Analog VLSI Circuits Design

Program: B.Tech (ECE)   Year:2018-19   Semester :VI - UG
Course: Program Elective   Credits: 3   Hours: 3

Course Context and Overview (100 words): This course is to teach the fundamentals of analog integrated circuits design using MOSFET for advanced integrated-circuit applications. Topics to be covered include device/process background, IC passives, analog amplifiers, current mirrors, op-amp design, noise fundamentals, oscillators and switched capacitor circuits and other analog circuitry used in today's analog and mixed-signal ICs. The course includes circuit, layout design and simulation using EDA tools like spice, cadence, ADS, electric etc.

Prerequisites Courses: none

Course outcomes (COs):

On completion of this course, the students will have the ability to:
CO1 Explain the key concepts including specification and design aspects of analog integrated circuits and their implementation using MOSFETs. Understand the MOS device/circuits working, modeling and characteristics.
C02 Offer the design of important analog building blocks (like amplifies, oscillators, reference signal generators etc.) based on the specification and constrains given with optimization.
C03 4. Offer the specific design methodology and architecture or given specification to achieve desire outcome in like integration, speed, area, power, fabrication and cost.
C04 Understand the practical challenges and limitations of analog system design come from the difference between theoretical, simulation and real life hardware level design.
C05 To design and simulate the analog circuits and layout using IC design design tools like cadence, spice, electric etc.

Course Topics:

Topics	Lecture Hours	
UNIT – I		
1.1 Analog MOS transistor models, fundamentals and analog IC specification parameters.	1	
1.2 Threshold voltage, MOSFET I-V and C-V characteristics, characterization of resistive, capacitive elements of MOS devices.	2	
1.3 Second order effects. MOS small signal model.	2	
UNIT - II		
2.1 Basics of single stage amplifier, small signal analysis of common source, common drain, common gate and cascode stage amplifier with various kind of loads.	4	
2.2 Various type of reference/bias voltage and current generators, passive current mirrors various architectures, active current mirrors, Supply independent and temperature independent references Band gap references, PTAT current generation and constant Gm biasing.	4	
2.3 Frequency response of amplifiers.	4	

UNIT - III		
3.1 CMOS Differential Amplifiers with balanced and unbalanced output.	3	
3.2 CMOS Operational Amplifiers: telescopic, diff-amp, folded cascode and multistage architecture.	3	
3.3 boosting Common mode feedback (CMFB), feedback topologies in amplifiers	3	
3.4 Stability and frequency compensation.	2	
UNIT - IV		
4.1 Noise in amplifiers.	2	
4.2 Non-linearity and mismatch analysis	2	
UNIT - V		
5.1 Switch capacitor circuits	2	
5.2 Oscillators: LC oscillator and ring oscillators	3	
5.3 VCO and PLL, state-of-the-art analog IC.	5	
5.4 Conclusion.	1	

Textbook references (IEEE format):
Text Book:
- Design of Analog CMOS Integrated Circuits, B. Razavi, McGraw-Hill, 2001

Reference books:
- Analog Integrated Circuit Design, David. A. Johns and Ken Martin, John Wiley and Sons, 2001.
- CMOS Analog Circuit Design, Philip Allen & Douglas Holberg, Oxford University Press, 2002.
- Analysis and Design of Analog Integrated Circuits, 5th Edition, Paul R. Gray, Paul J. Hurst, Stephen H. Lewis, Robert G. Meyer.
- CMOS circuit design, layout and simulation, 2nd Edition, R. Baker, John Wiley and Sons, 2005.

Additional Resources (NPTEL, MIT Video Lectures, Web resources etc.):
www.cmosedu.com
http://www.ee.iitm.ac.in/videolectures/doku.php?id=start
http://pages.hmc.edu/harris/cmosvlsi/4e/index.html

Evaluation Methods:

Item	Weightage
Quiz1	20-25%
Quiz2	
Quiz3	
Assignments	
Midterm	25-30%
Final Examination	45-50%

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