Washington State University
School of EECS
Electrical Engineering Course Assessment Report

Course Number  EE 331
Course Title    Electromagnetic Fields and Waves
Semester Offered Spring 2006
Instructor      John B. Schneider
10th Day Enrollment 31  Number Completing Successfully (C grade or better) 20

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.

| Outcome                                      | Topics                                      | Specific Measures (Samples should be available in the |
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.
and (E) Ability to identify, formulate, and solve engineering problems.

All the test and homework assignments essentially served as a measure of outcomes (A) and (E). Note that topic 6 was not covered as there was not adequate time for it. This was in part a function of the instructor having to leave town for one week in the middle of the semester owing to a family emergency and was also a function of the weak mathematical skill many of the students possess (this is discussed more in the sections below).

Students were allowed to collaborate on the homework, which was not a significant part of the grade, and hence homework should not generally be considered a reliable metric for assessing individual student understanding of the material. (The homework average, including those students who ultimately failed the course and had very poor homework scores, was 76.8.) I consider test scores a more meaningful metric and these are discussed in the following section.
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.

This course had a rather high attrition rate and the students who did pass showed that they understood the concepts being discussed. The weak mathematical skills of some of the students often translated to poor homework or test scores even though the students would profess that they understood that material. This argument only went so far, and ultimately the students had to convey some mastery of the material on the test and the assessment material collected for the course demonstrates that this is the case. Essentially all the tests and homework served as an assessment of ABET (a) and (e). Additionally, the basic competency test (BCT) had to be passed with a perfect score (this served to “weed out” a few of the students whose mathematical skills were clearly so poor as to make their assimilation of the material virtually impossible).

Test scores, including those students who subsequently failed the course, were T1=73.1, T2=70.8, T3=53.2, Final=78.5 (out of 143). The final had, as part of the exam, a somewhat standardized true-false, fill-in the blank, multiple-choice portion with 50 questions (for 50 points). The average on this was 31.6 which is in line with performance of the students in previous years. The rest of the exam was worth 93 points and consisted of questions similar to those asked on the previous exams (i.e., where the student must provided the answer to a word problem). The average was 46.9 out of 93 points (50.4 percent). Clearly these averages are lower than one would like, but if one removes the students who did not pass the course, the grades are a bit more reasonable. For example, for the third exam, the students who did not pass the course had an average of 25.8. Removing them from the average tally, one obtains an average of 61.8. Again, this is lower than one would like but, as the instructor is not a fan of partial credit on the exams and there are not many questions on the exam due to the length of the question, the student could get tripped up on one questions and botch some calculations on another and be down in the 60's. The test scores tend to indicate that the students can more easily master the material on transmission lines than they can the material on electro- and magneto-statics. This is not surprising as the mathematics accompanying transmission lines is much less advanced.

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.

Generally the students demonstrated disconcertingly weak mathematical skills. Because of this, more class time was spent ensuring that the math did not obscure the underlying concepts. Even for students who are sufficiently well versed in math, this course can sometimes seem abstract. For students with poor math skills, translating the math into a phycially meaningful conceptual framework is nearly impossible.

The basic competency test (BCT) which is administered outside of the normal class grading system, but which the students must pass, helps remind the students of the importance of math within the curriculum. It also forces the students to review and practice some of the math skills on which they are currently weak. However, it seems the BCT does not go quite far enough in
that it only tests the most basic concepts.

The textbook by Ulaby was, in my opinion, very weak. The transmission-line first approach was very ad hoc. Some of the concerns I have already expressed to the next EE 331 instructor are:

- Notation is not odd. For example use of $R'$ in situations where sources are present is inconsistent.

- Definition of resistance makes little sense (pg. 159).

- Students are not prepared to solve problem 4.58 (and the solutions manual is incorrect for this problem).

- For magnetostatics the $\hat{R}$ that appears in (5.22) is not what it usually is.

- Using degrees in the exponent of a function is mathematically offensive.

- Most of the material one spends time introducing in Chap. 1 are not relevant to Chap. 2. So, the students forget about this material and then it has to be covered again/reviewed after transmission lines.

Unfortunately, as many weaknesses as there are in Ulaby, I have not yet encountered a transmission-line-first text which I consider satisfying.

Signature _____________________________ Date: _____________________________

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