

## EE 220/220L: *Circuits I*

### CATALOG DATA:

EE220/220L – *Circuits I*: (3-1) 4 Credits

Prerequisite : Prerequisites: MATH 125 completed with a grade of “C”. Corequisite: MATH 321. 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.

### TEXTBOOK:

*Fundamentals of Electric Circuits*, 3rd Edition, Alexander and Sadiku, 2006

### COORDINATOR:

Elaine Linde, Instructor

### CLASS SCHEDULE:

Lecture: 3 hours per week. (8:00 – 8:50 MWF, EP252)

Laboratory: 2 hours per week (1 cr. hr.) Thurs., 8:00-9:50, 10:00-11:50, or 12:00 – 1:50 EP336.

### INSTRUCTOR INFORMATION:

E-mail: [Elaine.Linde@sdsmt.edu](mailto:Elaine.Linde@sdsmt.edu)

Office: EP 316; Phone: 394-5196

Office Hours: 9:00 – 11:00 MWF, any time my door is open or by appointment

### ADA INFORMATION:

Students with special needs or requiring special accommodations should contact the instructor, Elaine Linde at 394-5196 and/or the campus ADA coordinator, Jolie McCoy at 394-1924 at the **earliest** opportunity.

### TENTATIVE TEST SCHEDULE:

- One short quiz each week,
  - Quizzes can only be made up with prior approval and are taken after the class.
  - Two quizzes will be dropped for grade calculations.
- 4 exams during the semester and a final exam.

### TENTATIVE GRADING POLICY:

- Homework 10%
- Labs 10%
  - Points will be deducted for not completing pre-lab.
  - All Labs must be completed to pass the class. Make-up labs for unexcused absences are scheduled for 6 am.
- \*\*Quizzes 15%
- \*\*Laboratory Exam 10%
- \*\*Exams 40%
- \*\*Final Exam 15%

\*\* A passing grade MUST be obtained as a weighted average of these measures to pass the class..

### ELECTRONIC DEVICE POLICY:

Unless otherwise specified, no electronic devices are to be used in class. An exception to this is a notebook computer that can be use for taking notes. It must be flat on the desk in note-taking configuration using that function only and must not be a distraction to other students.

**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.

**Topics:**

Chapter 1 Basic Concepts  
Chapter 2 Basic Laws  
Chapter 3 Methods of Analysis  
Chapter 4 Circuit Theorems  
Chapter 5 Operational Amplifiers  
Chapter 6 Capacitors and Inductors  
Chapter 7 First-Order Circuits  
Chapter 8 Second-Order Circuits  
Chapter 9 Sinusoids and Phasors  
Chapter 10 Sinusoidal Steady-State Analysis  
Chapter 11 AC Power Analysis

**Course Policies****Homework:**

- To help the TA and myself deal with the assignments to grade in this course, please adhere to the following specifications for submitted work.
  - Use the front (i.e., single-sided) of 8.5" × 11" engineering graph paper or plain white paper (NO pages torn from spiral notebook) for assignments.
  - Keep a course notebook for future reference. This should include homework, quizzes, exams, and laboratory/projects.
  - Students are encouraged to solve homework problems with fellow classmates. However, blatant copying, plagiarism, (i.e. without proper referencing) is not acceptable and will be penalized.
  - Laboratory/Project Assignments are to be typed in Times New Roman or Arial/Helvetica fonts, 11pt or 12 pt, 1.5 line spacing. Pages should be numbered at the bottom of the pages. Submit lab assignments by email to the instructor in a single MS Word document.
  - All work exceeding one page must be stapled - no paper clips, folded corners, or folders.
  - Writing should be legible and literate - if we cannot read your writing → no credit.
  - To facilitate the grading of homework problems, it shall meet the following specifications:
    - (a) For text and equations, use HB or No. 2 pencil (or darker), or blue or black ink. (pencil preferred). No other colors please, except in diagrams or graphs.
    - (b) All pages should be numbered (*i/j* format) in top right hand corner, with the course number and your name appearing at the top of each page.
    - (c) All work must be shown for full grade - be as thorough as possible.
    - (d) Answers are to be boxed or double underlined, with the variables, values (if any) and units (if any), included.
    - (e) Leave a space (e.g., 1/2") between consecutive parts of a problem, and draw a line across the page at the end of each complete question. No more than two problems on any single page.
    - (f) Diagrams/figures/plots/graphs should be of a good size (e.g., 3" × 5"), and may contain colors. As applicable, they should be titled (at bottom), labeled (i.e., names /

units on axes), scaled (i.e., numbers on axes), and clearly drawn. Tables should also be titled (at top).

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

### **Working in Groups**

Effectively working in groups can enhance learning. The key word in the last sentence was “effectively.” Some key components to effectively working in groups are:

- Working with a group **after** you have reviewed the material and have attempted the problems.
- Note any problem areas so that they can be discussed within the group.
- Take personal responsibility for understanding the problems and material.
- **!!! As advised in the grading section, a passing grade for the class requires that each student pass the “individual events” of quizzes, exams, and the lab final exam. Homework and laboratory grades cannot be used to raise an “F” on quizzes and exams to a passing grade.**

### **Use of Tools (Calculators, MathCad<sup>®</sup>, Matlab<sup>®</sup>, Excel<sup>®</sup> ...)**

The use of tools to solve problems is encouraged on homework and pre-labs. However, students should not use any tool as a substitute for learning the required material.

- Most tests and quizzes will **NOT** allow calculator use. Therefore, students should be able to understand the concepts and work a solution without the use of computing tools.
- Learning to use a computational tool is the **student’s** responsibility. There are many avenues for learning to use your tool of choice. These resources should be exhausted before the instructor is approached for help.
  - The user manual or help files.
  - On-line tutorials (searching on [www.google.com](http://www.google.com) usually provides a good starting point).
  - Other students using the same calculator or software package.

### **Homework and Laboratory Report Deadlines**

Our industrial advisory board has emphasized that meeting deadlines is a critical skill for our students to learn. With this goal in mind, the expectations are

- Late homework and laboratory reports will be assessed a penalty of 20% per day. No homework will be accepted after the solution is posted. The only acceptable variances will relate to serious illness, death in the family, and other extreme cases.
- If you feel that you want to hand your homework in incomplete, it may be advisable to make a copy of your work so that you can seek help and finish the assignment to ensure the topic is understood before a quiz or test.
- A due date may be revised by the instructor to a later date if sufficient material has not been covered in class.

### **Classroom Behavior**

Classroom behavior is to be consistent with a good learning environment for all. While the “rules” of good behavior should not be a mystery at this point, a reminder is given.

- Do not talk in class unless participating in class discussion.
- Keep your body parts to yourself and do not be a distraction to your classmates.
- Do not take cell phone calls – in cases of emergency, take the call outside the class. Please turn ringers off before class.
- Do not play on electronics devices. The noise (even clicking of keys) is distracting for other students.
- Any tablet PC use should be for note taking only.
- The **PENALTIES** will be as follows:
  - Do not count on a warning before being penalized.
  - You will be asked to stop the bad behavior or leave class immediately.
  - You will receive a “0” for any homework and quizzes due that week. A “0” for behavior will NOT be eligible for the “drop quiz” policy.

### **Laboratory Behavior**

Basically the same rules apply as for the classroom, but with added responsibility that safety practices are important to keep everyone from being injured.

- Follow all safety rules in the manual.
- If the instructor or TA can smell alcohol on your breath, you will be asked to leave the lab. It is not safe to operate laboratory equipment under the influence of alcohol.
- If the Instructor or TA request to see pre-labs before you start, please comply. This is done to keep you from building a dangerous circuit.
- All labs must be completed to pass the class. Make-up labs for unexcused absence will be scheduled for 6am.

### **Examinations**

- No electronic device can be present during an exam. All cell phones, audio players, calculators (unless specified by instructor), PDA, computer, etcetera must be turned off and put away during exams.
- No beverage containers are allowed in the exam.
- All hats must be removed and put away.
- Random seating will be assigned at the time of the examination.
- Different versions of the examination may be used.

**Course Objectives:**

**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.

**COURSE OUTCOMES:**

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

1. Apply the fundamentals of electric circuits including Ohm's Law, Kirchhoff's Current and Voltage Laws, and voltage and current division to analyze and build circuits.
2. Use DC circuit analysis techniques such as node analysis, mesh analysis, and Norton and Thevenin equivalent circuits to solve for circuit parameters.
3. Extend DC analysis techniques to AC networks using phasor notation and conversion of time domain sinusoidal voltages and currents.
4. Identify the characteristics of first and second order transients.
5. Have an awareness of the advantages of using the frequency domain by way of Bode plot, Fourier series and filtering.
6. Use the basic operation and applications of operational amplifiers including inverting, non-inverting, summing, differential amplifiers using ideal analysis and the limitations of real op-amps.
7. Be familiar with the basic operation and applications of semiconductor devices such as diodes, LED's, and BJT transistors.
8. Be familiar with the basic operation of digital logic gates and their application and link to other technologies (PLC, microcontrollers).
9. Have an awareness of electric machines and AC power and their uses.
10. Use basic laboratory measurement equipment including the power supplies, digital multimeters, function generators, and oscilloscopes to conduct experiments.

**RELATION OF COURSE TO PROGRAM OUTCOMES:**

These course outcomes fulfill the following program outcomes:

- (a) An ability to apply knowledge of mathematics, science, and engineering.
- (b) An ability to design and conduct experiments, as well as to analyze and interpret data.
- (c) An ability to design a system, component, or process to meet desired needs.
- (d) An ability to function on multi-disciplinary teams
- (e) An ability to identify, formulate, and solve engineering problems.
- (f) An understanding of professional and ethical responsibility
- (g) An ability to communicate effectively
- (h) The broad education necessary to understand the impact of engineering solutions in a global and societal context
- (i) A recognition of the need for, and an ability to engage in life-long learning
- (j) A knowledge of contemporary issues
- (k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

The following table indicates the relative strengths of each course outcome in addressing the program outcomes listed above (on a scale of 0 to 4 where 4 indicates a strong emphasis)

		Course Outcomes										
		1	2	3	4	5	6	7	8	9	10	11
ABET Objectives	(a)	4	4	4	4	4	3	3	2	2	4	4
	(b)	2	2	2	2	2	2	2	1		4	4
	(c)	1	1	1	2	3	3	1	1	1	3	2
	(d)	2	2	2	1	1					1	
	(e)	1	1	2	2	2	2	2	1		2	2
	(f)										3	3
	(g)										2	4
	(h)				1			2	2			1
	(i)	2	2	2	2	2	2	2	2	2	3	2
	(j)				2	2		2				
	(k)	3	3	3	3	3	2	2	2	2	3	4

**NOTES:**

- Outcome (d) is emphasized in relation to teams that student will likely be a part of when on the job and how knowledge of other members' disciplines (EE in this case) can be of benefit.
- Outcome (i) is emphasized due to this being a course outside the students' discipline and discussions of how a basic knowledge could be turned into a deeper knowledge with further study

**PREPARED BY:**

Elaine Linde, Date: August 20, 2003 (revised for spring 2004 on Jan. 5, 2004, and Aug. 28 for Fall 2004)