Course Number: EE 331  
Course Title: Electromagnetic Fields and Waves  
Semester Offered: Spring 09  
Instructor: Patrick D. Pedrow  
10th Day Enrollment: 31  
Number Completing Successfully (C grade or better): 25

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 life long 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 electromagnetics.  
2. Transmission lines.  
3. Vector analysis.  
4. Electrostatics.  
5. Magnetostatics.
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</th>
</tr>
</thead>
<tbody>
<tr>
<td>(A) Ability to apply knowledge of mathematics, science, and engineering.</td>
<td>1-5</td>
<td>Exams #1-#3 Final Exam Homework #1-#9 Project</td>
</tr>
<tr>
<td>(E) Ability to identify, formulate, and solve engineering problems.</td>
<td>1-5</td>
<td>Exams #1-#3 Final Exam Homework #1-#9 Project</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
(E) Ability to identify, formulate, and solve engineering problems

The three exams given during the semester, the final exam, the nine homework assignments, and the project all served as measures of outcomes (A) and (E). Exams 1, 2 and 3 had mean values of 93, 84 and 86%, respectively. The average for the comprehensive final exam was 84%. The relatively large Exam 1 mean score of 93% showed that this group of students was quite strong and the other exams were made more challenging.

The average homework score was 69%. One student ignored most homework sets and was still able to finish with a course grade of B-. Homework problems were a mix of those from the textbook and those made up by the instructor. Very complete homework keys were posted after homework sets were collected. Some students tended to put in minimal effort on homework and relied heavily on the instructor’s key to prepare for exams.

A basic competency test (BCT) was administered three times before all students passed. For the first offering of this test 12/27 of the students passed which implied that they took it seriously and took advantage of the TA’s study session. This test requires students to review (or learn!) the basic math skills covered from middle school through the first two years of college. In addition, the ability to convert to and from phasor form is tested. The test is comprised of twenty questions, and students must answer all twenty questions correctly to pass. If they do not pass by the sixth week, they must withdraw from the course. The BCT is not included in the course grade. Students don’t like the stress of having to pass the BCT, but they are usually glad they were forced to review. Not only does it help them with the material in EE 331, but it helps them in other core courses as well. Students who missed one question were given an opportunity to take an oral exam based just on the concept they missed.

Students completed a project based on the gas insulated substation coaxial cable shown in Figure 1. Students studied the electrostatic field quantities in this high voltage cable using freeware
available on the web. This project made a connection between theory and engineering practice. All students completed the project and the average score was 92%.

Figure 1. Gas insulated substation coaxial cable modeled with Maxwell SV freeware available to students on the web. This was the electrostatics project completed by these EE331 students. Comparisons were made to equations derived for the spherical and cylindrical capacitors.
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.

Of the original 31 students enrolled in the course, 27 took the final exam. One of the 27 received a D and one received a C- in the course and, thus, they were both forced to repeat the course. The D student received a 74% on the final and the C- student received a 68% on the final. Both of these students were weakest on Exam 2 which covered electrostatics. The 25 students who passed the course also passed the BCT as required.

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.

These students perform better on transmission lines rather than electrostatics or magnetostatics probably because they relate to circuit concepts more closely than to field concepts at this stage of their learning. The electrostatics project was inserted to make them more comfortable with visualizing fields and potentials. Based on the high scores for the project the use of software appeared to have resonated with this set of students. I suggest that other teachers of EE331 consider inserting a software-based project into the course. Ansoft Maxwell SV is readily available on the web as a free download and students were very skilled at getting the software to run on their laptop computers.

Signature _____Patrick Pedrow_________________ Date: ____12/22/09______________

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