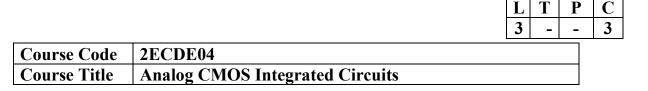# NIRMA UNIVERSITY
SCHOOL OF TECHNOLOGY, INSTITUTE OF TECHNOLOGY
B.Tech. Electronics & Communication Engineering
Semester - VI
Department Elective II

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Course Code	**2ECDE04**
Course Title	**Analog CMOS Integrated Circuits**

Course Outcomes (COs):

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

1. Analyze the given analog circuit using a large signal, small signal and high-frequency models and evaluate performance parameters.
2. Design an analog signal conditioning circuit using the operational amplifier for the given specific application.
3. Apply noise analysis for analog CMOS circuits and evaluate input signal noise and output signal noise.
4. Design an amplifier using switching capacitors circuits for the given specifications.

Syllabus: **Teaching Hours:45**

UNIT I: Introduction   **03**

Analog Integrated circuit design, Analog signal processing, examples of Analog VLSI mixed-signal circuit design.

UNIT II: CMOS Device Modelling   **04**

Simple MOS large-signal model, a small-signal model for the MOS transistor, sub-threshold MOS model.

UNIT III: Noise Analysis   **06**

Noise in single-stage amplifiers, Noise in Differential amplifiers.

UNIT IV: Analog CMOS Sub-Circuits   **08**

MOS switch, MOS diode/Active resistor, current sinks and sources, Voltage references, current mirrors.

UNIT V: CMOS Amplifiers   **08**

Inverters, differential amplifiers, cascade amplifiers, current amplifiers.

UNIT VI: CMOS Operational Amplifiers   **06**

Design of CMOS OPAMPs, compensation of OPAMPs, Design of a two-stage opamp, measurement parameters of an OPAMP.

UNIT VII: Comparators   **05**

Characterization of a comparator, Two-stage open-loop comparator.

UNIT VIII: Switched Capacitor Circuits   **05**

Basic concept, switched capacitor amplifiers, switched-capacitor integrators, PLL.

Self-Study:

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

Assignments:

The students will be given 8-10 programming/simulation assignments based on the above syllabus as mentioned below

    i. Design different types of current mirrors.
    ii. Design and evaluate the performance of a CMOS Differential amplifier using
    iii. Design and compare the performance of different bandgap voltage references
    iv. Design and verify the specifications of CMOS two-stage operational Amplifier

v. Design and simulate CMOS Comparator using 0.18μm Technology model
vi. Design and simulate Sense Amplifier using 0.18μm Technology model
vii. Design and simulate Flash type ADC using 0.18μm Technology model
viii. Mini Project

Suggested Readings:
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.

L = Lecture, T = Tutorial, P = Practical, C = Credit