ESE 516
Integrated Electronic Devices and Circuits I

Fall 2024

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Classes: TuTh 12:30pm-1:50pm, in Frey Hall 211
Office hours: W 11am-1pm, Th 10am-11am and Th 2pm-3pm or by appointment using Zoom

Recommended Textbooks:
B. Razavi, "Design of Analog CMOS Integrated Circuits", 2nd edition, McGraw Hill Education
References:
D.A. Johns and K. Martin, "Analog Integrated Circuit Design", 2nd edition, Wiley 2011.
P.R. Gray, P.J. Hurst, S.H. Lewis, and R.G. Meyer, "Analysis and Design of Analog Integrated Circuits"

Course Description

This is an advance circuit design course that will discuss the principles, concepts and techniques required to produce successful designs of analog integrated circuits. Fundamentals of MOS transistor, analog circuits and basic topologies will be reviewed. Topics of noise, distortion, mismatch, feedback and frequency compensation will be covered in the class. The emphasis will be on the design of high-performance operational amplifiers.

Course Schedule

Week 1	Introduction to VLSI technology, fundamentals of diode and MOS transistor. MOS transistor modeling.
Week 2	Single-stage amplifiers.
Week 3	"Small-signal/moderate frequency" transistor models. Frequency response of single-stage amplifiers.
Week 4	Basic analog building blocks: current mirrors and biasing.
Week 5	Differential pair.
Week 6	Noise, distortion and mismatch.
Week 7	High-gain amplifiers: "classic" two-stage amplifier.

Week 8	High-gain amplifiers: "current-mirror" amplifier, "telescopic" and "folded cascode" architectures.
Week 9	Frequency response of amplifiers: feedback and compensation.
Week 10	Deviations from idealities of practical op-amps and designs that minimize some of them.
Week 11	Common-mode feedback.
Week 12	Nanometer design. gm/Id design methodology.
Week 13	Biasing of the amplifiers. Bandgap references.

Goals:
The purpose of this course is to introduce students to principles of analysis and design of analog integrated circuits, starting from single transistor circuits to the multi-stage operational amplifier design.

Objectives:
Students should be able to:
1) analyze and design single-stage amplifier
2) analyze and design multi-stage differential amplifiers
3) analyze the frequency response of a single-stage and multi-stage amplifier
4) design a high-gain amplifier based on defined set of performance parameters.

Homework:
To help prepare for the midterm and final exams, homework exercises will be assigned. They will not be graded. Solutions will be given a week after they are assigned. The example problems and exams will be provided prior to both exams.

Project:
The project will include a set of three Cadence assignments: single-stage amplifier analysis and simulation; two-stage operational amplifier analysis and simulation; the final part of the project is to design and verify performance of a high-gain amplifier based on defined set of performance parameters.

Students can do project by themselves, or they can form a group comprising 2 members (single project report required in the case of a 2 member group).

The students will have access to department Linux machines (in-person and remote).

Credit Distribution

1. Midterm (30%): tentatively scheduled for October 15th.
2. Final (40%): will be held in the finals week according to the University schedule
3. Project (30%)

Student Accessibility Support Center Statement

If you have a physical, psychological, medical, or learning disability that may impact your course work, please contact the Student Accessibility Support Center, Stony Brook Union Suite 107, (631) 632-6748, or at sasc@stonybrook.edu. They will determine with you what accommodations are necessary and appropriate. All information and documentation is confidential.

Students who require assistance during emergency evacuation are encouraged to discuss their needs with their professors and the Student Accessibility Support Center. For procedures and information go to the following website: https://ehs.stonybrook.edu//programs/fire-safety/emergency-evacuation/evacuation-guide-disabilities and search Fire Safety and Evacuation and Disabilities.

Academic Integrity Statement

Each student must pursue his or her academic goals honestly and be personally accountable for all submitted work. Representing another person's work as your own is always wrong. Faculty is required to report any suspected instances of academic dishonesty to the Academic Judiciary. Faculty in the Health Sciences Center (School of Health Professions, Nursing, Social Welfare, Dental Medicine) and School of Medicine are required to follow their school-specific procedures. For more comprehensive information on academic integrity, including categories of academic dishonesty please refer to the academic judiciary website at http://www.stonybrook.edu/commcms/academic_integrity/index.html

Critical Incident Management

Stony Brook University expects students to respect the rights, privileges, and property of other people. Faculty are required to report to the Office of Student Conduct and Community Standards any disruptive behavior that interrupts their ability to teach, compromises the safety of the learning environment, or inhibits students' ability to learn. Faculty in the HSC Schools and the School of Medicine are required to follow their school-specific procedures. Further information about most academic matters can be found in the Undergraduate Bulletin, the Undergraduate Class Schedule, and the Faculty-Employee Handbook.