GUJARAT TECHNOLOGICAL UNIVERSITY

ELECTRONICS & COMMUNICATION (SIGNAL PROCESSING AND VLSI TECHNOLOGY) (26)
ANALOG CMOS CIRCUIT DESIGN
SUBJECT CODE: 3712602
SEMESTER: I

Type of course: Basic MOSFET based analog circuit design

Prerequisite: Basic knowledge of MOSFET and device modeling.

Rationale: This course provides a platform for students to analyze working of the analog circuit using MOSFET. Students are also taught to simulate, analyze and design circuits. This is one of the foundation courses which are required for students to understand the working of MOSFET based complex analog electronic circuits and systems.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE(E)	PA (M)	PA (V)	PA (I)	
3	0	2	4	70	30	30	20	150

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	3	12 %
2	**Single-Stage Amplifiers:** Basic Concepts, Common-Source Stage, Source Follower, Common-Gate Stage, Cascode Stage – Folded Cascode	10	20 %
3	**Differential Amplifiers:** Single-Ended and Differential Operation, Basic Differential Pair, Common-Mode Response, Differential Pair with MOS Loads, Gilbert Cell.	10	20 %
4	**Passive and Active Current Mirrors:** Basic Current Mirrors, Cascode Current Mirrors, Active Current Mirrors	4	13 %
5	**Frequency Response of Amplifiers:** General Considerations, Common-Source Stage, Source Followers, Common-Gate Stage, Cascode Stage, Differential Pair	5	15 %
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.	10	20 %
TOTAL		42	100 %

Reference Books:

1. Design of Analog CMOS Integrated Circuits, Behzad Razavi, TMH
2. CMOS Circuit Design, Layout, and Simulation, R. Jacob Baker, Wiley, 2nd Edition
3. CMOS Analog Circuit Design, Phillip E. Allen and Douglas R. Holberg, Oxford, 3rd Edition
4. Basic VLSI Design, Pucknell, D.A. and Eshraghian, K, PHI, 3rd Edition

Course Outcome:

1. To analyze the basic principle, operation and applications of single stage amplifiers like Common- Source Stage, Source Follower, Common-Gate Stage, Cascode Stage – Folded Cascode.
2. To analyze the basic principle, operation and applications of Basic Differential Pair, Common-Mode Response, Differential Pair with MOS Loads, Gilbert Cell.
3. To analyze the basic principle, operation and applications of Basic Current Mirrors, Cascode Current Mirrors, Active Current Mirrors.
4. To analyze the Frequency Response of Common-Source Stage, Source Followers, Common-Gate Stage, Cascode Stage, Differential Pair.
5. To analyze the basic principle, operation and applications of one-stage Op Amps, Two-Stage Op Amps.
6. To study and understand the Input Range Limitations, Slew Rate, Power Supply Rejection, Noise in Op Amps.

List of Experiments:

1. To implement common source amplifier with
   (a) resistive load
   (b) diode connected load
   (c) current source load
   (d) triode load
   (e) source degradation.
2. To implement cascode circuit.
3. To implement and analyze the basic differential pair circuit
4. To implement and analyze Gilbert Cell.
5. To implement and analyze basic current mirror.
6. To implement and analyze cascode current mirror.
7. To implement and analyze active current mirror.
8. Plot frequency response of common source amplifier.
9. To implement and analyze one stage OP-AMP circuit.
10. To implement and analyze two stage OP-AMP circuit

Major Equipment: C.R.O., Function Generator, Power Supply, Multimeter, Digital Storage Oscilloscope

List of Open Source Software/ Learning website:

LTspice /Ng-spice /Multisim
www.nptel.com
www.nptel.ac.in