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Spring 2-1-2017

### PHSX 323.01: Intermediate Physics Lab

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# PHSX 323 -- Intermediate Physics Lab Spring 2017

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Instructor: Paul Janzen

Office: CHCB 128

Office hours: M 10:00 - 11:00, MW 4:00 - 5:00, F 1:00 - 3:00, and by appointment

Phone: 243-2374

Email: paul.janzen@umontana.edu

Text: *Building Scientific Apparatus*, 4th ed. by Moore, Davis, and Coplan (Cambridge University Press, 2009).

Lecture: Mondays and Wednesdays 3:00 - 3:50 PM in CHCB 012

Lab: Tues 12:30-4:20 PM **or** Thurs 12:30-4:20 PM

Prerequisites: PHSX 217N-218N or PHSX 207N-208N

PHSX 311 (Oscillations and Waves)

Credits: 3

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## **Description:**

This is a laboratory course in the application of analog and digital electronics to experimental physics, with additional emphasis on data analysis techniques.

## **Goals:**

To introduce a variety of electronic circuits, circuit analysis and design, and measurement techniques.

To advance the ability to perform data analysis, including the propagation of uncertainties.

To begin the transition from pre-prepared laboratory apparatus to experiments that need to be designed, built, and optimized by the student.

## **Learning Outcomes:**

- Will be skilled in the use of oscilloscopes, digital multimeters, and other electronic measurement devices
- Will be able to explain the physical principles underlying the operation of diodes and transistors, and underlying the frequency response of various circuits
- Will be able to design, build, and analyze basic op-amp circuits

- Will be able to interface a variety of measuring devices to computers in order to accomplish specific measurements
- Will be able to set up and document experiments, and take measurements, correctly and appropriately for a physics laboratory environment, and analyze the data statistically

### **Grading:**

At the end of Monday's lecture, a homework assignment will be given out. It will be due by the start of your next lab period. Late assignments, unless approved in advance, will automatically receive a 50% reduction. The homework assignment is designed to give you some practice in the type of calculations you will need to complete the laboratory efficiently.

Lab notebooks will be due by 5 PM Friday. One experiment, later in the course, will require a full formal write-up beyond the lab notebook.

One test will be given during the semester (March 29). In addition, there will be a written comprehensive final exam (May 9, 3:20 PM).

Laboratory Notebook: 45%

Lab Report: 10%

Homework Assignments: 15%

Test: 10%

Final Exam: 20%

This course can be taken for a traditional letter grade only.

### **Notes:**

**Add/Drop** can be performed online until February 10. **Add/Drop** can be performed with the instructor's and advisor's signatures until April 3.

*All students must practise academic honesty. Academic misconduct is subject to an academic penalty by the course instructor and/or a disciplinary sanction by the University. All students need to be familiar with the Student Conduct Code. The Code is available for review online at*

[http://www.umt.edu/vpsa/policies/student\\_conduct.php](http://www.umt.edu/vpsa/policies/student_conduct.php)

*Students with disabilities may request reasonable modifications by contacting me. The University of Montana assures equal access to instruction through collaboration*

*between students with disabilities, instructors, and Disability Services for Students. ``Reasonable'' means the University permits no fundamental alterations of academic standards or retroactive modifications.*

## **Tentative Course Outline**

<b>Week</b>	<b>Laboratory Topic</b>
1	DC circuits
2	Capacitors and AC circuits
3	Filters and diodes
4	Cables and Impedance Matching (Speed of Light)
5	Transistors
6	Op-amps I
7	Op-amps II
8	FETs
9	Review and test of analog electronics
10	Logic and flip-flops
11	Lock-In Amplifier
12	Modern physics experiment
13	Computer interfacing I
14	Computer interfacing II (embedded controllers)