The Hong Kong University of Science and Technology

UG Course Syllabus Template

Analogue Integrated Circuits Design and Analysis

ELEC 4420

4 Credits

Pre-requisite: ELEC 3400 Introduction to Integrated Circuits Design

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Course Description

ELEC4420 is a high-level UG course about the design and analysis of analog integrated circuits. Built on the pre-requisite course, this course focuses on further educating students about the design methodology and analysis method of fundamental of analog circuits. The topics include frequency response, feedback, stability and compensation, and 2-stage OTA design.

Intended Learning Outcomes (ILOs)

By the end of this course, students should be able to:

1. Analyze basic analog circuit schematics composed of MOS transistors; know how to compute the gain, bandwidth, input/output voltage range, PSRR, CMRR with a given circuit schematic

2. Design basic analog circuits, including single-stage amplifiers, two-stage amplifiers, reference circuits, etc.

3. Understand what feedback in analog circuits is; identify corresponding feedback types and the sources of instabilities.

4. Understand basic compensation strategies in analog amplifiers; implement basic compensation strategies in multi-stage amplifiers.

Assessment and Grading

This course will be assessed using criterion-referencing and grades will not be assigned using a curve. Detailed rubrics for each assignment are provided below, outlining the criteria used for evaluation.

Assessments:

Assessment Task	Contribution to Overall Course grade (%)	Due date
Homework	25%	28/11/2025
Midterm Exam	20%	28/11/2025
Group Midterm Project	10%	01/11/2025
Group Final Project	45%	22/12/2025

* Assessment marks for individual assessed tasks will be released within two weeks of the due date.

Mapping of Course ILOs to Assessment Tasks

Assessed Task	Mapped ILOs	Explanation
Analyzing analog circuit built with CMOS transistors	ILO1, ILO3, and ILO4	This task assesses students' ability to analyze analog integrated circuits (ILO 1), with especially emphasis on amplifier's stability (ILO 3) and noise (ILO 4) performance.
Designing an amplifier based on given specifications	ILO2, ILO3, and ILO4	The performance of the design project reflects the student's ability to apply analysis knowledge to design problems (ILO 2), especially since the amplifier needs to be stable (ILO 3) and demonstrates low noise (ILO 4).

Grading Rubrics

Task	Excellent (4)	Good (3)	Satisfactory (2)	Absent (1)
Analog CMOS circuit analysis	Can derive important circuit metrics, including gain, bandwidth, input/output voltage range, input/output referred noise, phase margin, etc., of a circuit from transistor parameters correctly.	Can derive important circuit metrics and know how to verify the results through simulation.	Understand important circuit metrics. Knows the method of how to derive them.	Shows a lack of knowledge about circuit metrics or do not know how they correlate with transistor parameters.
Analog CMOS circuit design	Can design an amplifier using transistors from a given technology to meet the target specifications.	Can design an amplifier using transistors from a given technology with a few specifications not met. Can propose potential solutions to improve the performance.	Can design an amplifier using transistors from a given technology, and understands what specifications are not met. Can propose potential solutions to improve the performance.	Do not know how to arrange transistor topologies to build amplifiers.

Final Grade Descriptors:

Grades	Short Description	Elaboration on subject grading description
A	Excellent Performance	Demonstrates a comprehensive understanding of CMOS analog circuits and expertise in amplifier design. Develops a systematic engineering methodology to optimize the performance of analog circuits. Exhibits a high capacity for scholarship and collaboration, going beyond core requirements to achieve learning goals.
B	Good Performance	Shows good knowledge and understanding of CMOS analog circuits and can design amplifiers that meet the specification. Knows how to optimize the performance of amplifiers. Displays motivation to learn and the ability to work effectively with others.
C	Satisfactory Performance	Possesses adequate knowledge of CMOS analog circuits and knows how to use the tools to design amplifiers. Understand the specifications of an amplifier. Shows persistence and effort to achieve broadly defined learning goals.
D	Marginal Pass	Has threshold knowledge of CMOS analog circuits, potential to apply the knowledge in amplifier designs, and the ability to spot trade-offs in engineering problems. Benefits from the course and has the potential to develop in the discipline.
F	Fail	Demonstrates insufficient understanding of CMOS analog circuits and lacks the necessary design skills. Shows limited ability to think critically or analytically and exhibits minimal effort towards achieving learning goals. Does not meet the threshold requirements for professional practice or development in the discipline.

Course AI Policy

The students can use generative AI for homework assignments and final projects. However, the students should be aware that AI generated answers may trigger academic integrity checks by the instructor/TA, as they may look similar to other students AI generated answers.

Communication and Feedback

Assessment marks for individual assessed tasks will be communicated via Canvas within two weeks of submission. Detailed feedback on assignments will be provided upon reasonable enquiry. Students who have further questions about the feedback, including marks, should consult the instructor within five working days after the feedback is received.

Resubmission Policy

The students have 1 chance to submit the homework no later than 72 hours after the deadline. There will be no resubmission opportunities for the group final project.

Required Texts and Materials

B. Razavi, Design of Analog CMOS Integrated Circuits, Mc-Graw Hill, 2nd ed., 2016

Academic Integrity

Students are expected to adhere to the university's academic integrity policy. Students are expected to uphold HKUST's Academic Honor Code and to maintain the highest standards of academic integrity. The University has zero tolerance of academic misconduct. Please refer to Academic Integrity | HKUST – Academic Registry for the University's definition of plagiarism and ways to avoid cheating and plagiarism.

Additional Resources

The following two books are recommended as additional reading materials:

Phillip E. Allen and Douglas R. Holberg, CMOS Analog Circuit Design, 3rd ed., 2012

Paul R. Gray, Paul J. Hurst, Stephen H. Lewis, and Robert G. Meyer, Analysis and Design of Analog Integrated Circuits, 5th ed., 2009