ECE : LINEAR INTEGRATED CIRCUITS

Programme: B.Tech. ECE **Year:** 3rd **Semester:** Odd
Course Type: Programme Elective **Credits:** 3 **Hours:** 40

Course Context and Overview (100 words):
This course is to teach the fundamentals of Integrated Circuits and basic blocks to build integrated circuits. Topics to be covered include IC fabrication steps, circuit configurations to build an IC, amplifiers behavior at low and high frequency, operational amplifier and its application, PLL and Bi-CMOS circuits. The course also includes introduction to Spice language including few design examples and simulations.

Prerequisites Courses: Semiconductor Devices & Circuits, Analog Electronics

Course outcomes (COs):

On completion of this course, the students will be able
CO1: To understand the basic building blocks of linear integrated circuits.
CO2: To gain in-depth knowledge of operational amplifier and its application.
CO3: To gain knowledge in PLL and Bi-CMOS logic.
CO4: To understand the Spice programming software.

Course Topics:

Topics	**Lecture Hours**	
UNIT - I **1. Integrated Circuit**	**8**	
1.1 Manufacturing Process of IC	2	
1.2 Construction & working of BJT and FET devices	4	
1.3 Integrated circuit design and complexity	2	
UNIT - II **2. Amplifiers**	**12**	
2.1 Single Stage CS amplifier, Types of load, Gain calculation, Low frequency and High frequency behavior, Gain boosting technique	5	
2.2 Differential amplifiers, Differential amplifier with and without Active load, performance parameters, Low frequency and High frequency behavior	5	
2.3 Two-stage CMOS op-amp, Frequency compensation	2	
UNIT-III **3. Analysis and Applications of OP-AMP**	**7**	
3.1 Op-amp parameters	1	
3.2 Open loop and Closed loop op-amp configurations	1	
3.3 Inverting & Non-inverting modes	1	
3.4 Applications of op-amp in Active filters, Instrumentation amp, I-V and V-I converters, Log and Anti-log amplifiers etc.	4	

UNIT-IV **4. Phase Locked Loop & Bi-CMOS**	**9**	
4.1 PLL: Basic PLL topology, Voltage controlled oscillator, Charge pump PLL, DLL, Applications	5	
4.2 Bi-CMOS: Basic understanding, Performance comparison of CMOS & Bi-CMOS, Applications	4	
UNIT-V **5. SPICE Programming**	**4**	
5.1 Introduction to Spice, Structure & statements	1	
5.2 Basic Analyses Types: DC, AC & Transient	2	
5.3 Simulation examples	1	

Text Books:

[1] Linear Integrated Circuits, S Salivahaan and V S Kanchana Bhaaskaran, 2nd Ed., McGraw-Hill, 2015.
[2] Design of Analog CMOS Integrated Circuits, B. Razavi, McGraw-Hill, 2001.
[3] Design with Operational Amplifiers and Analog Integrated Circuits, Sergio Franco, 4th Ed., McGraw-Hill, 2014.

Reference book:

[1] OP-AMP and Linear ICs, Ramakant A. Gayakwad, 4th Edition, Prentice Hall Pearson Education, 2001.
[2] Operational Amplifiers and Linear Integrated Circuits, Robert F. Coughlin and Frederick F. Driscoll, PHI, 2001.

Additional Resources (Web resources etc.):

http://www.ee.iitm.ac.in/videolectures
https://www.sciencedirect.com/science/article/abs/pii/0026269289901237

Evaluation Method:

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

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