ECE 3600

Introduction to AC Power Engineering
Fall 2024 Class Syllabus

Instructor: Arn Stolp
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Cell: (801) 783-6589 **Always TEXT FIRST & start text with "ECE 3600"**. This is the best way to contact me.
E-mail: arnstolp@ece.utah.edu I rarely check my e-mail, so text me if you send me email that I need to read. Subject should start with "ECE 3600". DO NOT use other email addresses or Canvas messaging.
Office hours: We will discuss possible office hours during the first class. They will be on Tuesdays and Thursdays or on zoom. Most likely: T & Th 12:45 - 1:45 pm or T & Th 3:30 - 4;30 pm. If I'm not in my office during these hours, check the map on the door for my location.
DO NOT send messages via Canvas. I don't monitor them.

Web Site: http://www.ece.utah.edu/~ece3600/

Required and Recommended books and lab supplies:
Textbook: *Electrical Machinery and Power System Fundamentals*, by Stephen J. Chapman. International edition is cheaper and fine for this class.
Calculator that easily handles complex-number arithmetic.
Ring binder for additional materials to be handed out in class.
Lab notebook (bound or spiral)

Prerequisites: ECE 2210 or ECE 2240

Introduction:

Why do people care about electricity? Basically for two reasons-- information and energy. Computers, TVs, wireless devices, ipods and control systems all process, present, store and use information in the form of electrical signals. The circuits and theories behind these occupy the majority of your studies in Electrical Engineering. These circuits also require some energy to function (power supplies) and often need to control some energy to produce outputs (power amplifiers), both subjects for a power electronics class, not this class. Here we cover electrical energy in a more primal form– the energy that lights your house, washes your clothes and moves you up the ski lift, all of which is done with AC power.

This class will introduce you to AC power use and generation, AC and DC machines, and AC power systems. We will study single-phase and 3-phase power, power factors and corrections, transformers, synchronous and induction machines, DC motors, power transmission lines, and introduce the concepts used to analyze power flow and faults.

I teach will concepts and the use of those concepts to solve problems, not formulas and memorization. The hands-down easiest way get a good grade in this class is to learn the concepts.

This class consists of:

Lectures: T & Th 2:00 - 3:20 pm in WEB L103 AND a few lectures in the Wed. lab time.
Lectures set the direction and tone of the class and cover more than the written material. You will be held accountable for everything discussed in the lectures, so your attendance is important. Some lectures may be held at the normal Wed. lab time, in place of lab.

Problem Sessions: on zoom? , time: TBA
I will use this time to work examples and to answer your questions in detail. I will not cover new material in the problem session times.

Textbook:
Electrical Machinery and Power System Fundamentals, by Stephen J. Chapman.

Handouts:
There will be a number of handouts for, homework, labs, notes, etc.. I will hand these out before class or you may download them from canvas or the class web site; http://www.ece.utah.edu/~ece3600/.

Homework, homework, and more homework: 15%
I will assign a lot of homework, it will be your main study tool. As such, I'll give you all the numeric answers so that you can check your work immediately. In fact, you'll have to self-correct your homework. If you can't get the answer, check the web site for corrections, study some more, come to the problem session, ask for help, or see the posted solutions. Sometimes I even post solutions before the homework is due. So, you might ask, "Why is it handed in and 'graded'?". Well, to answer a question with a question, "Would you even do it otherwise?"

Your homework should be neat and clear and show all your work. For most problems the grader will simply check to see that you've done it and that your paper shows the necessary work to get the answer. Only a few problems will be checked in greater detail. You may collaborate with others to learn how to do the homework, but will need to hand in your own work. Copying or allowing another student to copy your work is considered cheating.

You will probably learn more from doing the homework than any other part of this class. If you thoroughly understand the homework, you will know what the class is about, and the exams should give you no trouble.

You will need to scan your homework, create a .pdf file, and turn that in on canvas by 11:59 pm of the due date. Solutions will be posted in my office window. Most graded material will be returned on Canvas.

Midterms: (300 exam pts) 43.75%
You will take three 50-minute midterms throughout the semester. They will cover material up to the time of the test. All exams are closed book, closed notes, no phones, tablets or computers allowed. These exams will usually be in two parts, a no calculator, no reference material part where I ask for items that you should have committed to memory, and a part with *some* reference material where I will ask you to solve problems that may require your calculator. The second section will be designed to see if you learned concepts and

problem solving strategies and whether you can work with them, sometimes in new and different ways. Don't try to memorize formulas or specific problems. Exams also cover what you learn in the labs and field trips. Exams will be returned in class. If you miss class, come to my office.

Final: Tuesday, 12/10/24, 1:00 - 3:00+ pm (180 exam pts) 26.25%

The final will be comprehensive with greater emphasis on the most recent material. It will also be in two parts. There will be a zoom review session. Listen for details in class.

Labs: MEB 2365 & 2337 15%

Lab will be held every other week. Many of the subjects covered in lab aren't covered anywhere else in class, so make sure you pay attention and read the lab instructions. You will have to keep a laboratory notebook as a requirement of the lab. Your lab TA will either collect and grade these notebooks or ask you to scan them and submit on canvas.

Labs are **not optional.** For each lab that you miss or fail (< 60% score), your final grade will suffer a **half letter drop** (5% of possible points). Be sure to make-up any labs you miss or fail.

Field Trips: scored as labs

I'm planning three field trips which will take place during lab and class time (approximately); Gadsby power plant, Rocky Mountain Power dispatch, and Terminal Substation. You will be responsible for your own transportation. If you cannot make a field trip you will have to make it up with some personal field investigation. Field trip reports will be graded with your labs. A missed field trip can also result in a 5% grade drop.

Grades:

Homework:	15%
Labs:	15%
Exams:	70%
Total:	100%
Failed lab:	-5%
Cheating:	-100%

% of total	Grade
> 93	A
90-93	A-
87-90	B+
83-87	B
80-83	B-
77-80	C+
73-77	C
70-73	C-
67-70	D+
63-67	D
60-63	D-
< 60	E

If you want any deviations from the normal requirements (say credit for labs, you've done before) you will need to see me before the work would normally be due and get an agreement *in writing*. You'll need to turn in your copy of the agreement with your final, so I'll remember to grade you properly.

Disclaimer:

All information provided here is subject to change due to external factors or unintended typos or errors.

ECE 3600

A. Stolp

Tentative

08/10/24

Fall 2024 COURSE SCHEDULE

Week		Date	lect	Topics	Textbook
1	T	08/20	1	Introduction, Energy sources, generation, & environment	1.1
	Th	08/22	2	Review of steady-state AC and phasors	notes, 1.2
2	T	08/27	3	RMS, Single-phase AC power	notes, 1.8
	Th	08/29	4	Single-phase AC power, P, Q, S, |S|, pf, pf correction	notes, 1.8
3	M	09/02		Labor Day	
	T	09/03	5	3-phase power, Y- and delta-connections	2.1 - 3
	Th	09/05	6	3-phase power, balanced systems, efficiency, One-line diagrams	2.4 - 6
4	T	09/10	7	One-line diagrams, Electromagnetics, Ideal transformers, Ratings	1.4, Ch 3
	Th	09/12	8	Transformation of impedance, Model of the non-ideal transformer	3.4 - 5
5	T	09/17	9	Non-ideal transformer, Voltage reg., Autotransformers, 3-phase, etc.	3.7 - 10
	Th	09/19	10	Per-unit system, One-line diagrams	3.6, 10.1
6	T	09/24	11	Per-phase, Per-unit	3.6, 10.2
	W	09/25		Exam 1	
	Th	09/26	12	Rotational Motion, AC Machinery Fundamentals, Synchronous machi	1.3, Ch4, 5
7	T	10/01	13	Synchronous machines as generators, Examples	5.1-6, Ch 6
	Th	10/03	14	Placing generator on-line, Sync machines as motors, pf correction	notes
	S	10/05		Fall Break	
	Su	10/13			
8	T	10/15	15	Sync motor examples, Starting Sync motors, 3-phase Induction motor	5.9 - 13
	Th	10/17	16	3-phase Induction motors, examples	7.1 - 5
9	T	10/22	17	3-phase Ind motor examples	7.6 - 8
	W	10/23		Exam 2	
	Th	10/24	18	3-phase Ind motor types, tests, Single-phase Induction motors	7.9-10,notes
10	T	10/29	19	Single-phase Induction motors, DC motors	notes, 8.1-2
	Th	10/31	20	DC motors	8.4 - 9
11	T	11/05	21	DC motors & loads	8.10, notes
	Th	11/07	22	Finish DC motors, Transmission lines	notes, 9.1-5
12	T	11/12	23	Transmission line models and calculations	9.8-9, 9.6
	W	11/13		Exam 3	
	Th	11/14	24	Finish transmission lines, Power Flow	10.1-3, 11.1
13	T	11/19	25	Power Flow & example	8.1
	Th	11/21	26	Faults	Ch 12 - 13
14	T	11/26	27	Types of faults, The 3 "sequences"	Ch13, notes
	Th	11/28		Thanksgiving	
15	T	12/03	28	Sequence Impedances, Protection, ME Design Day	notes
	Th	12/05	29	Protection	notes
16	M	12/09		Review	
	T	12/10		Final 1:00	
	F	12/13		Freedom	

ECE 3600 Fall Semester 2024 08/10/24

Week	Month	Mon	Tue	Wed	Thur	Fri
1	Aug	19	20 L1 Introduction, Energy sources, generation, & environment	21	22 L2 Review of steady-state AC and phasors	23
2		26	27 L3 RMS, Single-phase AC power	28	29 L4 Single-phase AC power, P, Q, S, |S|, pf, pf correction	30
3	Sept	2 Labor Day	3 L5 3-phase power, Y- and delta-connections	4	5 L6 3-phase power, balanced systems, efficiency, One-line diagrams	6
4		9	10 L7 One-line diagrams, Electromagnetics, Ideal transformers, Ratings	11	12 L8 Transformation of impedance, Model of the non-ideal transformer	13
5		16	17 L9 Non-ideal transformer, Voltage reg., Autotransformers, 3-phase, etc.	18	19 L10 Per-unit system, One-line diagrams	20
6		23	24 L11 Per-phase, Per-unit	25 Exam 1	26 L12 Rotational Motion, AC Machinery Fundamentals, Synchronous machines	27
7	Oct	30	1 L13 Synchronous machines as generators, Examples	2	3 L14 Placing generator on-line, Sync machines as motors, pf correction	4
		7	8 Fall Break	9	10	11
8		14	15 L15 Sync motor examples, Starting Sync motors, 3-phase Induction motors	16	17 L16 3-phase Induction motors, examples	18
9		21	22 L17 3-phase Ind motor examples	23 Exam 2	24 L18 3-phase Ind motor types, tests, Single-phase Induction motors	25
10	Nov	28	29 L19 Single-phase Induction motors, DC motors	30	31 L20 DC motors	1
11		4	5 L21 DC motors & loads	6	7 L22 Finish DC motors, Transmission lines	8
12		11	12 L23 Transmission line models and calculations	13 Exam 3	14 L24 Finish transmission lines, Power Flow	15
13		18	19 L25 Power Flow & example	20	21 L26 Faults	22
14	Dec	25	26 L27 Types of faults, The 3 "sequences"	27	28 Thanksgiving	29
15		2	3 L28 Sequence Impedances, Protection, ME Design Day	4	5 L29 Protection	6 Read Day
16		9 Review	10 Final 1:00	11	12	13 Freedom

ECE 3600 Fall Semester 2024

ECE 3600 Fall Semester, 2024 Likely Homework Due Dates (Canvas will overide)

08/10/24

Week	Month	Mon	Tue	Wed	Thur	Fri	Sat
1	Aug	19	20	21	22 Hw1 Energy sources, generation, & environment	23	24 Hw2A Review of steady-state AC and phasors
2		26	27	28 Hw2B AC Superposition, Thevenin	29	30 Hw3A RMS	31
3	Sept	2 Labor Day	3	4 Hw3B Single-phase AC power	5	6	7 Hw4 3-phase power
4		9	10	11 Hw5 3-phase power	12	13 Hw6 Electromagnetics	14
5		16	17 Hw7 Ideal transformers	18	19	20	21 Hw8 Non-ideal Transformers
6		23	24 Hw9 Autotransformers, 3-phase	25 Exam 1	26	27	28 Hw10 Per-unit system
7	Oct	30	1	2 Hw11 Per-unit system	3	4	5 SG1 Synchronous machines
		7 Fall Break	8	9	10	11	12
8		14	15	16 SG2 Synchronous generators	17	18	19 SG3 Synchronous motors
9		21	22	23 Exam 2	24 Ind1 3-phase Induction motors	25	26 Ind2 3-phase Induction motors
10	Nov	28	29	30	31 Ind3 3-phase & single-phase Induction motors	1	2 DC1 DC motors
11		4	5	6 DC2 DC motors	7	8	9 DC3 DC motors & mechanical loads
12		11	12 TL1 Transmission lines	13 Exam 3	14	15	16 TL2 Transmission lines
13		18	19	20	21 PF1 Power Flow	22	23
14		25	26	27 LF1 Line Faults	28 Thanksgiving	29	30
15	Dec	2	3 Go to Design day	4 LF2 Line Faults	5 DD ME Design day, Protection	6 Read Day	7
16		9 Review	10 Final 1:00	11	12	13	14 Freedom

ECE 3600 Fall Semester, 2024 Likely Homework Due Dates (Canvas will overide)

MERRILL ENGINEERING BUILDING (BLDG. 064)

SECOND FLOOR PLAN