Birla Institute of Technology and Science, Pilani, Hyderabad Campus
Second Semester 2022-23

Date: 16-01-2023

Course No.: PHY F344
Course Title: Advanced Physics Laboratory
Instructor-in-charge: **Prof. KANNAN RAMASWAMY**
Instructors: Prof. HariharaVenkataraman, Dr. Sankar, and Nilofar

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?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.
- Ability to perform basic tasks like soldering of components to put together an electronic circuit.
- Ability to make measurements from a digital/analog oscilloscope.

Instructors Role:

- Give introductory lecture about experimental the techniques included in the handout.
- Provide formative assessments about student's progress.

Student's Role:

- Understand the fundamental physics of the given experiments.
- Understand the experimental techniques used to measure physical parameters.
- Propose experimental techniques different from that is given in the study material.

- Communicate their understanding about the experimental techniques through written report and oral presentations as deemed necessary.

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 each. The students are divided into two groups. While one group perform the given experimental task on their first week day in the laboratory the other group will be working on completing their lab report of the experiment they have completed. This cycle will continue until all the planned experiments are completed.
- The students will be provided with the resource materials to understand the relevant theory along with the details of the experiments each group has to perform. Instructor will provide assistance only if it is very much required.

How does evaluation for this course happen?

- Written report and presentation of experiments will carry a weightage of 80%.
- Every student group will be given an open research project which will carry a weightage of 20%.

Rubrik's for evaluating Written Laboratory report:

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

Rubrik's for evaluating Oral presentation:

- Content of the power point slides
- Clarity of the presentation
- Ability to answer questions
- Ability to present ideas in the given time

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.	20%
Project Presentation	20 minutes	20%

List of experiments

S.No.	Experiment	Learning Objective
1	X-ray diffraction (Bulk) (4 students)	To understand the use of the technique to derive the crystal structure of a given material which is in bulk form (e.g. Powder or single crystal.)
2	Soldering and Multi-meter (4 students)	To develop soldering skills as well as the ability to use a multi-meter for simple measurements.
3	Thermal Conductivity Measurements in Metals (2*2 = 4 students)	Verification of Wiedemann–Franz law and the measurement of Lorenz number.
4	Classical Hall Effect (2*2 = 4 students)	To understand how to obtain charge density and mobility of a semiconductor from Hall effect experiments.
5	Measurement of Boltzmann constant (2*2 = 4 students)	To understand the measurement of fundamental constants using basic ideas from semiconductor physics.
6	Measurement of dielectric constants of solids (2*2 = 4 students)	To understand the measurement of capacitance in Solids.
7	Measurement of dielectric constants of liquids (2*2 = 4 students)	To understand the measurement of capacitance in liquids.
8	Lattice dynamics kit (2*2 = 4 students)	To understand the dispersion relation in monoatomic and diatomic lattice. To teach the use of oscilloscope.
9	P-N junction (2*2 = 4 students)	To measure the bandgap of a semiconductor.
10	Fourier Series (2*2=4 students)	To verify Fourier Theorem through 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, PHYF344