

COLL 198: Practical Circuit Theory and Electronics

Contact Information

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Office Hours: MWF 2:00-3:00 PM or available anytime by appointment

Course Title: Practical Circuit Theory and Electronics

Faculty Sponsor: Dr. Don H. Johnson

Course Description:

As electrical and computer technology increasingly infiltrates the world around us, understanding how they work becomes important for appreciating their reach and limitations. As complex as these systems may become, the fundamental concepts of circuit theory serve as a basis for designing electronic devices. This course will survey the principles and devices that have served to create many useful gadgets around us, while exploring how certain circuits are built and function to solve past and current real-world problems. Topics covered include, circuit theory (RLC circuits, transformers), and semiconductor devices, such as diodes, transistors, and op-amps. Demonstrations will be used to verify theory and calculations. Students will understand and apply these concepts through exercises, exams and in-class participation to design, critique, and troubleshoot circuits. No prior physics or calculus is required; instead, a practical approach and intuition will be used to solve and analyze circuits to determine their advantages, disadvantages, and uses. Students will complete the course with skills that allow them to understand the function of elements and components in larger electronic systems, as well as a better intuition on how to troubleshoot and design these systems.

Course Objectives and Learning Outcomes

Skills-Based

1. Identify various electrical components and give examples of their behavior in circuits.
2. Compare various designs and determine the advantages and disadvantages of each system for a particular function.
3. Design analog circuits based on necessary requirements, specifications, and power/voltage considerations.
4. Develop an intuition about how complex systems work given a set of parameters and conditions.

Content-Based

1. Recognize the importance of analog systems in today's digital world.
2. Explain the fundamental difference between electrical and electronic systems and properties of each.
3. Explore the applications of analog circuits and their contribution to advancements in technology.

Coursework and Assessments

There will be notes and background information to prepare students for the next lecture, with homework consisting of several problems to reinforce what students learned in class that week. Homework will be assigned weekly. Also, there will be in-class exercises that have students analyze problems together and communicate their thoughts. There will be one midterm and four small labs throughout the semester. The midterm exam will cover all circuit theory (DC and AC, RLC circuits, transformers), and the labs will have students apply practical knowledge learned in class.

Texts and Resources

- Floyd, Thomas L. *Electronics Fundamentals: Circuits, Devices, and Applications*. 5th Edition. New Jersey: Prentice Hall, 2001.
- Scherz, Paul, and Monk, Simon. *Practical Electronics For Inventors*. 3rd Edition. McGraw Hill, 2013.
- <http://www.electronics-tutorials.ws/>

Grade Policies

I request that everyone attend all class meetings and participate in class when the time arises. In order to pass the course, the exam and final project must be completed, homework must be finished and turned in, and participation is required when the class solves problems together or in groups. The following weight is given to each category:

45% = Exam 20%, Labs 25%

35% = Homework

20% = Attendance and Active Participation

As with all student-taught courses, the grading will be on a satisfactory/unsatisfactory scale. Letter grades will be returned throughout the course to help determine where the student stands, but the final grade is not a letter grade.

Absence Policies

Since the material of each week relies heavily on the material of the week before, students who miss more than one class lecture/lab will not pass the course. If there is a foreseeable absence, please contact me in advance.

Rice Honor Code

In this course, all students will be held to the standards of the Rice Honor Code, a code that you pledged to honor when you matriculated at this institution. If you are unfamiliar with the details of this code and how it is administered, you should consult the Honor System Handbook at <http://honor.rice.edu/honor-system-handbook/>. This handbook outlines the University's expectations for the integrity of your academic work, the procedures for resolving alleged violations of those expectations, and the rights and responsibilities of students and faculty members throughout the process.

Disability Support Services

If you have a documented disability or other condition that may affect academic performance you should: 1) make sure this documentation is on file with Disability Support Services (Allen Center, Room 111 / adarice@rice.edu / x5841) to determine the accommodations you need; and 2) talk with me to discuss your accommodation needs.

Syllabus Change Policy

This syllabus is only a guide for the course and is subject to change with advanced notice.

Tentative Course Schedule

Section I: Electric Circuits

Week 1: Introduction & Ohm's Law (Scherz and Monk pages 6-24)

- Syllabus Review
- Atoms and Electrical Charge
- What is a circuit?
- Voltage, Current, Resistance and Ohm's Law

Week 2: DC Circuits: Resistor Networks (Scherz and Monk pages 50-62)

- Voltage drop
- KVL and KCL
- Total Current/Resistance
- Wheatstone Bridge

Week 3: Lab 1: Resistor Networks

Week 4: DC Circuits: RL and RC (Floyd pages 395-408, pages 508-520)

- Inductors
- Capacitors
- Energy Storage
- DC Circuit Analysis/Time Constant

Week 5: AC Circuits (Floyd pages 409-414, 440-450, 521-526)

- Complex Numbers
- AC Sources
- ELI the ICEman
- Reactance

Week 6: AC Circuits/Filters (Floyd pages 450-467, 542-558, 596-606, 612-618)

- Impedance
- Filters
- Resonance

Week 7: Transformers (Scherz and Monk pages 374-384)

- Mutual Inductance
- Step Up, Step Down Transformers
- Loading
- Center Tap Transformer
- Limits of Electric Circuits

Week 8: Midterm Exam – NO CLASS

Section II: Electronic Circuits

Week 9: Introduction to Semiconductors (Scherz and Monk 401-425)

- Atomic Structure and Bonding
- Doping
- PN Junctions
- Diodes

Week 10: Lab 2: Power Supplies

Week 11: Bipolar Junction Transistors (Scherz and Monk pages 429-445)

- The Impact
- BJT's: Biasing
- Single Stage Amplifiers: Power Gain

Week 12: Metal Oxide Semiconductor Field Effect Transistors (online notes)

- MOSFETs
- Switching Mode
- Logic
- Computer Architecture

Week 13: Lab 3: MOSFETs

Week 14: Operational Amplifiers and Applications (Scherz and Monk 635-645)

- Idealities and Properties
- Node Method
- Common Configurations
- Active Filters

Week 15: Lab 4: Op-Amps