SCHOOL of ARTS and SCIENCES
BUFFALO STATE • The State University of New York

SYLLABUS

Course Number: PHY 214	**Course Name: OPTICS AND HEAT LAB**
Semester: Fall 2024	**CRN: 1906**
Schedule: T: 9:25-11:15 am (SAMC 358)	**Mode: Traditional**
Instructor: Ram Rai, PhD	**Email: rairc@buffalostate.edu**
Office Hours: T: 12-1 pm or by appointment	**Office Location: SAMC 280**
Phone: 878-3767	

Course Description:

Performing basic physics experiments chosen from the areas of optics, heat, and thermodynamics. Students carry out experiments; acquire, analyze, and interpret experimental data; write lab reports in a standard scientific format.
Prerequisite: PHY 112, PHY 213 (or corequisite) or instructor permission
Enrollment Restrictions: Required for physics majors

Required Materials:

Textbook: Not required. The lab handouts will be provided on Brightspace.

Student Learning Outcomes:

Upon completion of this course, the students should be able to:

- demonstrate understanding of uncertainty in measurement and propagation of uncertainty.
- design experiments to measure physical properties of materials.
- analyze the data using theoretical models.
- evaluate the agreement between the experimental results and the expected values to improve the methods.
- write comprehensive lab reports in a scientific format.
- discuss the experimental results with peers through the oral presentation.

Course Requirements:

This physics lab course covers fundamental experiments selected from the heat and optical domains. This course aims to help students improve their laboratory skills by doing more structured experiments than those performed in the introductory physics laboratory. Students should analyze experimental data and associated uncertainties and write reports in the standard format. For each experiment, a lab manual or a short description of experimental procedures will be provided (Check on Brightspace). We will talk about uncertainty analysis involving systematic and random sources of uncertainty in the first week. Students should use data and uncertainty analysis to interpret experiment results.

You are expected to complete **nine labs** from the list below:

- Young's Double-Slit Interference
- Fraunhofer Diffraction of a Single Slit
- Fraunhofer Diffraction of a Single Circular Aperture
- Diffraction of a Grating/Prism
- Interference of Newton's Ring.
- Analyzing Polarization Status of Light Beams
- Specific Heat of Metals
- Specific Heat Ratio (C_P/C_V) of Air
- Thermal Conductivity of Poor Conductor
- Thermal Expansion Coefficient Using Optical Interference

Attendance:

Attendance is required and will be taken during the class. You are responsible for making up the labs missed because of unexcused class absences. I can help you with the lab in case of the excused absences, but the lab must be completed outside the regular class hours.

Reading Assignment:

Students MUST read the related theory for the lab from the recommended textbook or provided reading materials before coming to the lab. A short lecture will be given on theory for each experiment before starting the lab. You should always discuss with your group member(s) to make the plan for the experiment.

Lab Notebooks:

Learning to maintain a good notebook is one of the important things you should learn in this course. A good notebook is essential when you must write up your report or develop a presentation based on your laboratory work.
I recommend the **quadrille-ruled laboratory notebook**, but the regular notebook is also fine. Be sure to bring your lab notebook to all classes. Your lab notebook will be collected twice for evaluation, at the midterm and at the end of the semester. The following are some guidelines for maintaining your notebook.

- Create a table of contents and add to it every time you make an entry.
- Make drawings or diagrams of all relevant designs or setups.
- Record data in tabular form with units indicated.
- Write "Learning Commentaries" in your notebook, including the calculations of any data or uncertainty analysis and any conclusions drawn.
- Record any notes from discussions or mini-lectures in your notebook.

Laboratory Reports:

For each lab completed, you MUST write an individual lab report as a separate document. Lab reports should be computer-typed as an MS document. Check on Brightspace for a sample lab report, which can be used as a template for writing lab reports. Note that your lab report constitutes a significant portion of this lab course.

In general, your lab report should contain the following sections:

1) **Title**: Make a short, catchy title.
2) **Introduction**: You should state what the lab is about. What is the main objective of the lab? You should also briefly discuss the theory, including mathematical equations, related to the lab.
3) **Experimental technique**: This section should provide all the important details about the experimental setup and how the measurements were taken. Try to make a very short description of the set-up including a schematic diagram and a brief procedure.
4) **Results and Discussions**: This is the main body of the lab report. In this section, you present the data and results clearly and quantitatively, using appropriate figures and tables. If the data fitting is necessary, you should use a least-squares fitting technique in Excel.
5) **Conclusion**: Conclude your experiment in a short paragraph with the key points or results.
6) **References**: You should list a few references; scientific papers, books, and manuals. There are various styles to list references at the end. Below are two examples for a book and a paper, in a format widely used in Scientific Journals.

- D. Preston, "The Art of Experimental Physics", (John Wiley and Sons, New York 1991), p. 350.
- R. Feynman, "Feynman's Theory of Liquid Helium", Phys. Rev. 93, 1412 (1954).

All lab reports should be submitted in hard copies **no later than one week after the experiment is completed. Late lab reports will be subject to penalty.** Each Lab report must be self-contained. Any lab report that is not written according to the above guidelines or that does not meet the expected standard will be returned to be rewritten. There is no penalty for rewriting the lab report.

Final Exam/Presentation:

There will be a final exam or final presentation at the end of the semester. The format of the final exam will be announced in the class. The final exam/presentation will be given during the Critique and Evaluation Week (**9:40 – 11:30 am, Tuesday, Dec 10, 2024**)

GRADING:

The grade for this course will be based on the following:

Lab attendance and participation	15 %
Lab notebook	10 %
Lab reports	55 %
Final Exam/Presentation	20 %

SAFETY:

Please use common sense to avoid injuring yourself or others when working in the lab. The most common hazards are from electrical shock, hot objects, and lasers.

● When using electrical devices exercise caution and if you are not sure how to hook something up please ask me before you turn it on. Be particularly aware of bare wires and devices capable of providing sizeable currents.

● The heat experiments require using the electrical heater to heat up the material which can attain more than 100 ^{O}C. You should exercise caution to handle the hot objects with a proper tool and thermal gloves.

● When using a laser be careful not to look into the beam directly or to throw the beam on someone else. Also be aware that a laser beam can reflect off a shiny surface and may go somewhere that you are not expecting.

Student Resources:

Title IX:

My priority as your professor is to ensure a safe, respectful education environment where all students can learn and thrive. The University does not tolerate any form of discrimination or harassment (including sexual assault, dating and domestic violence, stalking) based on protected characteristics (e.g., sex, gender identity, sexual orientation, religion, pregnancy, etc.) or related retaliation. All faculty and teaching assistants are considered mandated reporters by the University, which means that if they observe or learn of sex-based harassment/ discrimination or related retaliation, they are obligated to immediately share that information with the University's Title IX Coordinator. This obligation, grounded in law and policy, is designed to protect the safety of students and the broader Buffalo State community, as well as ensure that students receive information about available supportive measures and resolution options to enable them to make informed choices. Supportive measures include reasonable academic accommodations available with or without the filing of a formal complaint.

If you need academic accommodations due to sex discrimination, harassment, or related retaliation, you may:

On Campus Resources:

- Contact the TIX Coordinator directly (titleix@buffalostate.edu or 716-878-5212), without sharing any personal information with me.
- If you would like to speak with a **confidential** counselor about sexual misconduct, The Counseling Center provides 24/7 confidential support for students via the Bengal Support Line (833-823-0260), or by scheduling an appointment at 716-878-4436.
- If you are a student with a disability and require reasonable accommodations to meaningfully participate in this course, please contact the University's Student Accessibility Services at your earliest convenience (sas@buffalostate.edu or 716-878-4500), as SAS is responsible for processing and approving such requests.
- If you are pregnant, have recently experienced childbirth, and/or have medical needs related to childbirth, please contact our Title IX Coordinator for assistance.
- You can file an anonymous report with our University Police Department: 716-878-6333, police@buffalostate.edu

Off Campus Resources

- Crisis Services: 24/7 hotline, 716-834-3131
- National Suicide Prevention Lifeline: 1-800-273-8255
- Family Justic Center: 716-558-7233, safe@fjcsafe.org

Tutoring

Buffalo State offers a wide array of FREE tutoring services: Math Center, Writing Center, Other Subject Tutoring Center, STAR-NY online tutoring and EOP/ACE. Most tutoring is face to face in the Academic Commons area of Butler Library. For details check out the tutoring website: https://academicsuccess.buffalostate.edu/tutoring.

Support

The Dean of Students Office helps students navigate the college experience, particularly during difficult situations such as personal, financial, medical, and/or family crises. If you or someone you know needs support, services are available. For a list of support services and information, please visit http://deanofstudents.buffalostate.edu/, 716-878-4618 or stop by 311 Campbell Student Union during business hours.

Coronavirus Information

Check the website (https://coronavirus.buffalostate.edu/) for current guidance.

Policy on Cell Phone Use:

During the class, cell phones and other electronic devices must be turned off or set to SILENCE.

Academic Misconduct:

All students at Buffalo State College are expected to display honesty and integrity in completing course requirement. "Academic misconduct" refers to any form of plagiarism or cheating on examinations or assignments and is inconsistent with the aims and goals of Buffalo State College. The violation of "Academic Misconduct Policy" will lead to an "E" grade in this course. For details, visit the website at https://academicstandards.buffalostate.edu/misconduct.

Students with Disabilities:

Students who require accommodations to complete the requirements and expectations of this course because of a disability are invited to make their needs known to the Student Accessibility Services Office, Butler Library 160, (716) 878-4500, or email sas@buffalostate.edu.

Procedures Regarding Disruptive Individuals:

Disruptive behavior (cell phones, talking, noise, tardiness, etc.) by students in my class will not be tolerated. Whenever I deem a student to be acting in a disruptive or threatening manner, I will exercise my right to ask that individual to leave the classroom. If refused, I will exercise my right to notify University Police. The responding officer will determine whether an arrest should be made or whether a referral to medical or counseling staff is appropriate. If a student is perceived as a danger to themselves or others, the Dean of Students may propose an interim suspension until a hearing is held. Any student removed from class will have the right to a hearing.
For details, see https://facultyhandbook.buffalostate.edu/disruptive-students