Washington State University
School of EECS
Electrical Engineering Course Assessment Report

Course Number   EE 311
Course Title    Microelectronics
Semester Offered Spring 2007
Instructor      Osman
10th Day Enrollment 33 Number Completing Successfully (C grade or better) 30

I. Assessment Outcomes from the Course Syllabus

- (A) Ability to apply knowledge of mathematics, science and engineering.
- (B) Ability to design and conduct experiments as well as analyze and interpret data.
- (C) Ability to design a system, component, or process to meet desired needs.
- (D) Ability to function on multidisciplinary teams.
- (E) Ability to identify, formulate, and solve engineering problems.
- (F) An understanding of professional and ethical responsibility.
- (G) Ability to communicate effectively in written and oral formats.
- (H) A broad education necessary to understand the impact of engineering solutions in global, economic, and societal context.
- (I) Recognize the need for, and have the ability to engage in lifelong learning.
- (J) Have a broad education and knowledge of contemporary issues.
- (K) Ability to use techniques, skills and modern engineering tools necessary for engineering practices.

II. List of Course Topics from the Course Syllabus

1. Introduction to electronics.
2. Operational amplifiers.
3. Diodes: physics, small-signal model, applications.
4. BJT: physics, biasing, small-signal model.
5. BJT single-stage amplifiers: analysis and design.
6. BJT current mirrors.
7. BJT differential amplifiers: analysis and design.
8. MOSFETs: physics, biasing, small-signal model.
9. MOSFET single-stage amplifiers: analysis and design.
10. MOSFET current mirrors and differential amplifiers.
11. Frequency response.
III. Course Assessment Summary Table: one row of the table should be devoted to each of the checked outcomes in part I.

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Topics</th>
<th>Specific Measures (Samples should be available in the course materials file for inspection.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(A) Ability to apply knowledge of mathematics, science and engineering.</td>
<td>2-11</td>
<td>Most homework, quizzes and exams</td>
</tr>
<tr>
<td>(C) Ability to design a system, component, or process to meet desired needs.</td>
<td>2-11</td>
<td>HW 6, 8 &amp; 10, Q 3 &amp; 6, E 2.2, 2.3, Final.2</td>
</tr>
<tr>
<td>(K) Ability to use techniques, skills and modern engineering tools necessary for engineering practices.</td>
<td>2-11</td>
<td>Q2, 4, 5, 6, 7, E1.1, 1.2, 2.1, 2.5, F1, 4, 5, 8, 9</td>
</tr>
</tbody>
</table>

IV. Using the table as a guide, for each outcome summarize your evaluation of the students' achievement of that outcome; cite student performance on the identified measures as evidence to support your conclusions.

(A) Ability to apply knowledge of mathematics, science and engineering.

The entire course involves the application of mathematics to analyze and design amplifier circuits and determine their performance parameters. The underlying behavior for diodes and transistors is the physics of the device. This ability can be assessed by the students' overall average.

(C) Ability to design a system, component, or process to meet desired needs.

Although most of the course emphasizes analysis of circuits, more emphasis is directed to design in the latter part of the course. 30% of exam 2 and quizzes 4 through 7 include design related questions.

(K) Ability to use techniques, skills and modern engineering tools necessary for engineering practices.

Techniques introduced in this class include small and large signal models, small signal analysis, zero value time constants, Miller's theorem and summing point constraints for op-amps. Half of the final exam questions concern these techniques. Homework 3 involved using SPICE circuit simulation to examine frequency response of operational amplifiers.

V. Qualitative Assessment of Student Performance: using the arguments above and other data support the claim that students who completed this course with a grade of C or better have achieved each of the intended outcomes of this course.

The final comprehensive examination is used as assessment tool of student's performance and comparing them to other groups. The highest score was 106, the mean score was
73.5, the lowest score was 33, and the standard deviation was 18. Figure 1 shows the histogram of scores for the assessment exam. This class had a lower mean and high score as last year. The standard deviation is up to near 20 this year and is the same as last year after being 12 two years ago. The percentage of students scoring 90 or above is 18% compared to 37, 33%, and 7% the previous 3 years. The percentage scoring below 60 was 10%, which is not significantly different than the 17%, 15% and 14% and 10% percentages the previous 3 years. Only 3 students scored lower than 55 this year which is the same as last year.

![Histogram of assessment exam scores from EE311 Spring 2007.](image)

Figure 1. Histogram of assessment exam scores from EE311 Spring 2007.

The lowest grade on the final of a passing student was 60 out of 120. The lowest overall weighted average including homework, quizzes, exams and a comprehensive final was 60%. Assessing Outcome A is based on the overall average, which is greater than 60% for every student. The final is a good assessment for Outcome K, since over half the questions concern techniques to analyze circuits. The minimum score was 50%, which shows some competence in using these skills. Outcome C is not a major objective of this course but directly impacts about 15% of their overall average. Although it is possible for a student to have a passing overall average of 60% while scoring 0% on design related problems, the student would need an average of 70% in the non-design related 85% of the score. However, it is my experience that the students that can analyze circuits better are also better able to reverse the process and design circuits.

VI. Concerns: state any concerns you may hold about this class – were the students adequately prepared coming into it? Are there topics or outcomes where (some) students were weak after completing the course? Other concerns? Were there any comments on students' course evaluations that should be addressed in future instances of the course? This section is very important for improving our program: it provides critical input to the curriculum committee for identifying areas requiring attention.
I reduced the number of quizzes from 9 to 7 and kept the number of exams from as 2 in order to allow more time for working examples in lecture. I think it would be better to go back to 3 exams and having 10 or 11 quizzes.

The TA provided weekly review and problem solving sessions.

I also provided help and review sessions before the exams.

I also added an Op-amp frequency response analysis using SPICE as one of the homework assignments.

I was pleased with the Sedra and Smith, Fifth Edition text book.

I recommend assigning homework assignments with SPICE simulation component. This will allow students to explore issue in multistage amplifier design.

I recommend using the text book problems as practice problems only. Several students got perfect scores on homework problems from text book and were unable to solve similar problems in the exams.

Signature ___________________________ Date: 5/5/2007

Please email a copy of the completed form to Patricia Arnold, patricia@eecs.wsu.edu and deliver a signed hardcopy to her mailbox.