Electric Circuit Analysis Lab
EE2446-Lab

Section 331/332

Electrical Engineering department
The University of Texas at Arlington

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General Circuit Lab Policies and Guidelines

Introduction:
The experiments in this laboratory course are designed to cover the theoretical and analytical materials in EE2315 and EE2446 (Electrical Circuit Analysis I and II). The objective of the experiments is to enhance the students' understanding of important analytical principles developed in these courses by engaging them in the real-world application of these principles in the laboratory.
In addition to further develop the students' laboratory practice for experimentally testing and evaluating electrical circuits and systems. In this course the students will be acquainted with modern lab equipment and software similar to that which is used in industry. Each bench is equipped with PC that will be used to acquire experimental data, to control laboratory instruments, to process experimental data, and to provide a highly flexible means for visualizing experimental results. LabView, MatLab, Multisim and Pspice are installed to each PCs which will be used throughout the lab experiments.

**Policies:**

Each lab session lasts three hours and starts promptly at the scheduled time. A brief introduction and guide line for the experiments will be given by the instructor at the beginning of the each lab section. Everybody has to finish on time, so please time yourself carefully. Doing the pre-lab can save you a lot of time.

A. Preparing the lab is very important as it will save you time and allows you to work more efficiently. The pre-lab includes reading the lab assignment in advance, and doing the pre-lab assignment specific to each lab experiment. All pre-lab assignments have to be handed in with the main lab report at the beginning of the class.

B. Review the material prior to coming to the lab; consult the textbook(s) if required. Draw the connection diagram for the experiments, sketch anticipated graphical results, and get an idea of the approximate range and scale of the quantities you will be measuring.

C. As part of the lab preparation, you can use Multisim or Pspice to simulate the actual experiments you will be doing in the lab or drawing the schematics of the test set up. You can paste the simulation results in the lab report.

D. Each lab is done in groups of two. The team approach encourages interaction and helps with the debugging and data
collection. Each student required to have one lab notebook and is responsible for recording the measurement data and any observations which will be helpful for writing your lab report and reviewing for the Lab exams.

E. Students are working in groups of two in the laboratory. This encourages team work and makes the conduct of the experiments more efficient. You can collaborate on the pre-lab and on interpretation of the measured data. However, each student is responsible for writing the pre-lab and main Lab report. Copying of data from other groups or submitting artificial or altered information is in violation of the Code of Academic Integrity and will result in a zero grade for the course. The lab report is an individual effort and each student should present his or her own report.

F. Each lab notebook will be reviewed and signed and dated by the instructor or TA before leaving the lab.

G. The major instruments are permanently installed in the stations. Reusable components such as resistors, capacitors, and ICs will be provided to you at the beginning of each lab period. Components such as capacitors, and integrated circuits (ICs) can be reused and should be left on the table in the same manner (inside the plastic bag) as they were obtained (stretch the leads if necessary).

H. Leave your workplace at least as clean and tidy as you found it. Please put everything back in its proper place before you leaving the Lab.

I. Be on time to the class, late coming between 10 to 20 minutes will be recorded and after 20 minutes you will be not allowed to start your lab and you need to make an arrangement to come and makeup the lab with 25% penalty.

J. Cell-phone ringing or use is not allowed in the lab.

K. Your lab activities will be continuously monitored and graded by your instructor and GTA.

Grading Policy:
1. Each pre-lab and lab report will be graded based on 100 points and their average will be one-third ($\frac{1}{3}$) of your lab grade.

2. Lab activity, coming to the lab one time, lab notebook and responsible handling of the lab experiments will count one-third ($\frac{1}{3}$) of your lab grade.

3. Midterm and final lab exams will count one-third ($\frac{1}{3}$) of your lab grade.

**Lab Report Turn-In Policy:**

The lab reports are due to the beginning of the following lab session. For each week late turn-in 30% will be deducted.

**Lab Work Makeup Policy:**

All laboratory work has to be completed during the designated lab period. Students who miss a lab session due to a documented emergency are expected to schedule a makeup time with GTA to conduct the missed lab work. Reports are still due in accordance with the policy stated above.

**Guidelines for writing Lab Reports**

Each student is required to maintain a laboratory notebook which is used to take notes during the lab session, record, data, circuit analyses, calculations, graphs, etc. The goal of the lab notebook is to keep complete and accurate records of your work in the lab. You will be using these notes to write your report.

The lab reports will be graded according to the experimental procedure, clarity of presentation, neatness, data recording, analysis, calculation, and discussion of the results. The main purpose for the report is to communicate the results to others and to enable others to duplicate the work in a straightforward manner.
When preparing the lab report you can use a word processor (it may save you time to have a template that you follow for each lab, according to the guidelines described below). Feel free to use Excel or MatLab (or any other appropriate analysis and graphing program) to analyze and present your data in a graphical form. You can also include result of Multisim, LabVIEW or Pspice simulation in the report if appropriate. Reports are to be either neatly hand written or typed (or a combination of both) and should contain the following information.

Here are instructions on lab report. Grading will be done in accordance with these instructions.

1. Write your names, student ID, date, Lab section, course title and number on the front page.

2. Title of the experiment, and name of partner(s).

3. Objective of the lab experiment.

4. Experimental procedure.

5. Show the experiment measurement set-up (schematics); record the data with proper units, sketches and observations. When recording data always mention the name of the instruments used. It is recommended that you make some quick, but neat plot of the data to ensure they make sense before leaving the lab.

6. Your graphs must be in standard form with proper paper, label, title, and units. Measured data points should be clearly visible even if a line has been interpolated through the data points.

7. Tables must have column headings and units.

8. Compare the measured results with the expected ones (from your pre-lab and/or simulations). Explain any deviations between the theoretical and experimental results.

9. Discussions and conclusions. This is an important part of the report. The conclusion should contain the following items:
   - Summary of the results;
   - Mention briefly what you have learned;
<table>
<thead>
<tr>
<th>Exp. #</th>
<th>Week of Spring (2005)</th>
<th>NOTE: The schedule is tentative and is subject to change</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Jan 26/ Jan 27</td>
<td>Lab Overview, Safety, Policies, Lab Reports, and Breadboard. The Basics of Resistance Measurements</td>
</tr>
<tr>
<td>2</td>
<td>Feb 02/ Feb 03</td>
<td>Measuring DC Voltage, Current and Voltage and Current Dividers</td>
</tr>
<tr>
<td>3-4</td>
<td>Feb 09/ Feb 10</td>
<td>Function Generator/ Oscilloscope</td>
</tr>
<tr>
<td>3-4</td>
<td>Feb 16/ Feb 17</td>
<td>Function Generator/ Oscilloscope</td>
</tr>
<tr>
<td>5</td>
<td>Feb 23/ Feb 24</td>
<td>Superposition, Thévenin and Norton Equivalent Circuits, and Maximum Power Transfer Theorem</td>
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<tr>
<td></td>
<td>Mar 02/ Mar 03</td>
<td>Midterm Exam</td>
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<tr>
<td>6-7</td>
<td>Mar 09/ Mar 10</td>
<td>Operational amplifiers</td>
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<tr>
<td></td>
<td>Mar 16/ Mar 17</td>
<td>Spring Vacation</td>
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<tr>
<td>6-7</td>
<td>Mar 23/ Mar 24</td>
<td>Operational amplifiers</td>
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<tr>
<td>8</td>
<td>Mar 30/ Mar 31</td>
<td>RC circuit: Transient Response</td>
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<td>9</td>
<td>Apr 06/ Apr 07</td>
<td>Filter Circuits</td>
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<tr>
<td>10</td>
<td>Apr 13/ Apr 14</td>
<td>AC Steady-State Power</td>
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<td>Apr 20/ Apr 21</td>
<td>Final Exam</td>
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1. **Introduction**
   
   Objective:
   
   a. Lab Overview,
   b. Policies,
   c. Lab Reports
   d. Safety, and
   e. Breadboard.

2. **Equivalent Resistance**
   
   Objectives:
   
   a. Verify single resistance which is equivalent to group of resistances connected in series, parallel, and series/parallel.
   b. Star-Delta and Delta-Star Conversion.
   c. To become physically acquainted with different types of resistors, potentiometers and color code reading.
d. To be familiar with operation of an ohmmeter.
e. To learn how to hook-up electrical circuit using breadboard.
f. Measure the i-v characteristic of a two-terminal device.
g. Distinguish between linear and nonlinear devices.
h. Measure small resistances, e.g., of a wire.
i. Determine the internal resistances of volt and ampere meters.
j. Converting non-electrical parameters (light intensity and temperature) to electrical resistance, using simple sensors.
k. Verify the lab experiment with Electronic Workbench
l. Verify the lab experiment with LabView

3. DC Circuit – Measuring DC Voltage, Current and Power

Objectives:
a. Measure voltage and current in series and parallel circuits.
b. Calculate power dissipated in a DC circuit and show that the power dissipated in a load is equal to the power supplied by source.
c. Experiment with a voltage and current divider.
d. Verify the lab experiment with Electronic Workbench
e. Verify the lab experiment with Labview

4. Oscilloscope and Function Generator

Objectives:
a. Become familiar with the operation of the oscilloscope.
b. Become familiar with the operation of the signal generators.
c. Frequency measurement
d. Time constant measurement
e. Phase angle measurement
f. Voltage difference measurement
g. Impedance measurement.
h. Virtual instrument in LabView
i. Virtual instrument in Electronic Workbench

5. AC Measurements: Impedances, RC circuit transients

Objective:
a. Study circuit using capacitor and resistors.
b. Observe charging and discharging of the capacitor
c. Evaluating time constant

6. Kirchhoff’s laws, loop and node equations
7. Superposition, Thévenin and Norton Equivalent Circuits, and Maximum Power Transfer Theorem.

Objectives
a. Explore and apply the superposition principle.
b. Analyze, model and measure linear sources.
c. Determine the Thévenin and Norton equivalents for linear sources.
d. Verify the Thévenin/Norton theorem experimentally.
e. Explore and verify the maximum power transfer theorem.

8. LRC Circuit, Resonance, Vectors and Phasors
Objectives:
   a. Examine the frequency dependent behavior of R, L, and C impedances.

9. AC Power Analysis
   Objective:
   a. Determine active, reactive, and apparent power of a single phase LRC circuit.
b. Calculate power factor
c. Power factor correction
d. Maximum power transfer

10. OP-Amp Characteristics
Objectives:
   a. To be familiar with important ways in which practical op-amp circuits depart from the ideal op-amp model.
b. Explore, selectively, ways to compensate for some of the imperfections in applications such as the Miller integrator.
c. Learn about the differences between real and ideal Op Amps.
d. Extract and interpret Op Amp parameters from a data sheet.
e. Determine the values of the external resistors for non-inverting and inverting Op Amp circuits for a given gain $K$.
f. Analyze the inverting circuit configuration with a real Op Amp.
g. Measure the offset voltage and the internal output resistance $R_o$ of a real Op Amp.
h. Measure the open loop gain at various frequencies.

11. Analyze the behavior of real Op Amps in the non-inverting and inverting circuit configurations.

12. Use of LabView to Measure OP-Amp Characteristics
   Objective:
   a. To be familiar with the use of Data Acquisition (DAQ) boards
   b. To be familiar with LabVIEW software
   c. Learn the principles of sampling, analog-to-digital conversion and digital-to-analog conversion.
d. Measure the input-output characteristic of an op-amp circuit.
e. Plot the characteristic and store the data points in a spreadsheet.