University of Utah
Electrical and Computer Engineering

ECE 3300: Introduction to Electromagnetics

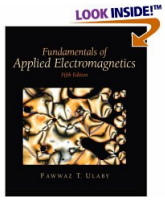
Fall 2008
MWF-9:40-10:30
WEB 2230

Professor overseeing the course: Dr. Cynthia Furse, 585-7234, cfurse@ece.utah.edu
Instructors: Sai Ananthanarayanan, saianantha21@gmail.com
James Nagel, nageljr@gmail.com

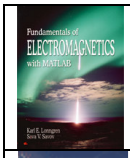
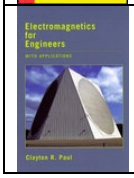
Office hours: Sai: M,W, F 11am-12:00pm MEB 1222A, or by appointment
James: T,Th 11 am-12:30 pm MEB 2420, or by appointment

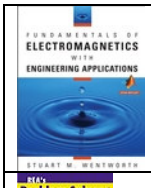
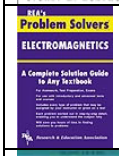
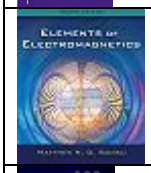
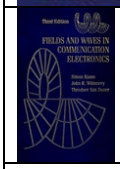
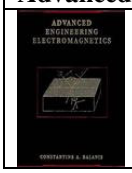
Texts :

Required

 or 	"*Fundamentals of Applied Electromagnetics*," Prentice Hall; 5th edition, **ISBN:** 0132413264

References: (Will be available in the ECE office)

	"*Fundamentals of Electromagnetics with MATLAB*," Karl E. Lonngren and Sava V. Savov, SciTech Publishing, 2005, ISBN: 1-891121-38-3
	"*Engineering Electromagnetics, 7th Edition*" William H. Hayt and John A. Buck, McGraw-Hill, 2006, ISBN 0-07-252495-2
	"*Schaum's Outline of Electromagnetics, 2nd Ed*." by Joseph Edminister, McGraw-Hill, 1994, ISBN 0-07-021234-1
	"*Electromagnetics for Engineers with Applications*", C.R. Paul., John Wiley & Sons, 2004, ISBN 0-471-27180-2

	"*Fundamentals of Electromagnetics with Engineering Applications*," Stuart M. Wentworth, John Wiley & Sons,2004, ISBN: 0-471-26355-9
	"*Electromagnetics Problem Solver*," by Research and Education Association, available from Amazon.Com, 2000, ISBN: 0878915508
	"*Elements of Electromagnetics*," by Matthew N. O. Sadiku, *Oxford University Press*, 2006, ISBN:0195300483
	"Fields and Waves in Communication Electronics, 3rd Edition," Simon Ramo, John R. Whinnery, and Theodore Van Duzer, John Wiley & Sons, 1994, ISBN: 0-471-58551-3
Advanced Texts	
	"Engineering Electromagnetics," by Constantine Balanis, John Wiley & Sons, 1989, ISBN: 0-471-62194-3

Webpage: www.ece.utah.edu/~ece3300

TA:

Prerequisites:

PHYCS 2220 and MATH 2250 and ECE 2100

Course Material: Introduction to electromagnetics. Fundamentals of wave propagation, transmission lines, impedance matching, electrostatics, magnetostatics, Maxwell's equations, plane waves in free space, lossy media, and reflections from planar interfaces, wireless communication systems. Electromagnetic safety. Applications include wireless communication systems, high speed digital circuits, electromagnetic sensors, and bioelectromagnetics.

Course Outcomes:

At the conclusion of ECE 3300 students should be able to:

1. Calculate voltages, currents, and impedances on TEM transmission lines. This will include time domain (TDR) analysis, frequency domain analysis (standing waves and Smith charts), and power analysis.
2. Calculate electric and magnetic fields from a plane wave impinging on a metallic or dielectric material from either normal or oblique incidence.
3. Design matching systems for transmission lines and plane waves.

4. Calculate the electric and magnetic fields from simple charge and current distributions.
5. Compute the link budget for a simple wireless communication system and explain how the environmental affects the received power.
6. Identify potentially hazardous electromagnetic environments.

Homework : Homework assignments will be given approximately weekly and will be posted on the class webpage. Homework will be by 5:00 p.m. on the specified date on the 3rd floor lockers of MEB near the ECE office (MEB 3280). Homework assignments turned in up to 24 hours late will be penalized 10%. Assignments turned in more than 24 hours late will not be accepted. Home work solutions will be posted after the problems are due.
Homework problems will be graded on a ten-point scale, with credit being assigned as follows:

Answer	Method	Score
right	**right**	**10**
wrong	**Right, arithmetic mistake**	**9**
-	**Close**	**8**
-	**Not close**	**5**
-	**No attempt**	**0**

Picking up Homework: Your homework, exams and labs will be returned in your student mailbox across the hall from the ECE office. Please sign a sheet allowing us to place your materials there. If you prefer NOT to have your materials left in your mailbox, Sai/James will hand it over in class. All homework, exams, labs should be returned within 1 week of when they were turned in (not counting holidays/breaks). If they are not, please complain to Sai/James.

Random Student ID #: You will be assigned a random number, which will be prominently written in RED on the first homework you turn in. Please write this number on everything you turn in. Your grades will be posted on the website according to this number. (**We think of you as much more than a number, but probably you'd rather have a secret number when it comes to grades**.)

Laboratory: This lab is part of a new curriculum development project in the ECE department. In collaboration with the ECE3500 lab, we will integrate the components of the lab into an FSK communication system for a cardiac pacemaker. It is strongly advised that you take ECE3300 and 3500 concurrently. It is not required. You should choose lab partners that you can work with through the entire semester. Do all work in your (bound) lab notebook, in ink. The lab write up will be done separately, one writeup for each student individually. You will be receiving more information (standard format, etc.) on the first week of the lab.

Lab Schedule: Labs Begin September 2nd, 2008.

Exams: Three midterms are scheduled as shown on the lecture schedule. Please check your schedule to be sure that you do not have conflicts with these exams. The final exam will be comprehensive, however it is optional (see grading):

Grading (you will automatically receive the grade for whichever is higher) :

Midterm I or Final Part 1	25%
Midterm II or Final Part 2	25%
Midterm III or Final Part 3	25%
Labs	15%
Portfolios & Homework	10%

(To do well in this class: Keep up in class, study hard, do well on your midterms, and you do not have to take the final exam. But, if you bomb a midterm, or all of them for that matter, all is not lost. You can completely erase mistakes made during the semester and make up your grade on the final.)

The Lab Grade will be based on:

101% Attendance (mandatory)

Do not miss a lab. If you are traveling, contact Sai/James in advance to determine how to make up a lab. If you have an emergency or serious illness, contact Sai/ James immediately upon your return to determine how to make up a lab. We have a very limited supply of EM lab equipment (it is extremely expensive), so there is no extra lab space.

50% Lab Notebook

50% Lab Reports

Work Load:

It is anticipated that a typical student will need to spend

3 hours in class per week
3 hours in lab for 8 weeks
6-9 hours on homework each week
2-3 hours on lab writeup each week for 8 weeks
2-3 hours on the final report
Additional time studying for exams.
17+ hours per week

PLEASE plan your schedule so that you have time to learn the material. I am delighted to have the opportunity to teach you about electromagnetics, a subject that is truly exciting and magical. I am very confident that you will find many times in your career when you will be able to apply this material, and I hope that you will not only learn from the class but enjoy it as well. ☺

Disability Accommodations: The University of Utah seeks to provide equal access to its programs, services and activities for people with disabilities. If you will need accommodations in the class, reasonable prior notice needs to be given to the Center for Disability Services, 162 Olpin Union Building, 581-5020 (V/TDD). CDS will work with you and the instructor to make arrangements for accommodations. All written information

in this course can be made available in alternative format with prior notification to the Center for Disability Services.

Cheating Policy: Just don't

Here are some things that constitute cheating in this class:

1) ***Copying someone else's work on an exam.*** If you accidentally see another student's work on an exam, WRITE a NOTE in your exam *and* tell me during the exam. Honesty is of great value. You will not be penalized for this. Do not pass any papers to anyone for any reason during the exam. Do not sit near your study partners during the exam. If you use any scratch paper for doing exam problems, please just staple it at the back of your exam. Loose scratch paper could look like notes passed between students.
2) ***Copying someone else's work on portfolio homework.*** I hope you WILL work in groups on your homework, labs, software assignments, etc. And I hope that every team member will contribute to this work. If you do not contribute (had to work late and couldn't make the group meeting), then don't copy their work.
3) ***Copying things (ANYthing) from a book, web, magazine, etc.*** Give a complete reference and clearly "quote" anything that you want to reference that someone else has done. Even if you don't use their words, but you mention or discuss their ideas, give them a reference. If you are asked to write a report or essay, it must all be in your own work. Just rearranging the words is called paraphrasing. (Paraphrasing is just rearranging the words.) Paraphrasing is also NOT your work.

What happens if you cheat?

Under UofU policy, you could receive an F in the class, be suspended from school, be fined, or be expelled from the university. So just don't cheat.

What happens if someone else cheats?

Statistically, this could lower YOUR grade. Please tell me or the TA or any other professor or TA (anonymously is fine) if you see instances of cheating in this or any other class. The ECE Department is committed to reducing instances of cheating in our labs and classes in order to provide the best possible education for all students.

Errata:

If you find a mistake in the online lecture notes, textbook, solution manual, lab handouts, etc., turn in a copy of the mistake plus your corrections. Clearly label where the mistake occurs, so I can fix it. You will receive an extra 5 homework points (each day is 10 points, so this is good for half a day's extra credit)

Tentative Schedule

Month	Day	Chapter	Lecture	Demos	Hw	Lab
Aug	25	1.1 – 1.2.2	1) Syllabus 2)Applications 3) Why do you need EM (Big Picture) 4) Course outline 5)Difference between statics and dynamics 6) Coulomb's law (and analogies)		Hw 1 posted	
	27	1.2.2 - 1.3	Review Coulomb's law Electric fields Magnetic fields (Biot Savarts law and Ampere's law) Start Traveling waves			
	29	1.3,1.5,1.6	Traveling waves (Lossy and lossless) Complex number and phasors			
Sept	1		**Labor day**			
	3	2.1-2.3	Transmission lines Lumped element model Transmission line equation (explain eq 2.18 in detail)		Hw1 due Hw2 posted	Lab 0
	5	2.4	Wave propagation on T-line	FDTD animations		
	8	2.5	Lossless t-line VSWR Voltage reflection coefficient Standing waves	Lecher Lines FDTD animations		
	10	2.6,2.7	Input impedance Short ckt and open ckt line	Lecher Lines FDTD animations	Hw 2 due Hw 3 posted	

	12	2.7	Applications of short and open ckt Throw in table 2-3(Review)	FDTD animations		
	15	2.8,2.9.1	Power flow in T-lines Smith charts (Understand its polar plot of Voltage reflection coefficient)			Lab 1
	17	2.9.2,2.9.3	Detailed derivation of smith chart VSWR Maxima and minima Plotting points Input impedance		Hw 3 due Hw 4 posted	
	19	2.10	Series stub matching Impedance to admittance			
	22	2.10	Shunt stub matching			Lab 1
	24	2.11	Bounce diagrams	FDTD animations	Hw 4 due Hw 5 posted	
	26	2.10	More matching examples			
	29		Exam Review		Hw 5 due	Lab 2
Oct	1	**MIDTERM-1**				

	3	3.1-3.3	Basic vector and coordinate system			
	6		FDTD	FDTD animations		Lab 3
	8	4.1-4.3	Coulombs law Field intensity Flux Flux density Problems	Electrostatics kit Electroscope Repelling Metal balls	HW 6 posted	
	10	5.1-5.3	Biot Savart's Law	Parallel wires repelling when current flows through them		
	13-18	**Fall Break**				
	20	4.4	Gauss Law			Lab 4
	22	5.4	Ampere's law		Hw 6 due Hw 7 posted	
	24		Problems			
	27	4.5,5.5	Vector potential			Lab 4
	29	4.10,4.7,5.8	Capacitance, Inductance, Resistance		Hw 7 due Hw 8 posted	

	31	4.9, 5.7	Electric and magnetic boundary conditions			
Nov	3	6.1-6.5	Faraday's law and lenz law	Wire coil with magnet and light bulb DC motor		Lab 5
	5	6.6-6.10	Displacement current		Hw 8 due Hw 9 posted	
	7	6	Link Budget and Problems			
	10		Exam Review		Hw 9 due	Lab 5
	12	**MIDTERM-2**				
	14	7.1,7.2	Plane wave in Lossless material	Oscillator w/ antenna and light bulb		
	17	7.3,7.4	Plane wave in lossy, layered material			Lab 6A
	19	8.1,8.2	Normal incidence Snell's law	Faraday cage Two cell phones & Aluminum foil	Hw 10 posted	
	21	8.4	Reflection and transmission (oblique incidence) Perpendicular polarization			

	24	8.4,8.3	More on Parallel polarization and optics	Laser and prism		
	26	7.6	Power		Hw 10 due Hw 11 posted	
	28	**Thanksgiving**			Holiday Assignment (300 points)	
Dec	1		Exam review	Signal generator, 2 dipole antennas, and a spectrum analyzer	Hw 11 due	Lab 6B
	3	**MIDTERM-3**				
	5	9	Antennas			
	8		Review Exam 1			
	10		Review Exam 2			
	12		Review Exam 3			
	17	**FINAL** 6:00 am to 10:00 am				

Please tell us about yourself: (turn this in at the end of class)

Name_____

Are you a Senior or Junior?

What area of electrical engineering have you found most interesting?

What do you hope to learn in this class? (What part of electromagnetics sounds interesting?)

What have you heard about this class?

How do you like to learn things?

- Lectures
- Interactive software
- Web research
- Library research
- Reading the text, other books, or magazine articles
- Hands-on / In the Lab
- Demos
- Studying with friends
- Other _____

Circle things you need review on:

- Integration (single, double, triple integrals)
- Differentiation
- Complex numbers
- Fourier Transform (DFT)

Thank you!