

ECE 5021: Analog Integrated Circuits II

Course Description

Advanced analog integrated circuits. Linear feedback networks design and stability analysis, multi-stage CMOS op-amp design and compensation, fully-differential op-amps and common-mode feedback networks, comparators, transconductors, bandgaps, sample and hold circuits, switched-capacitor circuits, noise analysis of CMOS circuits.

Prior Course Number: ECE720 and ECE722

Transcript Abbreviation: Analog ICs II

Grading Plan: Letter Grade

Course Deliveries: Classroom

Course Levels: Undergrad, Graduate

Student Ranks: Senior, Masters, Doctoral

Course Offerings: Spring

Flex Scheduled Course: Never

Course Frequency: Every Year

Course Length: 14 Week

Credits: 3.0

Repeatable: No

Time Distribution: 3.0 hr Lec

Expected out-of-class hours per week: 6.0

Graded Component: Lecture

Credit by Examination: No

Admission Condition: No

Off Campus: Never

Campus Locations: Columbus

Prerequisites and Co-requisites: Prereq: 4021; or Grad standing in Engineering, and permission of instructor.

Exclusions: Not open to students with credit for 720 or 722.

Cross-Listings:

Course Rationale: Existing course.

The course is required for this unit's degrees, majors, and/or minors: No

The course is a GEC: No

The course is an elective (for this or other units) or is a service course for other units: Yes

Subject/CIP Code: 14.1001

Subsidy Level: Doctoral Course

Programs

Abbreviation	Description
CpE	Computer Engineering
EE	Electrical Engineering

Course Goals

Be competent in the large-signal and small-signal analysis of CMOS differential amplifiers, multi-stage amplifiers, single and fully-differential opamps, and comparators
Be competent in the design techniques of various CMOS amplifiers and comparators and their design and performance tradeoffs
Be competent in identifying poles and zeros and their types in analog circuits

Be competent in the stability analysis of linear feedback networks
Be competent in noise analysis of CMOS analog circuits
Be competent in the use of modern integrated circuit design CAD tools, such as CADENCE
Be competent in performing AC, DC, and Transient simulations
Be competent in performing stability analysis and simulations
Be competent in writing design reports

Course Topics

Topic	Lec	Rec	Lab	Cli	IS	Sem	FE	Wor
Introduction to basic analog circuit blocks	2.0							
Linear feedback networks design and analysis	2.0							
Multi-stage CMOS op-amp design and compensation	3.0							
Applications to linear power regulators	2.0							
Fully-differential op-amps and common-mode feedback networks	5.0							
Comparators and Transconductors	7.0							
Bandgaps and Sample and hold circuits	6.0							
Switched-capacitor circuits	6.0							
Noise analysis of CMOS circuits	6.0							

Representative Assignments

HWs and HW-based short quizzes
Cadence design/simulation final project of various CMOS analog building blocks
Comprehensive written report on the assigned design project

Grades

Aspect	Percent
HWs and/or HW-based quizzes	20%
Two Midterm Exams	50%
Final Project/Report	30%

Representative Textbooks and Other Course Materials

Title	Author
<i>Analog Integrated Circuit Design</i>	T. Carusone, D. Johns, and K. Martin
<i>CMOS Circuit Design, Layout, and Simulation</i>	R. J. Baker

ABET-EAC Criterion 3 Outcomes

Course Contribution	College Outcome
**	a An ability to apply knowledge of mathematics, science, and engineering.
**	b An ability to design and conduct experiments, as well as to analyze and interpret data.
**	c An ability to design a system, component, or process to meet desired needs.
*	d An ability to function on multi-disciplinary teams.

Course Contribution		College Outcome
**	e	An ability to identify, formulate, and solve engineering problems.
*	f	An understanding of professional and ethical responsibility.
*	g	An ability to communicate effectively.
*	h	The broad education necessary to understand the impact of engineering solutions in a global and societal context.
*	i	A recognition of the need for, and an ability to engage in life-long learning.
*	j	A knowledge of contemporary issues.
**	k	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

CpE ABET-EAC Criterion 9 Program Criteria Outcomes

Course Contribution		Program Outcome
**	1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
**	2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
*	3	an ability to communicate effectively with a range of audiences
*	4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
*	5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
**	6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
*	7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

EE ABET-EAC Criterion 9 Program Criteria Outcomes

Course Contribution		Program Outcome
**	1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
**	2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
*	3	an ability to communicate effectively with a range of audiences
*	4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
*	5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
**	6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
*	7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

Additional Notes or Comments

Updated the pre-req to 4021. Updated the title, and updated coverage to advanced analog topics. Moved the original topics to 4021. The changes to 5021 should be contingent on approving 4021.

Changed the offering of the course to Spring instead of Fall. Ayman Fayed 09/20/2018.

Updated course goals and stars for new outcomes. 5/31/19 BLA

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