EE 220L Circuits I Laboratory, SDSM&T, Spring 2009

Laboratory Room & Times: EP336 Th from 10-11:50 am (section 51) & 12-1:50 pm (section 52)
Instructor: Dr. Thomas Montoya, EP325, Tel: 394-2459, e-mail: Thomas.Montoya@sdsmt.edu
Office Hours: 10-11 am MWF, or by appointment.

WWW: See link from http://montoya.sdsmt.edu. The course web page will be used for posting laboratory assignments, ... E-mail will be utilized to notify students of course-related information and events (check daily). Your first.last@Mines.sdsmt.edu address will be used.

Catalog Description: This course is designed to provide the electrical engineering student with an understanding of the basic concepts of the profession. Topics covered include resistive circuits, transient circuits, and sinusoidal analysis. Students also investigate essential principles by conducting laboratory experiments related to the topics studied in the classroom. P-spice is used to analyze electrical circuits using personal computers.

EE 220L Prerequisite: MATH 125 (Calculus I) completed with a grade of “C”.

EE 220L Corequisite: MATH 321 (Diff. Eqn.).


Lab Policies:

➢ Attendance is required. All laboratories must be completed by every individual at a passing level to pass the class. If you miss a laboratory, contact instructor to arrange to make up the work.

➢ Late laboratory assignments will incur up to a 20% per week penalty.

➢ Students are encouraged to discuss laboratory assignments with classmates. However, blatant copying, plagiarism, … (without proper referencing) is not acceptable and will be penalized.

➢ Complete preliminary laboratory work in your logbook prior to the scheduled laboratory session.

➢ Safety- see ECE Department General Laboratory Safety Policy.

➢ Laboratory logbook guidelines (see Figure 1 for examples):

(a) Why keep a laboratory logbook? There are many reasons- 1) intellectual property (e.g., patents) issues, 2) jog memory as to how an experiment or test was conducted, 3) institutional memory, i.e., help the person who inherits your old job get up to speed, 4) invaluable for writing up articles, reports, papers etc. They may be kept informally by individuals or formally. At some corporations, you must check out logbooks from a secured library and follow rigid style/content guidelines. The goal of a logbook is that another person should be able to duplicate the work done in the lab without outside references.

(b) Each person will keep and use a bound logbook (NO spiral bound notebooks) for all laboratory work.

(c) All entries should be in ink (black and blue preferred) and only on the fronts of pages. Backs of pages may be used as scratch paper. No pencil entries, erasing, obliterating, or using white-out to obscure any entries (intellectual property issues). Errors should simply be crossed out with a single line (no big deal).
(d) On cover, prominently put **EE 220L-xx** (appropriate section #), **Spring 2009**, and **your name**. While not required, it is a good idea to put some contact information on or inside the front cover in case you misplace your logbook.

(e) Make a **Table of Contents** (TOC) on the first page including the lab number, title, date(s), and pages (both start-finish).

(f) After the TOC, insert the **ECE Department General Laboratory Safety Policy** (available at web page). After reading, initial each page to indicate your acceptance and understanding.

(g) **All** pages should be consecutively numbered in upper right hand corner. Never tear out pages (intellectual property issues).

(h) Start each lab by attaching the lab assignment (glue/paste/tape). Next, do the preliminary work. List other lab partner(s) present, if any. In the experimental portion of a laboratory, lab partner(s), equipment list (brand & model #s), time & date ... should be listed, as applicable. Also, circuit(s) & test instrument(s) being used for measurements should be drawn/specified.

(i) Get professor or TA (teaching assistant) to initial your logbook after the preliminary section (i.e., at the beginning of the lab period), and after the experimental section. This allows us to check your values and spot problems early, while you can still remedy them.

(j) Writing/figures/graphs must be legible and of a readable size- if we cannot read your work, you will not receive credit. As applicable, they should be titled, labeled (i.e., names / units on axes), scaled (i.e., numbers on axes), and clearly drawn.

(k) Figures, graphs, printouts ... can be attached/pasted into logbook. The bottom of a figure/graph should be oriented toward the bottom or right hand side of the page.

(l) Answers should be **boxed/double-underlined** or tabulated/graphed as appropriate, with the variables, values (if any) and units (if any), included.

(m) Where applicable, use conventional engineering units such as microfarads, millivolts, picoseconds, gigahertz, … Answers without applicable units are incomplete.

(n) Logbooks are not supposed to be a mystery, just ask if you have questions!

**Course Goals:** The objective of this course is to provide students with the working knowledge of the fundamentals of electrical engineering. A particular emphasis is made on DC, transient, and AC steady-state circuit analysis.

**Student Learning Outcomes:**

Upon completion of this course, students should demonstrate the ability to:

1. Understand, apply, and use the definitions of and the SI units for charge, current, voltage, energy, and power.
2. Apply Ohm’s Law to calculate voltages, currents, and impedances/resistances for AC and DC circuits.
3. Understand and calculate equivalent capacitances, inductances, resistances, and impedances for series, parallel, Wye, and Delta connected resistors, capacitors, and inductors.
4. Understand and apply the voltage and current division rules to AC and DC circuits.
5. Understand and apply Kirchoff’s Laws, including Nodal and Mesh analysis, to AC and DC circuits.
6. Understand and apply the principles of linearity and superposition to AC and DC circuits.
7. Understand and calculate the Thevenin and Norton equivalents for AC and DC circuits.
8. Analyze and design simple operational amplifier circuits.
9. Understand the properties of capacitors and inductors and apply the current-voltage relationships of capacitors and inductors.
10. Analyze natural and step response of first order circuits (series RC and RL)
11. Analyze natural and step response of second order circuits (series and parallel RLC)
12. Understand, apply, and use phasors for sinusoidal steady-state AC circuit analysis.
13. Understand and calculate apparent, complex, instantaneous, and average power, effective or RMS voltages and currents, power factor, and power factor correction for AC circuits.
14. Use PSpice to model/simulate simple DC, transient, and AC circuits.
15. Use Matlab to assist with problem solutions and preparing plots.
16. Use basic laboratory measurement equipment including the power supplies, digital multimeters, function generators, and oscilloscopes to conduct experiments.
17. Understand and use a laboratory notebook for documenting experiments and writing technical reports.

**Evaluation:** The laboratory grade is worth 25% of the overall grade. Further, all laboratories must be completed at a passing level to pass the course. The overall laboratory grade will be based on a combination of logbook(s), memorandum reports, and a practical exam near the end of the semester. Throughout the semester, we will announce when to turn-in logbooks or when to write & submit a memorandum report (in-class). Typically, several laboratories will be grouped together for grading (e.g., Labs 1-3). For grading, grouped labs, the practical exam, memorandum report(s), ... will be weighted equally.

**Grading scale:** 100 > A > 90, 89 > B > 80, 79 > C > 70, 69 > D > 60, F < 60.

**ADA:** Students with special needs or requiring special accommodations should contact the instructor and/or the campus ADA coordinator, Jolie McCoy, at 394-1924 at the earliest opportunity.

**Freedom in learning:** Under Board of Regents and University policy student academic performance may be evaluated solely on an academic basis, not on opinions or conduct in matters unrelated to academic standards. Students should be free to take reasoned exception to the data or views offered in any course of study and to reserve judgment about matters of opinion, but they are responsible for learning the content of any course of study for which they are enrolled. Students who believe that an academic evaluation reflects prejudiced or capricious consideration of student opinions or conduct unrelated to academic standards should contact the dean of the college which offers the class to initiate a review of the evaluation.

**Electronic Devices Policy:** Please turn off your cell phone before class starts. No text messaging in class. No headphones. No other use of any other electronic/computer media is allowed during class time.
**Tentative Laboratory Schedule**

<table>
<thead>
<tr>
<th>Lab</th>
<th>Date(s)</th>
<th>Topics</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1/15</td>
<td>Overview &amp; intro to use of logbooks; lab policies; lab safety</td>
</tr>
<tr>
<td>1</td>
<td>1/22</td>
<td>Matlab</td>
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<tr>
<td>2</td>
<td>1/29</td>
<td>Using the Digital Multimeter and Ohm’s Law</td>
</tr>
<tr>
<td>3</td>
<td>2/5</td>
<td>Voltage and Current Division</td>
</tr>
<tr>
<td>4</td>
<td>2/12</td>
<td>Nodal Analysis</td>
</tr>
<tr>
<td>5</td>
<td>2/19</td>
<td>Mesh Analysis</td>
</tr>
<tr>
<td>6</td>
<td>2/26</td>
<td>PSpice Demonstration and Use</td>
</tr>
<tr>
<td>7</td>
<td>3/5</td>
<td>Thevenin and Norton Equivalent Circuits</td>
</tr>
<tr>
<td></td>
<td>3/12</td>
<td>Spring Break</td>
</tr>
<tr>
<td>8</td>
<td>3/19</td>
<td>Use of the Signal Generators and Oscilloscopes</td>
</tr>
<tr>
<td>9</td>
<td>3/26</td>
<td>Operational Amplifiers</td>
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<tr>
<td>10</td>
<td>4/2</td>
<td>RC/RL Circuits</td>
</tr>
<tr>
<td>11</td>
<td>4/9</td>
<td>First-Order Circuits</td>
</tr>
<tr>
<td>12</td>
<td>4/16</td>
<td>Second-Order Circuits</td>
</tr>
<tr>
<td>13</td>
<td>4/23</td>
<td>AC Sinusoidal Circuits</td>
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<tr>
<td></td>
<td>4/30</td>
<td><strong>Practical Exam</strong></td>
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### Table of Contents

<table>
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<th>Description/Title</th>
<th>Date(s)</th>
<th>Pages</th>
</tr>
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<tbody>
<tr>
<td>0</td>
<td>Lab Safety</td>
<td>1-28-xx</td>
<td>1-5</td>
</tr>
<tr>
<td>1</td>
<td>Introduction to Matlab</td>
<td>2-13-xx</td>
<td>6-7</td>
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<td></td>
<td></td>
<td>2-14-xx</td>
<td>8-14</td>
</tr>
<tr>
<td>2</td>
<td>Using the Digital Multimeter and Ohm's Law</td>
<td>2-17-xx</td>
<td>15-19</td>
</tr>
</tbody>
</table>

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#### Sample of lab cover page

**EE 220L-5x**  
Circuits I Laboratory  
Spring 20xx  
Joe Resistor

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#### Sample of lab work

**Laboratory 2- Intro to DMM cont.**  
2-17-20xx

**Preliminary**

1. $V = IR = (10)(3) = 30\,\text{V}$

**Procedure**

Lab Partners Present: Joe Resistor, Ray Capacitor, Julie Inductor

**Equipment List**

<table>
<thead>
<tr>
<th>Description</th>
<th>Model</th>
<th>Quantity</th>
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</thead>
<tbody>
<tr>
<td>Fluke Multimeter</td>
<td>FL77</td>
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</tr>
<tr>
<td>Acme DC Power Supply</td>
<td>CX45</td>
<td>1</td>
</tr>
</tbody>
</table>

1. Set-up circuit as shown in Fig. 1 below.

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**Figure 1** Laboratory Logbook examples