SARVAJANIK UNIVERSITY
Sarvajanik College of Engineering and Technology
Bachelor of Technology

B. Tech. Semester VI

Subject Name: **Analog VLSI** **Subject Code: BTEC14616**
Type of course: PEC
Prerequisite: Knowledge of Basic Electronics, BJT, MOS, CMOS, and Digital Logic.
Rationale: The course introduces the students to the main principles of the MOS transistor implementation, the basic VLSI analog design flow and the analog design environment. The students will learn how to draw schematics, run different types of analog simulations and how to draw and verify layout.

Teaching and Examination Scheme:

Teaching Scheme				Theory Marks			Practical Marks		Total
L	T	P	C	TEE	CA1	CA2	TEP	CA3	150
3	0	2	4	60	25	15	30	20	

CA1: Continuous Assessment (assignments/projects/open book tests/closed book tests **CA2:** Sincerity in attending classes/class tests/ timely submissions of assignments/self-learning attitude/solving advanced problems **TEE:** Term End Examination **TEP:** Term End Practical Exam (Performance and viva on practical skills learned in course) **CA3:** Regular submission of Lab work/Quality of work submitted/Active participation in lab sessions/viva on practical skills learned in course

Content:

Sr. no.	Topics	Teaching Hrs.	Module % Weightage
1.	**Introduction to CMOS Analog Circuit Design:** Introduction to Analog Design, Basic MOS Device Physics-General Consideration, MOS I/V Characteristics, Second-Order Effects, MOS Device Models.	5	12
2.	**Single-Stage Amplifiers:** Basic Concepts, Common-Source Stage, Source Follower, Common-Gate Stage, Cascode Stage – Folded Cascode.	5	12
3.	**Differential Amplifiers:** Single-Ended and Differential Operation, Basic Differential Pair, Common- Mode Response, Differential Pair with MOS Loads, Gilbert Cell.	6	12
4.	**Passive and Active Current Mirrors:** Basic Current Mirrors, Cascode Current Mirrors, Active Current Mirrors	5	12
5.	**Frequency Response of Amplifiers:** General Considerations, Common-Source Stage, Source Followers, Common-Gate Stage, Cascode Stage, Differential Pair.	6	12

6.	**OTA circuits-Operational Trans-conductance Amplifier:** General Considerations, differential pair, cascodes, folded-cascodes, One-stage Op Amps, two-stage OTAs. Gain Boosting, Comparison, Common-Mode Feedback, Input Range Limitations, Slew Rate, Power Supply Rejection, Noise in Op Amps.	8	16
7.	**Stability and Frequency Compensation:** Introduction, Multi-pole Systems, Phase Margin, Frequency Compensation, Compensation of Two-Stage Op amp, Other Compensation Techniques.	5	12
8.	**Applications of Analog Building Blocks:** Comparators, Oscillators, Multipliers, PLL, Frequency Synthesizers, Sample-And- Hold Circuits, DC-DC converters.	5	12

Suggested Specification table with Marks (Theory/Practical):

% Distribution of Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
20	20	20	20	10	10

Legends: R: Remembrance, **U:** Understanding; **A:** Application, **N:** Analyze, **E:** Evaluate **C:** Create and above Levels **(Revised Bloom's Taxonomy)**

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Text Books:

Sr. No.	Title of book /article	Author(s)	Publisher and details like ISBN	Year of publication	Publication Edition
1.	Design of Analog CMOS Integrated Circuits	Behzad Razavi	TMH.	2017	2nd
2.	Analysis and Design of Analog Integrated Circuits	P R Gray and R G Meyer	Wiley	2009	5th
3.	RF Microelectronics	Behzad Razavi	Prentice Hall	2012	Latest
4.	CMOS Analog Circuit Design	P. Allen and D. Holberg	Oxford Press.	2013	3rd
5.	VLSI Design Techniques for Analog and Digital Circuits	Geiger, Allen and Stradder	TMH	2010	Latest

Course Outcome:

Sr. No.	CO Statement After learning this subject students will be able to,	Marks % weightage
CO-1	Explain MOS structure and its characteristics in detail.	25
CO-2	Apply techniques to design actively loaded amplifiers with and without feedback.	25
CO-3	Design operational amplifiers, comparators and oscillators and analyse their performances.	20
CO-4	Evaluate amplifier characteristics from top-level specifications using circuit simulators.	20
CO-5	Apply various analog building blocks for real time applications.	10

Mapping with POs:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO-1	2	-	-	-	-	-	-	1	-	-	2	2	-	-	-
CO-2	3	2	3	2	3	1	-	1	-	-	2	2	2	2	2
CO-3	3	2	3	2	3	1	-	1	-	-	2	2	2	2	2
CO-4	3	3	3	3	3	-	-	-	-	-	2	2	-	2	-
CO-5	3	2	2	2	3	2	2	2	2	2	2	2	2	2	2

List of practical:

1. Analyse Trans conductance plots (voltage bias, current bias and technology bias).
2. Design of basic amplifier.
3. Design of positive feed back boot strap current sink.
4. Design of cascode amplifier.
5. Design of basic current sink.
6. Design current sink by using negative feed back resistor.
7. Design of cascode current sink.
8. Design of simple current mirror
9. Design of cascode current mirror.
10. Design of wilson current mirror.
11. Design of Analog to Digital converter using CMOS technology.

List of Open Source/learning websites:

- https://nptel.ac.in/courses/117101105-CMOS Analog VLSI Design

- **https://nptel.ac.in/courses/108106105-**Analog IC design
- https://nptel.ac.in/courses/117106030-Course introduction and Negative feedback control

List of Open Source software:

- HSpice simulation
- LTSpice
- Electric