Course Number & Name: ELC 120 Electronics I: Semiconductor Components

Credit Hours: 4.0  Contact Hours: 6.0  Lecture: 3.0  Lab: 3.0  Other: N/A

Prerequisites: Grade of “C” or better in ELC 115 or permission of the instructor

Co-requisites: None  Concurrent Courses: None

Course Outline Revision Date: Fall 2010

Course Description: This course introduces students to the active components used in electronics circuits. It covers the physics, the characteristics, and some applications of semiconductor diodes and transistors. The emphasis is on transistor biasing circuits. These devices and their applications are also studied through laboratory experiments.

Course Goals: Upon successful completion of this course, students should be able to do the following:

1. use appropriate technical vocabulary;
2. analyze and solve problems in basic electronic circuits using correct theory, laws, and formulas;
3. correctly follow laboratory procedures to assemble, test, and troubleshoot basic electronic circuits; and
4. use state-of-the-art technology to solve electronics problems.

Measurable Course Performance Objectives (MPOs): Upon successful completion of this course, students should specifically be able to do the following:

1. Use appropriate technical vocabulary:
   1.1 distinguish between conductors and semiconductors in terms of their atomic structures;
   1.2 describe the relationships between the base, emitter, and collector currents of a bipolar junction transistor;
   1.3 use appropriate vocabulary and solid state models to explain the characteristics of semiconductor junction diodes; and
   1.4 explain the characteristics of bipolar junction transistors in terms of their semiconductor structure
Measurable Course Performance Objectives (MPOs) (continued):

2. Analyze and solve problems in basic electronic circuits using correct theory, laws, and formulas:
   2.1 use appropriate models for junction diodes in the solution of circuits employing these diodes;
   2.2 calculate the electrical characteristics of common AC to DC converters employing rectifier diodes;
   2.3 explain the I-V characteristics of transistors and utilize them to calculate a transistor’s operating point;
   2.4 use load line graphical techniques to determine the operating point of a variety of linear and nonlinear devices; and
   2.5 analyze and design various types of transistor-biasing circuits

3. Correctly follow laboratory procedures to assemble, test, and troubleshoot basic electronic circuits:
   3.1 list three items of interest found on a diode or transistor data sheet;
   3.2 connect DC circuits involving diodes and transistors and determine their operating points by measuring their currents and voltages with a multi-meter;
   3.3 correctly use an oscilloscope to observe waveforms resulting from nonlinear action of diodes and transistors; and
   3.4 interpret the results of experiments using fundamental laws and equations

4. Use state-of-the-art technology to solve electronics problems:
   4.1 use an application software package such as Multisim or PSpice to solve DC diode and transistor-biasing circuits; and
   4.2 use a scientific calculator to solve electronics problems

Methods of Instruction: Instruction will consist of a combination of lectures, class discussions, classroom demonstrations, laboratory experiments, board work, group work and individual study.

Outcomes Assessment: Quiz, test, and exam questions are blueprint to course objectives. Checklist rubrics are used to evaluate the laboratory reports for the presence of course objectives. Data is collected and analyzed to determine the level of student performance on these assessment instruments in regards to meeting course objectives. The results of this data analysis are used to guide necessary pedagogical and/or curricular revisions.

Course Requirements: All students are required to:
1. Maintain regular attendance.
2. Complete homework assignments and laboratory reports on time.
3. Sit for all quizzes, tests, and exams as scheduled.
4. Read all assigned textbook pages.
5. Participate in classroom discussions.
**Methods of Evaluation:** Final course grades will be computed as follows:

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<tr>
<th>Grading Components</th>
<th>% of final course grade</th>
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<tr>
<td>• Homework, quizzes, class participation, and attendance</td>
<td>25 – 30%</td>
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<td>A perusal of homework problems and quizzes and an analysis of class discussion will indicate the extent to which students master course objectives.</td>
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<td>• 8 or more Laboratory Reports</td>
<td>20 – 25%</td>
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<td>Students will be expected to show that they have read assigned lab manual sections, can follow written procedures, measure and record data, perform calculations and write reports including all specified components. Lab reports will provide evidence of the extent of student mastery of course objectives.</td>
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<tr>
<td>• Midterm Exam</td>
<td>20 – 25%</td>
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<td>The midterm exam will show evidence of the extent to which students meet course objectives, including but not limited to identifying and applying concepts, analyzing and solving problems, estimating and interpreting results and stating appropriate conclusions using correct terminology, based on course material covered during the first half of the semester.</td>
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<td>• Final Exam (comprehensive)</td>
<td>25 – 30%</td>
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<td>The same objectives apply as with the Midterm Exam, but it is anticipated that students will provide increased evidence of synthesizing a combination of concepts covered throughout the semester.</td>
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**NOTE:** The instructor will provide specific weights, which lie in the above-given ranges, for each of the grading components at the beginning of the semester.

**Academic Integrity:** Dishonesty disrupts the search for truth that is inherent in the learning process and so devalues the purpose and the mission of the College. Academic dishonesty includes, but is not limited to, the following:

- plagiarism – the failure to acknowledge another writer’s words or ideas or to give proper credit to sources of information;
- cheating – knowingly obtaining or giving unauthorized information on any test/exam or any other academic assignment;
- interference – any interruption of the academic process that prevents others from the proper engagement in learning or teaching; and
- fraud – any act or instance of willful deceit or trickery.

Violations of academic integrity will be dealt with by imposing appropriate sanctions. Sanctions for acts of academic dishonesty could include the resubmission of an assignment, failure of the test/exam, failure in the course, probation, suspension from the College, and even expulsion from the College.
**Student Code of Conduct:** All students are expected to conduct themselves as responsible and considerate adults who respect the rights of others. Disruptive behavior will not be tolerated. All students are also expected to attend and be on time for all class meetings. No cell phones or similar electronic devices are permitted in class. Please refer to the Essex County College student handbook, *Lifeline*, for more specific information about the College’s Code of Conduct and attendance requirements.

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<tr>
<th>Week</th>
<th>Content/Topics</th>
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| 1    | Approximations of Voltage and Current Sources, Review of Thevenin’s Theorem (Chapter 1)  
Lab 1: Voltage and Current Sources (Exp1) |
| 2    | Intrinsic Semiconductors, Doping a Semiconductor, Unbiased and Biased Diodes (Chapter 2) |
| 3    | Approximations of Diodes, Bulk Resistance and DC Resistance, Load Lines, Reading a Data Sheet (Chapter 3)  
Lab 2: Diode Curve (Exp5) |
| 4    | Half-Wave, Full-Wave, and Bridge Rectifiers, Troubleshooting of Power Supply (Chapter 4)  
Lab 3: Rectifier Circuits (Exp7) |
| 5    | Capacitor-Input Filter, Ripple Voltage, Clippers, Clampers, and Voltage Multipliers (Chapter 4) |
| 6    | Zener Diode, Zener Regulator, and Troubleshooting of Zener Regulator (Chapter 5) |
| 7    | LED, Photodiode, Schottky Diode, Varactor, and other Special-Purpose Diodes (Chapter 5)  
Lab 4: Zener Regulator (Exp13) |
| 8    | Review and **Midterm Exam** |
| 9    | Three Regions of Bipolar Junction Transistors, Base Curve and Collector Curve (Chapter 6) |
| 10   | Transistor Approximations, Up-Down Analysis of Base Bias Circuit (Chapter 6)  
Lab 5: The CE Connection (Exp15) |
| 11   | Variations in Current Gain, Load Line and Q-Point, Saturation and Cutoff (Chapter 7)  
Lab 6: Transistor Operating Regions (Exp16) |
| 12   | Base Bias and Emitter Bias, LED Drivers, Up-Down Analysis of Emitter Bias Circuit (Chapter 7) |
| 13   | Analysis of Voltage-Divider Bias and Two-Supply Emitter Bias (Chapter 8)  
Lab 7: Setting Up a Stable Q-Point (Exp19) |
| 14   | Feedback Biases, Troubleshooting of VDB Circuit (Chapter 8)  
Lab 8: Transistor Bias (Exp21) |
| 15   | **Final Exam** |