National Institute of Technology, Jamshedpur
Department of Electronics & Communication Engineering

M.Tech - Embedded Systems
Course Syllabus

SEMESTER I

ANALOG VLSI DESIGN

Unit-I

Basic MOS Device Physics: General considerations, MOS I/V Characteristics, second order effects, MOS device models, MOS Device as a Capacitor.

Unit-II

Single stage Amplifier: CS stage with resistance load, diode connected load, current source load, triode load, CSstage with source degeneration, source follower, common-gate stage, cascode stage, Folded cascode, choice ofdevice models.

Unit-III

Differential Amplifiers: Basic difference pair, common mode response, Differential pair with MOS loads, Gilbertcell.
Passive and active Current mirrors: Basic current mirrors, Cascode current mirrors, active current mirrors.

Unit-IV

Frequency response of Amplifier: General considerations, Common source stage**,** source follower, Commongate stage, Cascode stage and Difference pair. Noise in CS stage, CG stage, source follower, cascode stage,differential pair

Unit-V

Operational Amplifiers: One Stage OP-Amp, Two Stage OP-Amp, Gain boosting, Common Mode Feedback, Slewrate, PSRR. Compensation of two stage OP-Amp, Other compensation techniques.

Oscillators: Ring Oscillators, LC Oscillators, VCO, Mathematical Model of VCO.

PLL: Simple PLL, Charge pump PLL, Non-ideal effects in PLL, Delay locked loops and applications.

Text Books:

1. Fundamentals of Microelectronics, Second Edition, Behzad Razavi, Wiley Publication

Reference books:-

1. R2. R. Jacob Baker, Harry W. Li., David E. Boyce, **"CMOS : Circuit Design , Layout and Simulation ",** PHI, 2003
2. Holberg (Author) Publisher: Oxford University Press, Analysis and Design of Analog Integrated Circuits, 4th Edition; Paul R. Gray, Paul J. US Hurst, Stephen.

EMBEDDED SYSTEMS

Unit-I

Definition of Embedded System, Classification, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems,

Unit-II

Embedded Systems Vs General Computing Systems. Core of the Embedded System: General Purpose and Domain Specific Processors, ASICs, PLDs, Commercial Off-The-Shelf Components (COTS)

Unit-III

Memory: ROM, RAM, Memory according to the type of Interface, Memory Shadowing,Memory selection for Embedded Systems, Sensors and Actuators, Communication Interface: Onboard and External Communication Interfaces.

Unit-IV

Operating System Basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling. Shared Memory, Message Passing, Remote Procedure Call and Sockets,

Unit-V

Task Synchronization: Task Communication/Synchronization Issues, Task Synchronization Techniques, Device Drivers, How to Choose an RTOS.

Text Books:

1. Introduction to Embedded Systems - Shibu K. V, Mc Graw Hill.

Reference Books:

1. Embedded Systems - Raj Kamal, TMH.
2. Embedded System Design - Frank Vahid, Tony Givargis, John Wiley.
3. Embedded Systems — Lyla, Pearson, 2013
4. An Embedded Software Primer - David E. Simon, Pearson Education.

MICROCONTROLLERS FOR EMBEDDED SYSTEM DESIGN

Unit-I

ARM Architecture: ARM Design Philosophy, Registers, Program Status Register, Instruction Pipeline, Interrupts and Vector Table, Architecture Revision, ARM Processor Families.

Unit-II

ARM Programming Model – I: Instruction Set: Data Processing Instructions, Addressing Modes, Branch, Load, Store Instructions, PSR Instructions, Conditional Instructions. ARM Programming

Unit-III

Model – II: Thumb Instruction Set: Register Usage, Other Branch Instructions, Data Processing Instructions, Single-Register and Multi Register Load-Store Instructions, Stack, Software Interrupt Instructions

Unit-IV

ARM Programming: Simple C Programs using Function Calls, Pointers, Structures, Integer and Floating Point Arithmetic

Unit-V

Assembly Code using Instruction Scheduling, Register Allocation, Conditional Execution and Loops.

Text Books:

1. ARM Systems Developer's Guides- Designing & Optimizing System Software – Andrew N. Sloss, Dominic Symes, Chris Wright, 2008, Elsevier.

Reference Books:

2. Embedded Microcomputer Systems, Real Time Interfacing – Jonathan W. Valvano – Brookes / Cole, 1999, Thomas Learning.

REAL TIME EMBEDDED SYSTEMS

Unit-I

Introduction to Real-Time Embedded Systems: Brief History if Real-Time Systems, a Brief History of Embedded Systems.

System Resources: Resource Analysis, Real-Time Service Utility, Scheduling Classes, The Cyclic Executive,
Scheduler Concepts, Preemptive Fixed Priority Scheduling Policies, Real-Time OS and its characteristics, Thread Safe Reentrant Functions

Unit-II

Processing: Preemptive Fixed-Priority Policy, Feasibility, Rate Monotonic Least Upper Bound, Necessary and Sufficient Feasibility, Deadline – Monotonic Policy, Dynamic Priority Policies, EDF Algorithm, Multiprocessor Scheduling Algorithms.

Memory: Physical Hierarchy, Capacity and Allocation, Shared Memory, ECC Memory: Illustration using Hamming encoding, Flash Fill Systems.

Multi-Resource Services: Blocking, Deadlock and Livestock, Critical sections to Protect Shared Resources, Priority Inversion and its solutions.

Soft-Real-Time Services: Missed Deadlines, Quality of Service, Alternatives to Rate Monotonic Policy, Mixed Hard and Soft Real-Time Services.

Unit-III

I/O Resources: Worst-Case Execution Time, Intermediate I/O, Execution Efficiency, I/O Architecture.

Unit-IV

Embedded System Components: Firmware Components, RTOS System Software Mechanisms, Software Application Components.

Debugging Components: Exceptions, Asserts, Checking Return Codes, Single-Step Debugging, Test Access Ports, Trace Ports, Power-On Self-Test and Diagnostics, Application Level Debugging.

Unit-V

Performance Tuning: Basic Concepts of Drill-Down Tuning, Hardware-Supported Profiling and Tracing, Building Performance Monitoring into Software, Path Length, Efficiency, and Call Frequency, Fundamental Optimizations.

High Availability and Reliability Design: Reliability and Availability, Similarities and Differences, Reliability, Reliable Software, Available Software, Design Trade Offs, Hierarchical Applications for Fail-Safe Design.

Design of RTOS: PIC Microcontroller. Case Studies Based on MUCOS, VxWorks such as ACVM, Sending Application Layer Byte Streams on TCP/IP Stack, and Smart Card Application.

Text Books:

1. Sam Siewert, "**Real-Time Embedded Systems and Components**", Cengage Learning India Edition, 2007.
2. Dreamtech Software Team, "**Programming for Embedded Systems**", John Wiley, India Pvt. Ltd., 2008.

Reference Books:

1. Raj Kamal, "**Embedded System- Architecture, programming and Design**", 2nd Edition, Tata McGraw-Hill Education Pvt. Ltd., 2008.
2. Myke Predko, "**Programming and Customizing the PIC Microcontroller**", 3rd Edition, TMH, 2008.
3. C.M. Krishna, Kang G Shin, "**Real Time Systems**", McGraw-Hill, 1997.

Elective-1

COMPUTATIONAL INTELLIGENCE

Unit-I

Introduction to soft computing Soft computing constituents and conventional Artificial intelligence, Neuro-Fuzzy and soft computing characteristics

Unit-II

Fuzzy Sets, Fuzzy Rules and Fuzzy reasoning Introduction, Basis definitions and terminology, Set- theoretic operations, MF formulation and parameterization, More on fuzzy union, Intersection and Complement , Extension principal and fuzzy relations, Fuzzy If- Then rules, fuzzy reasoning

Unit-III

Fuzzy interference System Mamdani fuzzy models, Sugeno fuzzy models, Tsukamoto fuzzy models, other considerations. Neuro- fuzzy Networks, Artificial Neural Network: Supervised Learning Neural Network, Preceptron, Adaline, multi-layer neural networks

Unit-IV

Back propagation algorithm, Radial basis function networks, Functional Link Artificial Neural network, update algorithms, trigonometric and power series expansions Unsupervised Learning Neural Network Competitive learning networks, Kohonen self-organizing networks, Hopfield network

Unit-V

Genetic Algorithm, Adaptive Genetic Algorithm, Ant Colony Algorithm, Bacteria foraging Algorithm, Particle Swarm Intelligence

Text Books:

1. Neuro-Fuzzy and soft Computing –J.S.R. Jng, C.T.Sun and E.Mizutani, PHI.
2. Neural Networks A Comprehensive foundation-Simon Haykin, Pearson Education.

Reference book

1. Neutral Networks, Fuzzy Logic and Genetic Algorithm Rajasekaran, G.A. Vijayalaksmi, PHI.

VLSI TECHNOLOGY

Unit-I

Crystal structure, crystal growth and vapor phase epitaxy. Unit processes for VLSI Oxidation, Photolithography, and diffusion ion implantation

Unit-II

Deposition of metal and dielectric films by vacuum evaporation, sputtering and CVD techniques, Wet chemical and Dry Etching techniques

Unit-III

Device and Circuit Fabrication-Isolation, Self-alignment and local oxidation techniques

Unit-IV

OS based silicon ICs-NMOS and CMOS IC, memory Devices, SOI Devices

Unit-V

BJT based ICs choices of transistor types, PNP transistors, advanced structures Bipolar-CMOS (BICMOS) ICs, Resisters, Capacitors.

Text Books:

1. S.K. Gandhi, "VLSI Fabrication Principles", John Wiley and Sons, NY, 1994.

Reference Books:

2. S.M. Sze, "VLSI Technology", McGraw Hill Book Company, NY, 1988.
1. D. Nagchoudhari, "Principles of Microelectronics Technology", Wheeler (India), 1998.

EMBEDDED COMPUTING SYSTEM

Unit-I

Circuits and DSP Architecture: Circuit Design basics, Deep submicron issues, low power techniques, High level power models, algorithm transformation techniques, Dedicated architectures for embedded systems

Unit-II

Architectures Design: Embedded processor architectures, architectural techniques for low power design methods for core-based ASICs

Unit-III

Compiler and OS: Introduction to compiler optimization, power models for compiler optimizations, core size vs. performance/power trade off

Unit-IV

DSP Algorithm Design: A/D conversion and finite precision analysis, algorithms for embedded systems, source and channel processing, potable embedded code

Unit-V

Networking: Networking Basics (addressing and routing), wireless vs. wire-line networking, distributed OS for networked embedded systems, Case study of JINI.

Text books:

1. K.Hwang, "Advance Computer Architecture: Parallelism, Scalability and Programmability", New York McGraw Hill Inc., 1993.
2. S.Y.Kung, "VLSI Array Processor ", Prentice Hall, Englewood Cliffs, NJ,1988

ADAPTIVE SIGNAL PROCESSING

UNIT I

Introduction to Adaptive Filters: Definitions, Characteristics, Adaptive filter structures, Applications, Examples of adaptive systems. Adaptive linear combiner: General Description, Desired Response and Error, the performance function, gradient and minimum mean square error, and alternative expression of gradient.

UNIT II

Wiener filter, Search methods and the LMS algorithm: Wiener FIR filter (real case), Newton's type algorithm, steepest descent search and the LMS algorithm, Extension of optimal filtering to complex valued input, Complex LMS algorithm (FXLMS), sign-LMS and the normalized LMS algorithm.

UNIT III

Convergence and Stability Analyses: Convergence analysis of the gradient search algorithms, learning curve and mean square error behaviour, Weight error correlation matrix, Dynamics of the steady state mean square error (MSE), Misadjustment and stability of excess MSE.

UNIT IV

Adaptive Recursive Filters and Structures: Least square (LS) estimation, pseudo-inverse of a data matrix, optimality of LS estimation, adaptive recursive filters, RLS algorithm, and convergence analysis of RLS algorithm, Application of RLS algorithm, Lattice structures, and adaptive lattice filters the adaptive Lattice Predictor.

UNIT V

Application of Adaptive Filters: Echo cancellation, Equalisation of data communication channels, Linear predictive coding and Noise cancellation, Adaptive control systems: Adaptive Model control, Adaptive inverse Control. Introduction of adaptive array and adaptive beam forming, Recent advances in adaptive filtering.

Text Books:

1. S. Haykin and T. Kailath, Adaptive Filter Theory, Pearson Education, 4th Edition, 2005.
2. B. Widrow and S. D. Sterns, Adaptive Signal Processing, Pearson Education, 2nd Indian reprint, 2002.

SEMESTER II

DIGITAL VLSI DESIGN

Unit-I

Introduction to VLSI Design, Levels of abstraction and the complexity of design, Challenges of VLSI design: power, timing, area, noise, testability, reliability and yield.

Unit-II

CAD tools: simulation, layout, synthesis, test; MOS modeling, MOS device models, Short-channel effects and velocity saturation, Scaling of MOS circuits; VLSI fabrication technology,

Layout design, Design rules, Stick diagrams; The CMOS inverter, VTC, Switching behavior, Noise margins and power dissipation; Static and dynamic CMOS combinational logic gate,

Unit-III

Transistor sizing in static CMOS, logical effort, Pass-transistor logic, sizing issues, Domino logic gates, estimating load capacitance , Simple delay models (RC) for CMOS gates , Power consumption;

Unit-IV

Latches and clocking, Flip-flops, Set-up and hold tests, Static and dynamic latch and flip-flop, Clock design; Datapath units, Adders, Shifters, Multipliers; Control logic strategies, PLAs , Multi-level logic, Synthesis and place-and-route CAD; MOS memories , Register, SRAM , DRAM;

Unit-V

Global interconnect modeling, Capacitance, resistance and inductance of interconnect; Signal and power-supply integrity issues, Electromigration, RC interconnect modeling Driving large capacitive load, reducing RC delays; Layout design, Standard-cell layout, Chip layout and floor planning, Array layout; Implementation issues, Design for testability, Packaging technology, I/O issues: ESD protection, boundary scan, inductance, synchronization

Text Books:

1. J. M. Rabaey, A. Chandrakasan and B. Nikolic, Digital Integrated Circuits: A Design Perspective, Second Edition, Pearson/PH, 2003. (Cheap Edition) Supplementary Reading:

Reference books:

2. J. P. Uyemura, Introduction to VLSI Circuits and Systems, Wiley, 2001.

3. W. Wolf, Modern VLSI Design: Systems-on-Chip Design, Third Edition, Pearson/PH, 2002. (Cheap Edition).
4. R. L. Geiger, P. E. Allen and N. R. Strader, VLSI Design Techniques for Analog and Digital Circuits, McGrawHill, 1990.

VLSI ARCHITECTURE

Unit-I

The Impact of VLSI on computer Architecture, VLSI Technology overview and trends, Dedicated and programmable VLSI architecture, Instruction set and through enhancement

techniques (parallelism, pipelining, caches etc.)

Unit-II

VLSI design methodologies: Custom, semicustom, synthesis, simulation and verification at the system, behavior, logic, circuit and layout levels. CPLD Structure, Programming techniques, device technologies

Unit-III

CISC Architecture concepts: typical CIC instruction set and its VLSI implementation, RISC Architecture concepts: typical RISC instruction set and its VLSI implementation, Execution pipeline, benefits and problems of pipelined execution

Unit-IV

Introduction to the ASIC: Full custom ASIC, standard cell based ASIC, gate array ASIC, CHANNELED GATE ARRAY, CHENNEL less gate array, programmable logic device, software design verification, verification strategy for ASIC bus fuctional models, verification Automation, physical verification, layout planning and verifications

Unit-V

ASIC design flow and HDL based ASIC design flow, EDA tools for ASIC design, FPGA Design and Architecture: introduction and fundamental concepts, the origin of FPGA, FPGA architecture and design flows, technology mapping, physical synthesis, design and synthesis.

Text Books:

1. Modern VLSI Design: Systems on Silicon, Wayne wolf. Prentice Hall; 2 Edition,
2. VLSI Technology, S.M.Sze, Mcgraw-Hill.

References Books:

1. Digital Integrated Circuit Design: From VLSI Architectures to CMOS Fabrication by Hubert Kaeslin, Cambridge University Press, 2008
2. FPGA Based system design, Wayne wolf, Pearson Education; First edition (2004)
3. Basic VLSI Design by Douglas A. Pucknell and Kamran Eshraghian, PHI; 1st edition (2005).
4. VLSI Design Methodologies for Digital Signal Processing Architectures by Mohamed Elgamel and Magdy Bayoumi, Springer/bsp Books (2005).

NETWORK EMBEDDED APPLICATIONS

Unit-I

Embedded Communication Protocols: Embedded Networking: Introduction, Serial/Parallel Communication Serial communication protocols RS232 standard RS485 Synchronous Serial Protocols Serial Peripheral Interface (SPI) USB and CAN

Unit-II

Bus: USB bus – Introduction Speed Identification on the bus – USB States USB bus communication: Packets Data flow types Enumeration Descriptors PIC 18 Microcontroller USB Interface Bus, Introduction Frames, Bit stuffing, Types of errors, Nominal Bit Timing, PIC microcontroller CAN Interface, A simple application with CAN

Unit-III

Ethernet Basics: Elements of a network, Inside Ethernet, Building a Network: Hardware options, Cables, Connections and network speed, Design choices: Selecting components–Ethernet Controllers using the internet in local and internet communications – Inside the Internet protocol

Unit-IV

Wireless Embedded Networking: Wireless sensor networks – Introduction – Applications - Network Topology – Localization – Time Synchronization

Unit-V

Energy efficient MAC protocols –SMAC – Energy efficient and robust routing – Data Centric routing

Text Books:

1. Embedded Systems Design: A Unified Hardware/Software Introduction - Frank Vahid, Tony Givargis, John & Wiley Publications, 2002.

2. Parallel Port Complete: Programming, interfacing and using the PCs parallel printer port - Jan Axelson, Penram Publications, 1996.

Reference Books:

1. Advanced PIC microcontroller projects in C: from USB to RTOS with the PIC18F series - Dogan Ibrahim, Elsevier 2008.
2. Embedded Ethernet and Internet Complete - Jan Axelson, Penram publications, 2003.
3. Networking Wireless Sensors - Bhaskar Krishnamachari , Cambridge press 2005.

SOFTWARE FOR EMBEDDED SYSTEMS

Unit-I

Real time and embedded systems: software issues in embedded system, software development process; requirement analysis: use cases, identification and analysis of use cases, use case diagrams

Unit-II

Design: architecture design, design patterns and detailed design, implementation: languages, compilers, runtime environments and operating systems for embedded software; testing: methodologies, test cases

Unit-III

Introduction, creating 'hardware delays' using Timer 0 and Timer 1, Creating a portable hardware delay

Unit-IV

The need for 'timeout' mechanisms, Creating loop timeouts, Testing loop timeouts

Unit-V

A more reliable switch interface, Creating hardware timeouts, Example: Testing a hardware timeout, Conclusions.

Text Books:

2. Embedded C - Michael J. Pont, 2nd Ed., Pearson Education, 2008

Reference Books:

3. PIC micro MCU C-An introduction to programming, The Microchip PIC in CCS C – Nigel Gardner.

Elective-2

ARCHITECTURE FOR DIGITAL SIGNAL PROCESSING

Unit-I

Digital Signal Processors: The Programmable DSP Architecture, Top-Down Design of Dedicated DSPs, A Library-Based Systems Design Environment. Classification of Architectures: An Abstract Computing Machine, Optimization of performance, Interconnection between Functional Units

Unit-II

A Multi-level Classification, Data and Instruction Memories: SISC Architectures, Addressing Modes, External Interface Units. VLSI SISC Processors: The SISC Processor, Pipeline Control in SISCs, Superscalar Processors.

Unit-III

Data Path Logic Design: Introduction, Synchronous Data Path Design, Monolithic Arithmetic Circuits, Implementation of Pipeline

Unit-IV

High level Synthesis (HLS) of Data Path, Low power Data Design, Floating Point Arithmetic. Rapid Prototyping: Introduction, High Level Languages (HLLs) in DSP

Unit-V

Hardware Description Languages (HDLs), Optimizing Compilers, DSP Prototyping Environment, Real-Time SISC Prototyping

Text Books:

1. Vijay. K. Madisetti, "VLSI Digital Signal Processors- An Introduction to Rapid Prototyping and Design Synthesis", IEEE Press, 1999.
2. Richard J. Higgins, "Digital Signal Processing in VLSI", Prentice Hall, 1990.
3. B. Venkata Ramani and M. Bhaskar, Digital Signal Processors, Architecture, Programming and Applications –TMH, 2004.

Reference Books:

1. Jonatham Stein, Digital Signal Processing, John Wiley, 2005.
2. Avtar Singh and S. Srinivasan, Digital Signal Processing –Thomson Publications, 2004.

3. Vijay K. Madisetti, “VLSI Digital Signal Processors – An Introduction to Rapid Prototyping and Design Synthesis”, IEEE Press, 1999.
4. Richard J. Higgins, “Digital Signal Processing in VLSI”, Prentice Hall.

MEMS & NEMS

Unit 1

Overview and Introduction: New trends in Engineering and Science: Micro and Nano scale systems Introduction to Design of MEMS and NEMS, Overview of Nano and Micro electromechanical Systems, Applications of Micro and Nano electromechanical systems, Micro electromechanical systems, devices and structures Definitions, Materials for MEMS: Silicon, silicon compounds, polymers, metals

Unit 2

MEMS Fabrication Technologies: Micro-system fabrication processes: Photolithography, Ion Implantation, Diffusion, Oxidation, Thin film depositions: LPCVD, Sputtering, Evaporation, Electroplating; Etching techniques: Dry and wet etching, electrochemical etching; Micromachining: Bulk Micromachining, Surface Micromachining, High Aspect-Ratio (LIGA and LIGA-like) Technology; Packaging: Microsystems packaging, Essential packaging technologies, Selection of packaging materials

Unit 3

Micro Sensors: MEMS Sensors: Design of Acoustic wave sensors, resonant sensor, Vibratory gyroscope, Capacitive and Piezo Resistive Pressure sensors- engineering mechanics behind these Microsensors, Case study: Piezo-resistive pressure sensor

Unit 4

Micro Actuators: Design of Actuators: Actuation using thermal forces, Actuation using shape memory Alloys, Actuation using piezoelectric crystals, Actuation using Electrostatic forces (Parallel plate, Torsion bar, and Comb drive actuators), Micromechanical Motors and pumps, Case study: Comb drive actuators.

Unit 5

Design & Interface: Design methods and design constraints for sensitivity and stability, Implementation of control method for improving measurement sensitivity, linearity and reproducibility, Interface Electronics for MEMS, MEMS Simulation Techniques, MEMS for RF application, Bonding, Packaging and Testing of MEMS Devices.

Text Books:

1. MEMS Introduction and fundamentals, Mohammed Gad-El-Hak, Taylor & Francis.
2. Foundations of MEMS, Chang Liu, Pearson education India limited, 2006.
3. MEMS and Microsystems Design and Manufacture, Tai Ran Hsu, Tata Mcraw Hill, 2002.

Reference Books:

4. Fundamentals of Micro fabrication, Marc Madou, CRC press, 1997.
5. Micro system Design, Stephen D. Senturia, Kluwer Academic Publishers,2001

HARDWARE SOFTWARE CO-DESIGN

Unit-I

Co-Design Issues: Co- Design Models, Architectures, Languages, A Generic Co-design Methodology. Co- Synthesis Algorithms: Hardware software synthesis algorithms: hardware – software partitioning distributed system co-synthesis

Unit-II

Prototyping and Emulation: Prototyping and emulation techniques, prototyping and emulation environments, future developments in emulation and prototyping architecture specialization techniques, system communication infrastructure Target Architectures: Architecture Specialization techniques, System Communication infrastructure, Target Architecture and Application System classes, Architecture for control dominated systems (8051-Architectures for High performance control), Architecture for Data dominated systems (ADSP21060, TMS320C60), Mixed Systems

Unit-III

Compilation Techniques and Tools for Embedded Processor Architectures: Modern embedded architectures, embedded software development needs, compilation technologies, practical consideration in a compiler development environment.

Unit-IV

Design Specification and Verification: Design, co-design, the co-design computational model, concurrency coordinating concurrent computations, interfacing components, design verification, implementation verification, verification tools, and interface verification

Unit-V

Languages for System – Level Specification and Design-I: System – level specification, design representation for system level synthesis, system level specification languages,

Languages for System – Level Specification and Design-II: Heterogeneous specifications and multi-language co-simulation, the cosyma system and lycos system

Text Books:

1. Hardware / Software Co- Design Principles and Practice – Jorgen Staunstrup, Wayne Wolf – 2009, Springer.
2. Hardware / Software Co- Design - Giovanni De Micheli, Mariagiovanna Sami, 2002, Kluwer Academic Publishers

Reference Books:

1. A Practical Introduction to Hardware/Software Co-design -Patrick R. Schaumont - 2010 Springer

VLSI TESTING & TESTABILITY

Unit-I

Defects and their modeling as faults at gate level and transistor level, Various types of faults, Functional vs. Structural approach to testing

Unit-II

Complexity of testing problem, controllability of observability, Generating test for a single stuck at fault in combinational logic, D-Algorithm

Unit-III

FAN and PODEM Algorithm, Test optimization and fault coverage, The problem of testing of sequential DFT hardware

Unit-IV

Ad-hoc and structured approaches of DFT, Various kinds of scan design, Fault models for PLAs, Bridging and delay faults and their tests

Unit-V

Memory testing, Testing with random patterns, The LFSR and their use in random test generation and response compression(including MISRS), Built-in self test

Text Books

1. M. Abramoviel, M.A. Breuer and A.D. Friedman, “Digital system testing and Testable Design”, IEEE Press.
2. V. Agrawal and S.C. Seth,”Test Generation for VLSI Chips”, IEEE CS Press,1989