

The ICFAI University Dehradun, Faculty of Science and Technology

First Semester, 2015-16

Course Handout

Course No	Course Title	L	P	U
MEL 605	CMOS Analog VLSI Design	3	2	4

Scope and objective of the course: Analog circuit design itself has evolved with the technology as well. Objective of this course is to develop fundamentals concepts as well as enable students to analyze and design of CMOS analog integrated circuits.

Textbook(s)	<i>Razavi, B., Design of Analog CMOS Integrated Circuits, Tata McGraw Hill (2008).</i>
Reference book(s) R1	<i>Gray, P.R., Hurst, P.J., Lewis, S.H., and Meyer, R.G., Analysis and Design of Analog Integrated Circuits, John Wiley (2001) 5th ed.</i>
R2	Allen, P.E. and Holberg, D.R., CMOS Analog Circuit Design, Oxford University Press (2002) 2nd ed.
R3	<i>Hastings, A., The Art of Analog Layout, Prentice Hall (2005).</i>

Lecture-wise plan:

Lecture Nos.	Learning Objective	Topics to be covered	Reference (Chapter/Sec./Page Nos. of Text/Ref. Books)
1	Introduction to Analog Design	Why analog? , Why integrated? Why CMOS?	T1
2-4	Basic MOS Device Physics	MOS IV Characteristics, Second order effects, Long channel vs. Short-Channel Effects, MOS Device capacitances, MOS Small Signal Model, MOS SPICE models.	T1
5-9	Single Stage Amplifiers	Common Source Stage, Source Follower, Common Gate Stage, Cascode, Folded Cascode.	T1

10-14	Differential Amplifier	Single ended and Differential Operation, Qualitative and Quantitative Analysis of Differential pair, Common Mode response, Differential Pair with MOS loads, Gilbert Cell.	T1
15-17	Current Sources and Mirrors	Current Sources, Basic Current Mirrors, Cascode Current Mirrors, Active Current Mirrors- Large Signal and Small Signal analysis.	T1
18-20	Frequency Response of Amplifiers:	Miller Effect, Association of Poles with nodes, Frequency Response of all single stage amplifiers.	T1
21-24	Noise	Noise Spectrum, Sources, Thermal and Flicker noise, Representation in circuits, Noise in single stage amplifiers, Noise Bandwidth, Noise Figure.	T1
25-27	Feedback	General Considerations, Topologies, Effect of Loading.	T1
28-33	Operational Amplifier	General Considerations, Theory and Design, Performance Parameters, Single-Stage Op Amps, Two-Stage Op Amps, Design of 2-stage MOS Operational Amplifier, Gain Boosting, Comparison of various topologies, slew rate, Offset effects, PSRR, Noise in Op Amps	T1
34-36	Stability and Frequency Compensation	General Considerations, Multi-pole systems, Phase Margin, Frequency Compensation, Compensation Techniques.	T1
37-39	Analog CMOS Process and Layout Techniques	Analog CMOS Process, IC fabrication, Fabrication of active devices, passive devices and interconnects, Analog Layout consideration and Techniques, Symmetry, Multi-finger transistors, Passive devices: Capacitors and Resistors, Substrate coupling, Ground Bounce.	T1

40-42	Non Linearity and Mismatch	Nonlinearity of Differential Circuits, Effect of Negative Feedback, Capacitor Nonlinearity, Linearization Techniques, Offset Cancellation Techniques, Reduction of Noise by Offset Cancellation.	T1
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PRACTICAL/LABORATORY WORK

Review of Mentor Tools; Analysis of Various Analog Building Blocks such as, Current and Voltage References/Sources, Current Mirrors, Differential Amplifier, Output Stages; Design and Analysis of Op-Amp (Closed loop and open loop) and its Characterization, Analog Layout Constraints, Layout Designs and Analysis.