EE 082 – Linear Circuits Laboratory 2, Spring 2020

Course Number, Title, Credit Hours
EE 082, Linear Circuits Laboratory 2, 2 cr

Semester, Meeting Time and Place
Spring 2020, M 09:40-10:55 am – Perkins 300 and W or F 9:30 – 11:45 am – Votey 334

Instructor Name, Contact Information, Office Hours
Dr. Eva Cosoroaba, ecosoroa@uvm.edu, Votey 375 - TBD

Teaching Assistant Name(s), Contact Information, Office Hours
Mr. Evan Fennelly, Evan.Fennelly@uvm.edu, Votey 334 - TBD

Pre- and Co-requisites
Pre: EE 081 or EE 100; PHYS 125 or 152, Co: EE 004

Course Description
The course is all hands-on through simulation and experimentation of electric circuits. We will explore concepts you see in EE004 and see how the actual behavior of a circuit differs from the theory. In the first part (labs 1-3) we focus on understanding phase shift, impedance, RMS, peak value, peak-to-peak value, active power, reactive power etc. which are concepts characteristic to only AC circuits (you won't hear about phase shift with DC circuits!). The second part (labs 4-7) looks at frequency selective circuits aka filters, both passive and active. Lastly, part three is dedicated to our design project. You will be designing, building and soldering a circuit with a minimum of 4 op-amps that will have audio-signal as an input and light at the output that indicate what frequencies the song you are playing contains.

Course Learning Objectives (CLO)
After this course, you will be able to:

1. Build and analyze AC circuits on breadboards in a lab setting (using a DMM, voltage source, function generator, oscilloscope).
2. Simulate AC circuits using PSpice to find specific circuit parameters.
3. Compare experimental and theoretic (analytic and numerical) results and discuss differences in results.
4. Write clear lab reports, present data in an orderly way and describe lab procedures.
5. Design, simulate and build a circuit that amplifies and filters an audio signal.
6. Solder a circuit.

Alignment with ABET outcomes
0 - little or no contribution 1 - moderate contribution 2 - high level of contribution

Outcome (1): An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics. Contribution: 0

Outcome (2): An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors. Contribution: 0

Outcome (3): An ability to communicate effectively with a range of audiences. Contribution: 1 *(See CLO 4)*

Outcome (4): An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts. Contribution: 0

Outcome (5): An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives. Contribution: 0

Outcome (6): An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions. Contribution: 2 *(See CLO 1, 2 and 3)*

Outcome (7): An ability to acquire and apply new knowledge as needed, using appropriate learning strategies. Contribution: 0

EE Criterion (A): The curriculum must include probability and statistics, including applications appropriate to the program name; mathematics through differential and integral calculus; sciences (defined as biological, chemical, or physical science); and engineering topics (including computing science) necessary to analyze and design complex electrical and electronic devices, software, and systems containing hardware and software components. Contribution: 1

EE Criterion (B): The curriculum for programs containing the modifier “electrical,” “electronic(s),” “communication(s),” or “telecommunication(s)” in the title must include advanced mathematics, such as differential equations, linear algebra, complex variables, and discrete mathematics. Contribution: 1

Required Course Materials:

Required software

- You will need a laptop to the lab lectures, capable to run PSpice (by Orcad). PSpice provides free student licenses (PSpice lite) that can be downloaded here: https://www.orcad.com/buy/orcad-educational-program . Alternatively, you can use “Virtual Votey”. Find instructions on how to access VV here: https://www.uvm.edu/cems/virtual-lab . Access requires multi-factor authentication https://www.uvm.edu/it/security/mfa.html .

Other required equipment or materials

- Will be made available as needed in the lab or through Blackboard

Blackboard or other course sites:

Blackboard will be used to send announcements, post lab manuals, and additional materials as needed. Reports and Journal entries must be submitted via Blackboard.

Attendance Policy and Classroom Environment Expectations:

Lab attendance and completion of all labs is mandatory. One lab may be made up at the end of the semester for any reason (no excuse needed). Lab reports are an important component of your grade and are only taken into account if you attend the lab, as this will assure that you completed the lab activity. If you must miss more than one lab for a valid reason, you must make advance arrangements with the instructor. Additionally, see the Religious Holiday section of the Syllabus.

This is a 2 credit hour course and the outside of class amount of work will therefore be an average of 4-6 hours a week. This work includes lab prep as well as lab wrap-up.

How to prepare for the lab activity:

- Read the lab manual attentive and highlight important sections with one color and questions with another. Once you get to the lecture and lab seek clarifications for your questions by your instructor, TA or lab partner.
- Attend and actively participate in the Monday lab lecture. Bring your laptop (see software requirements).
- Complete the simulation and hand calculations and take notes of your results in a neat fashion.
- Prepare and bring the circuit components you will need for the experiment. Coordinate with your lab partner who will be the Circuit Builder and who the Circuit Checker. Remember to switch roles each lab.
- Read the instructor feedback to your last lab journal (see Assessment section), reflect and implement the preparations you personally need to make for a more successful lab session.
- Be prepared to take accurate notes of experimental results. If you prefer analog: print out the lab manual and fill in your analytical and simulation data ahead of time. If you prefer digital: create an excel file with tables that summarize your data.
- Show up latest on time. Respect your partner's time.

How to wrap-up the lab activity:

- Take a clear photo of your circuit before disassembling it. You will need it for the report.
- Confirm that the TA marked your attendance.
- Make sure you completed all steps of the lab manual instructions before leaving the lab (including error calculations) and clean your station.
- If you have time in the lab, complete the reflection for extra credit. Alternatively, you have 24 hours to do so (see Assessment section of the Syllabus).
- Review the feedback you received from previous lab report submission and think on how you can incorporate it to improve your current report.
- Look at the number of Comprehensive and Quick Reports (see Assessment section) you still need to complete for the grade you want and at your workload this week. Decide based on these two things if you want to write a CR or QR.
- Start on your report early. This way you can ask the instructor and/or TA for help if you are stuck.
- Use the provided rubric to check if your report meets all criteria.
- Complete and submit your report before or on time.

Grading Criteria/Policies:

There are three grade components which each receive a letter grade: Lab Reports, Practical Midterm and Final Project. The final grade is obtained by averaging each of the four grade components. Read more about each in the Assessment section.

To average the component letter grades they are first converted to numerical values (scores) according to Table 1. After extra credit (see Assessment section) is added, they are averaged and converted to the final letter grade according to Table 2. There is no curving in this course. You earn your grade according to your own effort and accomplishments of the CLOs, not your colleague's performance.

TABLE 1 - COMPONENT LETTER TO NUMERIC SCORE CONVERSION

Letter	A	B	C	D	F
Score	95	85	75	65	55

TABLE 2 - GRADE AVERAGE TO FINAL LETTER GRADE CONVERSION

Score	97+	93+	90+	87+	83+	80+	77+	73+	70+	67+	63+	60+	60-
Letter	A+	A	A-	B+	B	B-	C+	C	C-	D+	D	D-	F

Assessments (Graded Work):

Component 1: Practical Midterm (tests for CLO 1 and 2, which are practiced during each lab time) – consists of analyzing circuits covered in labs 1-4 both through PSpice and experimentally. The table below illustrates the hurdles for each letter grade. Time and materials to practice for the midterm and final exam are scheduled. See the Semester Schedule at the end of the Syllabus.

TABLE 3 - PRACTICAL MIDTERM AND EXAM GRADE REQUIREMENTS

Passes Hurdle	Letter Grade Components 1 and 2
Arrived at correct measurement AND simulation result	A
Arrived at correct measurement OR simulation result	B
Build circuit AND simulation wiring diagram correctly	C
Build circuit OR simulation wiring diagram correctly	D
Nothing correct	F

Component 2: Final Project (tests CLO 5 and 6, which are practiced during specific labs and additional assignments) – consists of designing, simulating, building and soldering a device that connects to an audio input converting it to multiple LED output that blink when the music is at certain frequencies. More details will be provided before spring break. Work time is allocated during class time (See semester schedule).

Component 3: Lab Reports (practices and tests CLO 3 and 4) – There are two types of reports: Comprehensive Reports (CR) and Quick Reports (QR). The two types of reports reflect different types of ways you might be required to report on experiments and projects in your future work place. You can choose which you want to complete for which lab (depending on your personal work load that week) but a specific number of reports of each type that satisfy all grading criteria must be completed. See Table 4

for requirements. Rubrics for CR and QR as well as an example for each are provided in a separate documents.

Reports are due one week after the lab. For example: if you had Lab 2 on Wednesday, 8am, the report for Lab 2 is due the following week Wednesday 8am.

TABLE 4 - LAB REPORT COMPONENT GRADE REQUIREMENTS

Letter Grade	Total Reports Submitted	CRs that meet all criteria	QRs that meet all criteria
A	7	2	3
B	7	1	3
C	6	1	2
D	5	0	2
F	Less than 5	0	1 or less

Extra Credit: Lab Reflections – are journal entries after each lab that help you reflect on your experience as well as assist you in developing strategies to improve your performance. Entries are due within 24 hours of the lab. Example: if your lab started Friday 8 am, the reflection is due Saturday 8 am.

Five reflections that meet the requirements will earn you the right to bump up one grade component by one letter. Example: if you have A-B-B for the 3 grade components, complete extra credit will bring that up to A-A-B. See the additional document on the specific requirements for the journal entries. No make-up opportunity is offered for extra credit.

Course Evaluation:

All students are expected to complete an evaluation of the course at its conclusion. The evaluations will be anonymous and confidential, and the information gained, including constructive criticisms, will be used to improve the course. A midterm evaluation might be conducted.

Student Learning Accommodations:

In keeping with University policy, any student with a documented disability interested in utilizing accommodations should contact SAS, the office of Disability Services on campus. SAS works with students and faculty in an interactive process to explore reasonable and appropriate accommodations, which are communicated to faculty in an accommodation letter. All students are strongly encouraged to meet with their faculty to discuss the accommodations they plan to use in each course. A student's accommodation letter lists those accommodations that will not be implemented until the student meets with their faculty to create a plan.

Contact SAS: A170 Living/Learning Center; 802-656-7753; access@uvm.edu www.uvm.edu/access

Religious Holidays:

Students have the right to practice the religion of their choice. If you need to miss class to observe a religious holiday, please submit the dates of your absence to me in writing by the end of the second full week of classes. You will be permitted to make up work within a mutually agreed-upon time. https://www.uvm.edu/registrar/religious-holidays

Academic Integrity:

Discussions between students are encouraged, as these deepen the understanding of class topics, but dishonesty in all its forms is not tolerated. The four types of academic dishonesty are: plagiarism, cheating, collusion and fabrication. All types will be reported. Due to our lab facilities and number of student, you will be working in groups of two. You will record your data together and sharing data with your lab partner who participated in the experiment is therefore fine. All lab reports on the other hand are written individually. Furthermore simulations and analytical calculations must be completed individually, except ones completed in class (lab lecture). Anything you put into your report must either be your own work or properly cited from permitted sources such as "class notes" or "lab manual". Visit the UVM code of Academic here: https://www.uvm.edu/policies/student/acadintegrity.pdf

Grade Appeals:

All graded work should be reviewed promptly by the students. Any questions in regards to potential grading errors should be brought to the attention of the instructor within one week's time after the assignment is reviewed in class or solutions are posted. Clearly document in writing what you believe the error to be and attach that to the original work. After one week's time, no score adjustments will be made.

If you would like to contest a final grade, please follow the procedures outlined in this policy: https://www.uvm.edu/policies/student/gradeappeals.pdf

General Grading:

For information on general grading and GPA calculation, go to https://www.uvm.edu/registrar/grades

Code of Student Rights and Responsibilities:

http://catalogue.uvm.edu/undergraduate/academicinfo/rightsandresponsibilities/

FERPA Rights Disclosure:

The purpose of this policy is to communicate the rights of students regarding access to, and privacy of their student educational records as provided for in the Family Educational Rights and Privacy Act (FERPA) of 1974. http://catalogue.uvm.edu/undergraduate/academicinfo/ferparightsdisclosure/

Promoting Health & Safety:

The University of Vermont's number one priority is to support a healthy and safe community:

- Center for Health and Wellbeing: https://www.uvm.edu/health
- Counseling & Psychiatry Services (CAPS): Phone: (802) 656-3340
- C.A.R.E.: If you are concerned about a UVM community member or are concerned about a specific event, we encourage you to contact the Dean of Students Office (802-656-3380). If you would like to remain anonymous, you can report your concerns online by visiting the Dean of Students website at https://www.uvm.edu/studentaffairs

Final Exam Policy:

This course final exam is scheduled for Monday May 4, 7:30 – 10:15 am. This time may be used for project presentations. Details will be given whenever the final project is assigned. General University final exam

policy outlines expectations during final exams and explains timing and process of examination period. https://www.uvm.edu/registrar/final-exams

Alcohol and Cannabis Statement:

As a faculty member, I want you to get the most you can out of this course. You play a crucial role in your education and in your readiness to learn and fully engage with the course material. It is important to note that alcohol and cannabis have no place in an academic environment. They can seriously impair your ability to learn and retain information not only in the moment you may be using, but up to 48 hours or more afterwards. In addition, alcohol and cannabis can:

- Cause issues with attention, memory and concentration
- Negatively impact the quality of how information is processed and ultimately stored
- Affect sleep patterns, which interferes with long-term memory formation

It is my expectation that you will do everything you can to optimize your learning and to fully participate in this course.

Semester Schedule:

W1	Mo	Jan 13	Intro to 082, Expectations, Outcomes
	We	15	Lab 0: Safety and Equipment
	Fr	17	
W2	Mo	20	*MLK Day – No classes*
	We	22	*No Labs*
	Fr	24	
W3	Mo	27	AC features of PSpice + Lab 1 Prep
	We	29	Lab 1: Ohm's Law in AC
	Fr	31	
W4	Mo	Feb 3	Lab 2 Prep
	We	5	Lab 2: Thevenin's in AC
	Fr	7	
W5	Mo	10	Lab 3 Prep + Prep for PM
	We	12	Lab 3: AC Power Balance
	Fr	14	
W6	Mo	17	*Presidents Day – No classes*
	We	19	Prep for Practical Midterm (Phase Shift)
	Fr	21	
W7	Mo	24	TBD
	We	26	Practical Midterm
	Fr	28	
W8	Mo	Mar 2	Prep for Lab 4
	We	4	Lab 4: Frequency Dependent Behavior in AC
	Fr	6	
W9	Mo	16	Prep for Lab 5
	We	18	Lab 5: Op-Amps in AC (LPF + HPF)
	Fr	20	

W10	Mo	23	Lab 6 Prep
	We	25	Lab 6: Band Pass Filter
	Fr	27	
W11	Mo	30	Lab 7 Prep + Intro to the Final Project (FP)
	We	Apr 1	Lab 7: Band Reject Filter
	Fr	3	
W12	Mo	6	FP Work
	We	8	FP Work
	Fr	10	
W13	Mo	13	FP Work
	We	15	FP Work + Lab Make-Up Session
	Fr	17	
W14	Mo	20	FP Work
	We	22	FP Work
	Fr	24	
W15	Mo	27	Course Summary
	We	29	FP Work and Demos
	Fr	May 1	