Physics 334 **Cr. 3**
Electrical Circuits (Writing Emphasis) **2012 Spring Semester**

Instructor: Dr. Eric Gansen (Lecture)
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Office Hours: Monday 2:10-3:00 p.m., Wed 9 - 10 a.m., and Fri 9 - 10 a.m.
Lectures: MW 1:10 - 2:05 p.m.
Room 201 Cowley Hall
Labs: Friday 1:10 - 3:10 p.m. (Section 10L) and 3:20 – 5:20 p.m. (Section 11L)
Room 220 Cowley Hall
Text: ***Electrical Engineering: Principles and Applications*** by Hambley (Third Edition)

Description: Physical principles underlying modeling of circuit elements and fundamentals of analog electrical circuits are explored through lecture and laboratory. Topics will include the following: current and voltage sources, resistors, I-V characteristics, Ohm's Law, Kirchoff's Laws, capacitors, inductors, Thevenin and Norton theorems, circuits in sinusoidal steady state, diodes, transistors, op-amps, and elementary amplifier circuits.

Objectives: A student who successfully completes will be able to:

1) Use Kirchoff's Laws to solve multiple loop circuit problems.
2) Determine the Thevenin and Norton equivalent of a given circuit.
3) Determine the time-dependence of RC, RL, and RLC circuits.
4) Determine the steady-state properties of circuits using phasors and complex impedances.
5) Understand the "Transfer Function", and use various types of filters appropriately.
6) Use and predict the behavior of diodes in circuits.
7) Build and predict the behavior of amplifiers.
8) Use and predict the behavior of transistors in circuits.
9) Use and predict the behavior of op-amps in circuits.

Homework: There will be roughly 10 problem sets assigned during the semester. Problems sets will be assigned on Friday of each week and typically will be due the following Friday. Late assignments will receive half credit until the problem sets are returned to the students. After that, late assignments will not be accepted for obvious reasons. The problems sets will account for **20% of your final grade.**

Collaboration: You are encouraged to collaborate with other students in the class when working on problem sets; however, remember that 'collaborate' means

'work together with', not 'copy from'. Do not under any circumstances copy the work of another student nor let another student copy from you.

Grading: While it is important for you to attempt and understand all of the assigned problems, for each assignment, I will randomly select *one* problem for in-depth grading. Partial credit will be given for this problem, so make sure you show your work. No credit will be given if no work is shown even if the answer is correct. In addition, when solving the homework problems you should;

a) **Be neat.** A calculation is no good if no one can read it.
b) **Include circuit diagrams.** Whenever an assigned problem involves a circuit (which is often in this course) be sure to draw the circuit diagram, labeling all of the components.
c) **Indicate your reasoning in your solutions.** Communicate your thought process in your solution using words, phrases, and sentences in conjunction with diagrams, equations, and numbers. The steps you take in solving the problem are at least, if not more, important than your final answer. Again, substantial partial credit will be given for the right steps even if the final answer is incorrect. By contrast, no credit will be given for solutions where no work is shown.
d) **Always include units in your answer.** The answer is 12. 12 what? Amps, Volts, Monkeys,…?
e) **Box your final answer.**
f) **Staple the pages of your problems sets and please keep the problems in order.**

Solutions: I will post homework solutions after I have handed the problem set back to you. You are responsible for checking your answers with the posted solutions and making sure you understand the material.

Solution found at - **http://www.uwlax.edu/faculty/gansen/**

Exams: There will be two unit exams and the final exam. All exams are mandatory. Each unit exam is worth **20% of your final grade**. The final exam will be a comprehensive exam and also will be worth **20% of your final grade**.

Exam Dates: EXAM 1, March 2
EXAM 2, April 20
FINAL EXAM, Thursday May 10
(4:45 p.m. – 6:45 p.m.)

Labs: This course will include a series of laboratory sessions, where you will get the chance to build and design the circuits discussed in lecture. A Lab handout will guide you through each lab. You will be asked to test your circuits and to record

your measurements and observations in a **lab notebook**. For some of the labs, you will prepare a typed **lab report** complete with circuit diagrams, equations, and discussion. Students will work in pairs on the labs and can keep one lab notebook between them. However, each student will be asked to write and hand in their own lab reports.

Lab Attendance: As this course is meant to be a hands-on learning experience, laboratory attendance is mandatory. You will receive checkmarks (as prompted in the lab handouts) for accomplishing the tasks of the labs. These checkmarks will serve as your record of attendance for the lab. If circumstances arise such that you will miss a normally scheduled lab, notify the instructor beforehand to make arrangements to conduct the lab at another time.

Lab Notebooks: You and your partner will hand in your lab notebook periodically, where it will be checked for format and completeness. For each lab, start a new page in your lab notebook. On the top of the page, you should write the date and the title and number of the experiment. Beneath this heading you will record the details of your experiments, including: circuit diagrams, experimental parameters, calculations, titles of saved data, *etc*. Make sure all printed plots and figures are neatly taped into your lab notebook in the appropriate location. The lab notebook is worth **5% of your final grade.**

Lab Reports: You will be asked to write four lab reports throughout the semester. The labs reports will give you practice writing about technical subjects and are meant to mirror actual scientific journal articles. They typically will be collected two weeks after the lab is completed. On page 4 of this syllabus, a template for your lab reports is shown, including descriptions of the expected content of the lab reports. The lab reports are worth **15% of your final grade**.

Grading:

Problem Sets	20%
Lab Reports	15%
Lab Notebook	5%
2 Unit Exams	40%
Final Exam	20%
Total	**100%**

Students with Disabilities: Any student with a documented disability (e.g., physical, learning, psychiatric, vision, or hearing, etc.) who needs to arrange reasonable accommodations must contact the instructor and the Disability Resource Services Office (165 Murphy Library, 785-6900) at the beginning of the semester. Students who are currently using the Disability Resource Services Office will have a copy of a contract that verifies they are qualified students with disabilities who have documentation on file in the Disabilities Resource Service Office. It is the student's responsibility to communicate their needs with the instructor in a timely manner.

Lab Report Title (14 pt font)

Your Name (12 pt font)
Physics Department, University of Wisconsin-La Crosse
PHY 334, Electrical Circuits
Date

Introduction (12 pt font):
This section should be a couple of paragraphs and is meant to introduce the lab experiment. Your introduction should include;

1. *A background paragraph:* Give some background on the particular circuits (e.g. low-pass or high-pass filters) or circuits elements (e.g. capacitors, transistors, diodes, etc.) that are the focus of the lab. Describe why they are of significance, what they are used for, or something about their history. Use, information provided in the lab hand-out, in lecture, and in your text books as your sources. You may also want to use outside sources for background. Be sure to include references when appropriate.

2. *A paragraph summarizing your experiment(s):* Here, describe what was done in the lab (i.e. What did you construct and what did you measure?) and what were the important results of the experiments. Here, you don't need to be too *quantitative* or be too detailed (save that for the results section), but instead describe the key results of the lab *qualitatively*.

Experimental Results (12 pt font):
Write a section describing each electronic circuit explored in the lab. Use the same headings as used in the lab handout. In each of these sections, include;

1. *Figures:* A circuit diagram with labeled components should be included for each section. In addition, include any data plots that are asked for in the lab handout. Data plots and circuit diagrams should be produced using computer software. A caption should be placed beneath each of your figures and describe what is shown in the figure.

2. *Text*: In paragraph form, provide a description of the circuit (with reference to the circuit diagram), the results of measurements (both numerical and qualitative), comparisons with theory (see #3 below), and answers to any questions posed in the lab handout.

3. *Equations:* When appropriate, provide relevant equations, being sure to define the variables. Do scratch work on scratch paper – none should appear in report. In the text, refer to the appropriate equation when comparing theory with your measured results.

References (12 pt font):
List any references used in your report.

PHY 334, Spring 2012 **Course Schedule*** **Dr. Eric Gansen**

#	Date	Topic	Assignment Due Dates
1	Jan. 23	Course Intro	
2	25	Chapter 1; Introduction - Voltage, Current, KVL, and KCL	
	27	***Lab 1;*** **Hardware Introduction**	Assign HW1
3	30	Chapter 2; Power and Resistive Circuits - Series vs. Parallel	
4	Feb. 1	Sources, Voltage and Current Dividers, Node Analysis	
	3	***Lab2;*** **Series and Parallel Circuits (Lab Report 1: Intro)**	HW1 due, Assign HW2
5	6	Mesh Analysis	
6	8	Thevenin and Norton Equivalence	
	10	***Lab 3;*** **Potentiometers and Thevenin Equivalence**	HW2 due, Assign HW3
7	13	Finding Thevenin Resistance and Source Transformation	
8	15	Input and Output Resistance	
	17	***Lab 4;*** **Input and Output Resistance (Lab Report 2: Results)**	HW3 and Lab Report 1 due, Assign HW4
9	20	Chapter 3; Inductance and Capacitance - Basic Concepts	
10	22	Chapter 4; Transient Circuits – Solving First-Order Diff. Equations	
	24	***Lab 5;*** **Capacitors and Inductors**	HW4 due, Assign HW5
11	27	Step-by-Step Method	
12	29	RL and RC Circuits with Periodic Sources	
	Mar. 2	**EXAM 1 (Chapters 1-3)**	
13	5	RLC-Circuits	
14	7	Chapter 5; Steady-State Sinusoidal Analysis – Phasors and Complex Impedance	
	9	***Lab 6;*** **RLC Transient Response**	HW5 and Lab Report 2 due,
	12	No Class; Spring Break	
	14	No Class; Spring Break	
	16	**No Lab; Spring break**	
15	19	Steady-State Circuit Analysis	
16	21	Steady-State Sinusoidal Mesh/Node Analysis	
	23	***Lab 7;*** **Steady-State Sinusoidal Analysis**	Assign HW6
17	26	Chapter 6; Frequency Response, Bode Plots, and Resonance –Low-Pass Filter	
18	28	High-Pass Filter, Transfer function, and Bode Plots	
	30	***Lab 8:*** **High-Pass and Low-Pass Filters (Lab Report 3: Total)**	HW6 due, Assign HW7
19	Apr. 2	Resonant Band-Pass Filters	
20	4	Chapter 10; Diodes – Basic Concept and Load-Line Analysis	
	6	***Lab 9:*** **RLC Resonant Band-Pass and Notch Filters**	HW7 due, Assign HW8
21	9	Ideal Diode Model and Piecewise Model	
22	11	Chapter 12 and 13; Transistors – Basic Concept	
	13	***Lab 10;*** **Diodes (Lab Report 4: Total)**	HW8 and Lab Report 3 due, Assign HW9
23	16	Load-Line Analysis	
24	18	Large-Signal Analysis	
	20	**EXAM 2 (Chapters 4-6)**	
25	23	Small-Signal Analysis	
26	25	Transistor Amplifiers	
	27	***Lab 11;*** **Transistors**	HW9 due, Assign HW10
27	30	Chapter 14; Operational Amplifiers	
28	May 2	Operational Amplifiers Cont'd	
	4	***Lab 12;*** **Op Amps**	HW10 and Lab Report 4due
	10	**COMPREHENSIVE FINAL EXAM (4:45 p.m. - 6:45 p.m.)**	

* We will attempt to adhere to the stated schedule; however, adjustments may have to be made during the course of the semester.