ELCT 521 - Introduction to Microwaves

CREDITS/CONTACT HOURS: Credits: 3, Contact Hours: 42

COORDINATOR: Dr. Paul Huray

TEXTBOOKS AND OTHER REQUIRED MATERIAL:
Reading materials posted on the class web site.

CATALOG DATA:
(Prerequisite: •: ELCT 361 or PHYS 504 or equivalent). Three hour lecture. Introduction to plane electromagnetic wave propagation, transmission lines, transmission line equations, input impedance, waveguides and cavities, antennas and antenna arrays, microwave modeling. Restricted to graduate students and senior undergraduate students.

REQUIRED/ELECTIVE:
Elective

TOPICS COVERED:
- Intent of the book (review of introductory course concepts)
- Text chapters on:
  - Plane electromagnetic waves,
  - Plane waves in compound media,
  - Transmission lines and waveguides,
  - Ideal models vs. real-world systems,
  - Complex permittivity of propagating media,
  - Surface roughness.
  - Signal integrity simulations.

COURSE OUTCOMES:
1. Use the Lorenz gauge to express Maxwell’s equations in terms of scalar electric potential and electric charge density in the time and frequency domain (a).
2. Use Green’s theorems to find retarded potential solutions to Helmholtz equations for potentials and fields that satisfy causality (a).
3. Find time dependent solutions for electric potential and current in the RLGC transmission line approximation (a).
4. Express harmonic and pulse electromagnetic wave propagation along a finite transmission lines for various input and load impedances (a).
5. Deduce the effects of Doppler shifts in electromagnetic waves due to relative motions between generating sources and observers (a).
6. Find the magnitude and relative phase for electromagnetic field propagation between normal and oblique angle interfaces of conducting and dielectric materials (a).
7. Express the propagation of electromagnetic fields in terms of surface impedance between conductor and dielectric interfaces (a).
8. Define the real and imaginary parts of electric permittivity of materials in terms of their temperature, conductivity, and permanent / induced dipole moments (a).
9. Use Kramers-Kronig relations to express causal solutions between the real and imaginary parts of electric permittivity (a).
10. Explain how rough surfaces between conductors and dielectric materials influence power losses in transmission lines (a).

Relation of course outcomes to program outcomes

H = major importance, M = moderate importance, L = minor importance, blank indicates no relation

<table>
<thead>
<tr>
<th>Program Outcomes</th>
<th>Course Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>an ability to apply knowledge of math, science and eng. (a)</td>
<td>H H H H H H H H H</td>
</tr>
</tbody>
</table>

ASSESSMENT METHODS:

1. Homework and projects will be a factor in this course and will demonstrate the student’s ability to solve problems or to give creative explanations to open-ended topics.
2. Homework will be presented in a Word document, professionally written with drawings and equations, and textual explanations of each step. A statement of the problem will be expected at the top of the page, followed by the solution.
3. Graduate students will be expected to prepare an additional project in homework format.
4. The midterm exam will occur in two parts. Part #1 will concentrate on the first 4 ABET objectives and part #2 will concentrate on the next two ABET objectives.
5. The final exam will be on the material presented since the midterm exam but some knowledge is cumulative.
6. For exams students may bring three 3”x5” note cards with handwritten material (on both sides), a simple calculator, and pencils or pens; wireless devices or texts may not be used.
7. Grading Percentages: (Homework / project) 20%, (Midterm exam part #1) 20%,
   (Midterm exam part #2) 20%, (Final exam) 40%.
8. Grading Scheme: A=above 80%, B=65-80%, C=50-65%, D=40-50%, F=below 40%