

LOW POWER DIGITAL VLSI DESIGN

MODULE – I

(8 hours)

Introduction: Sources of power dissipation, Static power dissipation, Active power dissipation. Circuit Techniques for Low-Power Design: Designing for low-power, Circuit techniques for leakage power reduction – Standby leakage control using transistor stacks, Multiple V_{th} techniques, Dynamic V_{th} technique, Supply voltage scaling technique, Leakage reduction techniques for cache (SRAM). Low-Voltage Low-Power Adders: Standard adder cells – Half adders, Full adders and their various schematic configurations, CMOS adder's architecture – Ripple carry adders, Carry lookahead adders, Carry select adders, Carry save adders, Carry skip adders, Conditional sum adders.

MODULE – II

(10 hours)

Performance valuation of various adder architectures, BiCMOS adders – PT-BiCMOS Gate, Low-voltage low-power design techniques – Trends of technology and power supply voltage, Low-voltage low-power logic styles, Current-mode adders – Current-mode CMOS adders using multiple-valued logic, Residue adders based on binary adders, Fast addition using single-digit number system. Low-Voltage Low Power Multipliers: Overview of multiplication – Unsigned multiplication, Shift/add multiplication algorithms, Multiplication of signed numbers, Types of multipliers architecture – Serial multipliers, Parallel multipliers, serial-parallel multipliers, Braun multiplier, Baugh-Wooley multiplier, Booth multiplier, Wallace tree multiplier.

MODULE – III

(12 hours)

Low-Voltage Low Power Read-Only Memories: Types of ROM, Basic physics of floating gate non-volatile devices, Floating gate memories, Basics of ROM – Chip architecture, ROM cell arrays, Low-power ROM Technology – Sources of power dissipation, Low-power techniques at architecture level, Low-power techniques at circuit level. Low-Voltage Low Power Static Random-Access Memories: Basics of SRAM, Memory cell, Pre-charge and equalization circuit, Decoder, Address transition detection, Sense amplifier, Output latch, Low-power SRAM technology – Sources of SRAM power, Development of low power circuit techniques.

Low-Voltage Low Power Static Random-Access Memories: Types of DRAM – Conventional DRAM, Fast page mode DRAM, Enhanced DRAM, Extended data out DRAM, Burst extended data output DRAM, Synchronous DRAM, Enhanced synchronous DRAM, Double data-rate DRAM, Synchronous link DRAM, Rambus DRAM, Direct Rambus DRAM, Video RAM, Embedded DRAM, Basics of DRAM, Self-refresh Circuit, Half-voltage generator, Back-bias generator, Boosted-voltage generator,

2nd Semester

Reference-voltage generator, Voltage-down converter. Large Low-Power VLSI System Design Applications: Behavioral level transform, Algorithm and architecture level transforms for low power

MODULE – IV

(8 hours)

Differential coefficient for FIR filters, Algorithm using first-order differences, Algorithm using generalized mth-order differences, Negative differences, Sorted recursive differences, Shared multiplier based vector scaling operation, Architecture-driven voltage scaling, Power optimization using operation reduction, Power optimization using operation substitution, Precomputation based optimization for low power, Multiple and dynamic supply chain – Multiple supply voltage design, Dynamic supply voltage design, Choice of supply voltages, Rate of change of supply voltages, Power-supply network, Varying the clock speed, Varying the VDD of RAM structure, Level conversion on the path from V_{DD}^L to V_{DD}^H .

Text Books:

1. Kiat-Seng Yeo and Kaushik Roy, Low-Voltage Low-Power VLSI Subsystems, TMH Pvt. Ltd., 2009, ISBN-13: 978-0-07-067750-0, ISBN-10: 0-07-067750-6.
2. Kaushik Roy, Sharat C. Prasad, Low-Power CMOS VLSI Circuit Design , Wiley India Pvt Ltd, 2009, ISBN: 812652023X, ISBN-13: 9788126520237, 978-8126520237.

Recommended Reading:

1. AbdellatifBellaouar and Mohamed Elmasry, Low-Power Digital VLSI Design: Circuits and Systems, Kluwer Academic Publishers, 1995
2. Gary K. Yeap, Practical Low Power Digital VLSI Design, Kluwer Academic Pub, 1998
3. Anantha P Chandrakasan, A P Chandrakasan and R W Brodersen, Low Power Digital CMOS Design, Kluwer Academic Publishers, 1995, ISBN: 079239576X, EAN: 9780792395768