ECE   : ANALOG IC DESIGN

Programme: B.Tech. ECE   **Year:** 4th   **Semester:** Even

Course Type: Programme Elective   **Credits:** 3   **Hours :** 40

Course Context and Overview (100 words):
Course Context and Overview (100 words): This course is to teach the fundamentals of analog integrated circuits design for advanced integrated-circuit applications. Topics to be covered include analog fundamentals, MOS Device, Amplifiers, current mirrors, op-amp design and other analog circuitry used in today's analog ICs. The course also includes circuit design and simulation using EDA tools like Cadence, Mentor Graphics, HSpice, etc.

Prerequisites Courses: Semiconductor Devices & Circuits

Course outcomes (COs):

On completion of this course, the students will be able
CO1: Explain the key concepts including specification and design aspects of analog integrated circuits.
CO2: Design MOS Amplifiers & obtain the design of the biasing circuits for Amplifiers
CO3: Design various stages of Operational Amplifier.
CO4: Design and simulate the analog circuits using IC design tools like Cadence, Mentor Graphics, HSpice etc.

Course Topics:

Topics	Lecture Hours	
UNIT - I 1. **The MOS Device**	**4**	
1.1 Introduction to Analog, MOSFET structure and Symbol, Threshold voltage	1	
1.2 MOS I/V relations in different modes of operation	1	
1.3 Transconductance, MOS small-signal model, MOS thermal & flicker noise	1	
1.4 Second order effects	1	
UNIT - II 2. **MOS Amplifiers**	**9**	
2.1 Single Stage: Basic concept, Common Source Amplifier with Resistive, Diode-connected and Triode load, Common Drain amplifier, Common Gate amplifier, Cascode amplifier	5	
2.2 Differential Stage: Basic concept, Differential amplifier, Differential amplifier using MOSFET as a load, Gilbert Cell	4	

UNIT-III 3. **Analog sub-circuit & Feedback**	**8**	
3.1 Analog sub-circuit: Current Mirror, Active current mirror, Current Sink and Current Source, Large Signal and Small Signal Analysis of Current Mirror, Cascode Current Mirror	4	
3.2 Feedback: General considerations, Properties of Feedback, Type of Amplifiers, Feedback topology, Loading effects	4	
UNIT-IV 4. **Frequency response of MOS Amplifiers**	**4**	
4.1 General considerations, Frequency response of Common Source, Common Drain, Common Gate	3	
4.2 Miller effect, Association of Pole to circuit nodes	1	
UNIT-V 5. **OP-AMP Design and Stability**	**11**	
5.1 OP-AMP: General considerations, Single stage op-amp, Double-stage op-amp, Gain boosting techniques, Input range limitations, Slew rate	6	
5.2 Stability: Multi-pole system, Frequency compensation, compensation of two-stage op-amp	4	
5.3 Design of two-stage Miller Compensated OP-AMP	1	
UNIT-VI 6. **IC DESIGN FLOW**	**4**	
6.1 Overview, Semi-custom Design, Full Custom Design	1	
6.2 Full Custom Analog IC Design Methodology	2	
6.3 Introduction to SPICE	1	

Text Books:
[1] Design of Analog CMOS Integrated Circuits, B. Razavi, McGraw-Hill, 2001
[2] CMOS Analog Circuit Design, Philip E. Allen & Douglas R. Holberg, Oxford University Press, 2002.

Reference book:
[1] Analog Integrated Circuit Design, David. Johns and Ken Martin, John Wiley and Sons, 2001.
[2] Analysis and Design of Analog Integrated Circuits, 5th Edition, Paul R. Gray, Paul J. Hurst, Stephen H. Lewis, Robert G. Meyer.

Additional Resources (Web resources etc.):
http://www.ee.iitm.ac.in/videolectures
http://www.cnm.es/~pserra/uab/damics/damics-4-method.pdf

Evaluation Method:

Item	Weightage (%)
Assignments/Term paper	20
Mid Term	30
End Term	50

Prepared By: Dr. Nikhil Raj
Last Update: 15/11/2019