ECE 341   Fall 2022

This course is about electromagnetics (EM), the electrical foundation of Electrical and Computer Engineering, or, how electricity ***really*** works.

- Circuit theory is a simple part of EM, so it was taught first.
- Circuit theory fails in many cases (e.g. faster computers, higher communications frequencies, power electronics, power system transients,), and EM must supplement circuit theory.
- Also EM is the basis for many devices (machinery, antennas, etc.), and one of the physical foundations of any active electronic device.
- Serious hazards for electrical and computer engineers in all areas, such as interference and non-ideal behavior of circuit elements, are increasing with the higher frequencies today for Electrical and Computer Engineers in all areas.

We will cover only part of the book's material and add some notes, and you must keep up with what material that is.

The text is ***Fundamentals of Applied Electromagnetics*** **(8th, 7th, or 6th Edition)** by Ulaby. The CD included (but not in the Global Edition) seems to be helpful; it has some problem solutions, some good moving demonstrations, and some interactive exercises. You will find it useful to read other books (now and in your future pursuit of knowledge in this field), such as Ramo *et al*, *Fields and Waves in Communication Electronics*. This book is "old school": First the "true" field theory and then transmission lines. (You can find similar books in the library, around the call number for the text.) A modern book that teaches in the same order as our textbook: Inan, Inan, and Said, *Engineering Electromagnetics and Waves*. It can give you useful, additional insights. After this course, if you are really into the physics of EM fields, you can venture into Jackson, *Classical Electrodynamics*. A classic for physicists and microwave, optical engineers, it is not an easy book to read. One (actually the smallest) obstacle: We engineers use SI units, but the book uses Gauss units, which the physicists love. That makes some fundamental equations look different. Physicists think those forms are more elegant, but we have different opinions from a practical perspective.

Homework should be finished at the **start of class** on certain days, indicated in the schedule; homework will **not** be collected or graded. ***Solving*** problems is a means to learn principles; problems are ***not*** something to just be memorized. **Tests** will *partially* reflect homework and are certification that you have learned what you should. You should try your best to do homework thoughtfully on your own, not just "I got the right answer somehow so I'm finished". Ask "what have I learned form homework? Will I be able to do other problems in this topic?" **Do your homework and then check the answers I put online.** In lieu of graded homework, there will be random, in-class and take-home **quizzes** that I do grade.

There will be two **major tests**, on the days indicated in the schedule. **Make-ups are generally not given.**

A lab schedule will be worked out when the course is under way**.** Completion of all labs is required.

The **course grade** will be determined using these components: Test 1 15%; Test 2 15%; Quizzes 10%; project 15% lab 10%; final exam 35%.

E-mail will be used for some of my communications, and it's a good way for you to communicate with me.

Besides Canvas, we have a course website. Check it often for notes, homework, announcements, office hours, etc.
http://web.eecs.utk.edu/~ggu1/files/UGHome.html

Students are expected to adhere to the highest standards of academic integrity at all times.

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UGTA TBD

Office hours: TBD

Lab: MK 329

Tips

How to do well in this course (and others) and prepare to be a successful engineer:

- Don't overload your schedule with courses and/or work;
- Aim toward becoming a good engineer;
- Don't miss classes;
- See lab as an inquiry - not following a cook book;
- Don't just do the project; think and get insight.
- Study daily, not just the four nights before tests;
- Ask questions, take notes;
- Don't rely on somebody else (or my posted answers) for homework.
- **Pursue understanding of the principles -** not just memorizing the symbols in some homework problems and equations;
- **Try to visualize phenomena**- don't just manipulate math symbols;
- **Relate this material to other courses**.
- Revisit and reinforce the above three during the course, and, in your future study.
- Think in practical terms.

Tentative schedule (***subject to changes***)

CLASS	MONTH	DATE	DAY	HOME-WORK due	ACTIVITY Watch carefully; we don't cover all of each chapter. Numbers in parentheses are main section numbers within chapters.
1	Aug	25	R		**Introduction (**field, wave, lumped components, etc.). **Read on your own**: Sections 1-2 (on units; **important**; read now, will discuss later), 1-3.
2	Aug	30	T		**Generic sinusoidal waves**. Sect. 1-4, 1-5. ***Read Sect. 1-6 on your own if needed*** (brush up your math – complex numbers).
3	Sept	1	R	1 (P1-P9)	**Phasors**: Sect. 1-7. **Transmission lines** (Sects 2-1, 2-2)
4		6	T		**Transmission lines** (Sects 2-1 thru 2-4, 2-6 thru 2-9; **lectures take different approach than in book**): basic concepts
5		8	R	1; 2 (P1, P2)	Transmission lines continued: characteristic impedance (cont'd), reflection
6		13	T		CAD tool (ADS) tutorial and clinic.
7		15	R	2 (P1-P6)	Transmission lines continued: standing waves (Sect. 2-6)
8		20	T		Class canceled
9		22	R		Transmission lines continued: standing waves (2-6 thru 2-8)
10		27	T	2 3 (P1-P3)	Transmission lines continued: power flow (Section 2-9). **Smith chart for sinusoidal waves** (Sections 2-10, 2-11; class notes on double-stub). Basics (slide set *Smith Chart I*).
11	Sept	29	R	3	Smith chart cont'd: Basics (slide set *Smith Chart I*); Z to Y conversion (slide set *Smith Chart II*).
12	Oct	4	T	4 (P1-P3)	Smith chart cont'd: Z to Y conversion (slide set *Smith Chart II*); lumped component matching. Single stub matching.
		6	R		Fall Break
13		11	T	4	Smith chart cont'd: Single stub matching. **Read slides on your own:** Double stub matching. Pulse propagation on transmission lines (Section 2-12).
14		13	R	5	Pulse propagation on transmission lines, **bounce diagram (Section 2-12)**.
15	(	18	T	6	**Electrostatics** (**DC electric fields**): CH 4 (Ch 3 embedded) **Charge:** CH 4 sections 4-2.1**. Coulomb's law**: 4-3
16		20	R		**Gauss's law:** 4-4. **Dielectrics and polarization:** 4-7.
17		25	T	7 (P1-P4)	**TEST 1 (covers generic waves & transmission lines – Ch. 1 & Ch2)**
	Oct	27	R		Engineer's Day
18	Nov	1	T	7	**Gauss's law in dielectrics:** 4-7. **Electric boundary conditions** 4-8.
19		3	R	8	**Electric scalar potential**: 4-5. **Current & Ohm's law:** 4-2.2, 4-6. **Capacitors & Capacitance** 4-9, 4-10.
20		8	T	9 (P1-P6)	**Current & Ohm's law** (revisited). **Image method:** 4-11. **DC magnetic fields** (Ch. 5)**:** 5-1 (magnetic force)
21		10	R	9, 10 (P1-P2)	Sect. 5-1 cont'd. **Units** (Section 1-2 of Ch. 1). **DC magnetic fields:** 5-2 (Biot-Savart law) 5-3 (Gauss's law for magnetism, Ampere's law).
22		15	T	10	**DC magnetic fields:** 5-3 cont'd, 5-4 (vector potential), 5-6 (boundary conditions). **Dynamic fields & Maxwell eqs.** (Ch. 6 Sections 6-1 thru 6-6).
23		17	R		**TEST 2** (material since Test 1)
24	Nov	22	T		Sects 6-1 thru 6-6 cont'd. **Inductance: Ch. 5 Sections 5-7, 5-8. Practical effects of magnetic fields and time-varying fields. Magnetism of materials**: Section 5-5
	Nov	24	R		**Thanksgiving Holiday**
25	Nov	29	T	11	CH 7 (Sections 7-1 & 7-2) – **electromagnetic plane waves**
26	Dec	1	R		CH 7 (Sections 7-1 & 7-2) – **electromagnetic plane waves** cont'd
27	Dec	6	T		CH 7 (Sections 7-1 & 7-2) – **electromagnetic plane waves** cont'd. Review; Q&A
	Dec	9	F	12	**Final**