Phys4051: Methods of Experimental Physics I

Welcome to Methods! The entire class team is pleased to have you as a student and we look forward to an instructive, challenging and enjoyable experience.

This course is the first of a two-semester sequence on the techniques used in a modern experimental physics laboratory. Because of the importance of electronic instrumentation in today's physics experiments, the first semester of the laboratory will deal with the use of digital and analog techniques for processing electronic signals and with the use of computer instrumentation. The second semester laboratory will consist primarily of a single experimental project taken by the student through the stages of design, proposal, construction, data acquisition, analysis, oral presentation, and written report.

Class and Laboratory Schedule:

	Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**
10:10	Section 2	Section 5	Section 2	Section 5	
11:15	Section 2	Section 5	Section 2	Section 5	
12:20		Section 3		Section 3	
1:25		Section 3		Section 3	Recitation
2:30	**Lecture**	Section 4	**Lecture**	Section 4	**Lecture**
3:35		Section 4		Section 4	
4:40					

All lectures are in room 170 Physics and the labs are in room 65 in the basement of the physics department.

Prerequisites:

The 1300 series (1301, 1302) and the modern physics lab class (2605) are prerequisites.
Knowledge of basic electricity and magnetism and circuits at the 1000 level of physics is assumed. Error propagation, significant figures, chi-squared fitting, and similar material that is covered in 2605 is also assumed. English writing skills at the university level are required. No previous knowledge of electronics, digital logic and computer programming is assumed.

Staff:

The faculty member for this course is:
Jeremiah Mans (Office: Physics 377, 625-8994)
Office hours: Wednesday 1:00 – 2:00 pm and by appointment.

Technical and teaching assistance for the laboratory and course is provided by
Kurt Wick
(Physics 69, 624-2831, wick@umn.edu)

The teaching assistants are:
Bryce Beverlin II Sections 2 and 3
(Physics 46, 624-6305, beverlin@physics.umn Office Hours: by appointment.)
Schulz, Tanner Sections 4 and 5.
(Physics 58, 626-5503, schulz@physics.umn.edu Office Hours: by appointment.)

Information and Communication:

Please don't hesitate to ask questions or communicate your concerns. Your best mode of communication with the professor is either during class or in the office hour. Because of the large volume of email this mode of communication may not be the most efficient.

We will make an effort to update our class WWW page at: http://mxp.physics.umn.edu with any new information that pertains to the course. Please bear in mind that important information and announcements made in class may not be posted on the web site.

Lectures:

Three lectures will be given per week: M, W, F, 2:30 - 3:20, in room 170 Physics. You will be responsible for all announcements made in class.

Recitation:

A recitation section will be held in Physics 65, Fridays, at 1:25 PM. Course-related topics will be discussed in an informal manner. This session is optional and will be held as long as there is sufficient demand.

Textbooks and Lab Manual:

The course lab manual and text will be provided. The lab manuals will be handed out in the lab or class. The course text will partially available on the first day of class and additional chapters will be passed out during the semester.

For additional reference, we strongly recommend: *The Art of Electronics*, P. Horowitz and W. Hill, (Cambridge University Press), Second Edition. Chapter references to this text are included for many of the topics covered.

Reading:

Regular reading assignments are specified in the lab manual. You will be responsible for reading, either in the course text or in other references, material sufficient to gain a full understanding of what you are doing in the laboratory.

Labs:

Laboratory sections meet twice a week for two hours each in room Phys65 (phone: 625-4829). Students will work in pairs and must attend their assigned laboratory periods. Labs begin Tuesday, September 5.

To keep up, most students will find that a number of hours must be spent in the laboratory each week *in addition* to their scheduled hours. Access to the laboratory may be obtained during off hours by using the student id card. Students are responsible for having a working UCard.

Laboratory Reports:

Two different formats of lab reports exist, depending on the chapter in the lab manual covered. Chapters 1, 3, 4, 5, 7, 8, 10, 11, 12 and 13 are to be handed in as short reports and count a maximum of 15 points each. In these reports all questions in the lab manual must be answered. In approximately 3 pages, you should describe your work in a way that is comprehensible to the TA, using complete English sentences where appropriate, demonstrating an understanding of the material.

The reports of chapters 2, 6, 9 and 14 are to be longer, typed and in a more complete format. They each count a maximum of 25 points. They should contain a complete description of the exercises and results, including analysis, diagrams and plots, as well as answering all questions in the lab manual. In addition, you must record all your laboratory results in a lab notebook.

More detailed information and a sample short and long lab report can be found on our website at:
http://mxp.physics.umn.edu/f06/Announcements/Write-up%20Rules08a.htm

Reports are to be handed in on the scheduled due date to the TAs or instructors at the beginning of the scheduled lab session, or lecture, respectively. Approximate due dates for the reports are listed in the course plan at the end of the syllabus. For the exact due dates and rules consult the web at:
http://mxp.physics.umn.edu/f07/Announcements.htm.

Late submissions will not be accepted, unless there is a valid, documented medical or university approved reason.

To pass the class you must have submitted all of the reports but for two of the short ones.

Grade Policy:

Grading for this course will be based on an absolute scale of 400 points, distributed according to the following table:

Exam/Assignment	Number of Exams / Assignments	Possible Points Each:	Total Possible Points:
Final Exam	1	50	50
In Class Participation **Programming Quizzes** **Exam (Week 6)**	~10 2 1	~3 12.5 25	25 25 25
Long Reports	4	25	100
Short Reports	10	15	150
General Lab Work			25
TOTAL POINTS			**400**

Table 1

Note that your lab work (reports and general lab work) makes up approximately 70 % of the total grade. Please see the attached note on the expectations for lab reports. The 'general lab work' category (more than 5% of the total grade) is an essential give-away for those showing up on time to all lab sessions, reading the assigned material ahead of time, and following all the TAs instructions.

Occasionally during the lectures you will be asked to respond to questions on cards. BE SURE TO WRITE YOUR NAME ON THE CARD. A total of 25 points are allocated to these questions (see 'In Class Participation' in Table 1). The questions are intended to check both conceptual and quantitative understanding. They will be used by the instructor to understand whether there are wide-spread misconceptions and whether the class is following the material, as well as to monitor individual progress. These questions will be usually, but not always, asked on Friday and the lowest three grades will be dropped when calculating the final score.

Generally speaking, A's will be awarded for outstanding work that shows mastery of the material as demonstrated in both the lab reports and examinations. B's will be awarded for good work that exceeds the basic course requirements. C's will be awarded for work that meets the course requirements. Work that falls short of the basic course requirements will earn a D. F's will be given in cases of seriously deficient work. It will be very difficult to get an A or B in this course without doing well on the exams. For this reason, make every effort to really understand what is going on in lab!

Exams:

A 50 minute quiz will be held on October 12 covering analog electronics. Two 20-minutes C programming quizzes will be held November 9 and 16. The final exam will be held on Monday, December 17, 8:30 - 11:30 AM. The location of the final exam will be given later.

Homework:

Optional homework problems will be announced in class or listed on the web.

Academic Honesty:

All work on quizzes and the final examination must be your own, and you must follow any rules stated for a given examination. No collaboration is permitted on any of the quizzes or exams in this course. Your lab journal and your written lab reports should also be your own work, although you are expected to collaborate on collecting and discussing the data. Any other work submitted for a grade must be completed according to the guidelines established by the instructor or TA's. **Note that it is understood that in handing in your lab report you have actually completed all of the bench work and that the data presented in the reports are your own.** Failure to adhere to these standards will result in penalties ranging from zero on a particular quiz or assignment to expulsion from the University. Please note the official IT policy statement, which can also be found in the IT Bulletin and Student Guide:

The Institute of Technology expects the highest standards of honesty and integrity in the academic performance of its students. Any act of scholastic dishonesty is regarded as a serious offense, which may result in expulsion. The Institute of Technology defines scholastic dishonesty as submission of false records of academic achievement; cheating on assignments or examinations; plagiarizing; altering, forging, or misusing an academic record; taking, acquiring, or using test materials without faculty permission; acting alone or in cooperation with another to obtain dishonestly grades, honors, awards, or professional endorsement. Aiding and abetting an act of scholastic dishonesty is also considered a serious offense.

Access and Accommodation:

Please inform Jeremiah Mans in the first few days of the semester if there are any special circumstances which you feel will affect your performance in this course. Reasonable accommodation will be made according to University policies. Additional information can be obtained from Disability Services, Nicholson Hall, 626-1333.

Course Plan:

Week	Date	Lecture	Reading	Lab (Report Style)	Report Due
1	9/3/2007	*Labor Day*	E4E: 1, 2.1-2.2		
1	9/5/2007	Overview	H&H: 1.01 - 1.05, 1.06 - 1.11	1. Simple DC & AC Circuits	
1	9/7/2007	Thevenin Circuits	Lab manual: Appendix A & F	(Short)	
2	9/10/2007	Capacitors, RC Filters	E4E: 2.3-2.6	2. RC Circuits	
2	9/12/2007	Inductors	H&H: 1.12 - 1.21	(Long)	Lab 1
2	9/14/2007	RLC Circuits			
3	9/17/2007	Diodes	E4E: 2.7, 3.1	3. LC Circuits and Rectifiers	
3	9/19/2007	Diodes	H&H: 1.22 - 1.31	(Short)	Lab 2
3	9/21/2007	Op-Amps	Lab manual: Appendix E		
4	9/24/2007	Op-Amps	E4E: 3.2-3.3, 4.1	4. Basic Op-Amp Circuits	Lab 3
4	9/26/2007	Op-Amps		(Short)	
4	9/28/2007	Sensors			
5	10/1/2007	Sensors	E4E: 4.2, 3.4	5. Op-Amp Applications 1	Lab 4
5	10/3/2007	Sensors		(Short)	
5	10/5/2007	Op-Amps			
6	10/8/2007	Op-Amps	E4E: 3.4, 5.1	6. Op-Amp Applications 2	Lab 5
6	10/10/2007	Op-Amps		(Long)	
6	10/12/2007	**Quiz**			
7	10/15/2007	Digital Logic	E4E: 5.2-5.3, 6.1-6.2	7. Digital Electronics:	
7	10/17/2007	Digital Logic		Combinational Logic	Lab 6
7	10/19/2007	Digital Logic		(Short)	
8	10/22/2007	Digital Logic	E4E: 5.4, 6.3	8. Digital Electronics:	Lab 7
8	10/24/2007	Digital Logic		Sequential Logic	
8	10/26/2007	C Programming		(Short)	
9	10/29/2007	C Programming		9. Digital Electronics:	Lab 8
9	10/31/2007	C Programming		Freq. & Period Counter	
9	11/2/2007	C-Programming		(Long)	
10	11/5/2007	C Programming	C Manual: Part 1: 3.1 - 5.2	10. Programming Exercises	
10	11/7/2007	C Programming	C Manual: Part 2: 1 - 11	(Short)	Lab 9
10	11/9/2007	**C Quiz**; C Programming			
11	11/12/2007	C Programming	C Manual: Part 1: 5.3 - 9.3	11. Programming Exercises	Lab 10
11	11/14/2007	C Programming	C Manual: Part 1: 11.1 - 11.6	(Short)	
11	11/16/2007	**C Quiz**; C Programming			
12	11/19/2007	ADC/DAC	E4E: 7.1-7.2	12. Latched Binary Output	Lab 11
12	11/21/2007	ADC / DAC		& Stepper Motor	
12	11/23/2007	*Thanksgiving*		(Short)	
13	11/26/2007	ADC / DAC	E4E: 7.3-7.4	13. DAC/ADC Concepts	Lab 12
13	11/28/2007	Fourier Analysis		(Short)	
13	11/30/2007	Fourier Analysis			
14	12/3/2007	Fourier Analysis		14. Fast Fourier Transform	
14	12/5/2007	Spring Projects		(Long)	Lab 13
14	12/7/2007	Statistics			
15	12/10/2007	Statistics			
15	12/12/2007	Statistics		(Last Day of Class)	Lab 14
15	12/17/2007	**FINAL EXAM**			