

**Birla Institute of Technology and Science, Pilani**  
**Hyderabad Campus**  
**Second Semester 2021-22**

Date: 15-01-2022

Course No.: PHY F344

Course Title: Advanced Physics Laboratory

Instructor-in-charge: **B. Harihara Venkataraman**

Instructors: **Prof. Kannan Ramaswamy, Priyanka Mitra, Nilofar Naaz**

1. Scope and Objective of the course:

The aim of the course is to introduce students to some selected experimental techniques pertaining to Compulsory Discipline Courses such as Solid State Physics and Atomic and Molecular Physics. The main objective is to supplement textbook learning with experimental demonstrations.

2. Text Book: There is no text book for this course. The study materials will be provided by the instructors. The following websites have online demonstrations of some of the standard physics experiments at the undergraduate level.

<https://polyhedronphysics.com/>

<https://www.vlab.co.in/broad-area-physical-sciences>

<http://vlab.amrita.edu/index.php?sub=1&brch=189>

[https://phet.colorado.edu/en/simulations/filter?](https://phet.colorado.edu/en/simulations/filter?subjects=physics&sort=alpha&view=grid)

[subjects=physics&sort=alpha&view=grid](https://phet.colorado.edu/en/simulations/filter?subjects=physics&sort=alpha&view=grid)

<https://www.physport.org/recommendations/Entry.cfm?ID=119927#sims>

<https://www.physport.org/recommendations/Entry.cfm?ID=119927#sims>

**Learning Outcomes:**

- Ability to analyze data obtained using standard and well known experimental techniques.
- Ability to explain experimental data analytically using well known theoretical formulations.
- Ability to perform thorough error analysis.
- Ability to make written technical reports.

**Instructors Role:**

- Give introductory lecture about experimental techniques.
- Suggest material systems that can be taken up for a detailed understanding of a given experimental technique.
- Provide experimental data for analysis.
- Provide formative assessments about student's progress.

**Student's Role:**

- Understand the fundamental physical principles behind the experimental techniques.
- Understand the applicability of an experimental technique by analyzing the given data in detail for the suggested systems and interpreting the data using well known equations.
- Communicate their understanding about the experimental techniques through written report and oral presentations.

**What happens on a day to day basis in the laboratory sessions?**

- Every lab is for a total of 6 hours per week and is divided into two sessions of 3 hours.
- The instructors will give a presentation for about 30 to 45 minutes about each experimental technique that will be a part of this course. The students will be provided with resource materials to understand relevant theory.
- The instructor will give the data that needs to be analyzed by the students.
- In the second session, each student will submit a detailed written report based on the analyzed data.
- This process will continue for all the experiments.

**How does evaluation for this course happen?**

- Written report of experiments will carry a weightage of 60%.
- Every student is expected to participate in active discussions after the demonstration of an experiment is completed. This will carry a weightage of 10%.
- There will be a final written examination/seminar to test the understanding of theoretical ideas and experimental methods which carries a weightage of 30%

**Evaluation based on written laboratory report:**

- Clarity and originality of the write up.
- Analysis of the data including error analysis.
- Neatness of the graphical representation.

**Content for each experiment in the written report:**

No.	Component
1	Aim / Objective
2	Introduction: Physics of the phenomenon & About the Instrument
3	Experimental method
4	Data Collection
5	Analysis & Result: Curve fitting, Calculation & Error estimation
a)	Plotting, labeling the axes and units
6	Explanation for the agreement or disagreement of the result with theory

### Summary of the Evaluation Components:

Evaluation Component	Duration	Weightage
Laboratory Report	Within 7 days from the date of the experiment.	60%
Discussion/Viva-Voce	30 to 40 minutes of discussion after every experiment.	10%
Written Examination / Seminar at the end of this lab course	90 minutes for exam / 20 minutes seminar for each group	30%

S.No.	Experiment	Learning Objectives
1	Differential Scanning Calorimetry (Polymer)	To understand the use of the technique to examine glass transition and melting point in polymer materials.
2	Differential Scanning Calorimetry (Glass)	To understand the use of the technique to examine glass transition, crystallization and melting point in glassy materials.
3	X-ray diffraction (Bulk)	To understand the use of the technique to derive the crystal structure of a given material which is in bulk form (eg. Powder or single crystal.)
4	X-ray diffraction (Thin – film)	To understand the use of the technique to derive the crystal structure of a given material in the form of thin-films.
5	Atomic Force Microscope	To understand how forces at the atomic

		scale can be used to make images of surfaces of molecules.
<b>6</b>	Scanning Electron Microscope (Image)	To understand how secondary emissions from a given material can be used to form the image of the surface of a material.
<b>7</b>	Scanning Electron Microscope (EDAX)	To understand the use of energy dispersive X-ray spectroscopy for elemental analysis of materials.
<b>8</b>	X-ray Photoelectron Spectroscopy	To understand the use of the technique to study the surface oxidation states of elements in a material.
<b>9</b>	UV - Visible- IR-Spectroscopy (Transmission mode)	To understand phenomenon like surface plasmon resonance where light is absorbed at particular wavelengths by Noble metal nanoparticles such as Gold.
<b>10</b>	UV - Visible- IR-Spectroscopy (Reflection mode)	To understand extinction spectrum of materials and derive parameters like bandgap. Students will understand the idea of integrating sphere in this experiment.

6. **Make-up policy:** It will be given only if a student misses the laboratory session due to debilitating illness and other extraordinary situations. The student must produce valid documents to support the reason for their absence.

7. **Academic Honesty and Integrity Policy:** Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

**Instructors**  
PHY F344