ECE 332
Electronics II

Prerequisites: ECE 331 with a grade of C or above.
Course Credit: 4 (Lecture and Lab)
Office: Scott Building, Room 352
Textbook: "Fundamentals of Microelectronics" by Behzad Razavi, plus lecture notes.

Objectives: This course is the continuation of Electronics I. It builds on the knowledge of device characteristics, models and operation in linear and non-linear circuits. This course will focus on basic analog circuits based on the MOS technology. BJT type circuits will not be covered in general. Progression of design concepts from simple, single stage linear circuits, to multi-stage linear circuits, to reference circuit, and output stages covers the basic set of design principles and guidelines. The learning will be further enforced by actual design projects students perform in the corresponding lab sessions and the knowledge integration modules. The design projects focus on design principles and verification of the designs with SPICE simulation results with the goal of understanding design tradeoffs.

Assessments: Two assessments (tests) are planned during the semester. Students can use any reference books, notes, and calculators to solve problems during the test period. Each assessment lasts a class period. If you fail any assessment, you MUST contact the instructor to arrange for remedial actions. Failed to do so will result in your failing the class.

Final Exam: The final exam is open-book, open-notes. Use of calculators is allowed.

Homework: Homework assignments are posted online and they are due at 4pm on the day one week after the date of posting.

Laboratory: 5-6 laboratory sessions are planned. All lab assignments are turned in to the TA. The lab report must follow the required format. Fail to do so will have a negative impact on your lab grade.

Knowledge Integration (Tentative): There are three knowledge integration (KI) modules. Each KI module deals with a set of anchoring concepts taught in ECE312, ECE332, and ECE342 and shows how these concepts are integrated in a practical design. A set of questions related to the concepts used in each KI will be distributed before each KI module begins. Students are required to complete the pre-work in the form of a report by working through the questions and to understand how individual concepts are integrated in the practical design. Online presentations by each student to demonstrate his/her understanding of the materials in the first two KIs are required.

Lecture & Lab Schedule (Tentative), and Learning Outcomes:

All lecture and lab schedules are subject to change based on the learning progress and assessment outcome of this course. The contents and the schedules of the topics to be covered in the table below are tentative.

Lecture Topic & Schedule	**Learning Outcomes**	**Accompanying Hands-on Lab Sessions**
Week 1: review MOS	Be able to explain fundamental characteristics	Introduction to

transistors	of MOS transistors using the first order models.	Cadence
Week 2: review MOS transistors	Be able to explain fundamental characteristics of MOS transistors based on concepts using silicon process steps.	Build single-stage, single-ended amplifier
Week 3: single-stage amplifier circuits and design tradeoffs	Be able to analyze and design single-stage amplifiers using a number of design criteria (gain, and output swing, etc.).	Build single-stage, single-ended amplifier
Week 4: simple and cascode current sources	Be able to design and analyze current sources and the concept of cascading.	Build single-stage, single-ended amplifier
Week 5: output stage design	Be able to design and analyze output stages.	Optional design project
Week 6: simple differential circuits	Be able to understand the benefits of differential signaling and the basic concept of differential amplifiers	Build a simple differential amplifier
Week 7: simple differential circuits	Be able to design and analyze simple differential amplifiers.	Build a simple differential amplifier
Week 8: telescopic amplifiers	Be able to design and analyze telescopic differential amplifiers.	Build a simple differential amplifier
Week 9: folded differential amplifiers	Be able to design and analyze folded differential amplifiers.	Build a folded differential amplifier
Week 10	Spring break	Spring break
Week 11: common-mode feedback in differential amplifiers	Be able to analyze and design common-mode feedback structures.	Build a folded differential amplifier
Week 12: frequency response of MOS amplifiers	Be able to analyze frequency response of basic single-stage MOS amplifiers.	Build a folded differential amplifier
Week 13: frequency response of MOS amplifiers	Be able to analyze frequency response of multi-stage CMOS amplifiers.	Build a folded differential amplifier with feedback and compensation capacitance
Week 14: common amplifier feedback structures	Be able to analyze 4 common feedback structures.	Build a folded differential amplifier with feedback and compensation capacitance
Week 15: stability analysis	Be able to analyze circuit stability and make changes to circuits to make it stable.	Optional design project.

Grading:

- Laboratory 25%
- Homework 10%
- Total KI Activities and Participation 10% (Tentative)
- Assessment I 15%
- Assessment II 15%
- Final exam 25%
- Math Foundation 2% (extra)

Note:
No credit will be given to any lab work/report submitted after the solutions have been posted and discussed in the class. Thus, each student must complete all pre-laboratory assignments, attend lab sessions and submit a lab report. Lab reports must be done individually.

Office Hours:
Instructor office hours: T, Th, 11-noon or by appointment.
Instructor office telephone: 491 6574.
Instructor email address: thomas.chen@colostate.edu

Lab TAs are Ming-Hao Cheng (MingHao.Cheng@colostate.edu) and Ryan Way (Ryan.J.Way@rams.colostate.edu). There may be other TAs for this class. More details will be announcement later. Any questions related to the labs should be directed to the lab TAs during any of the lab hours.