ECE 2040 Circuit Analysis	GT-E
Instructor: Prof. David Citrin	email (best way to contact me): david.citrin@ece.gatech.edu
Office Hours: By appointment	WhatsApp and Text (NO voice, emergencies only!) +1 404 717 3085

Objectives:
• To introduce electric circuit elements, electronic devices, and analysis of circuits containing such devices.

Text: Dorf & Svoboda, *Introduction to Electric Circuits* (9th edition), John Wiley, 2013. ISBN 1118477502, ISBN 9781118477502 (recommended) (comment: This book is also available for purchase electronically.)

Optional means first check out the book and see if you want to purchase it. But, the class notes will be adequate if you do not want to go to the expense of purchasing a book or if you do not want to carry one around.

myDAQ unit, National Instruments. (comment: This item is also required for ECE 2020 and ECE 3084.)

Do not purchase MyDACs. GT-E has them.

MyDAC units will be available to you at GT-E; however, you must install the myDAC software on your laptop. I will not troubleshoot software problems.

I WILL POST MY CLASS NOTES ON CANVAS.

Grading Policy
There will be three quizzes. Each quiz is worth 20 % of the course grade. Quiz dates are to be announced on the separate Course Calendar. The use of a calculator will NOT be allowed unless I later give instructions to the contrary. I will provide formula sheets as appropriate. *Any request for regrading of a quiz assignment must be made in writing within one week of getting the quiz back.* Such requests have two components: (1) A hard copy of the graded quiz and (2) a description of what you think was graded in error **on a separate sheet of paper.** There will be no make-up quizzes for any reason other than an official GT activity or an unforeseen emergency (for example, family emergency, illness). Illness is an appropriate reason for missing a quiz, but you may need to produce a note from a doctor, the representative of the dean of students, or Prof. Paul Voss stating that you are not able to take the quiz. The MyDAC labs will collectively be worth 10 % of the course grade. The final exam is worth 30 %.

Note that if your quiz grades are sufficiently high, you can opt out of the final exam in which case I will use your quiz average for the final-exam grade.

Course Grade: The course grade will be computed according to the following weights:
Each quiz (3): 20 %
MyDac Labs: 10 %
Final Exam: 30 %

Class Attendance Policy:
Regard attendance to be required, though there is no grade (but see below) and I will not take attendance. Students are expected to attend lectures and be engaged with the class. Class attendance is also the easiest way I know of to attain a first attempt at an understanding of the material. (Of course, this has to be supplemented by working homework problems and other practice.) In addition, quizzes and other in class assignments may require you to be present in class. Note that your presence in the class is required on days of myDAC labs. Students not present might receive a

grade of zero for such labs missed.

Quizzes
There will be three in-class quizzes (or possibly online) tentatively on dates to be determined. **Failure to take a quiz will result in a grade of zero** unless you present written documentation that you have a valid excuse and that I accept the excuse (see above). Unless the excuse is related to an obviously unforeseen emergency, this documentation **must** be presented one week prior to the quiz or a grade of zero may result. The only excuses I will accept are official university or program activities of unforeseen emergencies. Personal travel is NOT an excuse.

The quizzes will be heavily drawn from problems given in the homeworks. Thus, mastery of homework problems is likely to translate into high quiz grades. The quizzes will be substantial and each quiz may be a fraction of the class period or the entire period as will be announced. It is your responsibility to arrive on time.

Each quiz will concentrate on material covered between specified cutoffs (TBA)—typically from the cutoff for the previous quiz. Nonetheless, knowledge of material that came before in the course will be required.

I will provide formula sheets for the quizzes. Calculators and other aids will **not** be permitted on the quizzes.

Note that Quiz 3 may be scheduled during dead week.

Labs
Before coming to GT-E or in the first week, please do Lab0 which can be accessed at
https://drive.google.com/open?id=1HwmC2sn-WhTxkFRadJatddR_pwFxLzja
The labs will be posted on Canvas once the course website is set up. Make sure you install the Elvis software and carry out other steps discussed in Lab0. The software can, I understand, also be installed on a Mac. It is your responsibility to figure this out before coming to GTL. If you are unable to install the software on your laptop, you will need to team up with another student in ECE 2040 at GT-E who has successfully installed the software to do the labs.

Students will work in a team of two or three, *i.e.*, with a partner. See above to ensure that at least on person on each team has the relevant software successfully installed on a laptop.

Labs will be done in class; however, you are responsible to have read the relevant lab assignment *before class* and to have done any preparatory work to ensure that you can do the labs efficiently. Lab reports might be assigned to be done in class or as homework, TBD. That means, any preparatory questions you can answer before doing the labs should be done before coming to class. You will be responsible for downloading the relevant lab and printing a hard copy of the lab assignment to be turned in at the end of the class period when the lab is done. Your team should turn in one completed lab assignment with all team members' names on it.

Office hours

By appointment. Please email me as I may not have my calendar with me at lectures.

Homework

Problems will be assigned roughly every week. Student collaboration on homework is permitted. Homework will NOT be graded, but solutions will be posted. Homework is an essential part of the course as problem solving is how most of us learn. It will also help prepare you for the quizzes.

Student-Faculty Expectations Agreement

A university is a place where scholars engage in free inquiry into a range of subjects. It is therefore necessary to foster an atmosphere of mutual respect, acknowledgement, and responsibility between faculty members and the student body. See http://www.catalog.gatech.edu/rules/22/ for an articulation of some basic expectation that you can have of me and that I have of you. In the end, simple respect for knowledge, hard work, and cordial interactions will help build the environment we seek. I also emphasize that the class provides an excellent opportunity to ask questions—both about specific subject-matter related material as well as about, well, anything. Therefore, I encourage you to remain committed to the ideals of Georgia Tech while in this class.

Academic Conduct:
Students in this class are expected to abide by the Georgia Tech Honor Code and avoid any instance of academic misconduct, including but not limited to:

- Possessing, using, or exchanging improperly acquired oral or written information in the preparation of a quiz or lab report.
- Submission of material that is substantially identical to that created or published by another individual, except as noted below.
- False claims of performance or work that has been submitted by the student.

Be sure to report observed instances of violations of the Honor Code! Remember, the Honor Code is about honor. Apart from devaluing your own work, the work of your classmates, and the Georgia Tech degree, Violations of the Honor Code carry significant penalties, here at Tech, and for life. Do you want to be labeled as having cheated? The trustworthiness of engineering and science (as well as the reliability and safety of products!) relies on the basic honesty of engineers and scientists. Students may work in groups of on homework assignments, though each must student make a good-faith effort to contribute to the group. Each student must also write up and turn in his/her work to integrate the knowledge.

Further information concerning materials and other aids allowed in quizzes will be given later.
See the Georgia Tech Honor Code for further information or ask instructor.

Communications:
You are responsible for all announcements (which may include information about the problem sets, quizzes, and labs) made in class. Problem sets and quizzes will likely strongly reflect material covered in class. If you miss class, do not ask me what was covered. Handouts may also be distributed from time to time in class; it is your responsibility to obtain information from classmates if you are not present when information is given or materials are distributed. I may also email the class various information. The alias for the class corresponds to the list of those students registered for the course. Thus, if you are not getting emails, you are probably not registered. (Wait until I announce in class that I am emailing information. This will probably happen toward the end of the first week of class.) It is your responsibility to save emails containing information about the class.

Notes, problem sets, solutions, and various other useful information will for the most part be posted on Canvas.

The best way to contact me is via email (**put "ece2040" in the subject line!!!**), briefly immediately after class (but another class may need the room), or by appointment.

Miscellaneous:
Cell phones and similar devices must be turned **off** in class.

Why are you here??
• Solid-state materials are the basis of a wealth of technologies. As educated people, we should know what is going on!
• All electric, electronic, and optoelectronic devices operate through the motion of electrons (or other charged particles – ionic conductors, plasmas, gaseous electronics) in materials. As scientists and engineers, we have to know the basics.
• Circuits are everywhere! How do they work?
• The technological developments that have led to the miniaturization of devices and their extremely high

speed have led to technological revolutions in your lifetime. Be part of the technology revolution!
• This may be the first time you really see the uncanny ability of mathematics to describe the physical universe. It is beautiful!

What do you have to do??
• Come to class.
• Master the concepts.
• Do the problem sets.
• Master problem solving.
• Avoid the cookbook approach to the above.
• Keep up with the material covered in lectures.
• Read the lecture notes and the book.
• Come to office hours.
• Keep an open mind.
• Ask questions.

Tentative Outline (very rough—topics may not be covered in the order listed here)

1. Basic Concepts
   a. Voltage, Current, Power and Energy
   b. Circuit elements (R, L, C, ideal operational amplifiers, ideal transformer)
   c. Independent and Dependent Sources
   d. Kirchhoff's Laws
   e. Series and Parallel Combinations of Elements
   f. Voltage Division and Current Division

2. DC circuit analysis
   a. Node Analysis
   b. Mesh Analysis

3. Network Theorems
   a. Linearity
   b. Superposition
   c. Source Transformations
   d. Thevenin's Theorem
   e. Norton's Theorem

4. Circuits Containing Operational Amplifiers
   a. Ideal Op Amp model, with negative feedback condition
   b. Inverting and Non-Inverting Configurations
   c. Voltage Followers, Adders, Difference Amplifiers

5. First and Second-Order Circuits
   a. Singularity Functions
   b. RC and RL Source-Free Circuits
   c. Constant and Non-Constant Forcing Functions
   d. Initial and Final Values
   e. Op-amp circuits for integration and differentiation
   f. Measurement of signals in physical circuits
   g. RLC circuits
   h. Time-Domain Analysis

6. Sinusoidal Steady-State (SSS) Analysis
   a. Sinusoids
   b. Complex Numbers
   c. Complex Exponential Representations of Sinusoids (Phasors)
   d. Impedance and Admittance
   e. Superposition, Thevenin???s and Norton???s Theorems
   f. Analysis and Network Theorems for SSS
   g. Frequency response
   h. Bode plots
   i. Resonance
   j. Measurement of frequency response of physical circuits

7. Power Analysis
   a. Instantaneous and Average Power
   b. Power Factor and Power Factor correction
   c. Complex Power
   d. Maximum Power Transfer