Washington State University  
School of EECS  
Electrical Engineering Course Assessment Report  

Course Number  EE 351  
Course Title  Distributed Parameter Systems  
Semester Offered  Fall 2007  
Instructor  Mohamed Osman  
10th Day Enrollment: 24  Number Completing Successfully (C grade or better) 22  

I. Assessment Outcomes from the Course Syllabus  

- ☑ (A) Ability to apply knowledge of mathematics, science and engineering.  
- ☑ (C) Ability to design a system, component, or process to meet desired needs.  
- ☑ (E) Ability to identify, formulate, and solve engineering problems.  
- ☐ (B) Ability to design and conduct experiments as well as analyze and interpret data.  
- ☐ (D) Ability to function on multidisciplinary teams.  
- ☐ (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 wave equation.  
2. Plane wave propagation in free space and lossy media.  
3. Normal and oblique incidence of plane waves  
4. Rectangular waveguides  
5. Resonators  
6. Antennas: Dipole and 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>Exam 1, Exam 2, Exam 3</td>
</tr>
<tr>
<td>(C) Ability to design a system, component, or process to meet desired needs.</td>
<td>4,5,6,7</td>
<td>Exam 3, Antenna design and test project.</td>
</tr>
<tr>
<td>(E) Ability to identify, formulate, and solve engineering problems.</td>
<td>4,5,6,7</td>
<td>Exam 3 and homework assignments on numerical methods.</td>
</tr>
<tr>
<td>(K) Ability to use techniques, skills and modern engineering tools necessary for engineering practices.</td>
<td>7,8</td>
<td>Exam 3</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 the waveguides and antennas, both important to optical and wireless communication. Exam 1 measured student performance on Topics 1, 2, and 3. Subjects listed on the study sheet for Exam 1 that are pertinent to Outcome “A” include: Wave equation, wave propagation in waveguides, losses in waveguides, and cavity resonators. Figure 1 shows a histogram of Exam 2 scores.
The two lowest scores in Figure 1 are 52% and 53%. It is difficult to argue that these two students had acceptable ability to apply knowledge of mathematics, science, and engineering. This exam exposed a weakness in their ability to solve wave equation, the use of phasor notation and the concept of cut off frequency. These concepts were repeatedly emphasized during the course. Two students dropped out of the class. From the Exam 2 results, all students completing EE321 with C or better grade appear to have suitable ability to apply knowledge of mathematics, science, and engineering.

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

During the study of waveguides and antennas, 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. They also determined the parameters and radiation pattern for dipole and array antennas. A project was also assigned to students to design and build an antenna operating either at 2.4 or 4.8 GHz. The students used the web as a resource for building their antennas. They also read about other types of antennas that were not covered in class. The antenna performance was examined by measuring the reflection coefficient using a network analyzer. The understanding of these concepts was measured by their performance in homework assignments, antenna design and test project and exam 3. Exam 3 scores revealed a weakness in understanding and using of the spherical coordinate system which is used extensively in examining dipole and array antennas. Three students scored below 55%. However, the antenna built by one of these students had the best performance in terms of the targeted design frequency.
This assessment report interprets “engineering problems” as those related to engineering devices or systems. Typical engineering devices analyzed in this course are waveguides and antennas which can easily represent communications channels and systems. Engineering devices are spread throughout EE351; however, Exam 3 and the project focused on antennas. Thus Exam 3 covers essential topics related to antennas. It appears logical to claim that a student passing Exam 3 has shown an ability to identify, formulate, and solve engineering problems. Figure 3 shows a histogram of Exam 3 scores.

Some of the homework problems on numerical methods required students to use the modern software package MATLAB. Similarly, testing of the antennas built in the design project required the use of these network analyzers to evaluate the reflection coefficient. The reflection coefficient concepts were covered in EE331 and the measurements had the effect of relating material covered in class to engineering practice.

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.

Exam scores have supported 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; 3) identify, formulate, and solve engineering problems; 4) use techniques, skills and modern engineering tools necessary for engineering practices.
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.

1. Many students starting EE351 had marginal knowledge of Numerical methods and MATLAB. Programming classes should do a more thorough job of integrating MATLAB and programming languages into the EECS curriculum.

2. The addition of a project component to EE351 involving building an antenna was well received by students. It also provided a venue for demonstrating the practical aspects of the material covered in EE351 on antennas and waveguides and in EE331 on transmission lines and reflection coefficient. For example, students achieved the target frequency in their antennas using some of the equations discussed in class and adjusting the corresponding parameters in their antennas. Many students suggested assigning the project at the beginning of the semester rather than in early November.

3. Weakness in Math remains an issue among students.

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.