PHYS 4580: Molecular and Condensed Matter Laboratory
Lecture: Tuesday, 12:10 pm; Location: R1, 2000N
Lab: Tues. 1:00 – 4:50 pm, also open Wed. and Thurs. 1-5 pm and other hours on request (please request this!);
Location: R1, 1070

Instructors: Profs. R. Ellingson and M. Heben

Syllabus updated Nov. 18, 2011

General advice and things to remember

1. Keep current with the lecture material, lab experiments, and lab reports.

2. Complete any reading assignments as soon as possible – these will help you follow the class. Review the reading material to gain the best possible understanding; this will help you consolidate your knowledge.

3. Follow the University's Missed Class/Excused absence policy.

4. Turn cell-phones and pagers off when in class and lab (please don't take calls during lab unless urgent).

5. Know the University's class withdrawal rules:
http://www.utoledo.edu/offices/registrar/registration_dates_fall.html

GRADING and EXAMS

1. Quizzes: We plan three quizzes during the semester, addressing materials previously from lectures, lab sessions, or assigned reading. Quizzes will be short (5 minutes), multiple choice, and closed book, closed notes.

2. Lab Reports: Lab Reports will be due following certain labs. Although lab experiments will be conducted in Teams, you should each prepare your own report, in your own words, and with your own graphs of what may (or may not) be based on data shared with teammates. Bring your laboratory notebooks with you to lab to facilitate with the writing of your lab report. Take careful notes on procedures, physical parameters during deposition and measurement, etc. Note how the measurement works in detail, and what information you'll need to reach the experimental goals.

Please include the following sections in each lab report:

1. Title
2. Name and Lab Partners names
3. Date
4. Abstract (Purpose of Experiment and major conclusions - c.a. 100 - 200 words).
5. Introduction (more info on the need for the experiments, and discussion of the general approach)
6. Experimental (Details of samples and equipment, including a sketch of the layout and a few words on the function of each major component)
7. Results and Discussion (analysis, appropriate graphs, a thoughtful explanation of the significance of the results, sources of uncertainty, and strengths and weaknesses of the measurement approach)
8. Conclusion
9. References

3. Final Project: Your final project will be based on a single 2-hour laboratory session in which you'll be asked to perform specific measurements on a specific photovoltaic material or sample using the equipment and capabilities you develop during the semester. Each student will be tested individually on all aspects of the hardware, software, and principles of the measurement system, as well as the materials physics relevant to photovoltaic devices. We may, or may not, need to use Finals week to schedule some of these Project exams.

Grading

Grades will be determined according to: Quizzes: 15%, Lab Reports: 60%, and Final Project: 25%. Note that undergraduate and graduate students work together on teams in this course. While graduate students are graded on a steeper curve, with increased expectations of (a) in-depth analysis of data and (b) demonstrated understanding of the key physical phenomena addressed in the laboratory experiments, undergraduate students are expected to pay careful attention to the quality of writing within their lab reports.

Projected Schedule:

Weeks of	**Topic(s)**
Aug. 23	Introduction to Igor Pro graphing and analysis software. Lab Report – 5 points.
Aug. 30	Introduction to LabView "virtual instrumentation" – instrument control software and data acquisition hardware. Lab Report – 5 points.
Sept. 6	Labor Day – no lecture Monday, and no lab this week.
Sept. 13 – Oct. 4	Setup of the optical system, working with a tungsten-halogen bulb coupled to a monochromator, troubleshooting new equipment, starting development of LabView control of the tunable light source. Lenses, optical mounts, thermopile detector, optical modulation, and phase-sensitive (lock-in) detection. Lab Reports due Oct. 3rd (parts 1 and 2, total of 10 points) and Oct. 10th (part 3, 10 points).
Oct. 11-25 Quiz #1 on 10/11/11	Optical characterization of transparent conductors (TEC-15, TEC-8, and thin Cr films – all on soda lime glass (SLG)): transmission and reflection measurements; determination of absorption coefficient vs. wavelength. TCO/metal film thickness measurement (profilometry); sheet resistance measurements (four-point probe). Compare sheet resistance to bulk resistivity for different metal film thicknesses. Fall Break Oct. 17-18, lab open Oct. 19-21. Quiz #1 Oct. 11. Lab report (20 points) due Oct. 31st.
Nov. 1 Quiz #2 on 11/1/11	Optical characterization of semiconductor thin films (CdS, CdTe, c-Si, a-Si, and CdS/CdTe solar cell stack). Quiz #2 Nov. 1. Lab report (10 points) due Nov. 7th.
Nov. 8-29 Quiz #3 on 11/22/11	Solar cell performance characterization (requires LabView development): Current-voltage; spectral response (quantum efficiency). Evaporation of metal back contact (Au). X-ray diffraction of CdS and CdTe thin films. Quiz #3 Nov. 22. Team-based lab report (20 points) due Dec. 5th. The lab report for the X-ray diffraction will be an individual report (10 points), and also due Dec. 5th
Dec. 6	Final Review Dec. 6th; Final project/exams scheduled individually Dec. 7, 8, 9.
Dec. 12	Finals Week (no exam)