SABANCI UNIVERSITY
Faculty of Engineering and Natural Sciences
Electronics Engineering: EE 202 - Electronic Circuits II
Spring-2022-2023

Instructor: Prof. Dr. Yaşar Gürbüz
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Room# 1044 (MDBF)
Phone# 9533

Course Zoom ID:
https://sabanciuniv.zoom.us/j/2554580251
https://sabanciuniv.zoom.us/my/yasar.gurbuz
Meeting ID: 255 458 0251

Recitation Zoom ID: https://sabanciuniv.zoom.us/j/2554580251

TAs:
1. **Tahsin Alper Özkan (PhD)** (talper@sabanciuniv.edu)
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Disclaimer:

"We may have to revise the course plan according to the countrywide reassessment to be made regarding higher education. This is expected to happen at the beginning of April. The content to be delivered is certain but the method of course delivery, the number and dates of exams, and some other details are subject to change."

We will start the course teaching online and use Zoom until the next official announcement from the Higher Education Council (YÖK) regarding the way the course will be carried out, online / physical / hybrid, hopefully before April 10ᵗʰ, 2023.

I will talk in detail about how we plan to begin carrying out during our first online lecture in FENS L045. Make sure that you do not miss the first lecture, yet alone, all the lectures.

A few additional announcements/details regarding the online/teaching at the beginning of the semester:

1. Please do let me know, send me an email, if you or someone you know are effected by the recent Earthquakes.

2. We will start teaching the course online in Zoom platform and will be using the classroom settings for the online teaching in FENS L045 during the lecture hours. We will continue in this way of implementation until the next official announcement by YÖK, hopefully no later than the beginning of April 2023.

3. We will also carry out the Recitation hours as the same as the Lectures, The course TAs will be solving problems and helping you with your questions during the recitation hours inside the assigned classrooms **online**.

4. There will be study problems assigned almost in each week

5. The following week of the study problem assignments, there will be a Quiz during the recitation hours – online - covering the content of the materials as represented by the assigned study problems.

6. No makeups for the missing quizzes but we will drop one of your Quizzes with the worst grade from the grading at the end of the semester.

7. All rules and regulations that are stated below about the course are also applicable for the online part of the labs.

I will clarify any issues you might have about the announcement above or any other you might have about the course during the first lecture of the course.

Electronic Circuits II - 20708 - EE 202 - 0

Type	Time	Days	Where
Class	2:40 pm - 4:30 pm	M	**FENS L045 online @ Zoom**
Class	11:40 am - 12:30 pm	W	**FENS L045 online @ Zoom**

Electronic Circuits II Recit. - 20710 - EE 202R - A

Type	Time	Days	Where
Class	4:40 pm - 6:30 pm	W	FASS G043 **online @ Zoom**

Electronic Circuits II Recit. - 20712 - EE 202R - B

Type	Time	Days	Where
Class	10:40 am - 12:30 pm	R	FENS L065 **online @ Zoom**

Electronic Circuits II Recit. - 20714 - EE 202R - C

Type	Time	Days	Where
Class	4:40 pm - 6:30 pm	R	FASS G056 **online @ Zoom**

Office Hours:

Course Instructor: Monday,   13:40-14:30   (FENS 1044)
TAs (Homework): Wednesday, 15:40-16:30   (FENS 1033)
TAs (Homework): Thursday,   15:40-16:30   (FENS 1033)

Prerequisites by Course: ENS 203 (Circuit I)
by Topic: Basic circuit analysis including Ohm's and Kirchhoff's Laws, loop and nodal analysis, Thevenin and Norton equivalents, Sinusoidal forcing functions, phasors, and impedance / admittance.

Co-requisites: EE 200, Electronics Circuit Implementation.

Catalog Description: PN diode/device structure, physical operation, current voltage characteristics, and DC operation of BJT/MOSFET transistors/devices, along with diode and Transistor Breakdown and Temperature Effects, are analyzed. BJT/MOSFET small signal operations and models, and applying these models in basic discrete amplifier designs/configurations, along with different biasing concepts, are emphasized. Low-frequency response of BJT/MOSFET and CS-CE Amplifiers are studied. Internal capacitive effects and high frequency model of the BJT/MOSFET, along with high-frequency response of the CS-CE amplifiers, CG-CB, CD (Source follower)-CC (Emitter follower), Cascade and Cascode amplifiers are studied. Other wide band amplifier configurations, multistage amplifier examples, along with the BJT/MOSFET differential amplifiers are covered. Finally, the general feedback structure, some properties of negative feedback, and basic feedback circuit topologies are studied.

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

1. Ability to analyze physical operation, current voltage characteristics, and DC operation/biasing of PN diode/device and BJT/MOSFET devices/transistors/structures,

2. Ability to analyze and understand electrical breakdown mechanisms and temperature effects of PN diode and BJT/MOSFET transistors,

3. 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,

4. Ability to apply DC biasing concept to maximize the performance of discrete amplifier designs/configurations,

5. Understand and analyze the low/high-frequency response of BJT/MOSFET, including internal capacitance effects,

6. Ability to design and analyze MOSFET/BJT based different amplifier concepts, including CS-CE, CG-CB, CD-CC, Cascade and Cascode amplifier configurations,

7. Understand and analyze the stability of amplifier, feedback concepts (positive and negative) and basic feedback topologies.

Implementation:
Classroom concepts are reinforced through recitations, implementing design exercises and homework problems.

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.

Incompletes are not given out as course grades as a consequence of missing an exam or homework assignment. Examinations are closed-book, closed-notes, and closed homework. Single sheets of summary equations are, however, permitted.

Textbooks:
- 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**
- **R. C. Jaeger, Microelectronic Circuit Design. New York: McGraw-Hill, 1997**.
- R. T. Howe and C. G. Sodini, Microelectronics, Prentice Hall
- **D. A. Neamen, Electronic Circuit Analysis and Design, New York: McGraw-Hill, 1996**
- M. N. Hornstein, Microelectronic circuits and devices
- **SPICE, Gordon Roberts and Adel Sedra, Second Edition, 1996**

Study Problems, Homework (**Total of 10 assigned last year!!**) in early years:

Study problems will consist of corresponding week's lectures and given out on a weekly basis, nominally on Thursday's. You are encouraged to work together on the problems, but please ensure that you have a good understanding of the solutions.

We will have a Quiz each week that consists of representative study problems assigned the previous week. We usually have one or two problems on each Quiz and will be carried out during the recitation hours, at the beginning, in the middle or at the end of recitation hours determined by the TAs work program of the corresponding recitation hours.

No physical homework submissions are expected this semester but the instructor could revise this position at any time during the semester.

Quizzes for the online sessions of the course will be carried out online and we will practice how we carry out the online Quiz during the first week's recitation hours. Hence, attending the recitation hours first week is important.

Late-online Quiz submissions will not be accepted.

The grading of Quizzes (as well as the exams) 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. In addition, computer output, e.g. from SPICE, must be properly annotated to explain and label its key features.

Lectures:
Lecture attendance strongly recommended since you are responsible for any material covered in class.

Calculators:
An electronic hand calculator is necessary for both the exams and homework in this class. A programmable calculator or one that offers an equation "solver" function is not required, but strongly recommended. Students are responsible for knowing how to use their own calculators.

Computers and Software:
This class will also involve computer simulation of circuits using PSPICE. This program will be available on the course web-site for downloading or you obtain the same PSPICE student version software from the OrCAD website: http://www.orcad.com. Be sure to use PSpice 9.1 student edition. This includes PSpice A/D, Capture, Schematics, and PSpice Optimizer. Only PSpice A/D and Capture will be used in this course.

Grading:

2-Midterms   :   50 % (25% + 25%)
Homework + Quiz   :   15 %
Final   :   35 %

Top 5-Ways to Avoid an "A" Grade

1. Skip lectures

2. Don't put adequate effort into HW assignments
    a. Do it at the last minute
    b. Rely too much on collaboration

3. Don't attend discussion/recitation sections

4. Don't turn in HWs

5. Don't review HW solutions, lecture notes and additional work/study problems

EE 202 - Circuits II
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

   LAST DAY OF CLASSES 14th Week
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