ECE 3600

Introduction to AC Power Engineering
Spring 2023 Class Syllabus

Instructor: Arn Stolp
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Cell: (801) 657-7766 **Always TEXT FIRST & start text with "ECE 3600"**. This is the best way to contact me. I may call back from (385) 429-3439 (a google voice number). Do not initiate contact on the 385 number.
E-mail: arnstolp@ece.utah.edu (I don't check my e-mail everyday, so let me know by some other method if you send me email that I need to read.) Subject should start with "ECE 3600". DO NOT use other email addresses.
Office hours: My "office hours" are the problem sessions at the end of class. Otherwise it's catch me if you can. To increase your chances, talk to me after class. I'm usually around between 12:20 a.m. & 3 p.m. M,W & F. If I'm not in my office, check the lab.
DO NOT send messages via Canvas. I don't have the time to 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.
Ring binder for additional materials to be handed out in class.
Lab notebook (bound or spiral) and standard ECE lab supplies

Prerequisites: ECE 2210 or ECE 2240

Introduction:

Why do people care about electricity? Basically for two reasons-- information and energy. Computers, TVs, phones 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: M, W & F 3:00 - ~4:00 pm in WEB L114

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.

Problem Sessions: M, W & F ~4:00 - 4:20 pm in WEB L114

I will use this time to work examples and to answer your questions in detail. I will rarely cover new material in the problem session times, although I will sometimes be flexible about the boundary between class and problem session.

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 may hand these out before class or may have to download them from 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 (outside my office). 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: Wednesday, 5/3/23, 3:30 - 5:30+ 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 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 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 Spring Semester 2023 Likely HW Due-Dates (canvas date will overide) 01/08/23

Week	Month	Mon	Tue	Wed	Thur	Fri	Sat
1	Jan	9	10	11	12	13 Hw1 Energy sources, generation, & environment	14
2		16 Martin Luther King Day	17 Hw2a Review of steady-state AC and phasors	18	19	20 Hw2b AC Superposition, Thevenin	21 Hw3a RMS
3		23	24 Hw3b Single-phase AC power	25	26	27 Hw4 3-phase power	28
4		30 Hw5 3-phase power	31	1 Hw6 Electromagnetics	2	3 Hw7 Ideal transformers	4
5	Feb	6 Hw8a Non-ideal Transformers	7	8 Hw8b Non-ideal Transformers	9	10 Exam 1	11 Hw9 Autotransformers, and 3-phase
6		13	14	15 Hw10 Per-unit system	16	17	18 Hw11 Per-unit system
7		20 Presidents Day	21	22	23	24 SG1 Synchronous machines	25
8		27	28 SG2 Synchronous generators	1	2	3 SG3 Synchronous motors	4
	Mar	6 Spring Break	7	8	9	10	11
9		13 Ind1 3-phase Induction motors	14	15	16 Ind2 3-phase Induction motors	17 Exam 2	18
10		20	21	22 Ind3 3-phase & single-phase Induction motors	23	24	25 DC1 DC motors
11		27	28 DC2 DC motors	29	30	31 DC3 DC motors & mechanical loads	1
12	April	3	4	5 Exam 3	6 TL1 Transmission lines	7	8
13		10 TL2 Transmission lines	11	12	13	14 PF1 Power Flow	15
14		17	18 LF1 Line Faults	19	20 ME Design Day, Union Build.	21 LF2 Line Faults	22 DD Design day
15		24 P1 Protection	25 P2 Protection	26 Reading Day	27 Finals Begin	28	29
16	May	1	2 ECE 3600 Review	3 3600 Final 3:30 pm	4 Freedom	5	6

ECE 3600 Spring Semester 2023 Likely HW Due-Dates (canvas date will overide)

ECE 3600

A. Stolp

Tentative

01/08/23

Spring 2023 COURSE SCHEDULE

Week		Date	lect	Topics	Textbook
1	M	01/09	1	Introduction, Energy sources, generation, & environment	1.1
	W	01/11	2	Hw1 Review of steady-state AC and phasors	notes, 1.2
	F	01/13	3	Review of steady-state AC and phasors	notes
2	M	01/16		Martin Luther King Day	
	W	01/18	4	RMS, Single-phase AC power	notes, 1.8
	F	01/20	5	Single-phase AC power, P, Q, S, |S|, pf, pf correction	notes, 1.8
3	M	01/23	6	Single-phase AC power, 3-phase power	2.1 - 2
	W	01/25	7	3-phase power, Y- and delta-connections	2.3 - 6
	F	01/27	8	3-phase power, balanced systems, efficiency, One-line diagrams	2.4 - 6
4	M	01/30	9	Electromagnetics, Ideal transformers, Ratings	1.4, Ch 3
	W	02/01	10	Transformation of impedance, Model of the non-ideal transformer	3.4 - 5
	F	02/03	11	Non-ideal transformer, tests	3.7 - 8
5	M	02/06	12	Transformer voltage reg., Autotransformers, 3-phase, etc.	3.9 - 10
	W	02/08	13	Finish transformers, Power system diagrams	3.6
	F	02/10		Exam 1	
6	M	02/13	14	Per-unit system	3.6, 10.1
	W	02/15	15	Per-unit system	3.6, 10.2
	F	02/17	16	Rotational Motion, AC Machinery Fundamentals	1.3, Ch 4
7	M	02/20		Presidents Day	
	W	02/22	17	Synchronous machines	5.1 - 6
	F	02/24	18	Synchronous machines as generators, examples	5.8, Ch 6
8	M	02/27	19	Placing generator on line, Synchronous machines as motors	Ch 6, 5.9
	W	03/01	20	Synchronous motors, pf correction	5.10 - 13
	F	03/03	21	3-phase Induction motors,	7.1 - 5
9	S	03/04		Spring Break	
	Su	03/12			

ECE 3600 Spring 2023 Course Schedule p2

Week		Date	lect	Topics	Textbook
10	M	03/13	22	3-phase Induction motors, examples	7.6 - 8
	W	03/15	23	3-phase Induction motors, tests	7.9 - 10
	F	03/17		Exam 2	
11	M	03/20	24	Single-phase Induction motors	notes
	W	03/22	25	DC motors	notes, 8.1-2
	F	03/24	26	DC motors	8.4 - 9
12	M	03/27	27	DC motors & loads	8.10
	W	03/29	28	DC motors & loads	notes
	F	03/31	29	Transmission line models and calculations	notes, 9.1-5
13	M	04/03	30	Transmission line models and calculations	9.8 - 9
	W	04/05		Exam 3	
	F	04/07	31	Transmission lines, Power System & Power Flow	9.6, 10.1-3
14	M	04/10	32	Power Flow	11.1 - 3
	W	04/12	33	Power Flow, Faults	11.1-3,
	F	04/14	34	Types of faults, The 3 "sequences"	notes, 12.0
15	M	04/17	35	Faults, Sequence Impedances	Ch 12
	W	04/19	36	Protection	notes, Ch
	Th	04/20		ME Design Day, Union Build.	
	F	04/21	37	Protection	Ch 13
16	M	04/24	38	Protection	Ch 13
	T	04/25		Last Day of Classes	
	W	04/26		Reading Day	
	Th	04/27		Finals Begin	
	F	04/28			
17	M	05/01			
	T	05/02		ECE 3600 Review	
	W	05/03		3600 Final 3:30 pm	
	Th	05/04		Freedom	

ECE 3600 Spring Semester 2023 01/08/23

Week	Month	Mon	Tue	Wed	Thur	Fri
1	Jan	9 L1 Introduction, Energy sources, generation, & environment	10	11 L2 Hw1 Review of steady-state AC and phasors	12	13 L3 Review of steady-state AC and phasors
2		16 Martin Luther King Day	17	18 L4 RMS, Single-phase AC power	19	20 L5 Single-phase AC power, P, Q, S, |S|, pf, pf correction
3		23 L6 Single-phase AC power, 3-phase power	24	25 L7 3-phase power, Y- and delta-connections	26	27 L8 3-phase power, balanced systems, efficiency, One-line diagrams
4		30 L9 Electromagnetics, Ideal transformers, Ratings	31	1 L10 Transformation of impedance, Model of the non-ideal transformer	2	3 L11 Non-ideal transformer, tests
5	Feb	6 L12 Transformer voltage reg., Autotransformers, 3-phase, etc.	7	8 L13 Finish transformers, Power system diagrams	9	10 Exam 1
6		13 L14 Per-unit system	14	15 L15 Per-unit system	16	17 L16 Rotational Motion, AC Machinery Fundamentals
7		20 Presidents Day	21	22 L17 Synchronous machines	23	24 L18 Synchronous machines as generators, examples
		27 L19 Placing generator on line, Synchronous machines as motors	28	1 L20 Synchronous motors, pf correction	2	3 L21 3-phase Induction motors,
8	Mar	6 Spring Break	7	8	9	10
9		13 L22 3-phase Induction motors, examples	14	15 L23 3-phase Induction motors, tests	16	17 Exam 2
10		20 L24 Single-phase Induction motors	21	22 L25 DC motors	23	24 L26 DC motors
11		27 L27 DC motors & loads	28	29 L28 DC motors & loads	30	31 L29 Transmission line models and calculations
12	April	3 L30 Transmission line models and calculations	4	5 Exam 3	6	7 L31 Transmission lines, Power System & Power Flow
13		10 L32 Power Flow	11	12 L33 Power Flow, Faults	13	14 L34 Types of faults, The 3 "sequences"
14		17 L35 Faults, Sequence Impedances	18	19 L36 Protection	20 ME Design Day, Union Build.	21 L37 Protection
15		24 L38 Protection	25 Last Day of Classes	26 Reading Day	27 Finals Begin	28
16	May	1	2 ECE 3600 Review	3 3600 Final 3:30 pm	4 Freedom	5

ECE 3600 Spring Semester 2023

MERRILL ENGINEERING BUILDING (BLDG. 064)

SECOND FLOOR PLAN