EE4803: ANALOG IC DESIGN

Effective Term
Semester A 2022/23

Part I Course Overview

Course Title
Analog IC Design

Subject Code
EE - Electrical Engineering
Course Number
4803

Academic Unit
Electrical Engineering (EE)

College/School
College of Engineering (EG)

Course Duration
One Semester

Credit Units
3

Level
B1, B2, B3, B4 - Bachelor's Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
EE3122 Analogue Circuit Fundamentals

Precursors
Nil

Equivalent Courses
Nil

Exclusive Courses
Nil

Part II Course Details

Abstract

This course is aimed at providing students with an understanding of Analog Integrated Circuit (IC) design as well as provide exposure to the CAD software used in the IC design industry through hands-on projects.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Describe device modelling for circuit design		x	x	
2	Identify various circuit blocks used in operational amplifier		x	x	
3	Analyze analog circuits of moderate complexity with tens of transistors		x	x	
4	Utilize this knowledge to design CMOS differential amplifiers		x	x	x

A1: Attitude
Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: Ability
Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to real-life problems.

A3: Accomplishments
Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

Teaching and Learning Activities (TLAs)

	TLAs	Brief Description	CILO No.	Hours/week (if applicable)
1	Lecture	Students are taught the fundamental principles to design and analyze analog circuits in typical IC process. Key concepts are clarified and reinforced based on problems.	1, 2, 3	3 hrs/week
2	Laboratory	Students will have laboratory session to practice the learnt concepts in designing analog circuits using Industry standard CAD software.	2, 3, 4	3 hrs/week (4 weeks)

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Tests(min.: 2)	1, 2, 3	30	
2	#Assignments (min.: 3)	1, 2, 3	30	2 Lab reports, 1 take home assignment
3	Lab Exercises/Reports	2, 3, 4		

Continuous Assessment (%)

60

Examination (%)

40

Examination Duration (Hours)

2.5

Additional Information for ATs

Remark:
To pass the course, students are required to achieve at least 30% in the coursework and 30% in the examination. Also, 75% laboratory attendance rate must be obtained.

may include homework, tutorial exercise, project/mini-project, presentation, lab report

Assessment Rubrics (AR)

Assessment Task

Examination

Criterion

Achievements in CILOs

Excellent (A+, A, A-)

High

Good (B+, B, B-)

Significant

Fair (C+, C, C-)

Moderate

Marginal (D)

Basic

Failure (F)

Not even reaching marginal levels

Assessment Task

Coursework

Criterion

Achievements in CILOs

Excellent (A+, A, A-)

High

Good (B+, B, B-)

Significant

Fair (C+, C, C-)

Moderate

Marginal (D)

Basic

Failure (F)

Not even reaching marginal levels

Part III Other Information

Keyword Syllabus

Introduction to CMOS process and device modelling
CMOS IC fabrication process; Available MOS/BJT devices; Large signal and Small signal modelling; Sub-threshold and above-threshold operation;

Single transistor circuits
Current sink/source; Switch; Active resistor;

Two transistor circuits
Common-source/Common-gate/Common-drain amplifier; Cascode; Current mirror (simple, cascode, Widlar; Wilson)

Differential Amplifier
Differential pair; Active load; Current reference

Non-idealities
Noise; Mismatch/offset; Slew-rate

SPICE simulation
Simulation of above circuits leading to design of differential amplifier

Reading List

Compulsory Readings

	Title
1	Nil

Additional Readings

	Title
1	P. R. Gray, P. J. Hurst, S. H. Lewis and R. G. Meyer: Analysis and Design of Analog Integrated Circuits, 6th Edition, (Wiley, 2017)
2	Phillip E. Allen and Douglas Holberg: CMOS Analog Circuit Design, Oxford University Press; 3rd edition (2011)
3	B. Razavi: Design of Analog CMOS Integrated Circuits, McGraw-Hill Education; 1st edition (August 15, 2000)