EECE 682: Time-Harmonic Electromagnetic Fields

**Catalogue description**

**Number of Credits:** 3 Credits

**Prerequisite**
**By Courses:** EECE 380: Engineering Electromagnetic
**By topics:** Basic EM analysis, plane waves, transmission lines, and waveguides

**Textbook**

**References**

**Course Objective**
1. Students will learn how to construct two and three dimensional Green's functions.
2. Students will learn to apply scalar Green's functions in higher dimensions to solve potentials (and field) for electromagnetic problems with arbitrary source excitation.
3. Students will learn to formulate integral equations in terms of appropriate Green's functions to solve more general guided wave discontinuity, radiation and scattering problems.

**Course Topics**
1. Fundamental concepts
2. Introduction to waves: Wave equations, waves in perfect dielectric, intrinsic wave constants, waves in lossy matter, reflection of waves, transmission lines concepts, waveguide concepts, resonator concepts, and antenna concepts.

3. Theorems and concepts: Source concept, duality, uniqueness, image theory, the equivalence principle, fields in half space, reciprocity, Green’s functions, integral equations, and radiation fields.

4. Plane wave functions: Wave functions, rectangular waveguide, mode sets, rectangular cavity, partially filled waveguide, modal expansion of fields, and currents in waveguide.

5. Cylindrical waveguide: Wave functions, circular waveguides, radial waveguides, circular cavity, other guided waves, apertures in circular guides.

Course Outcomes
1. Students are familiar with the vector analysis concepts.
2. Students are familiar with the fundamental concepts of Maxwell’s equations in differential and integral forms.
3. Students are able to use Maxwell’s equations for the derivation of Wave equations in different electromagnetic media.
4. Students are able to tackle problems involving scattering and radiation.
5. Students show good understanding of the TE, TM, and TEM notations.
6. Students are knowledgeable in determining the far field due to magnetic and electric source elements.
7. Students are familiar with the concept of duality.
8. Students are able to use the equivalent principle in aperture problems.
9. Students are able to determine the EM fields in half-spaces.
10. Students show good understanding of the rectangular waveguide problem.
11. Students show good understanding of the dielectric-filled rectangular cavity problem.
12. Students show good understanding of the partially dielectric-filled rectangular waveguide problem.
13. Students show good understanding of the cylindrical waveguide problem.
14. Students show good understanding of the dielectric-filled cylindrical cavity problem.
15. Students show good understanding of the partially dielectric-filled cylindrical waveguide problem.

Class/Laboratory schedule
Two 75-minute lectures per week

Resources of the course
Textbook, references, selected papers
Assessment
Problem sets
Midterm
Project
Final exam.

Computer usage:
Matlab and other software packages like HFSS

Professional component
Engineering topics: 80%
Mathematics: 20%
General education: 0%

Person(s) who prepared this description and date of preparation
Karim Kabalan, January 2013