SABANCI UNIVERSITY

Faculty of Engineering & Natural Sciences

EE 202 – Electronic Circuits II

Spring 2023/2024 Syllabus

Instructor: Ömer Ceylan

e-mail: omer.ceylan@sabanciuniv.edu

Office: FENS 1039

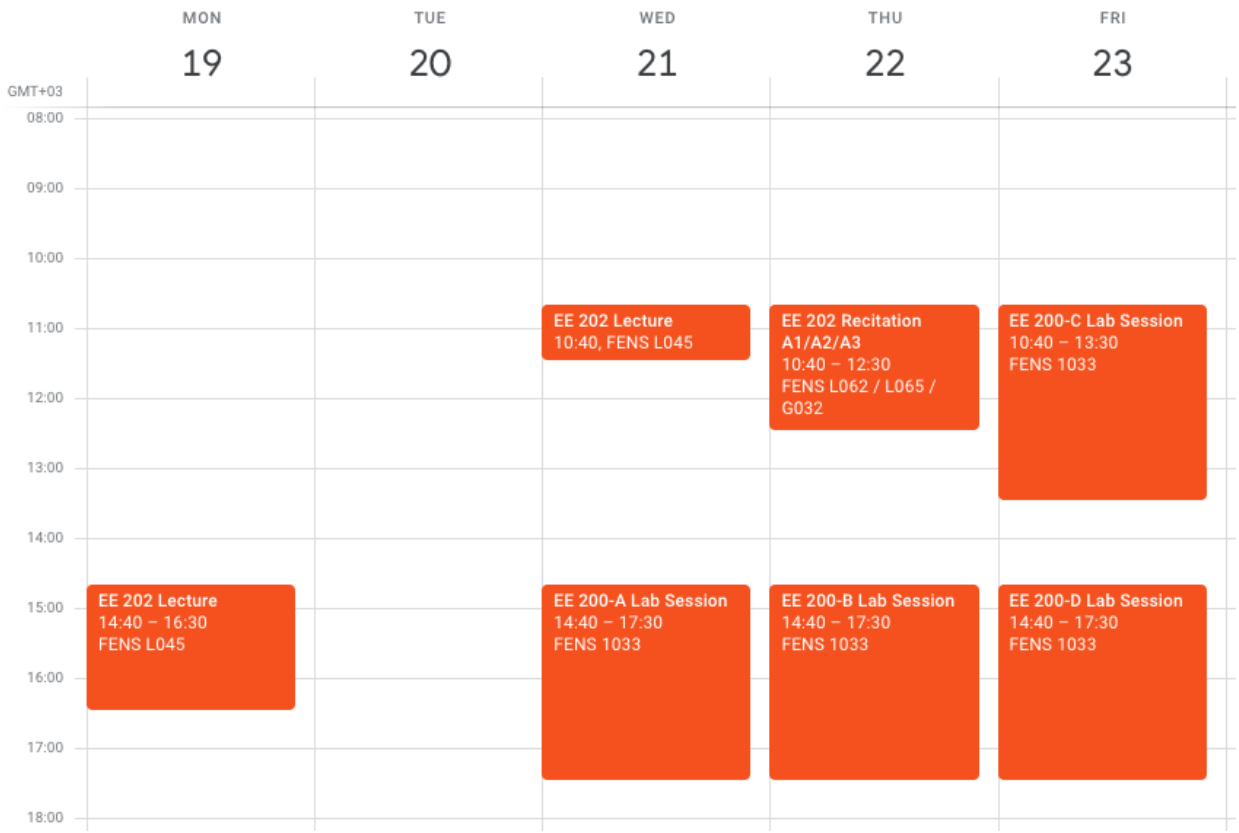
Teaching Assistants

Tahsin Alper Özkan (PhD) alper.ozkan@sabanciuniv.edu

Hüseyin Kaya (MSc) kayahuseyin@sabanciuniv.edu

Mehmet Emre Çakır (MSc) cakirmehmet@sabanciuniv.edu

Weekly Schedule



Office Hours

Course Instructor: Wednesday 13.30-14.30 FENS 1039

TAs: TBD

Prerequisites: ENS 203 (Electronic Circuits)

Co-requisites: EE 200 (Electronic Cicuit Implementation)

Catalog Description: Concepts of basic semiconductor devices (PN junctions, MOSFETs and BJTs); design of DC bias circuits; DC/AC models of semiconductor devices; Frequency response, small/large-signal analysis of devices/circuits; single-stage, multistage and differential amplifiers; feedback and stability concepts in amplifiers.

Learning Outcomes

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

- Ability to analyze physical operation, current voltage characteristics, and DC operation/biasing of PN diode/device and BJT/MOSFET devices/transistors/structures,
- Ability to understand small-signal operation and models of BJT/MOSFET transistors and applying these models for the realization of basic discrete amplifier designs/configurations,
- Ability to apply DC biasing concept to maximize the performance of discrete amplifier designs/configurations,
- Understand and analyze the low/high-frequency response of BJT/MOSFET, including internal capacitance effects,
- Ability to design and analyze MOSFET/BJT based different amplifier concepts, including CS-CE, CG-CB, CD-CC, Cascade and Cascode amplifier configurations,
- Understand and analyze the stability of amplifier, feedback concepts (positive and negative) and basic feedback topologies.

Textbook:

- Adel S. Sedra, Kenneth C. Smith, Microelectronic Circuits, 7th Edition, Oxford University Press, 2015 (www.sedrasmith.com)
- Can be purchased through: https://www.homerbooks.com/urun/microelectronic-circuits-8e

Reference Books (available at the Information Center):

- B. Razavi, Fundamentals of Microelectronics, Wiley-2008
- D. A. Neamen, Electronic Circuit Analysis and Design, New York: McGraw-Hill, 1996

Tentative Course Outline

Semiconductors (1 Week)
Chapter 3: (Page No: 134 – 167)
3.1 Intrinsic Semiconductors
3.2 Doped Semiconductors
3.3 Current Flow in Semiconductors
3.4 The p-n Junction
3.5 The p-n Junction with an Applied Voltage
3.6 Capacitive Effects in the p-n Junction

Bipolar Junction Transistors BJTs (2.5 Weeks)
Chapter 6: (Page No: 304 – 351)
6.1 Device Structure and Physical Operation
6.2 Current Voltage Characteristics
6.3 BJT Circuits at DC

BJT in Amplifier Design (2 Weeks)
Chapter 7:
7.1.1 Applying the BJT in Amplifier Design (Page No: 368 – 369)
7.2.2 Small Signal Operation and Models (Page No: 399 – 420)
7.3 Basic BJT Amplifier Configurations (Page No: 423 – 454)
7.4.2 Biasing in BJT Amplifier Circuits (Page No: 461 – 466)
7.5 Discrete Circuit BJT Amplifiers (Page No: 467 – 478)
6.4 Transistor Breakdown and Temperature Effects (Page No: 351 – 354)

Midterm I

Frequency Response of BJT (2 Weeks)
Chapter 10:
10.1 Low-frequency Response of the CS-CE Amplifiers (Page No: 699 – 710)
10.2.2 Internal Capacitive Effects and High Frequency Model of the BJT (Page No: 717 – 722)
10.3 High-frequency response of the CS-CE amplifiers (Page No: 722 – 738)
10.4 Useful tools for the analysis of the high frequency response of amplifiers (Page No: 739 – 747)
10.6 High Frequency Response of the Source and Emitter Followers (Page No: 760 – 767)
10.8 Other Wide Band Configurations (Page No: 778 – 788)

MOS Field-Effect Transistors (1 Week)
Chapter 5: (Page No: 247 – 287)
5.1 Device Structure and physical operation
5.2 Current Voltage Characteristics
5.3 MOSFET Circuits at DC

Small Signal Operation of MOSFETs (1.5 Weeks)
Chapter 7:
7.2.1 Small Signal Operation and Models (Page No: 383 – 398)
7.3 Basic MOSFET Amplifier Configurations (Page No: 423 – 454)
7.4.1 Biasing in MOS Amplifier Circuits (Page No: 455 – 460)
7.5 Discrete-Circuit MOS Amplifiers (Page No: 467 – 478)

Frequency Response of MOSFETs (1 Weeks)
Chapter 10:
10.1 Low Frequency Response of the CS CE Amplifiers (Page No: 699 – 710)
10.2.1 Internal Capacitive Effects and High Frequency Model of the MOSFET and the BJT (Page No: 711– 716)
10.3 High Frequency Response of the CS CE Amplifiers (Page No: 722 – 739)
10.5 High Frequency Response of CG and Cascode Amplifiers (Page No: 748 – 760)
10.6 High Frequency Response of the Source and Emitter Followers (Page No: 760 – 767)
10.8 Other Wideband Amplifier Configurations (Page No: 778 – 787)
9.6.1 Multistage Amplifier Examples (Page No: 659 – 663)

Midterm II

Differential BJT Pair (1 Weeks)
Chapter 9:
9.2 The BJT Differential Pair (Page No: 614 – 627)

Feedback (1 Week)
Chapter 11: (Page No: 808 – 828)
11.1 The General Feedback Structure
11.2 Some Properties of Negative Feedback
11.3 The Four Basic Feedback Topologies

Course Policies:

- Cheating will not be tolerated. You can discuss homework problems with your classmates. However, everyone should submit his/her own solution.
- Attendance is extremely important. You are responsible from the content covered in class. Top Hat application will be used to take attendance for each day. You will get an attendance grade proportional to the ratio: *(attended lectures / total number of lectures)*.
- Homework will be assigned each week, which will cover the corresponding week's content. Homework will be submitted through SuCourse. For homework no late submission is accepted.
- There will be random quizzes during the recitations. Their date will not be announced.
- Two in-class exams and one final exam will be implemented. It is in your best interest to attend all exams on the date of their delivery. Conflicts must be stated before the fact. Failure to attend an exam or to make previous arrangements results in a score of zero. Examinations are closed-book, closed-notes, and closed homework.
- The grading of exams and quizzes will emphasize the method used to arrive at the answer rather than the numerical result itself. Hence, it is most important that your work be

legible, organized, and understandable. Writing just the correct numerical result will not get any points.

- An electronic hand calculator is necessary for both the exams and homework in this class. Students are responsible for knowing how to use their own calculators.

Grading Policy:

Midterm 1	25%
Midterm 2	25%
Quizzes	5%
Homework	10%
Final	35%
Attendance (Bonus)	3%

Important Notes:

- In case of an online or hybrid education, your webcam and microphone should be on during the exams. In the case of non-compliance with this and other declared exam procedures, your exam will be void. Make sure to check that your webcam and microphone function properly before the exam.
- You may be given an oral exam to check the authenticity of the written exam by going through the questions of the written exam.
- You must attend the synchronous Zoom lectures, recitations, etc. and real-time online exams with your SU email account in case of an online or hybrid education.