Washington State University
School of EECS
Electrical Engineering Course Assessment Report

Course Number        EE 351
Course Title        Distributed Parameter Systems
Semester Offered   Fall 2006
Instructor         John B. Schneider
10th Day Enrollment: 18 Number Completing Successfully (C grade or better) 13

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. Maxwell’s equations and the wave equation.
2. Plane wave propagation, transmission, and reflection, polarization.
3. Waveguides, fiber optics, resonators.
4. Antennas, antenna arrays.
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>all</td>
<td>Test 1, Test 2, Test 3, Test 5, HW 1-12</td>
</tr>
<tr>
<td>(C) Ability to design a system, component, or process to meet desired needs.</td>
<td>3, 4, 5</td>
<td>Test 2, Test 3, Test 4, HW 7-12</td>
</tr>
<tr>
<td>(K) Ability to use techniques, skills and modern engineering tools necessary for engineering practices.</td>
<td>5</td>
<td>Test 4, HW 12</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.

Mathematics, science, and engineering permeate nearly all topics in EE351. All topics listed in the table are especially pertinent with respect to the students’ ability to apply knowledge of mathematics, science, and engineering. Students studied Maxwell’s equations and solutions of the wave equations under different boundary conditions. The class also studied engineering devices closely related to these science topics including waveguides and antennas, both important to optical and wireless communication.

Test 1 measured student performance on Topics 1 and 2. The average score of all students who took this test was 77.5 which is rather high. When we remove the scores of the five students who did not pass the course, the average was 84.2. This high score clearly indicates the students met this objective in terms of wave fundamentals.

Test 2 measured performance on Topic 3. The average on this test was 81.1 and was 86.4 when the scores of students who did not pass the course are removed. This is again high but it must be noted that in this offering of the course we did not cover fiber optics. The students only considered rectangular waveguides and resonators which are much simpler than fiber optic cables. Fiber optic cables were dropped in order to spend more time at the beginning of the semester reviewing electromagnetic theory (for reasons stated in the S'05 EE 331 assessment).

Test 3 measured performance on Topic 4. The average on this test was 47.8 for all students and 54.2 for the students who passed the course. This is a very low score! A significant factor in this low score is that the last lecture on this material was given November 17th, before the Thanksgiving break, but Test 3 was not given until December...
This late date was at the unanimous request of the class owing to the fact that nearly all the students had a significant test in other subjects for each of the days in the week following Thanksgiving break. The students felt they would have more time to study if the exam in 351 were postponed. However, in hindsight, this was a mistake. The lack of homework or lectures on this material between November 17th and December 4th clearly hurt the students. The test was somewhat challenging even if the students were “fresh” with the material in that the questions were not clearly variations of what had been assigned as homework. It should also be noted that the students were allowed to drop their lowest homework score. It appears that most students failed to submit one of the three homeworks associated with this topic, probably realizing that they could afford to drop one score and concentrate their time on other courses at this point in the semester. Hence, unfortunately, it is not clear that the students who completed the course with a C or better truly understood this particular material.

Test 4 measured the performance on the Topic 5. The average of all students was 69.2 and for the students passing the course it was 74.4. This score was satisfactory for this material and demonstrates a relatively good understanding of the material. In this offering of the course we only covered the method of moments applied to electrostatics. Matlab was used for coding a solution for the homework, but the test was merely “pencil and paper.”

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

During the study of waveguides, as part of home work assignments and exams, students designed waveguides to meet desired cutoff frequencies. Students determined the appropriate dimensions of the waveguide and whether the waveguide supports TE or TM modes. For the material on antennas, the students had to determine phase difference in driving currents in order to obtain maximum radiation in a particular direction. The students clearly demonstrated mastery over the material related to rectangular waveguides, but their understanding of antenna design is open to question as noted above.

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

The topic of numerical methods required students to write code using Matlab which is a tool widely used in practice. Students receiving a C or better in the course showed good performance on the homework problems related to this subject.

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.

Overall, the test scores support the hypothesis that students completing EE351 with C or better are suitably equipped to 1) apply knowledge of mathematics, science and engineering; 2) design a system, component, or process to meet desired needs; and 3) use techniques, skills and modern engineering tools necessary for engineering practices. The students’ performance on Test 3 was somewhat worrisome, but there were mitigating circumstances. Given their performance on the
other exams, it is fair to assume the low score on the third exam was indicative more of these mitigating circumstances than of the students' failure to learn this material.

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.

As stated in the previous assessment, many students in EE351 had marginal knowledge of Matlab but there was no significant class time which could be devoted to this software. However, the department is trying to rectify this by requiring a course in the program of studies which will ensure the students have the necessary Matlab skills. Thus is is hoped that this concern will, in the coming semesters, no longer be a concern. In general the students demonstrated weak mathematical skills (e.g., with calculus in general and with vector calculus in particular). This weakness was not so bad as to preclude their learning of the material, but it did require that more time be spent on subjects that were somewhat outside of the core material with which the class is concerned. Teaching evaluations for this course have not been returned yet.

Signature __________________________________________ Date: __________
Please email a copy of the completed form to Patricia Arnold, patricia@eeecs.wsu.edu and deliver a signed hardcopy to her mailbox.