ECE362 Electromagnetic Fields II (3 credits, 3 contact hours)

Instructor: Gerald M. Whitman, Ph.D.
email: whitman@njit.edu; **phone**: 1-973- 596 -3232; **office**: MIC405 inside MIC403

Textbooks: [DC] D. C. Cheng, *Fields and Wave Electromagnetics*, 2nd ed., Addison-Wesley, 1989. ISBN 0- 210-12819-5.
[SC] J. Edminister and M. Nahv-Dekhordi, *Electromagnetics*, 3rd ed., Schaum's Outlines, McGraw-Hill, 2010. ISBN 978-0-07-163235-5.
M.Spiegel and J. liu, *Mathematical Handbook of Formulas and Tables, 2nd ed.*., Schaum's Outlines, McGraw-Hill, 1999. ISBN 0-07-038203-4. (or equivalent)

Reference Textbooks
M. Sadiku, *Elements of Electromagnetics, 6th ed.,* Oxford University Press, 2015.
S. Marshall, R. DuBroff, G. Skitek, *Electromagnetic Concepts and Applications*, 4th ed. , Prentice Hall, 1996.

Course Description: Maxwell's equations solutions, reflection and refraction pf plane waves in dielectric and conducting media; transmission lines, transient and frequency domain solutions in lossy and lossless lines, Smith Chart and its applications; parallel plate and rectangular waveguides.

Prerequisites: ECE361; Co-requisites: none

Specific Course Learning Outcomes (CLO):

The student will be able to:

1. understand the mathematics of vector analysis and vector calculus.
2. understand the fundamental laws of electrostatics, such as, Coulomb's Law and Gauss's Law.
3. understand the fundamental definitions of capacitance, resistance and inductance.
4. understand how to solve electrostatics problems using Poison and Laplace equations.
5. understand the fundamental electromagnetic fields description of Ohm's Law, KVL, KCL and Joule's Law.
6. understand the fundamental laws of static magnetic fields, which include the Biot-Savart Law and Ampere's Circuital Law.

Relevant Student Outcomes:

(1) an ability to apply knowledge of mathematics, science and engineering (CLO1-5)
(2) an ability to apply engineering design to produce solutions that meet specific needs with consideration of public health, safety and welfare, as well as global, cultural, social, environmental factors (CLO 1-5)
(7) an ability to acquire and apply new knowledge as needed, using appropriate learning strategies (CLO 1-5)

Course Outline: ECE362 Electromagnetic Fields II

Week	Chapter/ Pages	Topics*	Problems**
1,2	Ch.7/pp.307-310, 314-347	Faraday's Law, Maxwell's Eqs, Boundary Conditions, Wave Eq. Time Harmonic Fields	7-2, 4a, 7, 23, 24(but do not write the general solutions), 25, 27, 30
3,4	Ch.8/pp.354-373	Plane Waves in Lossless & Lossy Media, Polarization	8-1 (in the time domain), 2,4, 5 (for 5a only find k_0), 6, 10a (make a **chart**), S1

For (8-6) assume permeability of air (non-magnetic means $\mu = \mu_0$. Do 8-6 c if we have discussed polarization.

For (10a), calculate $\sigma / (\omega\varepsilon)$ and show that all metals are good.conductors.

S1 is special HW problem #1.

	Ch.8/pp.375-379	Group Velocity, Dispersion,	8-11,12 (use formulas in (8-9) but explain when they can be used),20(a,b)
	Ch.8/pp. 379-386	Poynting Vector	8-16,17 (find also the time- average Poynting vector), 20c
			For 8-16 and 8-17 assume uniform plane wave.
5,6	Ch.8/pp. 379-390	Normal Incidence at a Plane PEC Normal Incidence at Plane Dielectric Boundaries	8-21,27,28
	Ch.8/pp. 390-397 Ch.8/pp. 397-401	Oblique Incidence at a Plane PEC	8-22, 23, 24
	Ch.8/pp. 406-419	Oblique Incidence at Plane Dielectric Boundaries	S2, 8-37, 40, 43

S2 is special HW problem #2.

Examination I

6-8	Ch.9/pp.437-441	Transmission Line (TL) Equations	9-5
	Ch.9/pp.441-444	Lossless TL, Low-loss TL and Distortionless TL	9-8
	Ch.9/pp.449-471	Waves on Terminated Lines	9- 9,11,12,14,15 ($Z_L=Z_0$), 18, 27, 30, 31

For 9-9, prove that TL is distortionless(i.e., that $R/L = G/C$) and then use formulas on page 442.
For 9-15, use in your solution the coordinate distance s from the load; do not use the coordinate distance z from the input.
In 9-14 assume $Z_L=R_L$.
In 9-30, do not use 9-153(a) and (b) other than tocheck your result; assume $\beta l=90^0$ with β known.
In 9-31(d), find the reflection coefficient of the load

9	Ch.9/pp.471-485	Transients on lossless TL	9-36, 38
		In 9-36 and 9-38, use time scale with divisions 0, T, 2T, … where T=l/c, u=c for air dielectric.	
		In 9-38, replace R_0 by R in 2nd sentence and in Fig.9-46, add terminal resistor R after the switch.	
10	Ch.9/pp. 485-497	Smith Chart	9-43, 45,
		In 9-43(b), find the reflection coefficient of the load.	
11	Ch.9/pp.497-505	Impedance Matching	9-48, 49

Examination II

12	Ch.10/pp. 520-534	Waveguides***	10-1, 2
13	Ch.10/pp. 534-543	Parallel Plate Waveguides***	10-3,5,7,11
		In 10-11, the Dielectric Strength of air is $\lvert \boldsymbol{E}_{MAX} \rvert = 3 \cdot 10^6$ *(V/m) at room temperature and one atmosphere of pressure [P. Rizzi]*	
14	Ch.10/pp. 547-555	Rectangular Waveguides**	10-14,16,17

Grade Breakdown: Two class examinations: 50%
Final examination: 45%
Quizzes, homework and class participation: 5%
Less than 50% HW submission will result in a drop of one letter grade in final grade.

* Changes in the syllabus are possible. Students will be informed of these changes in class announcements.
**Addition homework problems may be added to HW assignments.
******* Only if there is time.

Course Standards
Attendance: required at class lectures and problem solving sessions
Lateness to class: unacceptable
Cellular phones and Beepers: Shut off or in quiet mode

NJIT Honor Code:
NJIT Honor Code will be upheld, and any violations will be brought to the immediate attention of the Dean of Students.

Formula sheets: 2 sides of 8.5"x11"page for Examination I, 4 for Examination II, 6 for Final.
In own handwriting, no derivations, no worked out examples, no calculations, no illustrative examples
Permitted: definitions, units, formulas, geometry that define parameters in formulas; equivalent circuits.
Allowed: Mathematical handbook of formulas, such as the one published by Schaums.

Homework Policy:
HW problems will be assigned, checked and accepted only when due. On the first page of your submitted HW solutions (using 8.5"x11" paper) on the first line, print your last name, your first name and your roster number. Under your name, state if you did your HW alone, worked with a group (give last names of your group members), had help from another instructor, or used the solutions manual or copies of the solutions to the HW (and how you obtained these solutions). Under this HW statement, sign your name; HW submitted without a statement will not be not be graded. List assigned HW problems in the upper right hand corner of the first page and start each new problem on a new page and use only one side of a page for your work. Students are expected to solve all assigned problems. Solutions will be provided and discussed in class. The text contains numerous examples. Students are encouraged to study these examples for practice.

Missing Examinations Policy: Check finals week schedule and do not make any plans to be away for the final examination dates. You will receive an automatic failure for missing the final examination unless for hospitalization or death in immediate family; documentation in required. No make-up class examinations and no excuse is acceptable for missing class examinations unless hospitalization or death in the immediate family; documentation is required.

Contact information: whitman@njit.edu, Telephone: 973-596-3232

Office hours: To be announced