EEO311: Electronics Circuits II

Spring 2017

2016-2017 Catalog Description:

Differential and multistage amplifiers with bipolar junction transistors(BJT) and field-effect transistors (FET). Biasing in integrated circuits and active loads. Frequency response of common-emitter (common-source), common-base (common-gate), common-collector (common-drain) single BJT (FET) stages. Frequency response of differential-pair, cascode, and multistage circuits. Selection of coupling and bypass capacitors. Analog integrated circuits. Metal-Oxide-Semiconductor (MOS) digital circuits with emphasis on CMOS. LEC/LAB (3 credits)

Course Designation: Required

Text Book: Sedra, Smith, "Microelectronic Circuits", 6th ed., Oxford, 2010, ISBN 978-0-19-532303-0

Prerequisites: Electronics I

Instructor: Dmitri Donetski

Goal: Gaining experience in design of analog integrated circuits

Objectives: Students should be able to: 1) understand the principles of analysis and design of the MOSFET- and BJT-based gain stages biased and loaded with current sources; 2) determine the magnitude and phase frequency responses of single-ended and differential gain stages without negative feedback; 3) analyze the stability of negative feedback circuits, identify the topology of the negative feedback, gain, input and output impedances; 4) analyze and design analog circuits with CAD tools.

Topics Covered:

Week 1.	IC fabrication technology. Review of MOSFET and BJT characteristics. Small signal parameters
Week 2.	Current mirrors. Analysis of Common-Source (CS) and Common-Gate (CG) amplifier stages.
Week 3.	Cascode current sources. Analysis of cascode amplifiers.
Week 4.	Current steering. Design of CS and CG amplifiers.
Week 5.	Review and Test 1.
Week 6.	Differential amplifiers with resistive load. Operation with small and large signals. Differential gain, common-mode gain, CMRR. Differential stage with current-mirror load.

Week 7.	Two-stage OpAmp. MOSFET capacitances. Transition frequency.
Week 8.	Frequency response of CS gain stages. Miller effect.
Week 9.	Poles and zeros. Frequency response of CG stages.
Week 10.	Frequency response of cascode amplifiers. Frequency responses of the differential gain and the common-mode gain of differential stages with current mirror load.
Week 11.	Review and Test 2.
Week 12.	Negative feedback topologies. Voltage amplifier. Transimpedance amplifier. Examples.
Week 13.	Transconductance amplifier. Current amplifier. Examples.
Week 14.	Stability of circuits with negative feedback. Review for Final Exam.

Class/laboratory Schedule: Lectures 2h40min per week.

Program Outcomes and Assessment	**% contribution**
✓ (a) an ability to apply knowledge of mathematics, science and engineering	20
❑ (b1) an ability to design and conduct experiments	
❑ (b2) an ability to analyze and interpret data	20
❑ (c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	20
❑ (d) an ability to function on multi-disciplinary teams	
✓ (e) an ability to identify, formulate, and solve engineering problems	20
❑ (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, economic, environmental, 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	20
❑ Any other outcomes and assessments?	