PHY 6450 Winter 2017

Introduction to Material and Device Characterizations

Instructor: Karur R. Padmanabhan
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Office hours:

Lecture: T & Th 10 to11:15 AM. Rm 177 Physics*
Lab: T 11: 30 to 1:10 PM

Office hours: TBA

Prerequisite: Basic physics at PHY217/218 level (Halliday Resnick)., chemistry, calculus
Suggested co-requisites: PHY7050/ECE5500

This course deals with modern techniques used in the characterization of materials and devices. A number of techniques based on diffraction, microscopy, spectroscopy, optical, magnetic, and electrical properties will be discussed. For each technique, the basic principles, the information that can be obtained using the technique, and an introduction to the practicalities of the technique will be provided, either by the instructor or by guest lecturers who are experts in the field. One of the goals of this course is to provide students with the tools necessary to design and implement experiments for their own graduate research projects.

Students will be required to participate in the laboratory sessions, where a first-hand experience into each technique will be provided. For some experiment the students will complete laboratory reports. At the end of the semester, groups of 3 students each will complete a research project based on the presented techniques. The results of the project will be written up in a report, and an oral presentation will be given.

Tentative schedule
(subject to change)

Week of	Lecture Topic	Lab (T)
Jan 10	Overview of course Introduction: material Characterization crystallography	General data analysis
Jan 17	Diffraction Methods: X ray diffraction	XRD : simulation
Jan 24	Diffraction Methods: electron diffraction	XRD : experiment
Jan 31	Optical spectroscopy methods (UV/Vis/IR)	UV/VIS/FTIR

Feb 7	Optical (TIR) microscopy	Polarized TIR
Feb 14	Electron Microscopy	SEM/TEM
Feb 21	Light scattering, Raman Spectroscopy	Raman (visit)
Feb 28	Electron spectroscopy (AES, XPS, UPS)	AES/XPS
Mar 7	Scanning Probe Microscopy	AFM
Mar 14	**SPRING BREAK**	
Mar 21	Ion/neutron Scattering Spectroscopy	Visit
Mar 28	Electrochemical Characterization	Electrochemical
Apr 04	Magnetic Characterization	VSM/Squid
Apr 11	Electrical Characterization of devices	I-V measurements
Apr 18	Projects presentation	

Grading:	Laboratory notebooks:	20%
	Technical Report:	20%
	Oral Presentation:	20%
	Quizzes:	40%

Laboratory notebooks: Students will participate in laboratory sessions where they experience first-hand many of the techniques discussed in the lecture. Students will collect data and write lab reports. The lab reports consist of answering questions about the technique used, the samples, data interpretation and analysis and conclusion. Questions will be provided during the lab session. Each student will maintain a bound lab notebook to record all the lab reports. Each lab will be 5% of the total grade of the course. The lab notebook grade will also be based on neatness, organization/ presentation of data etc. THERE ARE NO MAKE-UP LAB SESSIONS.

Technical Report: In the last 2 weeks of the class, student teams will be formed of 3 students each. These teams will characterize samples using at least 2-3 techniques discussed in the class or any other relevant characterization technique. The teams will then prepare technical reports on their findings, which should be written as if submitted to a technical/ scientific journal. They should include a review of the relevant background literature, experimental methods, results, and discussion, as well as all relevant plots, tables etc.

Oral Presentation: Each team will present their work in form of an oral presentation, similar to a presentation given at a scientific meeting. Every student will be allotted the same amount of time for their presentation. There will be short question & answer sessions. Grades will be based on knowledge and presentation style.

Quizzes: There will be unannounced short quizzes during class.