

# Physics 322, Fundamentals of Electronics, Spring 2022

(As of March 26, 2022)

**Instructor:** Milton From (he/his)  
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**Course Canvas site:** <https://wwu.instructure.com/courses/1504701>  
**Office hours:** Tuesdays 11-12 pm, 1-2 pm, 3-4 pm, 5-6 pm (in CF307 or CF377)  
Contact me to set up a time if the above times do not work for you.

**Lab TA:** Hunter Campbell, [campbeh3@wwu.edu](mailto:campbeh3@wwu.edu)

**Lectures:** Mondays and Fridays, 2-3:15 in CF316, **Labs:** Thursdays 9-12 pm or 2-5 pm in CF311  
Both lectures and labs will be offered in-person. Lectures will be simultaneous with Zoom meetings and video recordings of the Zoom meetings will be posted on Canvas.

**Zoom link:** Please try to come to class in person! If you cannot make it here is the zoom link:  
Monday and Friday Lectures 2-3:15  
<https://wwu-edu.zoom.us/j/96298582709>

## Course goals, objectives, and outcomes:

A few important *goals* of the Electronics course are for you to become adept at using equipment commonly found in modern physics laboratories, to gain a working knowledge of basic analog signal processing techniques, and to understand the main sources of electrical noise and how to reduce or eliminate this noise.

Specific *objectives* for the course are to gain a working knowledge of how resistors, capacitors, inductors, op amps, transistors may be used to transform electrical signals and to use this knowledge to build and understand circuits that perform useful tasks. An especially useful task these days is to simply transform a signal coming from a real-world sensor or an experiment into a signal that is compatible with a computer interface.

An important component of Physics 322 is the weekly lab where students will complete lab exercises related to the lecture material. This lab, together with weekly assignments, contributes to several desired course *outcomes*: (i) improved conceptual understanding of the Physics behind electronics, (ii) ability to use bench-top lab equipment and build and troubleshoot circuits (iii) ability to solve problems, both independently and in groups.

**Reference Materials:** Besides your own notes from lectures, an optional text for the course is *Electronics for Physicists* by Bryan H. Suits. A few other useful reference materials are as follows:

Source	Author	description
1.) Principles of Electronic Instrumentation (3 <sup>rd</sup> edition)	James Diefenderfer	A good alternate textbook for the course. Covers everything we need in 322. Same level as Suits' text.
2.) Electronics for Inventors	Paul Scherz	Hands-on textbook with lots of practical advice on building circuits

3.) The Art of Electronics	Horowitz and Hill	Graduate level reference book.
4.) TTL Cookbook	Lancaster	Spec sheets for ICs, lots of ideas and schematics for simple circuits. Great for hobbyists.
5.) Hands-On Electronics	Kaplan and White	Very concise summary of what we will cover in Physics 322. Mostly lab based. Almost no mathematics.
6.) CircuitLab.com		<b>Free online textbook for basic electronics</b>
<b>7.) Google!</b>	<b>Many sites!</b>	<b>Complete specifications for most components may be obtained by Googling their part numbers.</b>

The Canvas course website contains useful links including weekly assignments, assignment and test solutions, Video recordings of lectures, lecture notes, photos and videos of demonstrations, lab guide sheets, and other resource materials.

We'll be using the circuit simulation software [Multisim Online](#) throughout the course. *Please create a free account as soon as possible and try it out so that you are ready to use it in the first lab.* This software will allow you to "wire up" virtual circuits and take measurements of output voltages and currents. Occasionally we will use Mathematica to do algebra and plotting in assignments and/or lab work. *Please familiarize yourself with this software if you haven't already used it.*

**Tentative Schedule:** (The schedule may be updated several times throughout the quarter. Check the course website for the most recent version.)

Week	Date	Topic	Book chapters			Lab (Thurs.)	Test
			Suits	Dief.	Kaplan		
1	Mar 29-Apr 1	Direct current circuits	1,2	1	1	-	
2	Apr 4-8	RC circuits, RL circuits, AC circuits	3, 4	2, 3	2	1	
3	Apr 11-15	Diodes	6	5	3	2	
4	Apr 18-22	Transistors I	8	8	4	3	
5	Apr 25- 29	Transistors II	8,9	8	5	4	Fri, Apr 22
6	May 2-6	OP amps I	10	9	7	5	
7	May 9-13	OP amps II	10, 11	9	8	6	
8	May 16-20	Comparators and oscillators	11	10	9	7	
9	May 23-27	Combinational logic: gates	12	11	10	8	Fri, May 20
10	May 30-June 3 (Holiday Monday)	Sequential logic: Flip flops and counters	12, 13	12	11	Lab test June 2	
	<b>Thurs June 9 3:30-5:30</b>						<b>Final Exam</b>

**Homework:** There will be an assignment of 8-10 problems each week. The assignments will *not* be graded however it is extremely important that you do them. Many of the problems on quizzes and tests will be modeled after those in the assignments. Solutions to the assignments will be posted on Canvas. I encourage you to give the problems a serious try before looking at the solutions. Feel free to see me for hints or further explanations on problem solutions. In most cases what is important in the solution to a problem is the *reasoning* you use and not simply a numerical answer.

**Tests:** There will be two in-person midterm tests, and a final in-person exam. Tests may include material from the text, lectures, assignments, and labs. You may use any notes you have made during the quarter, and a calculator. However, consultation with fellow students, Chegg, or other repositories of assignment/test solutions is not allowed. Only the final exam is cumulative.

**Pre/post tests:** We will begin the course with a multiple choice “concept inventory” test. This same test will be repeated at the end of the course. My goal is to assess if 322 has succeeded in correcting common misconceptions that students often enter a first electronics course with. This test contributes an automatic 5% to your course grade provided you submit both pre and post-tests. **In other words, you get full credit for participating, regardless of your score on the test.**

That being said, please read each question through and try to answer it correctly. But don't feel you need spend a lot of time doing the test; 15-20 minutes should be sufficient. Don't bother answering questions that would require you to look something up on the web or in a textbook. Just use your own memory and/or intuition to answer the questions. And just skip a problem if you think it is going to take you a lot of time to reason it out!

The pre and post-tests will be administered online during the first and last weeks of the quarter. Please make sure to do these before the deadlines posted on Canvas.

**Quizzes:** There will be roughly ten 10-minute-long quizzes, generally given on Mondays. Your final quiz grade will be the sum of all the individual quiz grades. In most cases, quizzes will consist of four multiple choice questions. Material for quizzes will come from three possible sources:

- (i) questions in the previous week's homework assignment
- (ii) topics covered in the previous one or two lectures or the previous week's lab
- (iii) reading assignments given during the last week.

The quizzes will be administered online via Canvas. You can do them any time during the 24-hour period following the Monday class.

**Laboratory:** You will be doing a lab each week of the course. Guide sheets for the labs will be posted on Canvas before the lab. If you have the time, I suggest that you do laboratory exercises using Multisim Online as a way of preparing for the actual laboratory sessions.

The guide sheets may ask you to fill in data tables, plot graphs, answer questions, supply computer printouts, etc. Please complete the guide sheets during/after the lab and turn them in to your lab TA for grading, either at the end of the lab period, or before a deadline specified by your TA. Each lab will be graded out of 10 and contribute equally to your final lab grade in the course. Please be aware that quizzes, tests, and final exam questions may include material from the labs

Collaboration with other students is encouraged during the lab. However, if there is enough equipment available, I strongly encourage you to do the lab using your own equipment. If you are working with a lab partner, it is very important that both you and your partner be actively engaged in the hands-on

wiring of circuits and operating of equipment. Remember that tests and final exam questions may include material from the labs.

Labs occur on Thursdays in two time slots: either 9-12 or 2-5. If you have a one-time schedule conflict, it may be possible to change to the alternate lab section. However please let your TA and instructor know that you will be doing this before the lab period. If absolutely necessary, it may also be possible to do your lab on an alternate day. However, this is not recommended since your TA and instructor will, in general, not be available. Please contact the instructor to discuss your options.

**Lab Test:** During the last week of classes there will be a lab test in which you'll be required to wire up a circuit, troubleshoot it, and take data using the breadboards, bench top equipment and circuit components that you learned to use during the quarter. The test will be 50 minutes long and will be scheduled during your regular weekly lab period. *You will be able to use your class notes, lab notebook/guide sheets and textbook for this test.*

**Grades:**

<b>2 tests</b>	<b>Final Exam</b>	<b>Pre/post test</b>	<b>Weekly Lab</b>	<b>Lab Test</b>	<b>Quizzes</b>
40% (20% each)	20%	5%	15%	5%	15%

**LETTER GRADE SCALE**

<b>Percentage</b>	90-100	85-89	80-84	77-79	73-76	70-72	67-69	63-66	60-62	57-59	53-56	<53
<b>Grade</b>	A	A-	B+	B	B-	C+	C	C-	D+	D	D-	F

**Covid-19, Accomodations, and General WWU policies**

Please let me know if you have circumstances that require accommodations, and I will do my best to help. If you have ideas on how to make the course run more smoothly, please feel free to offer suggestions!

Please read the document <https://syllabi.wvu.edu/> for information on covid-19 related accommodations as well as complete information on general WWU topics such as Academic Honesty, Accommodations, Ethical Computing Resources Conduct, Equal Opportunity, Finals, and the Student Conduct Code.