

ECE 476

Electronic Circuits II

Spring 2022

| | |
|-----------------------------|--------------------------------------------------------------|
| <u>Instructor:</u> | Dr. George L. Engel (EB 3043) |
| <u>Time:</u> | T, R (12:30 -1:45 pm) |
| <u>Location:</u> | EB 0165 |
| <u>Phone:</u> | 650-2806 |
| <u>Email:</u> | gengel@siue.edu |
| <u>Website:</u> | www.siu.edu/~gengel |
| <u>Office Hours:</u> | M,W 3:00 PM - 4:00 PM and T, R 2:00 PM - 3:00 PM |

Course Description

Small signal analysis, transistor amplifier design, frequency response, feedback system analysis, output stage design, signal generation and waveform shaping circuits. Three hours lecture and one laboratory session per week.

Grading Policy

| | |
|--------------|------|
| Exam # 1 | 20 % |
| Exam # 2 | 20 % |
| Exam # 3 | 20 % |
| Projects (4) | 40 % |

For both undergraduate and graduate students the following grading scale will be used:

| |
|--------------|
| A = 90 - 100 |
| B = 80 - 89 |
| C = 70 - 79 |
| D = 60 - 69 |
| F = < 60 |

Required Texts

Microelectronic Circuits, Seventh Edition
Oxford University Press
Adel C. Sedra and Kenneth C. Smith
ISBN Number: 978-0-19-933913-6

Administrative Issues

Based on University Class Attendance Policy 119: It is the responsibility of students to ascertain the policies of instructors with regard to absence from class, and to make arrangements satisfactory to instructors with regard to missed course work. Failure to attend the first session of a course may result in the students place in class being assigned to another student.

If you have a documented disability that requires academic accommodations, please go to Disability Support Services (DSS) for coordination of your academic accommodations. DSS is located in the Student Success Center, Room 1270; you may contact them to make an appointment by calling (618) 650-3726 or sending an email to disabilitysupport@siue.edu. Please visit the DSS website located online at www.siue.edu/dss for more information.

Students are expected to be familiar with and follow the Student Academic Code. It is included in the SIUE Policies and Procedures under Section 3C2.2.

Graduate Credit

Students taking ECE476 for graduate credit will be required to complete ONE additional problem on each of the three exams. The problem will be worth 10 points. All students taking the course for undergraduate credit will receive full credit for the problem without having to solve the problem. The additional problem will be made more difficult and will bear less resemblance to problems worked in homework. Examples of past exams with "GRADUATE ONLY" exam problems are available on the instructor's website.

Moreover, for the final project in the class, graduate students will be need to design a circuit with additional functionality. For example, while undergraduates may be required to design a switching regulator, graduate students will need to modify the circuit so that it can be used as a battery charger. The first three design projects in the class will be same for both undergraduate and graduate students.

Course Outline

WEEK 1

- T Jan 11 Sec. 7.2 Small-Signal Operation and Models
 Sec. 7.3 Basic Configurations
 Sec. 7.5 Discrete Circuit Amplifiers
- R Jan 13 Sec. 7.5.2 A Common-Emitter (CE) Amplifier
 Sec. 7.5.3 CE Amplifier with Emitter Degeneration
 PROJECT CE Amplifier with Emitter Degeneration

WEEK 2

- T Jan 18 Sec. 7.5.3 CE Amplifier with Emitter Degeneration
 Sec 7.5.5 Emitter Follower Amplifier
- R Jan 20 Sec 8.2 Current Sources and Current Mirrors
 Sec 8.2.3 BJT Circuits

WEEK 3

- T Jan 25 Sec 8.6.4 The Widlar Current Source
 Sec 8.7.2 The Darlington Configuration
- R Jan 27 Sec 9.2 The BJT Differential Pair
 Sec. 9.2.1 Basic Operation

WEEK 4

- T Feb 01 Sec. 9.2.2 Input Common-Mode Range
 Sec. 9.2.3 Large-Signal Operation
- R Feb 03 Sec. 9.2.4 Small-Signal Operation
 Sec. 9.2.4 Common-Mode Rejection
 PROJECT Time-to-Voltage Converter

WEEK 5

- T Feb 08 Sec. 10.1 Low-Frequency Response of Discrete Circuit Amplifiers
 Sec. 10.1.2 The Method of Short-Circuit Time Constants
 Sec. 10.1.3 The CE Amplifier
- T Feb 10 Sec. 10.2 Internal Capacitive Effects and High Frequency Model
 Sec. 10.2.2 The BJT
 Sec. 10.3.2 High Frequency Response of CE Amplifier
 Sec. 10.3.3 Miller's Theorem

WEEK 6

T Feb 15 Sec. 10.4 Useful Techniques for Analysis of High-Frequency Response
 Sec. 10.4.3 The Method of Open-Circuit Time Constant Analysis

R Feb 17 ***** EXAM #1 (Chapters 7 , 8, 9) *****

WEEK 7

T Feb 22 Sec. 10.4.5 Application of Method to CE Amplifier

R Feb 24 Sec. 11.1 The General Feedback Structure
 Sec. 11.1.1 Signal-Flow Diagram
 Sec. 11.1.2 The Loop Gain
 Sec. 11.1.4 Summary

WEEK 8

T Mar 01 Sec. 11.2 Some Properties of Negative Feedback
 Sec. 11.2.1 Gain Desensitivity
 Sec. 11.2.2 Bandwidth Extension
 Sec. 11.2.3 Interference Reduction
 Sec. 11.2.4 Reduction in Non-linear Distortion

R Mar 03 PROJECT Heart Rate Monitor Project (Part I)

WEEK 9

T Mar 08 *** SPRING BREAK ***

R Mar 10 *** SPRING BREAK ***

WEEK 10

T Mar 15 PROJECT Heart Rate Monitor Project (Part II)

R Mar 17 Sec. 11.3 The Feedback Voltage Amplifier
 Sec. 11.4 Systematic Analysis of Feedback Voltage Amplifiers

WEEK 11

T Mar 22 Sec. 11.5 Other Feedback Amplifier Types
 Sec. 11.5.1 Basic Principles
 Sec. 11.5.2 Transconductance Amplifier
 Sec. 11.5.3 Transresistance Amplifier

R Mar 24 Sec. 11.5.4 Current Amplifier
 Sec 11.7 The Stability Problem
 Sec. 11.9 Stability Using Bode Plots

WEEK 12

T Mar 29 Sec. 18.4 Bistable Multivibrators
 Sec 18.4 Generation of Square and Triangle Waveforms Using an Astable

R Mar 31 ***** EXAM #1 (Chapters 10 and 11) *****

WEEK 13

R Apr 05 Sec. 18.7 IC Timers
 Sec. 18.7.1 The 555 Circuit

T Apr 07 Sec. 18.7.3 Implementing an Astable Using a 555
 PROJECT Simple Remote Control (Transmitter)

WEEK 14

T Apr 12 PROJECT Simple Remote Control (Receiver)

R Apr 14 Sec. 17.1 Filter Transmission, Types, and Specification

WEEK 15

T Apr 19 Sec. 17.2 The Filter Transfer Function

R Apr 21 Sec. 17.3 Butterworth and Chebyshev Filters

WEEK 16

T Apr 26 Sec 17.4 First-Order and Second-Order Filter Functions

R Apr 28 REVIEW Review for Final Exam

COVID-19 Pandemic Policies Related to Classroom Instruction (Spring 2022)

Health and Safety

The measures outlined below are required and any student who does not comply may be in violation of the *COVID-19 People-Focused Health and Safety Policy*, as well as the University's *Student Code of Conduct*.

The full text of the *COVID-19 People-Focused Health and Safety Policy* can be found here:
<https://www.siue.edu/policies/Covid.shtml>

Classrooms, Labs, Studios, and Other Academic Spaces

Under current University policy, whether in the classroom, lab, studio, or other academic spaces, students (regardless of vaccination status) shall wear face coverings that fully cover the nose and mouth and practice physical distancing measures to the extent practicable based on the specific classroom capacity and pedagogy. Classroom furniture should not be rearranged, and furniture that has been taped off or covered should not be used.

Students who forget to wear a face covering will be reminded of their obligation to comply with SIUE's *COVID-19 People-Focused Health and Safety Policy* and temporarily asked to leave the class until they are able to conform to the policy. Students who forget or lose their face coverings may be able to obtain replacements from a friend, a faculty member, or a nearby departmental office. Face coverings are also available for purchase in the Cougar Store (MUC).

Students who refuse to wear a face covering will be asked to leave the classroom and referred to the Dean of Students for non-compliance with community health and safety protocols. Repeated non-compliance may result in disciplinary actions, including the student being administratively dropped from an on-ground/face-to-face course or courses without refund if no alternative course format is available.

If a student has a documented health condition which makes wearing a face covering medically intolerable, that student should contact ACCESS to explore options with the understanding that ACCESS will not grant accommodations which excuse the need for a face covering while on campus or in the classroom. ACCESS will work with qualifying individuals to find reasonable alternatives, whenever such solutions are available. Please call or contact the ACCESS Office via email to schedule an online appointment to discuss potential alternatives. ACCESS office (Student Success Center, Room 1203, 618-650-3726, and myaccess@siue.edu).

General Health Measures

At all times, students should engage in recommended health and safety measures, which include:

- Conducting a daily health assessment. If you have [COVID-19 symptoms](#), but not yet tested positive, have had COVID-19 close contact exposure, or are COVID-19 diagnosed as presumptive or confirmed positive, contact your health provider or SIUE Health Service at cougarcare@siue.edu or 618-650-2842. More information on reporting procedures is available [here](#).
- Frequent washing or disinfecting of hands.
- Adhere fully to the current face mask and physical distancing rules as articulated in policy: <https://www.siue.edu/about/announcements/coronavirus/safety-guidelines-support/face-mask-pick-up.shtml>
- If present, adhere to directional signs and traffic flow patterns in buildings and offices. In many spaces, doors for entering and exiting buildings are designated.

Academic Integrity

Students are reminded that the expectations and academic standards outlined in the Student Academic Code (3C2) apply to all courses, field experiences and educational experiences at the University, regardless of modality or location. The full text of the policy can be found here: <https://www.siue.edu/policies/3c2.shtml>.

Recordings of Class Content

Faculty recordings of lectures and/or other course materials are meant to facilitate student learning and to help facilitate a student catching up who has missed class due to illness or quarantine. As such, students are reminded that the recording, as well as replicating or sharing of any course content and/or course materials without the express permission of the instructor of record, is not permitted, and may be considered a violation of the University's Student Conduct Code (3C1), linked here: <https://www.siue.edu/policies/3c1.shtml>.

Potential for Changes in Course Schedule or Modality

As the COVID-19 pandemic continues, there remains a possibility that planned classroom activities will need to be adjusted. Depending on circumstances and following state-issued recommendations, potential changes include alterations to distancing requirements, course modality (e.g., transition from face-to-face to online, hybrid, or hy-flex, mask wearing, in-course activities, etc). These changes would be implemented to ensure the successful completion of the course while preserving health and safety. In these cases, students may be provided with an addendum to the class syllabus that will supersede the original version. If the course schedule or modifications significantly alter expectations, a new syllabus will be issued.