

## 1<sup>st</sup> Semester

### COMPUTATIONAL TECHNIQUES IN DIGITAL SYSTEM DESIGN VED 501

Linear and non-linear circuit simulation techniques-Algorithms and computational methods; transient analysis; frequency domain analysis; moment methods; sensitivity analysis timing simulation. Numerical solution of differential equations-FEM, FVM and FDM, grid generation, error estimates, transient and small signal solutions applications to device and process simulation. Introduction to VHDL modeling. Layout algorithms, yield estimation algorithms, symbolic analysis and synthesis of analog ICs.

Introduction to physical design, part training algorithms, algorithms for placement and floor planning, global routing and detailed routing.

Familiarity with tools such as SPICE. Device and process simulators, MAGIC, VHDL and project.

#### **Books:**

1. L.O. Chua and P.M. Lin., computer aided analysis of electronics circuits: Algorithms and computational techniques, Prentice – Hall 1975.
2. L. Pallage. R. Rohrer and C. Visweswaraiiah Electronic circuit and system simulation methods, Mc. Graw Hill, 1995.
3. Naveed Shewani- Algorithms for VLSI Physical design automation, Kluwer academic 1993.

### VLSI TECHNOLOGY VED 502

Crystal structure, crystal growth and vapour phase expitaxy. Unit processes for VLSI-oxidation, Photolithography, diffusion and ion implementation. Deposition of metal and dielectric films by vacuum evaporation, sputtering and CVD techniques, wet chemical and dry etching techniques.

Device and circuit fabrication – oscillation, self alignment local oxidation techniques. MOS based silicon ICs-NMOS and CMOS ICs, memory devices, SOI devices, BJT based ICs choice of transistor types, pmp transistors, advanced structures, Bipolar CMOS (BICMOS) ICs, Resistors, Capacitors.

#### **Books:**

1. S.K.Gandhi, “VLSI Fabrication Principles”, John Wiley and Sons, NY 1994
2. S.M.Sze, “VLSI Technology” McGraw-Hill Book company, NY-1988
3. D.Nagchoudhary, “Principles of Microelectronics Technology”, Wheeler (India), 1998.

### ANALYSIS AND DESIGN OF ANALOG I.C. VED 503

#### **Circuit Configuration for Linear IC**

Current source, analysis of difference amplifiers with active load, supply and temperature independent biasing techniques, voltage references.

### **Operational Amplifiers**

Analysis of Operational amplifier circuits, slew rate model and high frequency analysis, operational amplifier noise analysis and low noise operational amplifiers.

### **Analog Multiplier and PLL**

Analysis of four quadrant and variable transconductance multiplier, voltage controlled oscillator, closed loop analysis of PLL.

### **MOS analog ICs**

Design of MOS operational amplifier, CMOS voltage reference, MOS Power amplifier and analog switches.

### **MOS Switched Capacitor Filters**

Design techniques for switched capacitor filter, CMOS switched capacitor filters, MOS integrated active RC filters.

### **Books:**

1. Gray and Meyer, "Analysis and design of analog ICs", Wiley International, 1996.
2. Gray, Wooley, Brodersen, "Analog MOS integrated circuits", IEEE Press, 1989.
3. Kenneth R. Laker Willy M.C. Sansen, William M.C. Sansen, "Design of analog intergrated circuits and systems", Mc Graw Hill, 1994.
4. Behzad Razavi, "Principles of Data conversion system design", S. Chand & Company Ltd. 2000.

## **ADVANCED DIGITAL SYSTEM DESIGN. VED 504**

### **Advanced Topics in Boolean Algebra**

Shannon' expansion theorem, consensus theorem octal designation, fun measure, INHIBIT/ INCLUSION/ AOI/ Driver/ Buffer gates, gate expander, reed muller expansion, synthesis of multiple output combinational logic circuits by product map method, design of static hazard free and dynamic hazard free logic circuits.

### **Threshold Logic**

Linear separability, unateness, physical implementation, dual comparability, reduced functions, various theorems in threshold logic, synthesis of single gate and multigate threshold network.

### **Symmetric Functions**

Elementary symmetric functions, partially symmetric and totally symmetric functions, Mc Cluskey decomposition method, unity ratio symmetric ratio functions, synthesis of symmetric function by contact networks.

### **Sequential Logic Circuits**

Mealy machine, moore machine, trivial/reversible/ isomorphic sequential machines, state diagram, state table minimization, incompletely specified sequential machines, state assignments, design of synchronous and asynchronous sequential logic circuits working in the fundamental mode and pulse mode, essential hazards unger's theorem.

### **Programmable Logic Devices**

Basic concepts, programming technologies, programmable logic element (PLE), programmable logic array (PLA), programmable array logic (PAL), structure and standard PLD's, complex PLDs (CPLD). System design using PLD's – design of combinational and sequential circuits using PLD's programmable PAL device using PALASM, design of state machine using Algorithmic State Machines (ASM) chart as a design tool. Introduction to field programmable gate arrays – types of FPGA, Xilinx XC3000 series, Logic Cell array (LCA), configurable logic blocks (CLB) input/output block (IOB) – programmable interconnect point (PIP), introduction to Actel ACT2 family and Xilinx XC4000 families, Design examples.

### **Books:**

1. William I Fletcher, "An Engineering Approach to Digital Design", Prentice Hall of India, 1996.
2. James E. Palmer, David E. Perlman, "Introduction to Digital Systems", Tata McGraw Hill, 1996.
3. N.N. Biswas, "Logic Design Theory", Prentice Hall of India 1993.
4. S.Devadas. A Ghosh and K Keutzer, "Logic synthesis", Mc Graw Hill, 1994.

**Elective I: (i) LOW POWER VLSI DESIGN**  
**VED 511**

Introduction – simulation – power analysis – probabilistic power analysis.

Circuit – logic – special techniques – architecture and systems.  
Advanced Techniques – architecture and systems.

Advanced techniques – low power CMOS VLSI design – physics of power dissipation in CMOS FET Devices.

Power Estimation – Synthesis for Low Power – Design and Test of Low Voltages – CMOS circuits.

Low Power Static RAM Architectures – low energy computing using energy recovery techniques – software design for low power.

**Books:**

1. Gary Yeap “Practical Low Power Digital VLSI Design” 1997.
2. Kaushik Roy, Sharat Prasad, “Low Power CMOS VLSI Circuit Design”, 2000

**Elective I: (ii) DESIGN OF SEMICONDUCTOR MEMORIES**  
**VED 512**

**Random Access Memory Technologies**

Static Random Access Memories (SRAMs):

SRAM cell structure- MOS SRAM architecture – MOS SRAM cell and peripheral circuit operation – bipolar SRAM technologies – silicon on insulator (SOI) technology – advanced SRAM architectures and technologies, application specific SRAMs.

Dynamic Random Access Memories (DRAMs): DRAM technology development – CMOS CRAMs – DRAMs cell theory and advanced cell structures- BiCMOS DRAMs- soft error failure 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 read-only memories (EPROMs)- Floating Gate EPROM cell- one – time programmable (OTP) Eproms – Electrically Erasable PROMs (EEPROMs) – EEPROM technology and architecture –nonvolatile SRAM-Flash memories (EPROMs or EEPROM) – Advanced flash memory architecture.

**Memory fault modeling, testing and memory design for Testability and fault tolerance,** RAM fault modeling, electrical testing, Pseudo random testing – megabit

DRAM testing – nonvolatile memory modeling and testing – IDDQ fault modeling and testing – application specific memory testing.

### **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.

#### **Books:**

1. Ashok K.Sharma, “Semiconductor Memories Technology, testing and reliability”, Prentice hall of India Private Limited, New Delhi 1997.

### **Elective I: (iii) ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY IN SYSTEM DESIGN VED 513**

#### **EMI Environment**

Sources of EMI, conducted and radiated EMI, transient EMI, EMI-EMC definitions and units of parameters.

#### **EMI Coupling Principles**

Conducted, radiated and transient coupling, common independence ground coupling, radiated common mode and ground loop coupling, radiated differential mode coupling, near field cable to cable coupling, power mains and power supply coupling.

#### **EMI Specification/Standards /Limits**

Unit of specifications, civilian standards military standards.

#### **EMI Measurements**

EMI test instruments/systems, EMI test, EMI Shielded chamber, open area test site, TEM Cell antennas, conductors nsures/injectors/couplers, military test method and procedures, calibration procedures.

### **EMI Control Techniques**

Shielding, filtering, grounding, bonding, isolation transformer, transient suppressors, cable routing, signal control, component selection and mounting.

### **EMC Design of PCBs**

PCB traces cross talk, impedance control, power distribution decoupling, zoning, motherboard designs and propagation delay performance models.

### **Books:**

1. Bernhard Keiser, "Principles of Electromagnetic Compatibility", Artech house, 3<sup>rd</sup> Ed., 1986.
2. Henry W.Ott, "Noise Reduction Techniques in Electronic Systems", John Wiley and Sons. 1988.

### **Elective I: (IV) COMPUTER COMMUNICATION NETWORK VED 514**

Study of function TCP/IP ref. Model in computer networks. Switching Techniques & Switches, Broadband ISDN & ATM. Polling techniques, multiplexing & concentration, LAN component, Transmission media used in physical layer, X.25 networks.

ALOHA. IEEE standards for LAN. High speed fiber optic networks. FDDI, SONET satellite networks, packet radio networks. Data link layer protocols, error detection & correction codes in DLL. Protocol performance evaluation, Protocol specification & verification. Routing & congestion in network layer, routing & congestion control algorithms. Network layer in Internet and ATM networks. Network synchronization, traffic analysis. Network management in routing control.

Connection management in transport layer. Protocols in transport layer, Internet transport protocols like TCP, UDP etc. ATM protocols.

Data security & cryptography techniques, access management in application layer, World Wide Web, e-mail, concept of virtual terminals.

Study of different computer networks.

### **Books:**

1. Computer Network, Tanenbaum, P.H.I publication.
2. Data and computer Communication: William Stallings.
3. Computer and Internet by Comer, McGraw Hill.