



Course Number: PHY 305
Semester: Spring 2025
Schedule: MWF: 2:00-2:50 pm (SAMC 355)
Instructor: Ram Rai, PhD
Office Hours: MW: 1-2 pm or by appointment
Phone: 878-3767

Course Name: Modern Physics I
CRN: 1807
Mode: Traditional
Email: rairc@buffalostate.edu
Office Location: SAMC 280

Course Description:

This is the first part of a two-semester Modern Physics course. It is a survey course covering contemporary topics, such as Introduction to Special Relativity, the Bohr model of the atom, wave-particle duality, introduction to quantum mechanics, applications of quantum mechanics to the atoms. (Required for majors)

Prerequisite: PHY 213 and CHE 112 or instructor permission.

Required Materials:

Modern Physics (Third Edition) by Serway, Moses, and Moyer, Brooks/Cole Cengage Learning, 2005.

Additional books: (strongly recommended) **Modern Physics** (2nd edition) (Schaum's Series) by Ronald Gautreau and William Savin.

Student Learning Outcomes

On completion of this course, students will be able to:

1. Explain how the postulates of Special Relativity were motivated by previous experimental results.
2. Investigate consequences of the Special Relativity postulates: Lorentz contraction and time dilation.
3. Calculate the atomic spectra predicted by the Bohr model and compare them with measured spectra.
4. Solve the Schrödinger equation to determine wavefunctions for different model systems.
5. Apply the solutions of the Schrödinger equation for atoms to understanding the systematics of the Periodic table.

Course Requirements:

You **MUST** read the chapter that is going to be covered before coming to the class. Lectures will not cover all the course content. You must make every effort to do all assigned homework problems not only to get a good grade but also to improve your problem-solving skills and to understand theoretical concepts. This course requires a significant amount of work outside the class. Students who are struggling to follow the lecture/discussion should meet with the instructor and discuss their difficulties individually. For information on assignments, the schedule of exams, and other announcements, you should frequently check the course page in **Brightspace**.

Homework, Quizzes, and Exams: There will be at least one homework problem set from each chapter and all homework assignments should be completed on paper before the specified time. I highly encourage collaboration among students on problem-solving, but the final write-up must be in your own words. You should show every important step of the problem, and the final answers should be labeled with appropriate units. The homework solutions will be accessible on **Brightspace**. **No late homework will be accepted without a reasonable excuse. Late homework will be penalized by 20% within the next week**, however, homework **will not be accepted** after the solution is posted.

Quizzes will be given unannounced during the class. There will be **three one-hour exams** and **one two-hour (comprehensive) final exam**. The tentative dates for the in-class exams are listed below in the Course Schedule Table. **The final exam has been scheduled for Wednesday, May 12, 2025, from 1:40 – 3:30 pm.** Note that all exams will be closed-book exams. You must notify me in advance if you expect to miss the scheduled tests. I'll only let you reschedule the exam if you have a legitimate reason.

Attendance: Regular attendance is necessary for this course even though attendance will not be taken during lectures. Exams, homework assignments, and quizzes are announced in class. You must review the content covered in class if you are absent.

Class Participation: Students are urged to participate in class discussions and ask questions. We often work in groups of two to three students to develop problem-solving skills. During the semester, there will be several in-class quizzes. Please note that class quizzes will not be rescheduled if missed due to unexcused absences.

Table 1: Grades will be distributed as follows:

Evaluation and Grading Scale:

Final grades on the course will be based on the following:

Exams (3 Exams)	50 %
Homework	15 %
Quizzes	10 %
Final Exam	25 %

Overall Percentage	Grade
90.0 - 100	A
85.0 - 89.9	A-
81.0 - 84.9	B+
77.0 - 80.9	B
73.0 - 76.9	B-
68.0 - 72.9	C+
63.0 - 67.9	C
58.0 - 62.9	C-
54.0 - 57.9	D+
50.0 - 53.9	D
< 50	E

Course Schedule:

Chapters are from Modern Physics (Third Edition) by Serway et al.

Week 1: Jan. 27 – 31	Ch 1: Relativity I HW 1a (due on Sep. 6): Ch 1: #2, 4, 8, 11, 13
Week 2: Feb. 3 – 7	Ch 1: Relativity I HW 1b (due on Sep. 8): Ch 1: #17, 21, 23, 27, 35 Ch 2: Relativity II
Week 3: Feb. 10 – 14	Ch 2: Relativity II Ch 3: The Quantum Theory of Light
Week 4: Feb. 18 – 21 <i>Feb. 17: President's Day</i>	Test #1: Feb 19 (Wednesday) Ch 3: The Quantum Theory of Light
Week 5: Feb. 24 – 28	Ch 3: The Quantum Theory of Light
Week 6: Mar. 3 – 7	Ch 4: The Particle Nature of Matter
Week 7: Mar. 10 – 14	Ch 5: Matter Waves
Week 8: Mar. 17 – 21	Test #2: Mar 19 (Wednesday) Ch 6: Quantum Mechanics in one dimension
Week 9: Mar. 24 – 28	Spring Break – No Classes
Week 10: Mar. 31 – Apr. 4	Ch 6: Quantum Mechanics in one dimension Ch 7: Tunneling Phenomena
Week 11: Apr. 7 – 11	Ch 7: Tunneling Phenomena
Week 12: Apr. 14 - 18	Test #3: Apr. 16 (Wednesday) Ch 8: Quantum Mechanics in Three-Dimensional
Week 13: Apr. 21 – 25	Ch 8: Quantum Mechanics in Three-Dimensional
Week 14: Apr. 28 – May. 2	Ch 8: Quantum Mechanics in Three-Dimensional Ch 9: Atomic Structure
Week 15: May. 5 – 9	Ch 9: Atomic Structure
Week 16: May. 12 – 15 (CEP)	Final Exam: 1:40 - 3:30 pm, May 12, 2025

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 accommodation 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 Justice 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.

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 requirements. "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 the 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>