INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal - 500 043, Hyderabad, Telangana

COURSE CONTENT

MIXED SIGNAL VLSI DESIGN								
VIII Semester: ECE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
AECD64	**Elective**	3	-	-	3	40	60	100
Contact Classes: 48	**Tutorial Classes: 15**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: VLSI Design								

I. COURSE OVERVIEW:
Mixed signal design gives the basics of analog and mixed-signal circuit design and systematic methods for designing CMOS integrated circuits. It focuses on the most familiar components are Submicron CMOS circuits, analog-to-digital converters, digital-to-analog circuits, sample-and-holds, and phase locked loops. It provides the platform for visualize the operation of mixed-signal circuits and analyze industrial grade circuits.

II. COURSES OBJECTIVES:
The students will try to learn

I. The mixed signal of submicron CMOS circuit and applications.
II. The various integrated circuit-based filters and topologies.
III. The data converters architecture, modeling and signal to noise ratio.

III. COURSE OUTCOMES:
At the end of the course students should be able to:

CO1	Apply the fundamental concepts for mixed signal CMOS circuit.
CO2	Analyze the characteristics of IC based CMOS filters and topologies.
CO3	Design the various data converter architecture circuits to verify its functionality.
CO4	Analyze the various signals to noise ratio for modeling of mixed signals.
CO5	Design the different oscillators and phase lock loop circuits to verify the ideal effects in the circuits.
CO6	Develop mixed-signal VLSI system solutions for real-time applications in communication, embedded, biomedical, and IoT systems.

IV. COURSE CONTENT:

MODULE - I: SUBMICRON CMOS CIRCUIT DESIGN (9)
Submicron CMOS: Overview and Models, CMOS process flow, Capacitors and Resistors. Digital circuit design: The MOSFET Switch, Delay Elements, An Adder. Analog Circuit Design: Biasing, Op-Amp Design, Circuit Noise.

MODULE –II: INTEGRATOR BASED CMOS FILTERS (9)
Integrator Building Blocks- low pass filter, Active RC integrators, MOSFET-C Integrators, gm- C integrators, Discrete-time integrators. Filtering Topologies: The Bilinear transfer function, The Bi-quadratic transfer function, Filters using Noise shaping.

MODULE –III: DATA CONVERTER ARCHITECTURES (10)
DAC Architectures- Resistor string, R-2R ladder Networks, Current Steering, Charge Scaling DACs, Cyclic DAC, and Pipeline DAC. ADC Architectures- Flash.

Two-step flash ADC, Pipeline ADC, Integrating ADC's, Successive Approximation ADC.

MODULE –IV: DATA CONVERTER MODELING AND SNR (10)
Sampling and Aliasing: A modeling approach, Impulse sampling, The sample and Hold, Quantization noise. Data converter SNR: An overview, Clock Jitter, Improving SNR using Averaging, Decimating filter for ADCs, Interpolating filter for DACs, Band pass and High pass sinc filters - Using feedback to improve SNR.

MODULE –V: OSCILLATORS AND PLL (10)
LC oscillators, Voltage Controlled Oscillators. Simple PLL, Charge pumps PLLs, Non ideal effects in PLLs, Delay Locked Loops.

V. TEXTBOOKS:

1. CMOS Mixed Signal Circuit Design by R. Jacob Baker, Wiley India, IEEE Press, reprint 2008.
2. Analog Integrated Circuit Design by D.A. Johns and K. Martin (John Wiley and Sons 1997).

VI. REFERENCE BOOKS:

1. CMOS Circuit Design, Layout and Simulation by R.Jacob Baker, Wiley India, IEEE Press, Second Edition, reprint 2009.
2. Design of Analog CMOS Integrated Circuits by Behzad Razavi, McGraw Hill, 33rd Re- print, 2016.

VII. ELECTRONICS RESOURCES:

1. https://www.allaboutcircuits.com/technical-articles/what-is-mixed-signal-ic-
2. https://www.mdpi.com/journal/electronics/special_issues/Mixed_Signal