PURDUE
UNIVERSITY

Course Information

Course number and title: ECE595B CMOS Analog IC Design
Meeting time: MWF 11:30 am – 12:20 pm (Room: BHEE 224)
Course credit hours: 3
Course web page: BrightSpace
Prerequisites: ECE 255 Introduction to Electronic Analysis and Design or Equivalent

Information About the Instructor(s)

Name of the instructor: Byunghoo Jung
Office Location: WANG 2053
Phone number: +765-494-2866
Email Address: jungb@purdue.edu
Office hours, times, and location: MWF 12:30 pm – 1:30 pm EST or by appointment
Online meeting place: https://purdue-edu.zoom.us/my/jungb
In-person meeting place: Wang 2053

Instructor's Email Availability and Policies

I will be available via email (jungb@purdue.edu) daily and try to respond as soon as possible (generally within 24-48) hours. When emailing me, please place the course number and topic in the email's subject line (*e.g.,* ECE595 – Exam 2 Question). This will help me tremendously in locating and responding to your emails quickly.

Course Description

The course covers general topics in CMOS analog IC design; biasing, noise, single-stage amplifiers, differential amplifiers, OP-Amp, OTA, frequency domain analysis, and active filters. While the course focuses on CMOS IC design, design in bipolar and BiCMOS technologies are also introduced. A design project is a key component of the course. The students conduct group or individual design projects. Process Design Kit and EDA tools are provided for the design project.

Learning Outcomes

A student who successfully fulfills the course requirements will have demonstrated:

i. basic knowledge of bias circuits
ii. basic knowledge of noise analysis
iii. an understanding of single-stage amplifiers and their applications
iv. an understanding of differential Op-amp, OTA, and practical design skills.
v. an understanding of feedback circuits
vi. an understanding of basic active filters, practical design skills, and applications

Learning Resources, Technology, & Texts

- Required Textbook:

    - Design of Analog CMOS Integrated Circuits by Behzad Razavi (McGraw-Hill)
    - Edition 1 or Edition 2 (Edition 2 is recommended.)
- Software
    - Cadence (Account will be provided)
    - LT Spice (Free version)
    - Optional: MATLAB (Purdue Educational License) or Python (Free version)
- BrightSpace page
    - You can access the course via BrightSpace.

Assignments and Points

Your learning will be assessed through a combination of projects and exams spread throughout the semester. Details on these project assignments and exams will be posted on the course website.

Assignments	Due	Points
Midterm Exam 1	Oct 13 (F) In-class / online exam	50
Project Report – Phase 1	Nov 3 (F, 11:59 pm)	50
Midterm Exam 2	Nov 20 (M) In-class / online exam	50
Project Report – Phase 2	Dec 11 (M, 11:59 pm)	50
		Total: 200
There will be no final exam. The project report will replace the final exam.		

Missed or Late Work

Late projects or assignments will NOT be accepted. You may request an extension for project assignments or make-up exams for documented emergencies (e.g., hospitalization, death of a family member, etc.) It must be requested BEFORE its due date except for a campus emergency.

Grading Scale

Absolute and relative scale:
Average < 65/100: 25% A, 40%B, 25% C, 10% D/F
Average > 65/100: 35% A, 40% B, 20% C, 5% D/F
Average > 75/100: 40% A, 50% B, 10% C
The final grade distribution will be adjusted based on the average and standard deviation.
2 exams each accounting for 25% of the grade (25% x 2 = 50%)
Design Project accounts for 50% of the grade (phase 1 = 25%, phase 2 = 25%)

Course Schedule

1. Device physics, modeling, and layout
2. Biasing
3. Single-stage amplifier
4. Single-stage amplifier
5. Differential amplifier
6. Differential amplifier
7. Frequency analysis
8. Frequency analysis
9. Noise analysis

10. Noise analysis
11. Feedback
12. Feedback
13. Operational amplifier
14. Integrated filter design
15. Integrated filter design

Attendance Policy

Students are expected to be present for every (in-person and online) meeting of the classes in which they are enrolled. Only the instructor can excuse a student from a course requirement or responsibility. When conflicts or absences can be anticipated, such as for many University-sponsored activities and religious observations, the student should inform the instructor of the situation as far in advance as possible. For unanticipated or emergency absences when advance notification to an instructor is not possible, the student should contact the instructor as soon as possible by email or phone. More than five unexcused absences will result in grading penalties of 5 points per absence after the fifth.

Academic Integrity

Academic integrity is one of the highest values that Purdue University holds. Individuals are encouraged to alert university officials to potential breaches of this value by either emailing or calling 765-494-8778. While the information may be submitted anonymously, the more information that is submitted provides the greatest opportunity for the university to investigate the concern.

The Purdue Honor Pledge "As a boilermaker pursuing academic excellence, I pledge to be honest and true in all that I do. Accountable together - we are Purdue"

Nondiscrimination Statement

Purdue University is committed to maintaining a community that recognizes and values the inherent worth and dignity of every person; fosters tolerance, sensitivity, understanding, and mutual respect among its members; and encourages each individual to strive to reach his or her own potential. In pursuit of its goal of academic excellence, the University seeks to develop and nurture diversity. The University believes that diversity among its many members strengthens the institution, stimulates creativity, promotes the exchange of ideas, and enriches campus life. Link to Purdue's nondiscrimination policy statement.

Students with Disabilities

Purdue University strives to make learning experiences as accessible as possible. If you anticipate or experience physical or academic barriers based on disability, you are welcome to let me know so that we can discuss options. You are also encouraged to contact the Disability Resource Center at: **drc@purdue.edu** or by phone: 765-494-1247.

Emergency Preparation

In the event of a major campus emergency, course requirements, deadlines, and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances beyond the instructor's control. Relevant changes to this course will be posted on the course website or can be obtained by contacting the instructors via email or phone. You are expected to read your @purdue.edu email on a frequent basis.

- To report an emergency, call 911. To obtain updates regarding an ongoing emergency, sign up for Purdue Alert text messages, view www.purdue.edu/ea.

- There are nearly 300 Emergency Telephones outdoors across campus and in parking garages that connect directly to the PUPD. If you feel threatened or need help, push the button and you will be connected immediately.
- If we hear a fire alarm during class, we will immediately suspend class, evacuate the building, and proceed outdoors. Do not use the elevator.
- If we are notified during class of a Shelter in Place requirement for a tornado warning, we will suspend class and shelter in [the basement].
- If we are notified during class of a Shelter in Place requirement for a hazardous materials release, or a civil disturbance, including a shooting or other use of weapons, we will suspend class and shelter in the classroom, shutting the door and turning off the lights.
- Please review the Emergency Preparedness website for additional information. http://www.purdue.edu/ehps/emergency_preparedness/index.html

Mental Health Statement

- **If you find yourself beginning to feel some stress, anxiety, and/or feeling slightly overwhelmed, try WellTrack.** Sign in and find information and tools at your fingertips, available to you at any time.
- **If you need support and information about options and resources**, please see the Office of the Dean of Students for drop-in hours (M-F, 8 am- 5 pm).
- **If you're struggling and need mental health services**: Purdue University is committed to advancing the mental health and well-being of its students. If you or someone you know is feeling overwhelmed, depressed, and/or in need of mental health support, services are available. For help, such individuals should contact Counseling and Psychological Services (CAPS) at 765-494-6995 during and after hours, on weekends and holidays, or by going to the CAPS office of the second floor of the Purdue University Student Health Center (PUSH) during business hours.

TaskHuman Support

TaskHuman offers private, real-time, on-demand, 1-on-1 video calls with wellness coaches covering over 800+ topics such as anxiety, mindfulness, reducing stress, clean eating, time management, in-home workouts, relationship tensions, financial issues, spiritual guidance, and many more. You can access these wellness coaches from around the world 24/7. The College of Engineering has an exclusive agreement with TaskHuman which gives you FREE and UNLIMITED access to these resources. Over 3,200 calls have been made by College of Engineering students, staff, and faculty so far with an average satisfaction rating of 4.89/5.
Learn more here: https://engineering.purdue.edu/ECE/TaskHuman.

DOWNLOAD TASKHUMAN:

- Scan the QR Code to download the TaskHuman App or download the TaskHuman App directly from the App Store or Google Play Store
- Create an account
- Go to Settings and tap on "Check for Discounts"
- Insert your code: purdue63

Don't see a topic you want or have other questions? Contact Brooke Parks, Senior Lecturer in ECE, at brookeparks@purdue.edu.

Violent Behavior Policy

Purdue University is committed to providing a safe and secure campus environment for members of the university community. Purdue strives to create an educational environment for students and a work environment for employees that promote educational and career goals. Violent Behavior impedes such goals. Therefore, Violent Behavior is prohibited in or on any University Facility or while participating in any university activity.
See the University's full violent behavior policy for more detail.

Diversity and Inclusion Statement

In our discussions, structured and unstructured, we will explore a variety of challenging issues, which can help us enhance our understanding of different experiences and perspectives. This can be challenging, but in overcoming these challenges we find the greatest rewards. While we will design guidelines as a group, everyone should remember the following points:

- We are all in the process of learning about others and their experiences. Please speak with me, anonymously if needed, if something has made you uncomfortable.
- Intention and impact are not always aligned, and we should respect the impact something may have on someone even if it was not the speaker's intention.
- We all come to the class with a variety of experiences and a range of expertise, we should respect these in others while critically examining them in ourselves.

Disclaimer

This syllabus is subject to change. When there is a change in the syllabus, the updated syllabus will be posted on BrightSpace.