ECE 836: Electromagnetics Fields and Waves: Part II
Spring 2014;

Instructor: Prof. Shanker Balasubramaniam
email: bshanker@msu.edu
Office Hours: 2214EB by appointment;
Recommended Text: Time Harmonic Fields, R. F. Harrington
Suggested Books:

1. J. Stratton, Electromagnetic Theory, McGrawHill.
2. A. Ishimaru, Electromagnetic wave propagation and scattering, Prentice-Hall.
3. J. A. Kong, Electromagnetic Wave Theory, John Wiley and Sons.
4. J. D. Jackson, Classical Electrodynamics, John Wiley and Sons.
5. C. A. Balanis, Advanced Engineering Electromagnetics, John Wiley and Sons.

Class Policies

1. **Homework** Approximately 7-8 homework assignments will be given. Some of these will involve programming in matlab and possibly, proofs.
2. **Grade Distribution**
   - Homework: 15%
   - Exam (2): 75% (mid term 35% and final 40%)
   - Final Oral: 10%

The goal of this course is to cover Chapters 5, 6, 8 and as much of 7 as time permits of Harrington's Time Harmonic Fields. For those who have not taken the 835 component of this course, I suggest getting hold of the notes for 835.
Tentative Course Outline:

1. Brief recapitulation of ECE 835 ($\approx$ 1 class)
2. Cylindrical wave functions
   (a) The wave functions
   (b) Orthogonality relationships
   (c) The circular waveguide
   (d) Radial waveguides
   (e) The circular cavity
   (f) Other waveguides
   (g) Sources of cylindrical waves
   (h) Two dimensional radiation
   (i) Wave transformations
   (j) Addition theorem

(k) Scattering by cylinders
(l) Scattering by wedges
(m) Three dimensional radiation
(n) Apertures in cylinders
(o) Apertures in wedges

3. Spherical wave functions

(a) The wave function
(b) The spherical cavity
(c) Orthogonality relationships
(d) Space as a waveguide
(e) Other radial waveguides
(f) Other resonators
(g) Sources of spherical waves
(h) Wave transformations
(i) Addition theorems
(j) Scattering by spheres
(k) Dipole and conducting sphere
(l) Apertures in spheres
(m) Fields external to cones
(n) Maximum antenna gain

4. Microwave networks

(a) Cylindrical waveguides
(b) Modal expansions in waveguides
(c) The network concept
(d) One-port networks
(e) Two-port networks
(f) Obstacles in waveguides
(g) Posts in waveguides
(h) Small obstacles in waveguides
(i) Diaphragms in waveguides
(j) Waveguide junctions
(k) Waveguide feeds
(l) Excitation of apertures
(m) Modal expansion of cavities
(n) Probes in cavities

(o) Aperture coupling to cavities

5. Perturbational and Variational Techniques

(a) Introduction
(b) Perturbation of cavity walls
(c) Cavity material perturbations
(d) Waveguide perturbations
(e) Stationary formulas for cavities
(f) The Ritz procedure
(g) The reaction concept
(h) Stationary formulas for waveguides
(i) Stationary formulas for scattering
(j) Scattering by dielectric obstacles
(k) Transmission through apertures