



SECOND SEMESTER 2020-21
COURSE HANDOUT

Date: 16.01.2021

In addition to part I (General Handout for all courses appended to the Time table) this portion gives further specific details regarding the course.

Course No : MEL G632
Course Title : Analog IC Design
Instructor-in-Charge : Anu Gupta
Instructor(s) : -
Tutorial/Practical Instructors: -

1. Course Description: Basic Analog IC Design Issues, Analog Layouts, MOS Switch-- Charge Injection, Current And Voltage Biasing and Reference Generation Circuits, Common Mode Feedback Circuit, Replica Bias, Design, Analysis and Synthesis of Single Stage Amplifiers, Differential Amplifiers, Operational Amplifiers and Operational Transconductance Amplifier Design, Low Power OPAMP, OPAMP/ OTA design in Subthreshold Operation region, Frequency Compensation, Current Mode Analog Circuit Design, Noise-Analysis and Estimation In Amplifiers, emerging trends.

2. Scope and Objective of the Course:

This course aims at thorough understanding of the behavior of analog circuits and systems. The course focuses on basic concepts in Analog IC design; different Design techniques for designing of analog and mixed-signal VLSI circuits. Performance characterization is also envisaged using intuitive analysis and simulation techniques. The simulation/ layout of linear integrated systems using EDA tools like Cadence, mentor graphics is also included.

Objectives of the Course:

- Understand analog IC design issues, MOS device models, impact of scaling on performance, amplifier characterization.
- Learn techniques to set DC bias, common mode feedback, replica bias, current/ voltage mirrors and reference design, types of amplifiers and quiescent point location
- Understand small signal analysis and synthesis of different single/ multi stage amplifiers, OPAMP, OTA and their design & characterization with and without feedback
- Current mode circuit design
- Noise/ distortion analysis in amplifiers, and low noise amplifier design
- Use of EDA tools in design/ characterization of amplifiers, analog layout techniques.

3. Text Book:

Design of Analog CMOS Integrated Circuits, Author: Behzad Razavi, Publisher: TATA McGRAW Hill 2001

4. Reference Books:

R 1. *Analysis and Design of Analog Integrated Circuits*

Author : Paul R. Gray & Robert G. Meyer



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Publishers : Wiley (International edition)

R 2. Analog Integrated Circuit Design

Author : David Johns & Ken Martin

Publishers : John Wiley & Sons 1997.

R 3. Analog VLSI Design – NMOS and CMOS

Author : Malcom R. Haskard & Ian C. May

R 4. Analog VLSI: signal and Information Processing

Author : Mohammed Ismail, Terri Fiez

Publishers : McGRAW-HILL International Edition, 1994.

R5 CMOS Analog Circuit Design

Author : Phillip E. Allen & Douglas R. Holberg

Publishers : Harcourt Bruce Jovanovich College Publishers, 1987

R6. Design of analog Integrated Circuits and Systems

Author : K. R. Laker & Willy M. C. Sansen

Publishers : McGRAW-HILL International Edition, 1994.

R7. IEEE Journal of Solid St. Circuits and other Journals.

R8 Analog MOS Integrated Circuits for Signal Processing

Author : R . Gregorian & G .C Temes

Publishers : Wiley (International edition, 1986)



R9. CMOS MIXED SIGNAL CIRCUIT DESIGN

Author : R . Jacob Baker

Publishers : IEEE Press (Wiley Inter-science 2002)

5. Course Plan:

Approx. No. of Lectures.	Module No.	Lecture sessions	Reference to text book/ref book	Learning Outcomes
01	Introduction	Introduction, two port networks, brief overview of MOS models for Analog Circuits MOS switch, charge injection Noise	Chap-1, R5, IEEE papers	MOSFET models in active , subthreshold region, switching performance of MOSFET device
04	DC Biasing	Advanced Current Biasing/ voltage and current reference generation Circuits	Chap-5, 11, R5	Setting DC bias, stable current/ voltage reference circuits design
12	Amplifiers	Single Stage Amplifiers, frequency response of amplifiers	Chap-3, R5	Analysis and synthesis of single stage amplifiers, low/ high frequency response
		Source Coupled Amplifiers	Chap-4, R5	Analysis and synthesis of Differential amplifier -common mode, differential mode, slew mode
07	Noise	Noise/ distortion --analysis and modeling	Chap. 7	Noise origin, modeling, analysis and estimation in amplifiers, low noise amplifier design



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10	Operational amplifiers- open/ closed loop	Design of Operational Amplifiers and operational trans-conductance amplifiers-- low voltage/ low power, subthreshold region design. G_m/I_D method, Gain, PSRR, CMRR, CMFB, SR, Adaptive bias, Linearity enhancement, Offset, etc. low/ high frequency small signal analysis. Op-amp, frequency response , Frequency Compensation	Chap-9, 10, R5	OPAMP, OTA - design, analysis and characterization with and without feedback
05	Current mode circuit	Current mode amplifiers	IEEE papers	Designing circuits with current input signal
02	Layout techniques	Analog Layouts - MOSFET, Capacitors, Resistors	Chap-13, 18	Layout techniques under PVT variations
01	Emerging trends	Overview of emerging trends- optional	IEEE papers	Current design research
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6. Evaluation Scheme :

Component	Duration	Weightage	Date, Time,	Nature of component (Close Book/ Open Book)
Mid-semester Test	90 min	30		OB
Analog design project / take home weekly lab- assignments	continuous	35	Spread throughout the semester	OB
Comprehensive	2 hrs.	35		OB /CB
		100		



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Laboratory / or Take home assignments: Home assignment/ lab work shall be assigned every week.

7. **Chamber Consultation Hour:** To be announced in the class. Alternatively, student can contact IC and fix up a meeting time.
8. **Notice:** Notice will be displayed on EEE Notice Board and NALANDA
9. **Make-up:** Make-up will be given only on genuine reasons. Prior permission is necessary.
10. **Note (if any):** -

Instructor-in-charge
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