

NIRMA UNIVERSITY

Institute:	Institute of Technology, School of Technology
Name of Programme:	B.Tech. in Electronics & Communication Engineering
Course Code:	4EC601ME25
Course Title:	Analog CMOS Integrated Circuits
Course Type:	Department Elective
Year of Introduction:	2025-26

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Course Learning Outcomes (CLOs):

At the end of the course, the students will be able to

- 1 apply noise analysis for analog CMOS circuits and evaluate input signal noise and output signal noise (BL3)
- 2 analyse the given analog circuit using a large signal, small signal and high-frequency models and evaluate performance parameters (BL4)
- 3 design an analog signal conditioning circuit using the operational amplifier for the given specific application (BL6)
- 4 construct an amplifier using switching capacitors circuits for the given specifications. (BL6)

Unit	Contents	Teaching hours (Total 45)
Unit I	Introduction: Analog Integrated circuit design, Analog signal processing, examples of Analog VLSI mixed-signal circuit design.	03
Unit II	CMOS Device Modelling: Simple MOS large-signal model, a small-signal model for the MOS transistor, sub-threshold MOS model.	04
Unit III	Noise Analysis: Noise in single-stage amplifiers, Noise in Differential amplifiers.	06
Unit IV	Analog CMOS Sub-Circuits: MOS switch, MOS diode/Active resistor, current sinks and sources, Voltage references, current mirrors.	08
Unit V	CMOS Amplifiers: Inverters, differential amplifiers, cascade amplifiers, current amplifiers.	08
Unit VI	CMOS Operational Amplifiers: Design of CMOS Op-Amps, compensation of Op-Amps, Design of a two-stage Op-Amp, measurement parameters of an Op-Amp	06
Unit VII	Comparators: Characterization of a comparator, Two-stage open-loop comparator	05
Unit VIII	Switched Capacitor Circuits: Basic concept, switched capacitor amplifiers, switched-capacitor integrators, PLL	05

Self Study:

The self-study contents will be declared at the commencement of the semester. Around 10% of the question will be asked from self-study contents.

Laboratory Work:

Laboratory work will be based on the above syllabus with a minimum of 10 experiments to be incorporated.

Suggested Readings/ Reference:

1. Philip E. Allen, Douglas R. Holberg, *CMOS Analog Circuit Design*, Oxford University Press
2. B. Razavi, *Design of Analog CMOS Integrated Circuits*, McGraw-Hill
3. David and Martin, *Analog Integrated Circuit Design*, Wiley Publication
4. R. Jacob Baker, *CMOS Circuit Design, Layout, and Simulation*, Wiley Publication

Suggested List of Experiments

Sr. No.	Name of Experiments/Exercises	Hours
1.	To simulate the output and transfer characteristics of MOS transistors for finding out technology parameters using cadence tool	02
2.	To design and simulate MOS based single stage amplifiers for given specifications	02
3.	To design and simulate current mirror circuit	02
4.	To design a CMOS differential amplifier and evaluate the performance of the same	02
5.	To design different bandgap voltage reference circuit and compare the performance of the same	02
6.	To design and simulate CMOS two stage operational amplifier	02
7.	To design and simulate sense amplifier	02
8.	To carry out Monte Carlo analysis for given circuit	02
9.	To design and simulate cascode amplifier	02
10.	To design and simulate CMOS comparator circuit	02
11.	To design and simulate CMOS Beta multiplier	02
12.	To design and simulate DRAM cell	02
13.	To design and simulate Voltage controlled oscillator	02
14.	To design and simulate Ring oscillator	02
15.	To design and simulate the circuit for specific application (Project work)	02