

## Electric and Electronic Circuits, PHYS 231, Spring 2015

### Instructor

Prof. Xiaoshan Xu

Office: 310M Jorgensen Hall, E-mail: xiaoshan.xu@unl.edu, Phone: 402-472-6134.

Office hour: Stop by or contact me by email with your questions or make an appointment.

### Prerequisite

PHYS 212 and 222 (Lab)

### Class Meeting Time

09:30-10:20 am      Tuesday and Thursday in Jorgensen Hall Room 145

### Lab Sessions

12:30-15:20    Tuesday in Jorgensen Hall Room 241

Or

12:30-15:20    Wednesday in Jorgensen Hall Room 241

### Textbooks

Enrique J. Galvez, “**Electronics with Discrete Components**” John Wiley & Sons (or the digital version).

### Course Overview

Designing experiments, realizing the measurements, and minimizing the experimental artifacts play a critical role in cutting-edge experimental research; these requires knowledge of signal measurements in controlled conditions, involving (programmable) electrical and electronic circuits. The overarching objective of this course is to teach you basic electronics as needed by experimental physicists. The specific objectives are

- 1) Reinforce the understanding in electricity and magnetism.
- 2) Learn theory of digital logical and feedback control.
- 3) Apply the principles to design and build simple analog and digital circuits for feedback control and signal measurements, especially those related to experimental physics.
- 4) Analyze problems involving electric and electronic circuits (e.g. power supply, amplifier, and etc).
- 5) Utilize basic programming techniques and useful software.

The concepts and techniques learned here will be useful in experimental physics as well as your entire careers.

### Course activities

#### *Lecture*

There are two one hour lecture session every week, which is meant to cover the principles related to the lab session of the following week.

## PHYS 231 ELEC&ELECTRONIC CIR

### *Lab*

There are two three hour lab session every week on the sample experiments. The students are required to attend either one of them.

The labs are an integral part of the course. Labs will include software as well as hardware construction, testing and troubleshooting of electronic circuits. It is necessary to attend the labs to maintain additional course information not found in the lectures or readings, particularly programming experience. Your work in the lab is thus essential for the homework, quizzes, and exams in the course.

Most of the labs require a formal report. Reports are to be of a professional nature, typed, graphed, and printed, using software of your choice or as instructed (Excel for example). When requested, some data might be submitted as part of the lab via my.unl.edu or an email attachment.

### *Pre-lab assignments*

There will be 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 the student get better prepared with the lab.

### *Homework*

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

### *Paper*

Students are required to write a paper about a topic chosen from a list given by the instructor.

### *Exams*

There will be one 50 minute exam around midterm and a two hour comprehensive final exam. These will both be closed book.

### *Late Work*

A **10% penalty per work day** 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, but 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 which is week 15 or "dead week", but there might be a lab or makeup lab depending on the semester's progress.

## **Grading**

Pre-lab assignments:	10%
Homework:	5%
Quizzes total (approx. one per two weeks):	15%

## PHYS 231 ELEC&ELECTRONIC CIR

Mid-Term Exam:	15%
Final Exam (comprehensive):	20%
14 labs:	30%
Paper:	5%
TOTAL:	100%

*Clickers* will not be used for this class.

*Calculators* will not be needed in the closed-book exams.

### Course Plan and Coverage

Each week, plan to spend 5 hours at school for the class and the lab and another 5 hours for study, homework, reading, and assignments.

A partial list of topic to be covered is below:

*Theory (mostly review of Physics 212)*

Voltage, Current, Resistance (dividers, series, parallel), Capacitors and Inductors, Kirchhoff's Law, Thevenin Theorem, ac circuits, PID control.

*Basic Electronic Circuit Components and Instruments*

Mostly included in the first laboratory sessions.

*Semiconductors*

Diodes, Transistors, other devices.

*Voltage Regulators and Power Supplies*

Basic dc power supplies

*Operational Amplifiers*

Buffer, Inverting, Non-Inverting, Summing, Difference, Integrator, Differentiator, Comparators.

*Filters*

High-pass, Low-pass, Band-pass, Notch (Passive and Active).

*Digital Electronics*

Gates, TTL, CMOS, Flip-Flops, Counters.

*Analog/ Digital Interfacing*

Analog to digital converter (ADC), Digital to Analog converter (DAC).

*Microprocessors/Computers/Controllers*

Stamp, Arduino, or other microcontrollers as time permits. BASIC programming of the "BOE-BOT" in lab.

*Introduction to LabView programming*

Mostly done in the lab.

## PHYS 231 ELEC&ELECTRONIC CIR

### Mark your calendars:

**First week:** *There will be a lab that week.*

**Spring Semester Break:** no class or lab that week.

**Paper assignment due:** Thursday, April 2<sup>nd</sup> at 9:30 am start of class.  
**No late papers accepted. Best to turn it in early.**

**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.