EE 220L Circuits I Laboratory, SDSM&T, Fall 2019

Laboratory Room & Times: EEP 336 Th from 8-9:50 am (-51) & 3-4:50 pm (-52)

Instructor: Dr. Thomas Montoya, EEP 310 & (605) 394-1219 **or** EEP 325 & (605) 394-2459 e-mail: Thomas.Montoya@sdsmt.edu

Office Hours: 8-9 am & 3-4 pm MWF, or when available (open door policy).

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 minimum grade of "C".

EE 220L Corequisite: MATH 321 (Differential Equations) and (EE 120/EE 120L or CENG 244/244L).

Text: *Fundamentals of Electric Circuits*, Sixth Edition, Charles K. Alexander and Matthew N.O. Sadiku, McGraw-Hill, 2018, ISBN 978-0-07-802822-9.

Lab Policies:

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

➢ To allow for more hands-on use of equipment, groups of more than two students will only be allowed for lab sections with more than 24 students and/or with permission of instructor.

➢ Missing or failing to complete a laboratory during the scheduled periods for other than <u>verified</u> situations (e.g., Doctor's letter, jury duty) or sanctioned school events will incur a **10% penalty**.

➢ Late laboratory assignments will incur up to a 10% /week penalty in addition to any other penalties. Laboratories more than 4 weeks late are considered failing and will result in failing the course.

➢ 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. To avoid disrupting laboratory work, **do not** enter laboratory until preliminary work is completed.

➢ **Safety-** see *EE Department General Laboratory Safety Policy* (posted on the course web page).

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

(a) Why keep a laboratory logbook? There are many reasons- 1) intellectual property issues (e.g., patents), 2) jog memory as to how an experiment or test was conducted, 3) institutional memory (e.g., help the person who inherits your old job get up to speed), 4) invaluable for writing up articles, reports, papers etc., and 5) professionalism. 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 laboratory without outside references.

(b) Each person will keep and use a bound logbook (**NO** spiral bound notebooks) for laboratory work. Expect to use ~100-120 pages.

(c) On cover, **prominently** put **EE 220L-xx** (appropriate section #) **Circuits I**, **Fall 2019**, and *your name*. If multiple logbooks used, add **Logbook *x* of *y***. Also, it is a good idea to put some contact information on or inside the front cover in case you misplace your logbook.

(d) **All** entries should be in **ink** (black/blue preferred) and **only on the fronts of pages** (writing on the back of pages will be ignored). 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).

(e) Make a **Table of Contents** (TOC) on the first page with labeled columns- Lab number, Lab Title, Date(s), and Page numbers (**both** start-finish).

(f) After the TOC, insert the *EE Department General Laboratory Safety Policy* <u>and</u> *IEEE Code of Ethics*. Attach one sheet per logbook page. After reading, <u>*initial*</u> each page to indicate your acceptance and understanding.

(g) **All pages**, whether used or not, in logbook should be consecutively numbered in upper right-hand corner. **<u>Never</u>** tear out pages, have loose pages/materials, have material overhanging logbook pages, or insert multiple pages that are not <u>individually</u> attached to logbook pages.

(h) Start each lab by attaching the lab assignment sheet in the logbook. Next, do the preliminary work (show completely in the logbook!). In experimental portion of laboratory, **lab partner(s), equipment list** (description, 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 teaching assistant (TA) to initial your logbook after the preliminary section (i.e., at the beginning of the lab period), and after the experimental section (leave circuit intact). This allows us to check your values and spot problems while you can still take remedial action.

(j) Writing/figures/graphs must be **legible** (spread out, don't squish lines together) and of a **readable** size (large)- if we cannot read your work, you will not receive credit.

(k) As applicable, figures/tables/graphs should be captioned (number and title), labeled (i.e., names & units on axes), scaled (i.e., numbers on axes), and clearly drawn. Figures, graphs, printouts can be electronically generated and taped/pasted into logbook. The bottoms of figure/graph/table(s) should be oriented toward the bottom or right-hand side of the page.

(l) Where applicable, use conventional engineering units & prefixes (i.e., MKS) as given in class and text. For example, 1.253 mW and 100 MHz *not* 0.001253 W and 10^5 kHz. Answers with missing or incorrect units are incomplete/incorrect.

(m) Answers should be boxed/double underlined, in **decimal** format if a number (no fractions) with variables, values & units (if any) included. Also, use lead zeros for fractional answers. For example, "$V_x = 0.4$ V" *not* "$V_x = .4$" or "$V_x = 2/5$ V". Typically, 4-5 significant digits are used.

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

<u>Course Goals</u>: 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.

Course Learning Objectives:

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

A. Understand, apply, and use the definitions of and the SI units for charge, current, voltage, energy, and power.

B. Apply Ohm's Law to calculate voltages, currents, and impedances/resistances for AC and DC circuits.

C. Understand and calculate equivalent capacitances, inductances, resistances, and impedances for series, parallel, Wye, and Delta connected resistors, capacitors, and inductors.

D. Understand and apply the voltage and current division rules to AC and DC circuits.

E. Understand and apply Kirchoff's Laws, including Nodal and Mesh analysis, to AC and DC circuits.

F. Understand and apply the principles of linearity and superposition to AC and DC circuits.

G. Understand and calculate the Thevenin and Norton equivalents for AC and DC circuits.

H. Analyze and design simple operational amplifier circuits.

I. Understand the properties of capacitors and inductors and apply the current-voltage relationships of capacitors and inductors.

J. Analyze natural and step response of first order circuits (series RC and RL)

K. Analyze natural and step response of second order circuits (series and parallel RLC)

L. Understand, apply, and use phasors for sinusoidal steady-state AC circuit analysis.

M. Understand and calculate apparent, complex, instantaneous, and average power, effective or RMS voltages and currents, power factor, and power factor correction for AC circuits.

N. Use PSpice to model/simulate simple DC, transient, and AC circuits.

O. Use Matlab to assist with problem solutions and preparing plots.

P. Use basic laboratory measurement equipment including the power supplies, digital multimeters, function generators, and oscilloscopes to conduct experiments.

Q. Understand and use a laboratory notebook for documenting experiments and writing technical reports.

Evaluation: The laboratory grade is worth 25% of the overall grade. The overall laboratory grade will be based on a combination of logbook(s), technical report(s), and a practical exam near the end of the semester. **All laboratories*** must be completed at a passing level to pass the course. [* The practical exam and Technical Report(s) do not fall under this requirement.] Announcements on when to turn-in logbooks or write & submit technical report(s) will be made as warranted. Typically, a couple laboratories will be grouped together for grading (e.g., Labs 4 & 5). For grading, the grouped labs, technical report(s), and practical exam will be weighted equally. The practical exam is a 'hands-on' exercise to evaluate your ability to build a circuit(s) and utilize laboratory equipment to take measurements. DO NOT allow yourself to be a 'secretary' during labs!

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

ADA: SD Mines strives to ensure that physical resources, as well as information and communication technologies, are accessible to users in order to provide equal access to all. If you encounter any accessibility issues, you are encouraged to immediately contact the instructor of the course and the Title IX and Disability Coordinator, Ms. Amanda Lopez at Amanda.Lopez@sdsmt.edu or 394-2533. Students with special needs or requiring special accommodations should also contact

the instructor and the Title IX and Disability Coordinator. More information can be found at https://www.sdsmt.edu/Campus-Life/Student-Support/Disability-Services/.
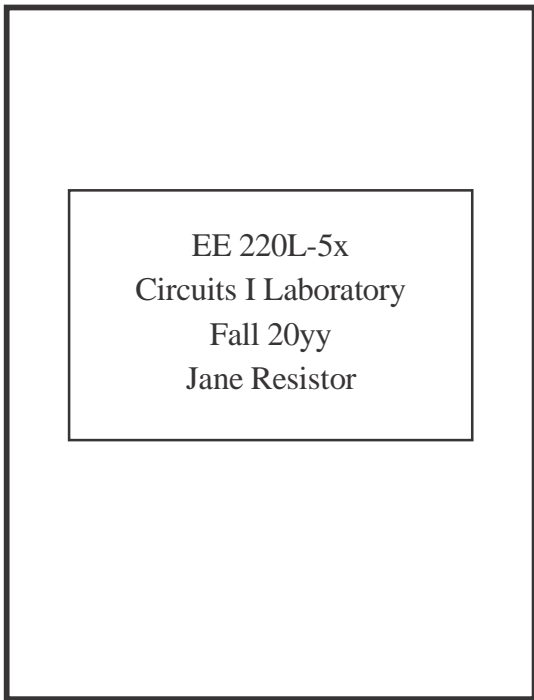
Freedom in learning: Under Board of Regents and University policy student academic performance may be evaluated solely on an academic basis, not on opinions or conduct in matters unrelated to academic standards. Students should be free to take reasoned exception to the data or views offered in any course 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 Provost and Vice President for Academic Affairs to initiate a review of the evaluation.

Electronic Devices Policy: Please mute/turn off your cell phone before class/lab starts. No text messaging in class/lab. No headphones. No other use of any other electronic/computer media is allowed during class time other than that directly related to the course.

Tentative Laboratory Schedule

Lab	Date(s)	Topics
0	8/29	Overview & intro to use of logbooks; lab policies; lab safety; Professional and Ethical Responsibility
1*	**9/5**	Introduction to Matlab
2/3	9/12	Using the Digital Multimeter and Ohm's Law; Voltage and Current Division
4	9/19	Nodal Analysis
5	9/26	Mesh Analysis
6*	**10/3**	PSpice Demonstration and Use
7	10/10	Thevenin and Norton Equivalent Circuits
8	10/17	Use of the Signal Generators and Oscilloscopes
9	10/24	Operational Amplifiers
10	10/31	RC/RL Circuits
11*	**11/7**	PSpice Transient Analysis and Technical Report
12	11/14	Second-Order Circuits
13	11/21	AC Sinusoidal Circuits
	11/28	Holiday
	12/5	**Practical Exam**

 * Be sure to bring your tablet PCs for these labs.

Cover

EE 220L-5x
Circuits I Laboratory
Fall 20yy
Jane Resistor

First sheet in logbook

Sample of lab cover page

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EE 220L Circuits I (Spring 20xx)
Laboratory 1 Introduction to Matlab

Introduction

Preliminary
1. ---
2. ---
3. ---

Procedure/Tasks
1. ---
2. ---
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3. ---
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4. ---

Conclusion

Sample of lab work

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Laboratory 2- Intro to DMM cont.   mm-dd-yy

Preliminary
1. $V = IR = (10)(3) = 30$ V
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TA initials:_____

Procedure
Lab Partners Present- Jane Resistor, Roy Capacitor, Jules Inductor

Equipment List

Description	Brand	Model	Quantity
Multimeter	Fluke	FL77	1
DC Power Supply	Tenma	CX45	1

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1. Set-up circuit as shown in Fig. 1 below.
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Figure 1 Laboratory Logbook examples