

VDPC3003 INTEGRATED CIRCUITS AND SYSTEMS (3-0-0)

Course Objectives

This course provides a comprehensive understanding of integrated circuits (ICs), covering analog, digital, and mixed-signal systems. Students will learn IC design principles, fabrication technologies, and applications in communication and consumer electronics. Emphasis is placed on circuit analysis, CMOS logic design, and emerging technologies like FinFET and SoC.

Module I: (06 Hours)

Introduction to Integrated Circuits: Overview of Integrated Circuits (ICs), Types of ICs: Analog, Digital, Mixed-Signal, Basic Semiconductor Devices: Diodes, BJTs, MOSFETs, Fabrication Technology Overview, IC Packaging and Testing.

Module II: (08 Hours)

Analog Integrated Circuits: Operational Amplifiers: Ideal and Practical Characteristics, Analog Building Blocks: Current Mirrors, Differential Amplifiers, Biasing Techniques and Active Loads, Analog Filters and Signal Conditioning, Voltage and Current References

Module III: (08 Hours)

Digital Integrated Circuits: CMOS Logic Gates: Inverter, NAND, NOR, XOR, Combinational and Sequential Logic Design, Flip-Flops, Latches, Registers, Counters, Timing Analysis and Setup/Hold Concepts, Power Consumption and Optimization Techniques

Module IV: (06 Hours)

Mixed-Signal Circuits and Systems: Introduction to ADCs and DACs, Sample and Hold Circuits, PLL (Phase Locked Loops) and Clock Generators, Signal Integrity Issues and Layout Guidelines, Introduction to VLSI System Design Flow

Module V: (04 Hours)

Emerging Technologies and Applications: IC Design Case Studies, Applications: Communication, Medical, Consumer Electronics, Trends in IC Technologies: FinFET, SoC.

Course Outcome:

Upon completion of the course, the students will be able to:

- CO1: Understand the types, characteristics, and fabrication technologies of integrated circuits (ICs) and semiconductor devices.
- CO2: Analyze and design analog IC components such as operational amplifiers, current mirrors, and analog filters.
- CO3: Design and evaluate digital circuits using CMOS logic gates, flip-flops, counters, and understand power optimization techniques.
- CO4: Comprehend the principles and operation of mixed-signal systems including ADCs, DACs, and PLLs.
- CO5: Use EDA tools like SPICE and Cadence for IC simulation and design verification, and explore current IC applications and trends.

Text Books:

1. Design of Analog CMOS Integrated Circuits by Behzad Razavi
2. Digital Integrated Circuits: A Design Perspective by Jan M. Rabaey, Anantha Chandrakasan, and Borivoje Nikolic
3. Microelectronic Circuits by Adel S. Sedra and Kenneth C. Smith

Supplementary Reading:

1. CMOS VLSI Design: A Circuits and Systems Perspective by Neil H.E. Weste and David Harris, 4th Edition