dependence on the device geometry and size, carrier mobility, doping concentration and temperature; important parameters governing the high power performance of devices and circuits: Break down voltage, resistances, device geometries, doping concentration and temperature.

Materials properties: Merits of III –V binary and ternary compound semiconductors (GaAs, InP, InGaAs, AlGaAs, SiC, GaN etc.), different SiC structures, silicon-germanium alloys and silicon carbide for high speed devices, as compared to silicon based devices, outline of the crystal structure, dopants and electrical properties such as carrier mobility, velocity versus electric field characteristics of these materials, electric field characteristics of materials and

device processing techniques, Band diagrams, homo and hetro junctions, electrostatic calculations, Band gap engineering, doping, Material and device process technique with these III-V and IV – IV semiconductors.

Metal semiconductor contacts and Metal Insulator Semiconductor and MOS devices: Native oxides of Compound semiconductors for MOS devices and the interface state density related issues. Metal semiconductor contacts,

Schottky barrier diode, Metal semiconductor Field Effect Transistors (MESFETs): Pinch off voltage and threshold voltage of MESFETs. D.C. characteristics and analysis of drain current. Velocity overshoot effects and the related

advantages of GaAs, InP and GaN based devices for high speed operation. Sub threshold characteristics, short channel effects and the performance of scaled down devices.

High Electron Mobility Transistors (HEMT): Hetero-junction devices. The generic Modulation Doped FET(MODFET) structure for high electron mobility realization. Principle of operation and the unique features of

HEMT, InGaAs/InP HEMT structures: Hetero junction Bipolar transistors (HBTs): Principle of operation and the benefits of hetero junction BJT for high speed applications. GaAs and InP based HBT device structure and the

surface passivation for stable high gain high frequency performance. SiGe HBTsand the concept of strained layer devices; High Frequency resonant – tunneling devices, Resonant-tunneling hot electron transistors

Textbooks/References:

1. *C.Y. Chang, F. Kai, GaAs High-Speed Devices: Physics, Technology and Circuit Applications, Wiley & Sons.*
2. *Cheng T. Wang, Ed., Introduction to Semiconductor Technology: GaAs and Related Compounds, John Wiley & Sons.*
3. *David K. Ferry, Ed., Gallium Arsenide Technology, Howard W. Sams & Co., 1985*
4. *Avishay Katz, Indium Phosphide and Related materials: Processing, Technology and Devices, Artech House, 1992.*
5. *S.M. Sze, High Speed Semiconductor Devices, Wiley (1990) ISBN 0-471-62307-5*
6. *Ralph E. Williams, Modern GaAs ProcessingMethods, Artech (1990), ISBN 0-89006-343-5,*

7. *Sandip Tiwari, Compound Semiconductor Device Physics, Academic Press (1991), ISBN 0-12-691740-X.*
8. *G.A. Armstrong, C.K. Maiti, TCAD for Si, SiGe and GaAs Integrated Circuits, The Institution of Engineering and Technology, London, United Kingdom, 2007,ISBN 978-0-86341-743-6.*
9. *Ruediger Quay, Gallium Nitride Electronics, Springer 2008, ISBN 978-3-540-71890-1, (Available on NITC intranet in Springer eBook section).*
10. *Prof. Dr. Alessandro Birolini, Reliability Engineering Theory and Practice, Springer 2007, ISBN-10 3-540-40287-X, Available on NITC intranet in Springer eBook section).*

E17: 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.Jacob Baker,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*

E18: 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

Texts/References

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.