ECE 331: Electronic Principles I

Brief Course Description: This course is designed as single semester, junior level, undergraduate course in the Department of Electrical and Computer Engineering at Colorado State University. The aim of this course is to provide undergraduate students with detailed understanding of diodes, MOSFETs and BJTs and their application in single-transistor circuits.

Prerequisites: ECE 202, MATH 340/345, PH 142

Course Credits: 4
Class Lecture Sessions: 3:00 – 4:15, Monday and Wednesday.
Classroom Location: Clark Building, A206
Instructor: Sourajeet Roy
Email: sjeetroy@engr.colostate.edu
Phone: 491-0595
Office Hours: Thursday 12:30 to 2:30 PM
These hours may be adjusted based on student feedback. If students have scheduled course conflicts with these times, they may request in advance an appointment at another time. Please plan ahead on homework to use available office hours.


Webpage: This course will use CSU’s RamCT (http://ramct.colostate.edu), and the ECE331 course webpage in RamCT is only accessible to registered students. To reach RamCT, direct your browser to http://ramct.colostate.edu and log in using your eID. If you are unable to log into RamCT, contact the ACNS helpdesk for support. If you have been registered for the class for more than about 48 hours, you should see a link for “2014FA-ECE-331-001: Electronics Principles I” listed on the screen.

Course Objectives

It is my expectation that after taking this course, students will have gained the following skills.

1. Qualitatively describe the basic semiconductor physics of these devices
2. Name the operating regimes for each device and determine the appropriate algebraic formula for the current-voltage terminal characteristics in that regime.
3. Plot the combined current-voltage characteristics of the regimes for each and use similar graphs to determine critical parameters for the devices.
4. Reproduce equivalent circuits for each device.
5. Apply the algebraic formulas, equivalent circuit models and graphical representations of current-voltage characteristics to solve for the terminal currents and voltages of the devices in simple circuits.
6. Describe the most important deviations from the ideal models observed in actual devices.
7. Describe the difference between large signal, small signal and bias point analysis and the associated assumptions.
8. Name the three basic single-transistor amplifier configurations and choose the best one for various applications.
9. Design circuits for biasing a transistor in each of the three basic amplifier configurations.
10. Describe how to use transistors in switching applications and as current sources.
11. Design rectifier circuits including selecting capacitor values to meet ripplespecifications.
12. Draw basic current mirror circuits and describe their purpose and function.
13. Build diode and single-transistor circuits and measure their operation usinglaboratory bench instruments.
14. Analyze simple circuits containing diodes or transistors using analytical methods.
15. Analyze circuits containing diodes and transistors using electronic designsoftware.
16. Write laboratory reports that effectively communicate the student’s design,analysis and characterization of simple diode or transistor circuits

Course Topics: The planned course topics are:

- Introduction to semiconductors and operation of pn junctions (Chapter 2): 1.5 weeks
- Diodes models, large/small signal operation model, diode circuits and their applications (Chapter 3): 1 week
- Bipolar junction transistors (BJTs): Physics of BJTs, large/small signal model, BJT biasing and amplifier topologies (Chapter 4, 5): 2.5 weeks
- Metal-oxide field effect transistors (MOSFETs): Physics of MOSFETs, large/small signal model, MOSFET biasing and amplifier topologies (Chapter 6, 7): 5 weeks
- Op-amps, exams, review, open 4 weeks

Grading: Your overall score will be based on the following weighting:

<table>
<thead>
<tr>
<th>Component</th>
<th>Weighting</th>
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<tbody>
<tr>
<td>Labwork</td>
<td>15%</td>
</tr>
<tr>
<td>Midterm</td>
<td>25%</td>
</tr>
<tr>
<td>Homework Assignments</td>
<td>20%</td>
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<tr>
<td>Final Exam</td>
<td>40%</td>
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The course TA will provide details on laboratory assignments and grading. Students who previously took this course the immediately preceding year may elect to receive the samelaboratory component score rather than repeating the lab section of the course.

The midterm exams will be held in class and are tentatively scheduled for October 8th. All exams are closed book, but you are allowed to bring one sheet of notes (frontand back) to the midterm exam, and threesheets of notes to the final exam.

All class notes, power point presentations, demons/videos etc. will all be uploaded onto RamCT. Homework is typically due a week from the date of uploading. All homework will be uploaded via RamCT or handed out in class. A total of 8 sets of homework assignments is required for this course. All homework assignments will be corrected and handed back with a 2 weeks from submission. There will be 2 review classes before the midterm and four before the final exam.

Grades will be assigned according to the following scale:

<table>
<thead>
<tr>
<th>Grade Interval</th>
<th>Grade</th>
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<tbody>
<tr>
<td>&gt; 97%</td>
<td>A+</td>
</tr>
<tr>
<td>93-97%</td>
<td>A</td>
</tr>
<tr>
<td>90-93%</td>
<td>A-</td>
</tr>
<tr>
<td>87-90%</td>
<td>B+</td>
</tr>
<tr>
<td>83-87%</td>
<td>B</td>
</tr>
<tr>
<td>80-83%</td>
<td>B-</td>
</tr>
<tr>
<td>77-80%</td>
<td>C+</td>
</tr>
<tr>
<td>73-77%</td>
<td>C</td>
</tr>
<tr>
<td>63-73%</td>
<td>D</td>
</tr>
<tr>
<td>&lt; 63%</td>
<td>F</td>
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The grading scale may be adjusted to award higher grades at the instructors’ option.
Proper crediting of academic sources and plagiarism: I take properly crediting sources of information seriously. I do not expect or anticipate that you will be able to complete all the assignments for class without outside help. In fact, part of learning should be locating and using additional sources of information independently of your instructor. I encourage you to discuss the homework with fellow students, and avail yourself of any other sources of information you wish. However, you must properly credit in each and every homework problem the sources of information you use including discussions with classmates or other individuals, articles, books, webpages, solutions manuals or any other information source; however, you do not need to cite lectures, lecture notes, or the textbook as it is assumed you will be using these. Do not simply write the names of your study group once for the assignment, but credit the actual individuals that help you on each individual problem. You must credit the source if you use its ideas whether or not you reproduce it verbatim. If you exactly reproduce more than a phrase or single equation verbatim, you must enclose the item in quotation marks and properly credit it. You are not allowed to exactly reproduce another current student’s work. Duplicate homework or other assignments will be substantially penalized and typically receive zero points. If you fail to credit your sources on homework, you will be penalized on the assignment and repeated offenses may incur harsher consequences up to and including failing the class. See penalties and procedures for dealing with plagiarism as outlined in the General Catalog. Unfortunately, I have had to reduce the final letter grades of students in upper level classes in the past due to plagiarism, and I have the prerogative to fail students for such offenses.