Friendly Introductions And Maxwell's Equations:

Integral Form, Differential "Point" Form

Jonathan B. Snively

Embry-Riddle Aeronautical University

About the Course:

First, some logistics:

Our syllabus and textbook(s).

ENGINEERING ELECTROMAGNETICS
EP440, FALL 2014

ERAU Daytona Beach Campus
M W F, 2:15-3:15
Room: CoAS 501

Instructor: Jonathan B. Snively
Email/Web: snivelyj@erau.edu
http://webfac.db.erau.edu/~snivelyj/ep440/
Phone: (386) 226-6306
Office: 319.05 (CoAS Building)
Office Hours: MWF 3:30-5:00 (or by Appt.)

Textbook: D. K. Cheng, Field and Wave Electromagnetics, 2nd Edition, Chapters 1-8, 9?, 10?
Prerequisites: CS223, MA442 (Co-Req.), PS250, PS303, and PS320.
Blackboard will only be used for mass emails and the posting of textbook solutions –
The most important course materials will instead be posted on the course website!

Homework assignments will be posted on the website and announced in class. Feel free to work on homework problems in groups or individually. Show all details of solutions (in legible form), and please cite all sources used and list any collaborators. Assignments should be submitted to the grader's mailbox by 5:00PM on the days they are due. *Late assignments will be graded at 70% credit if submitted before the next exam.*

All **Exams** are closed book and closed notes. Calculators are neither required nor allowed. The **Final Exam** will be comprehensive, and is tentatively scheduled for 12:30-2:30 PM on Saturday, December 6th.

Weighting:

Homework	15%
Exam #1 (9/17)	20%
Exam #2 (10/15)	20%
Exam #3 (11/14)	20%
Final Exam (12/6)	25%
	Total = 100%

Probable Grading Scale:

A	90 ≤ your grade
B	75 ≤ your grade < 90%
C	60 ≤ your grade < 75%
D	50 ≤ your grade < 60%
F	your grade < 50%

Required Textbook:

Note: Get a used Hardcopy (with two-color printing!)

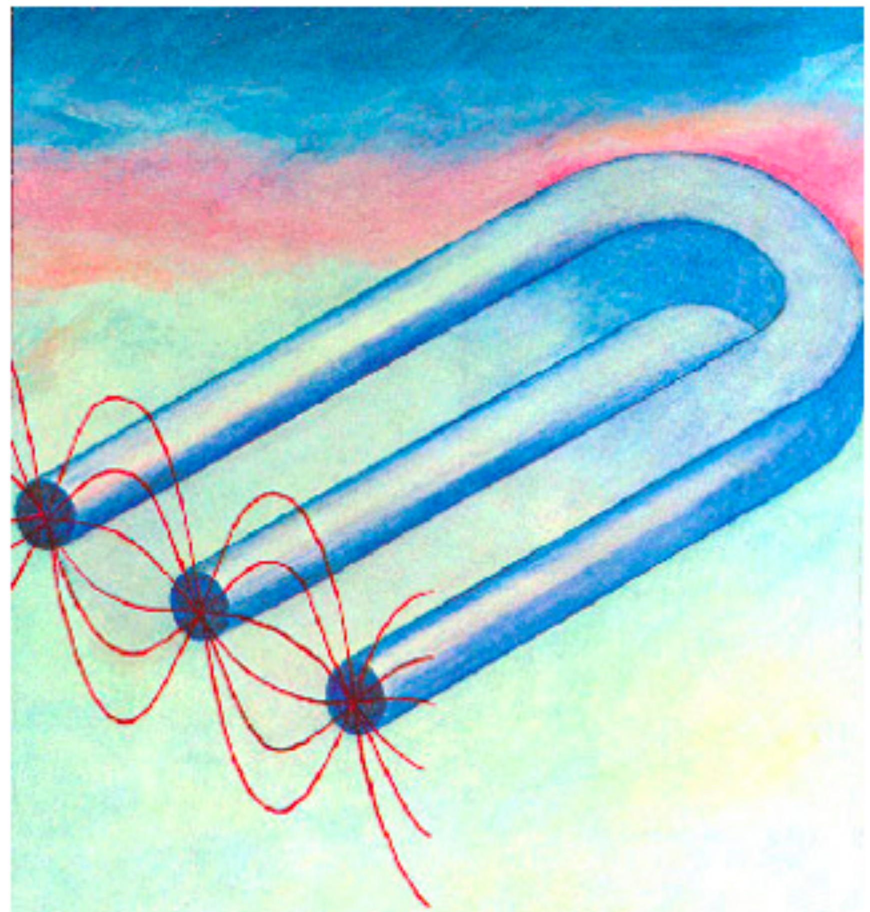
Electromagnetic Field Theory: A Problem Solving Approach

RESOURCE HOME

ABOUT THIS BOOK

TEXTBOOK CONTENTS

DOWNLOAD RESOURCE MATERIALS



Whimsical optical illusion drawing of a non-physical 3 pole magnet with electromagnetic wave sinusoids connecting magnet poles representing the study of electromagnetic fields and applications in this course. (Image by Prof. Markus Zahn. Used with permision)

Instructor(s)
Prof. Markus Zahn

CITE THIS COURSE

Free on MIT OCW!

Familiar Field Variables:

$\vec{E}$ Electric Field Intensity (V/m)

$\vec{B}$ Magnetic Flux Density (T)

V Scalar Electric Potential Field (V)

Constants of Interest:

$$e = 1.60 \times 10^{-19}\ [\mathrm{C}]$$

$$\epsilon_o = 8.854 \times 10^{-12}\ [\mathrm{Fm}^{-1}]$$

$$\mu_o = 4\pi \times 10^{-7}\ [\mathrm{Hm}^{-1}]$$

$$c_o = \frac{1}{\sqrt{\mu_o \epsilon_o}} = 299792458[\mathrm{ms}^{-1}]$$

Maxwell's Equations:
Integral Form

Gauss's Law: (E Field)

$$\oint \vec{E} \cdot d\vec{s} = \frac{Q_{\mathrm{encl}}}{\epsilon_o}$$

Gauss's Law: (B Field)

$$\oint \vec{B} \cdot d\vec{s} = 0$$

Faraday's Law:

$$\oint \vec{E} \cdot d\vec{l} = -\frac{d\Phi_B}{dt}$$

Ampere's Law:

$$\oint \vec{B} \cdot d\vec{l} = \mu_o \left(i_c + \epsilon_o \frac{d\Phi_E}{dt} \right)_{\mathrm{encl}}$$

Maxwell's Equations:
Electrostatics

Gauss's Law:
(E Field)

$$\oint \vec{E} \cdot d\vec{s} = \frac{Q_{\mathrm{encl}}}{\epsilon_o}$$

Faraday's Law:

$$\oint \vec{E} \cdot d\vec{l} = 0$$

Maxwell's Equations:
Magnetostatics

Gauss's Law:
(B Field)

$$\oint \vec{B} \cdot d\vec{s} = 0$$

Ampere's Law:

$$\oint \vec{B} \cdot d\vec{l} = \mu_o i_c$$

Static Maxwell's Equations: Differential "Point" Form

Gauss's Law: (E Field)

$$\nabla \cdot \mathbf{E} = \frac{\rho}{\epsilon_o}$$

Gauss's Law: (B Field)

$$\nabla \cdot \mathbf{B} = 0$$

Faraday's Law:

$$\nabla \times \mathbf{E} = 0$$

Ampere's Law:

$$\nabla \times \mathbf{B} = \mu_o \mathbf{J}$$

Summary

Maxwell's equations compactly summarize the structure and interactions of electric and magnetic fields.

This entire course will be dedicated to the applications and solutions of Maxwell's equations.

First, Chapters 3-6 are dedicated to applications and solutions of *static* Maxwell's Equations.

For Wednesday, read Chapter 1.