ELEC 201: Circuit Analysis I
January-April 2022

UBC calendar page for course synopsis, prerequisites, and corequisites:
https://courses.students.ubc.ca/cs/courseschedule?pname=subjarea&tname=subj-course&dept=ELEC&course=201

LEARNING OUTCOMES

The students will learn to analyze the electric circuit diagram and apply the laws of voltage and current, together with the voltage-current relationships that describe the elements in the circuit, in order to construct a set of equations to solve for all the circuit quantities and analyze the circuit's behaviour. This will enable both a quantitative and a qualitative understanding of circuits and the way the elements work. Resistors, capacitors, inductors, independent and dependent sources, and measuring elements are first considered, in both DC steady state and first- and second-order transient cases. This is then expanded to include diodes, opamps, and transistors, using circuit-level models, in both DC steady state and AC small signal. The students will learn the concepts of linearity, superposition, and equivalence, and apply them in solving circuits. They will learn systematic approaches to writing the circuit equations, namely nodal analysis and mesh analysis. They will gain practical experience in building circuits on a breadboard, and using various instruments including power supplies, function generators, multimeters, and oscilloscopes to perform measurements and analyze the circuits.

INSTRUCTIONAL TEAM

Instructor
Alireza Nojeh (research website: http://nanostructure.ece.ubc.ca/)

Teaching assistants
Assignments and exams: (TA1) Mukhlasur Tanvir, (TA2) Pegah Tekieh
Labs: (TA3) Gabriel Guerreiro, (TA4) Karim Elkholy

Communications
- All course-related announcements will be made on Canvas. Ensure that you are set to receive notifications, and check the Canvas page regularly for announcements.
- To contact the instructional team according to the areas they cover as listed above, use the following venues, in this order of preference: (1) office hours, (2) Piazza, (3) Canvas message (go to Inbox on the main menu on the left).

COURSE STRUCTURE, CLASSES, and OFFICE HOURS

- Approach: This is a primarily in-person course. However, it will include pre-recorded videos, and the in-person classes will also be broadcast live as well as recorded for viewing later. Participation in the classes is not mandatory and there is no participation mark. All office hours will be held over Zoom through Canvas. This structure will ensure that everyone has full access to the course content and instructional team regardless of individual circumstances. However, the labs will be only in person since they require access to specialized equipment. The exams will also be only in person.

- There will be, on average, approximately 3.5 hours of pre-recorded videos that you must watch on your own every week. These videos are given in a file under "Modules" for each week of the term. The notes for these videos are also posted there. In order to free up time in the schedule for watching the videos, we will not have classes on Tuesdays, nor tutorials on Wednesdays. However, the instructor will hold office hours on Zoom during the scheduled Tuesday class times. The classroom will also be available at this time for those who wish to use it for watching the videos or joining the office hours on Zoom.

- You must watch the videos for each week prior to the Thursday class time. On Thursdays, we will have an in-person class, where the instructor will present examples to reinforce some of the concepts, and there will be opportunities for questions and discussion. You can also participate in this class (including asking questions) live online, and the class will also be recorded and available for viewing later.

- TA1 and TA2 will also hold an additional weekly office hour each over Zoom through Canvas.

LABS

- The labs will be in person and start when in-person instruction starts at UBC, planned for the week of 24 January. There will be 5 lab exercises, each over 2 weeks. You must access the lab only during your weekly scheduled lab time.

- The lab exercises will be completed in groups of 3 students. You can choose your own groups, but must stay with the same group throughout the term. Lab reports will be due by 23:59 on the Friday of the second week for each lab, and must be submitted through Canvas.

- As part of lab 1, you must have completed the department's safety course: http://eng-services.ece.ubc.ca/safety/.

- Each student must have their own lab kit (UBC ECE Second-Year Tools and Parts Kit): https://eng-services.ece.ubc.ca/course-support/2021-winter-term-2/elec-201/. The majority of you will already have this kit from the previous term, and do not need to purchase a new one. Those who do not have one need to place an order through the above link using the password 2ndyear_2021.

- Students who have taken the course and passed the lab portion in a previous term recently do not need to participate in the labs (although they must still register in a lab section). If you would like your lab mark from the previous term to be transferred to this term, message TA1 on Canvas to indicate this and provide your full name and student #, within the first two weeks of the term. However, if instead you prefer to participate in the labs again this term, you have the option to do so. This is a decision to be made at the beginning of the term and cannot be changed once the labs start.

ASSIGNMENTS and PIAZZA

- To access the assignments, go to the Assignments link, click on the Webwork link and login in order to be registered with the system. Make sure you access all assignments through Canvas, otherwise your assignment mark will not be synchronized and will be missing from the grade book. There will be 8 assignments, some running over 1 week and some running over 2 weeks.

- Solve the assignment problems using only methods that we have already covered in the course up to that point, as this will give you the best practice. Even if you know other methods to solve the problems more efficiently, refrain from using them. In the assignment problems, do not use the “Email instructor” button. If you have questions, ask them during the office hours or on Piazza.

- There will also be periodic additional practice problems. These will not be graded.

- Piazza will be used only informally, and enrolling in it is optional. We will not use it for official announcements.

EXAMS

- There will be two midterm exams, held during scheduled tutorial times in the room allocated to tutorials:
Midterm 1: Wednesday 16 February, 5-7 pm
Midterm 2: Wednesday 16 March, 5-7 pm
(Other tutorial times will not be used.)

- The final exam will be held during the regular final exams season.

- The midterm and final exams will be in person and administered on Webwork through Canvas. You must have a laptop computer in order to take the exams. The use of a calculator will be allowed, and there is no requirement for any specific calculator type or model—programming calculators are allowed, but a basic scientific calculator is sufficient. The style of the exams will be similar to the weekly Webwork assignments. The grading will be done based on the final answers in Webwork. However, you may be required to hand in the hard copy of your exam work as proof of work done to help ensure academic integrity.

TOPICS and BOOKS

- The course will cover the following topics, with the approximate timeline given:

*** 3 weeks**
- Introduction to circuit theory and its connection to basic sciences.
- Charge, voltage, current, energy, power. Sign conventions.
- Wire, switch, resistor, capacitor, inductor, diode, transistor, opamp. Independent and dependent voltage and current sources. Voltmeter, ammeter and ohmmeter.
- Circuit as a graph. Circuit laws (KVL and KCL and element relationships such as Ohm's law).
- Solving circuits (including any element) using circuit laws.
- General approach to solving time-dependent circuits: using circuit laws to obtain the relevant differential equations. RC and RL circuits. Time constant, behaviour after infinite time, switching and initial conditions.
- LC and RLC circuits. Finite difference time domain analysis.

*** 1.5 weeks**
- Linearity. Superposition.
- Thévenin and Norton theorems. Equivalence. Series and parallel components.
- Voltage and current division. Source transformation.
- Maximum power transfer.
- Wye-delta transformations. Wheatstone bridge.

*** 1.5 weeks**
- Nodal analysis.
- Mesh analysis.

*** 2 weeks**
- Diode basics, half-wave and full-wave rectification.
- Filtering. Regulation, including using Zener diode.

*** 1 week**
- Opamp basics and operation, such as inverting, noninverting, summing and difference amplifiers.
- First-order opamp circuits such as differentiator and integrator.

*** 3 weeks**
- BJT basics and DC operation.
- MOSFET basics and DC operation.
- Small-signal analysis and amplification.

- We will not follow any particular textbook and there is no requirement to purchase one; the material provided during the term will form the primary resources for studying and emphasis will be on those. However, the following two books are available online through the UBC library, and you are encouraged to use the sections listed below for additional study since this will help reinforce the concepts and in some cases provide insights from new angles. Note that these book sections are not a one-to-one mapping to our lectures, but rather a guideline for further study and additional exercises on the relevant topics. Also, given that the topics of this course are general and basic, one can use essentially any circuits book for additional study, as well as a large number of resources online.

- "Introduction to Circuit Analysis and Design," by Glisson
(Download for free at http://resolve.library.ubc.ca/cgi-bin/catsearch?bid=5537582)
- Chapter 1, intro and sections 1.1 to 1.6
- Chapter 2, intro and sections 2.1 to 2.7
- Chapter 3, intro and sections 3.1 to 3.10
- Chapter 4, intro and sections 4.1 to 4.4, and section 4.6
- Chapter 5, intro and sections 5.1 to 5.9, and sections 5.14 to 5.16
- Chapter 6, intro and sections 6.1 to 6.2, and sections 6.6 to 6.7
- Chapter 7, intro and sections 7.1 to 7.6
- Chapter 8, intro, sections 8.1 to 8.5, and sections 8.9 to 8.10
- Chapter 9, intro, sections 9.1 to 9.8, and section 9.15
- Chapter 11, intro and sections 11.1 to 11.6

- "Electronic Circuits," by Tooley
(Download for free at http://resolve.library.ubc.ca/cgi-bin/catsearch?bid=11954874)
- Chapter 5, pages 89-94, and pages 98-104
- Chapter 6, pages 117-126

REQUIRED EQUIPMENT and MATERIALS

- A laptop for taking the midterm and final exams on Webwork through Canvas in person
- A webcam and a microphone (could be the laptop's webcam and microphone)
- A calculator (programming calculators are allowed, but not required—a basic scientific calculator is sufficient)
- The lab kit described previously

GRADING SCHEME

- x: Labs, out of 5
- y: Assignments, out of 10
- u: Midterm exam 1, out of 20
- v: Midterm exam 2, out of 20
- w: Final exam, out of 45

- In order to pass the course, in addition to receiving a total grade of at least 50, one must pa ss the labs and both parts of the the final exam (which will roughly include half on circuits and half on electronics). If any one of those conditions is not met, the course grade will be min[(x+y+u+v+w) and 49].

SUPPORT RESOURCES

- The following page includes a list of resources available to help support students academically:
https://ece.ubc.ca/student-life/academic-resources/

POLICIES

1. Students must abide by all UBC policies. Refer to the policies and resources:
https://senate.ubc.ca/policies-resources-support-student-success
https://www.calendar.ubc.ca/vancouver/index.cfm?tree=3,0,0,0

2. Students must be thoroughly familiar with all the information provided in this syllabus and abide by all the instructions given. Failure to do so may lead to missing critical information and loss of marks, without grounds for appeal.

3. Students must closely follow all Canvas announcements and the instructions provided therein. Failure to do so may lead to missing critical information and loss of marks, without grounds for appeal.

4. - Students must abide by the provincial guidelines with respect to the pandemic, as well as UBC's guidelines: https://covid19.ubc.ca/. In particular:

- If you have any symptom, no matter what you think it may be due to (cold, flu, etc.), do not come to class/lab/exam. Given the flexible and hybrid nature of course delivery and assignments and labs, there is no reason to come in if you have any doubt.
- Masks are required in all classrooms, labs, exam rooms, and other indoor public spaces. It is important that all of us feel as comfortable as possible engaging in course activities while sharing an indoor space. The term "masks" refers to medical and non-medical masks that cover our noses and mouths. You may be asked to remove your mask briefly for an ID check for an exam but, otherwise, your mask must cover your nose and mouth. Do not eat in class. If you need to drink, keep your mask on between sips. Drinking may not be used as a reason for not wearing a mask over an extended period of time. If you have a condition that prevents you from being able to wear a mask and have received an exemption to the requirement to wear a mask, inform the instructor.
- You are encouraged to sit in the same place or section of the classroom throughout the term to the extent possible, in order to minimize the number of close contacts you have with others.
- If the course instructor becomes ill and unable to communicate even online, the point of contact will be TA1, who will communicate the appropriate instructions.

- If any of the TAs become ill and unable to assist even online, the instructor will communicate the appropriate instructions.

5. Late submission of assignments and lab reports will not be accepted. All submissions are through Canvas with a strict due date and time. The system will not accept submissions past that date and time, and exceptions will not be made unless there is a justified academic concession agreed to ahead of time. For example, issues such as having a busy week or running into technical difficulties with uploading files near the deadline will not constitute a cause for extension. Given that each assignment or lab will run over 1 or 2 weeks, there is ample time to plan for the submission with a safety margin ahead of the deadline, in order to avoid risks associated with last-minute difficulties.

6. Academic concessions will be made only for serious cases such as medical issues. If you need to request an academic concession, contact the instructor and TA1 on Canvas, in addition to completing the self-declaration form: https://academicservices.engineering.ubc.ca/form-request-for-academic-concession-in-term-work/

7. If you are sick for a midterm exam, do not attend the exam. Instead, you must request an academic concession as per the above point and discuss your options with the instructor.

8. If you are sick for a final exam, do not attend the exam. Instead, you must apply for deferred standing through Engineering Academic Services no later than 48 hours after the missed final exam. Students who are granted deferred standing write the final exam at a later date.

9. UBC's institutional Zoom account, which will be used in this course, uses Canadian-based hosting. This means no student data will be stored on servers outside of Canada provided you are either logged in with a UBC Zoom account or you join anonymously. If you have privacy concerns: a) do not create your own account with Zoom, b) provide only your first name or a nickname when you join a session, c) keep your camera off and microphone muted as much as you can, and d) avoid sharing any identifying information.

10. The live lectures will be recorded and made available for subsequent viewing. Student participation, such as when asking questions in class using audio or chat, may be captured as part of these recordings.