Wabash College Department of Physics

PHY-220 Electronics and Instrumentation

Instructor: Dr. Martin John Madsen
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Office: Goodrich 309
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Semester: Spring 2009
Office Hours: MWF 9am-11am

Discussion Times: TTh 8:00 am – 11:00 am
Room: Goodrich 305
Lab Times: Same as coursetime

Introduction

This course will cover a few of the key ideas in electronics as they are related to the implementation of scientific experiments. Almost all experiments are now controlled in one way or another by electronics and computers. We will cover some of the basic tools and techniques used in computer-controlled data acquisition and in electronic control of experiments. This class will combine discussion of new ideas with practical implementation and testing of those ideas.

The learning goals for this course are to:

1. **Become familiar with computer-aided experiment control and data acquisition through the LabView programming environment.**
2. **Become familiar with the basic principles underlying the function of circuits, electronics, and digital computers**
3. **Research, test, and implement new electronics components in an experiment**
4. **Clearly communicate the technical details of electronics and instrumentation equipment**

The lab manual for this class is:

> *Instrumentation for Scientists*, (0.1st), by Paul W. Zitzewitz

The text for this class is printed as a lab manual and will be available at the bookstore. Read through the material for the day **prior** to coming to class. You should be prepared to ask questions and participate in the discussion in class. You will work through all the problems and exercises in the lab manual. Whatever you don't finish in class will be due the following period as homework.

Class Discussion

We will not have a formal lecture. Each joint class discussion and lab period will begin with a general discussion of the reading materials. We will then proceed to work through the examples and problems in the lab manual.

> **Attendance:** Attending class is essential. Excused absences (with a Dean's Excuse) must be made up with a 5 page paper covering the missed material that day plus an arranged time to do the make-up work in the lab. Each unexcused absence will dock 10% off of your final grade. No exceptions. If you have more than two unexcused absences, you will fail the class.

Homework

There will be no formal homework for this class. However, you are responsible for completing all the questions and projects in the lab manual. Each project will be due at the start of the following class period. Questions and problems will also be due at the start of each class period.

Exams

There will not be any formal exams for this class. Instead, your learning will be judged based on your projects.

Projects

There will be a number of projects during the semester. Each project will consist of a practical test of your project under the guidelines outlined in the project assignment. Projects will be graded on proper functioning of the experiment under the test conditions as well as your ability to explain the project to me as you are showing me the test. The oral evaluation will be graded as a part of the project grade.

Each project must also be accompanied with proper documentation and explanation including circuit diagrams and a written explanation of how each sub-component functions as a part of the whole project.

Project grades will be split between the practical test, the oral evaluation, and the written documentation.

The final project will be assigned near the mid-point of the semester and will combine many of the ideas and techniques for the semester into a larger project designed to taked data for an experiment of your choice. You will be designing, testing, fabricating, and implementing this project. Your final project should take data for your experiment– the data will be part of your presentation of the project.

> **Late Policy:** Project practical tests will be carried out on the day the project is due. Late projects will be penalized at a rate of 10% off of the total possible points per day late. A project due on Thursday but turned in the following Tuesday will be considered 5 days late. Special arraingments may be made to have a project evaluated on a non-class day. A project will not be considered for evaluation without the written documentation.

Grading

- Course grades will be determined by your total point score as follows:

Class (10 points per day)	190 points
Single-day projects (20 points per project)	100 points
Mid-term project	60 points
Final project	100 points
Total	450 points

- In addition, **To pass this course, all projects must be completed.**
- Your overall course grade is impossible to determine until the end of the semester when all of the points are counted. If you wish to measure your performance, compare your scores to the class distribution which will provided after each project. If your scores are much below the averages, you should consider getting help. Don't wait until it's too late!!
- Anyone who receives 90% of the total points will receive at least an A−, 80% will receive at least a B−, etc.

Academic Support Services:

Students with disabilities, whether physical, learning, or psychological, who believe they may need accommodations in this class, are encouraged to contact Academic Support Services as soon as possible to ensure that such accommodations are implemented in a timely fashion. Please meet with Julia Rosenberg (ext. 6024) to verify your eligibility for any classroom accommodations and for academic assistance related to your disability. You may also discuss your disability with the professor if you wish. All discussions will remain confidential. If you have a hidden or visible disability which may require classroom or test accommodations, please see me as soon as possible during a scheduled office hour. If you have not already done so, please visit Academic Support Services (Armory 101) which is responsible for coordinating accommodations and services for students with disabilities.

Emergency Procedures

In case of a fire, we are to proceed from the classroom, down the north stairs and out the nearest exit toward Sparks Center. You should join the instructor and the class at Sparks to make sure that everyone got out of the building ok. In the event of a severe weather storm, we are to proceed to the basement and shelter in the basement hallway.

Schedule

Class	Date	Class Topic	Reading
1	1/15/2009	Course overview	1A-1B
2	1/20/2009	Resistive Sensors	1C
3	1/22/2009	Resistnace to Potential Difference	1D
4	1/27/2009	**Wheatstone Bridge Project**	1D3
5	1/29/2009	Voltage Dividers	1E
6	2/3/2009	Sensor Intro	2A
7	2/5/2009	Scope Review	2B
8	2/10/2009	RC Filters	2C
9	2/12/2009	**RC Filter Phase Project**	2C3
10	2/17/2009	Operational Amplifiers 1	3A
11	2/19/2009	Operational Amplifiers 2	3B
12	2/24/2009	**Photometer Project**	3B3
13	2/26/2009	Diodes and transistors	3C
14	3/3/2009	**Light-Wave Communications Mid-term Project**	3C3
15	3/5/2009	**Light-Wave Communications Mid-term Project**	
	3/9/09-3/13/09	*Spring Break*	
16	3/17/2009	Analog to Digital Intro	4A
17	3/19/2009	Digital Logic	4B
18	3/24/2009	**Traffic Light Project**	4B3
19	3/26/2009	Sequential Logic	4C
20	3/31/2009	**Count-to-16 Project**	4C3
21	4/2/2009	ADC Fundamentals	5A
22	4/7/2009	DAC	5B
23	4/9/2009	Intro to USB-6009	6A
24	4/14/2009	Intro to LabView 1	6B
25	4/16/2009	Intro to LabView 2	TBA
26	4/21/2009	Intro to LabView 3	TBA
27	4/23/2009	**Final Project**	
28	4/28/2009	**Final Project**	
29	4/30/2009	**Final Project** and Review	