

**UNIVERSITY OF PUERTO RICO RIO PIEDRAS CAMPUS
DEPARTMENT OF PHYSICS**

FISI 4077: INTERMEDIATE PHYSICS LAB/ADVANCED PHYSICS LAB

"I hear and I forget, I see and I remember, I do and I understand." Confucius

1. General information:

Course Code: FISI 4077

Class hours: Tuesday 2:30pm-5:20Pm
Thursday 2:30pm-5:20pm

Class Room: C 340

Professor: Dr. Ratnakar Palai

Office: FB 219 Facundo Bueso Bldg

Email: r.palai@upr.edu

Telephone: 787 764 0000 Ext: 88465

Office hour: Friday 4:00pm-5.00 pm (online or request for other time).

2. Syllabus:

The Intermediate Physics Lab (IPL) and Advanced Physics Lab (APL) will introduce you to several modern experimental techniques in many physical disciplines, such as optics, electronics, atomic and nuclear physics, solid state physics, electromagnetism, semiconductor physics, quantum mechanics, etc. You will be responsible to for making scientific experiments and verify them by analyzing you observed data. It is very important that you understand the errors on your data.

3. Experiments:

1. Photoelectric effect (2 ways)
2. Atomic Spectra
3. Millikan Oil Drop Experiment
4. Velocity of Light
5. Rutherford Scattering
6. Frank-Hertz Experiment
7. Nuclear Physics- α , β , and γ decay –(13 Experiments)
8. Brag Diffraction (microwave)
9. Fiber Optics
10. Microwave Optics- (12 Experiments)
11. Superconductivity
12. Electron Spin Resonance
13. Hall effect (p type and n-type semiconductor and metal)
14. Ferromagnetic Hysteresis loop (5 samples)

15. Four-probe Resistivity measurement
16. Superconductivity & SQUID
17. Current-Voltage characteristics of LEDs
18. Electromagnetism
19. Light Emitting Diode (LED)

4. Course Objectives

- To get hands-on experience in using different modern physics experiments
- To broaden the understanding of fundamental physics
- To understand how to characterize semiconducting and magnetic materials

NOTE: The course will be offered in hybrid format (50% face-to-face (if situation permits) and 50% online). Due to the COVID-19 global pandemic, if it is not possible to offer face-to-face, the course will be offered online only. The experiments will be live/recorded and will be sent you for data analysis & interpretation. During the class (online) webcam should stay on. The Lab meetings and presentations will be done using Google Meet (link below):

<https://meet.google.com/tmf-fypb-fmu>

5. References:

- G.L. Squires, Practical Physics (Cambridge, 1987).
- D.C. Baird, Experimentation, 2nd ed. (Prentice Hall, 1988).
- P.R. Bevington, Data Reduction... (McGraw-Hill, 1969). Valuable reference for practical error analysis and curve fitting. Somewhat esoteric on the philosophic underpinnings.
- L. Lyons, Data Analysis. (Cambridge, 1991).

6. Course requirements:

Experiments:

You have to do **five experiments** and **one project** to complete the course. You are required to submit a lab report and give brief oral presentation at the end of the experiment and project. The selection of the experiments and project should be done in consultation with professor and TA. The experiment selection should be balanced with duration and diversity of the experiments. You can discuss with the professor/TA to check the availability and suitability of the experiment you are considering.

Do enough reading about the experiment prior to do it for the better understanding of the experiment. Once you finished an experiment, plot graphs using your data and meet individually with the professor/instructor/TA to discuss your results (bring your notebook).

Pay attention to the suggestions the instructor/TA may have on analysis and interpretation you include in your final report.

Procedures:

Work with one lab partner, normally the same one throughout the semester. Record all your data in your own lab notebook (**bound Lab notebook**) during the experiment. Describe briefly description of the apparatus (not just the name of the apparatus) and procedure in your own language. Find out the precision of all the measurements by repeating two to three times. Leave some space for data tabulation, calculation, interpretation, and summary.

Reports:

You are required to submit a lab report (4-5 pages for the experiment and 5-10 pages for the project) at the end of the experiment and project before the **deadline through “UPR Moodle”**. **The Moodle will NOT allow to submit after the deadline (before the class)**. In addition, you should prepare to a short (5-10 min) oral presentation on your experiment and 30 min for project (**experimental procedure, what the results were, and what conclusion can be drawn**) using power point.

The report is due on the next lab period after you finished the experiment or by the deadline announced in Moodle. The most important thing the instructor will look for qualitative and quantitative information you are able extract from your experiment and quality and clarity of the writing. The report and presentation will be graded on a scale of **10 point**. **Late penalties of 1 points/week will be deduced from the total point.** We encourage early submission. If the report is not satisfactory and you can revise and resubmit by the deadline but the **revised report will get maximum of 1 point from previously obtained points.**

The final grade will be assigned by adding all the points up obtained in experiment, project, and lab performance (sincerity, equipment maintenance, punctual, lab safety, etc.). The total grade point is distributed as follow.

Grade Point Distribution	
Experiment + Presentation	70%
Project +presentation	20%
Lab Performance (course participation)	10%

Format of the Lab Reports: The following is the standard Lab report format

- i. **Aim of the experiment**--- clear and concise
- ii. **Experimental Details**---
 - Brief description of the apparatus

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- Experimental procedures followed to carry out the experiment
- iii. **Theory** - Principle behind the experiment and required theoretical background and important formula need to be used.
- iv. **Results and discussion**- Tabulation, calculation, and interpretation
- v. **Error Analysis**- Compare the observed data with known data available in the literature/books
- vi. **Conclusion**—brief summary of the experiment
- vii. **References**

Course Grading:

The final grade will be assigned by adding all the points up obtained in all the three sections.

Grade Scale out of 100 points	
Total points	Letter Grade
≥ 90	A
≥ 80	B
≥ 70	C
≥ 60	D
< 50	F

Rights of Students with Disabilities:

UPR complies with all Federal and State Laws and regulations regarding discrimination, including the Americans with Disabilities Act 1990 (ADA) and the Commonwealth of Puerto Rico Law 51. Students receiving services through Rehabilitation Vocational must contact the professor at the beginning of the semester in order to plan for a reasonable accommodation and any required support equipment according to the recommendations given by the Oficina de Asuntos para Personas con Impedimentos (OAPI) of the Dean of Students. Likewise, students with special need that require some type of accommodation must contact the professor at the beginning of the semester.

Reasonable Accommodation:

The University of Puerto Rico complies with all federal, state and regulations concerning discrimination, including “The American Disabilities Act” (Law ADA) and Law 51 of the Commonwealth of Puerto Rico. Students receiving vocational rehabilitation services should contact the teacher at the beginning of the semester to plan for reasonable accommodation and necessary support equipment in accordance with the recommendations of the Office of Matters for Persons with Disabilities (OAPI) of the Dean of Students. A request for reasonable accommodation does not exempt the student from meeting the academic requirements of the course.

Academic Integrity:

The University of Puerto Rico promotes the highest standards of academic and scientific integrity. Article 6.2 of the UPR General Student Regulations (Certification Num. 13, 2009-2010, of the Board of Trustees) states that "academic dishonesty includes, but is not limited to: fraudulent actions, obtaining grades or grades academics using false or fraudulent simulations, copying all or part of another person's academic work, plagiarizing all or part of another person's work, totally or partially copying another person's answers to the questions of an exam, making or getting another take in your name any oral or written test or exam, as well as help or facilitation for another person to incur such conduct. "

Harassment:

The University of Puerto Rico prohibits discrimination based on sex and gender in all its forms, including sexual harassment. According to the Institutional Policy against Sexual Harassment at the University of Puerto Rico, Certification No. 130, 2014-2015 of the Governing Board, if a student is being or was affected by behaviors related to sexual harassment, he can go to the Office of the Student Prosecutor's Office, the Office of the Dean of Students or the Compliance Coordinator with Title IX for guidance and / or filing a complaint.

Name:-----

Student ID:-----

Report #	Point/10	70%	Total Point	Final Grade
1st repot				
2 nd Report				
3 rd Repot				
4 th report				
5 th report				
Project		20%		
Lab performance		10%		