ECE361 Electromagnetic Fields I **(3 credits, 3 contact hours)**

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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: This course introduces the student to the fundamentals of static electric and magnetic fields. Topics covered include: (1) electric force field due to elementary stationary charge, (2) the magnetic force field due to electric charge moving at uniform velocity, (3) electric and magnetic forces, (4) stored electric and magnetic energy, (5)potential, i.e., voltage, (6) power loss, (7) the meaning of capacitance, resistance, and inductance, (8) electrical properties and characterization of materials (conductors, insulators and magnetic materials, (9) mathematical formulation of the physical laws governing electromagnetic fields in the time-independent case, and (10) the mathematics of vector analysis: vector algebra, orthogonal coordinate systems (rectangular, cylindrical and spherical) and vector calculus.

Prerequisites: ECE231, Math213, Math222

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 and economic factors (CLO 1-5)
(7) an ability to acquire and apply new knowledge as needed, using appropriate learning strategies (CLO 1-5)

Course Outline: ECE361 Electromagnetic Fields I

Week	Chapter/ Pages	Topics	Problems
1, 2	Vector Analysis Notes by Dr.Whitman		
	[DC] Ch.2/pp.11-18, 23-36, 37-66	Vector Calculus	DC2-1,2,3,6,15,18,19; SC2.17,18,30,31,32
	[SC] Ch.2/pp.31-43;Ch.5/pp.78-96		DC2-21, 29, 36; SC5.28, 33
	For DC2-18: prove by drawing the coordinate systems and show all angles For DC2-19: prove all formulas you have to use		
3	[DC] Ch.3/pp.72-79, 82-92	Static Electric Fields	DC3-5, 8
	[SC] Ch.3/pp.44-62, Ch.4/pp.63-77	Coulomb's Law, Gauss's Law	SC3. 25, 32,36,38,48
4	[DC] Ch.3/pp.92-100	Electrostatics (continued)	DC3-12, 16 (do for ρ_L along z-axis), 19
	[SC] Ch.6/pp.97-112	Electric Potential	SC4.20, 22, 30 6.25, 26, 33 (note that $A(r=1m,\phi=0^o,z=0)$, $B(r=4m,\phi=0^o,z=0)$
5	[DC] Ch.3/pp.100-120	Conductors, Dielectrics	DC3-22, 25, 28
	[SC] Ch.7/pp.113-130	Polarization, Displacement	SC8.23, 27
6, 7	[DC] Ch.3/pp.121-126, 133-140	Capacitance, Electrostatic	DC3-30, 33, 34, 37, 40, 44
	[SC]Ch.8/pp.131-150	Energy	SC6.34; 8.32, 36
8		**Examination I**	
8	[DC] Ch.4	Poisson and Laplace Eqs.	DC4-1, 6, 23;
	[SC] Ch.9/pp.172-192		SC9.21, 31
	Add if cover Image Theory: DC 4-7		
	Add if cover more that one-dimensional solution to Laplace Eq.		DC4-21, PC4-21*
9	[DC] Ch.5/pp.198-200, 202-219	Steady Electric Currents	DC5-8, 9, 10, 14, 16
	[SC] Ch.7/pp.113-130		SC7.30, 37, 42
10, 11	[DC] Ch.6/pp.225-251 (not Sections 6-5.1,6-6.1)	Static Magnetic Fields Biot Savart Law, Ampere's Circuital Law	DC6-3, 4, 11, 12 SC10. 28, 30, 42
	[SC] Ch.10/pp.172-192	Vector Potential **A**	DC6-26, 40,S1
12,13	[DC] Ch.6/pp.262-276	Inductance	DC6-32,39
	[SC] Ch.12/pp.209-214		
13		**Examination II**	
14	[DC] Ch.6/pp.277-289	Magnetic Energy & Force	DC6-47, 50
	[SC] Ch.11/pp.193-208		SC11.25, 33, 34
15		**Final**	

*[PC] R. Plonsey and R. Collin, *Principles and Applications of Electromagnetic Fields*, McGraw-Hill,1961.

S1: Given two uniform infinite current sheets $\boldsymbol{J}_{s1} = \hat{\boldsymbol{x}} J_{s0}$, z= 0, $-\infty < x, y < \infty$ and $\boldsymbol{J}_{s2} = -\hat{\boldsymbol{x}} J_{s0}$, z=d, $-\infty < x, y < \infty$. Find $\boldsymbol{H}$ everywhere. Hint: see illustrative example in [SC3], ex.2 on p.173.

Grade Breakdown:

Two class Examinations	25, 25%
Final Examination	45%
Quizzes on homework and/or HW	5%

Attendance is required at class lectures and problem solving sessions.
Lateness to class is unacceptable.
Cellular phones and Beepers are to be shut off or in quiet mode. They are to be placed in your zippered backpack during examinations.

Formula Sheets: 2 sides of 8.5"x 11" pages for Exam I, 4 sides for Exam II, 6 sides 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.

Office Hours: to be announced.

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 and documentation is required. No make-up for class examinations and no excuse is acceptable for missing class examinations unless hospitalization or death in immediate family and documentation is required.

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

Miscellaneous:
Changes in the syllabus are possible. Students will be informed of those changes in class announcements.

Instructions:

A. Instructions for examination work:

1. Name on answer sheets: Print (Last, First), with **Roster Number**
2. Start new problem on a new sheet of paper at upper left corner
3. Work problem using only one side of a sheet of paper
4. Give units in answers

B. Instructions for allowed formulas in Formula sheet:

1. Use 8.5 inch x 11 inch sheets of paper.
2. All information on formula sheets are to be in your own handwriting.
3. Photocopy of tables are allowed, but no explanatory text is to be included.
4. Handbook of tables (such as the one by Schaum's) is allowed for integration, etc.

5. No worked out problems either theoretically or numerically, i.e., no steps in the solution of a problem are allowed on the formula sheets; you are allowed to include the results of a solved problem plus the original geometry that shows geometry and coordinates, but does not show any steps in the derivation.

C. Instructions for Proctor:

1. Take attendance
2. After distributing examination, check all formulae sheets
3. Collect: 1.All examination questions
   2. All student's work
   3. All Formula sheets (if asked to do so)
4. Count the number of exams handed in.