PHYS 231 – Electric and Electronic Circuits

Spring Semester 2022

January 16, 2021

Instructor

Robert Streubel | Office: Jorgensen Hall 310C | Email: streubel@unl.edu

Office Hours: Tuesdays and Thursdays after class, or by appointment

Teaching Assistants

Christopher Keck (christopher.keck), Asad Mahmood (amahmood9), and Yifei Hao (yfhao)

Pre-requisites: PHYS 212 and 222 (Lab)

Lectures: Tuesdays and Thursdays, 9:30 thru 10:20, JH 145

Lab: Tuesdays or Wednesdays, 13:30 thru 16:20, JH 241

Textbooks

Primary: Electronics–A physical approach, David W. Snoke, Pearson Education.

Secondary (alternative): Basic Electronics for Scientist and Engineers, Dennis L. Egleston, Cambridge University Press.

Reference: Electronics with Discrete Components, Enrique J. Galvez, John Wiley & Sons.

Face covering: All students are required to wear a face covering while in class or lab sessions.

Course Overview

Course Objectives

Acquire knowledge of signal measurements in controlled conditions, involving (programmable) electrical and electronic circuits. This course will teach you basic electronics as needed by experimental physicists to design experiments, conduct measurements, and minimize experimental artifacts. The specific objectives are:

1. Reinforce your understanding of electricity and magnetism,
2. Learn theory of digital logical and feedback control,
3. Apply the principles to build simple analog and digital circuits for feedback control and signal measurements,
4. Analyze problems involving electric and electronic circuits, and
5. Utilize basic programming techniques and useful software to control hardware.

A time investment of **at least 10 hours per week** is needed in addition to lecture and lab sessions.

Course Activities

Lecture. The two one-hour lecture sessions introduce the fundamentals related to the lab session of the following week.

Labs are an integral part of this course. There are three-hour lab sessions every week on the sample experiments. Students are required to choose one per week. Labs will include software and hardware construction, testing and troubleshooting of electronic circuits. It is necessary to attend the labs to attain hands-on experiences as well as additional course information not found in class or readings. Your work in the lab is, thus, essential for homework, quizzes, and exams.

All the labs require a **formal report**, i.e., typed, graphed, and printed using software of your choice or as instructed. The report, scientific sound, concise, and appealing, should be submitted on Canvas (assignments) no later than Sunday midnight.

There will be a lab in the first week.

Pre-lab Assignments. You will need to answer a few conceptual and reflection questions online before the deadline and the answers will not only be graded by correctness, but also by effort. These questions will help you prepare for the lab.

Homework. There will be homework every week assigned at the first class of the week and due the following week in class.

Exams. There will be two 50-minute midterm exams and one two-hour comprehensive final exam. They will both be closed book.

Paper. Students are required to write a course paper which is due **April 17**. It is recommended that the students participate in research labs and explain some electric and electronic circuits used in research in the paper. The other option is to write a review about a topic on advanced electronics. Clarity of the paper is important because the paper will be reviewed by the instructor and two other students.

Late Work. A 10% penalty per workday (up to 50%) is taken from work that is turned in after the due date.

Lab Absence. Because of partner interaction and equipment setup, labs cannot be made up without a very good excuse (doctor's slip, etc.). Special arrangements will be made in emergency situations for absence from labs, quizzes, or exams. Contact me as soon as possible if you cannot be present for a scheduled lab or exam, or have a doctor's slip, etc. There will be no new homework, papers, quizzes, or exams during the last week of coursework; depending on the semester's progress, there might be a lab or makeup lab, though.

Canvas. Class information, including syllabus, announcements, materials etc. will be posted and updated on the UNL Canvas page.

UNL Course Policies and Resources. Students are responsible for knowing the university policies and resources found at `https://go.unl.edu/coursepolicies`.

Exams and Grading

Mid-term Exams (in-class): Tuesday, February 15 and Tuesday, March 22

Final Exam: 10am thru 12pm on Thursday, May 12

Grading Scale

The grades will be determined from your final score using the table below. The table shows the lower cutoff for a grade. For example, if your score is greater or equal to 80% but less than 85% you will get a B+.

Score	95	90	85	80	75	70	65	60	57	53	50
Grade	A+	A	A-	B+	B	B-	C+	C	C-	D+	D

Pre-lab assignments	10%
Homework	10%
In-class tests (every other week)	10%
Two mid-term exams	15%
Final exams	20%
Paper	5%
Labs	30%

A single instance of academic dishonesty may result in a failing grade for the course. Academic dishonesty includes copying solutions for homework, recitations, or exams either from another student or from existing solutions, whether published or not. Students are allowed to discuss homework with each other, but copying is considered cheating. For more examples of what is considered academic dishonesty, see the Student Code of Conduct (`http://stuafs.unl.edu/ja/code/three.shtml`).

Course Content

Set 1

1. Linear DC circuit (voltage, current, resistance, capacitance, inductance, power supplies, Kirchhoff's laws, Thevenin's theorem)
2. Linear AC circuit (filters, impedance, Fourier transform)
3. Signal propagation (impedance matching, transformer, radiation losses, coherence)

Set 2

4. Nonlinear circuit elements (semiconductors, diodes, bipolar transistors, metal-oxide semiconductor field effect transistors, AC/DC amplifiers)
5. Operational amplifiers (buffers, comparators, integrators, differentiators, active filters, triggers, oscillators, artificial inductance)

Set 3

6. Digital electronics (binary information, logic gates, flip-flops, counters, digital-to-analog/analog-to-digital converters, frequency-modulated communication)
7. Processors and computers

Students with disabilities are encouraged to contact the instructor for a confidential discussion of their individual needs for academic accommodation. It is the policy of the University of Nebraska-Lincoln to provide flexible and individualized accommodation to students with documented disabilities that may affect their ability to fully participate in course activities or to meet course requirements. To receive accommodation services, students must be registered with the Services for Students with Disabilities (SSD) office, 132 Canfield Administration, 472-3787 voice or TTY.