GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Engineering
Level: PG
Branch: Electronics And Communication (VLSI Design)
Subject Code: ME01096051
Subject Name: CMOS Analog Circuit Design

WEF Academic Year	: 2025-26
Semester	: 01
Category of the Course	: PEC

Prerequisite:	Basic Electronic Circuit Design Concepts and CMOS based circuits.
Rationale:	The students need to learn basic concepts of CMOS based analog circuits and system which leads to design of complex analog system. The students need to know basic of analog circuits. The students will learn the design of various basic analog building blocks such as single stage amplifiers, differential amplifier, op-amp, etc. This is the first course by which students get exposure to CMOS based analog circuit design world.

Course Scheme:

Teaching Scheme			Total Credits	Assessment Pattern and Marks				Total Marks
				Theory		Practical		
L	T	PR	C	ESE (E)	PA(M)	ESE (V)	PA (I)	
03	00	02	00	70	30	30	20	150

Course Content:

U. No	Course Content	No of Hours	% weightage
1	**Basic MOS Device Physics:** MOS device layout, device capacitances, small-signal model, SPICE models,	2	05

2	**Single-Stage Amplifiers :** Basic Concepts, Common-Source Stage: common-source stage with resistive load, CS stage with diode-connected load, CS stage with current-source load, CS stage with source degeneration, Source Follower, Common Gate Stage, Cascode Stage - Folded Cascode	8	20
3	**Passive and Active Current Mirrors:** Basic Current Mirrors, Cascode Current Mirrors, Active Current Mirrors: large-signal analysis, small-signal analysis, common-mode analysis.	6	15
4	**Frequency Response of Amplifier:** General consideration, common-source stage, source follower, common-gate stage, cascade stage, differential pair,.	4	10
5	**Differential Amplifiers:** Single-Ended and Differential Operation, Basic Differential Pair, Common-Mode Response, Differential Pair with MOS Loads, Gilbert Cell	8	20
6	**Operational Amplifiers:** General Considerations, One-stage Op Amps, Two-Stage Op Amps, Gain Boosting, Comparison, Common-Mode Feedback, Input Range Limitations, Slew Rate, Power Supply Rejection, Noise in Op Amps.	8	20
7	**Stability and Frequency Compensation:** Introduction, Multipole Systems, Phase Margin, Frequency Compensation, Compensation of Two-Stage Op amp, Other Compensation Techniques.	6	10
		42	100

Recent Development in Data Analytics (Study from latest research papers published in Scopus indexed/web of science journals - 04 hours during laboratory hours)

Reference Book:

- Design of Analog CMOS Integrated Circuits, Behzad Razavi, TMH
- CMOS Analog circuit design, P. E. Allen and D.R. Holberg
- CMOS Circuit Design, Layout, and Simulation, R. Jacob Baker, Wiley, 2nd Edition

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level*
01	Understand MOS device capacitances.	UN
02	Analyze MOS amplifier circuits.	AN
03	Analyze MOS current mirror circuits.	AN
04	Simulate and measure performance parameters of various MOS analog circuits.	AP
05	Design MOS analog circuits.	AP

*RM: Remember, UN: Understand, AP: Apply, AN: Analyze, EL: Evaluate, CR: Create

Suggested Course Practical List:

- The practical work will be carried out based on the content covered during the academic session.

List of Laboratory/Learning Resources Required:

- List of Hardware: FPGA/CPLD programming tool, Multimeter, Power supply, function generator, oscilloscope
- List of Software: EDA Tools – Cadence, Synopsis, Siemens, Multisim
- List of Useful websites MOOCs:---
    - Course-related online MOOCs on NPTEL/SWAYAM platform
    - Recent publications in reputed journal/conferences

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