![Birla Institute of Technology & Science, Pilani — Hyderabad Campus]

**Birla Institute of Technology & Science, Pilani**
Hyderabad Campus

**SECOND SEMESTER 2022-2023**
**Course Handout Part II**

Date: Jan 05, 2023

In addition to Part-I (General Handout for all courses appended to the timetable) this portion gives further specific details regarding the course.

**Course No.**          : MEL G632
**Course Title**        : Analog IC Design
**Instructor-in-charge**: Dr. Parikshit Sahatiya

## 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.

**MEL G632 Analog IC Design**                                    **3 2 5**

The course describes both theoretical and practical aspects of Analog integrated circuits. Starting from the basic concepts of MOSFET to major analog building blocks; like operational amplifiers, trans-conductance amplifiers, advanced biasing circuits, switched capacitor circuits including in depth understanding of linear building blocks like differential amplifiers, current mirrors, references, comparators, cascode and buffer amplifiers. The characterization and the performance of the linear integrated circuits will be verified by powerful EDA tools like Cadence withstandard CMOS foundry model files.

## 2.  SCOPE AND OBJECTIVE:

This course deals with the analysis and design of analog CMOS integrated circuits, emphasizing fundamentals and new paradigms that student need to master in today's industry. Analog design is art and science at the same time. It is art because it requires creativity and science because a certain level of methodology requires to carry out a design. The objective of this course is to develop both a solid foundation and methods of analyzing analog circuits by inspection.

### 3. TEXT BOOK:

T1: B. Razavi, Design of Analog CMOS Integrated Circuits, McGraw-Hill, 1st ed., 2001.

### 4. REFERENCE BOOKS:

R1: Paul R. Gray & Robert G. Meyer. Analysis and Design of Analog Integrated Circuits. Wiley, 4th ed., 2010.
R2: David Johns & Ken Martin, Analog Integrated Circuit Design, John Wiley & Sons 2nd ed., 2012.
R3: Phillip E. Allen &Dogulas R. Holberg, CMOS Analog Circuit Design, Oxford University Press,3rd ed., 2013.
R4: Adel S. Sedra et. al., Microelectronic Circuits: Theory and Applications, Oxford University Press,6th., 2013.
R5: R. Jacob Baker, CMOS: Mixed-Signal Circuit Design, Wiley,2008.

### COURSE PLAN

| Section | Lecture # | Topic | Brief | Reference |
|---------|-----------|-------|-------|-----------|
| I | 1 - 2 | Introduction to Analog Design | A brief overview of the course and the role of Analog IC Design. | Lect notes/ Ch. 1, Razavi |
| II | 3- 4 | MOSFET Operation and the small signal models | Described both the operation and modelling of semiconductor devices | Lect notes/Ch. 2, Razavi |
| III | 5-6 | MOSFET Capacitance | Understand capacitance associated with MOS Devices. | Lect notes/ Ch. 2, Razavi Allen-Ch4 |
| IV | 7-10 | Basic Single stage Amplifiers | Varity of single stage amplifiers (CS, CD, CG) with active load will be discussed. | Lect notes/ Ch. 3, Razavi |
| V | 11-13 | Frequency response of single stage amplifiers | Briefly discussed an introductory view of the frequency response of electronic circuits. | Lect notes/R2 Ch. 4/ Ch. 6, Razavi |
| VI | 14-19 | Current Mirror circuits | Discuss various current mirror circuits for biasing | Lect notes/R2 Ch. 5/ Ch. 6, Razavi |
| VII | 20-22 | Negative feedback system and stability (using BODE and Nyquist plot) | Explore how to model negative feedback systems and how to analyze the negative feedback systems. | Lect note/ Ch. 8, Razavi |
| VIII | 23-29 | CMOS operational amplifier (different | Learn different amplifier topologies and how to design such a high gain | Lecture notes/ Ch. 9, |

| | | designs) | amplifiers. | Razavi/ |
|---|---|---|---|---|
| IX | 30-32 | Low Noise Amplifier | Designing of low noise amplifiers | |
| X | 33-36 | Bandgap and current reference circuits | Explore how a voltage and current references can be realized, the absolute value of which is highly accurate. | Ch. 12, Razavi |
| XI | 37-42 | Switched Capacitor Circuits | Learn the MOSFET based switched capacitors | Lecture note/ Ch. 13 Razavi. |

5. **EVALUATIONSCHEME:**

| Component | Duration (min) | Weightage | | Date &Time | Remarks |
|---|---|---|---|---|---|
| | | % | Marks | | |
| Mid Term | 90 | 25 | 75 | 13/03 2.00 - 3.30PM | CB |
| Assignment | | 15 | 45 | | OB |
| Lab | | 20 | 60 | | OB |
| Project | | 10 | 30 | | OB |
| Comprehensive Exam | 180 | 30 | 90 | 09/05 FN | CB |
| **Total** | | **100** | **300** | | |

6. **CHAMBER CONSULTATION HOUR:** To be announced in the class.

7. **NOTICES:CMS**

8. **Makeup Policy:** Make-up only to those who apply before start of test.  Those who apply after the start of test will not be granted any make-up. No make-up for Comprehensive test.

9. **Academic Honesty and Integrity Policy:** Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

Instructor-in-charge
MEL G632