

Course Syllabus

Physics 344: Modern Physics

Spring Semester, 2023

Instructor:	Dr. Steven Sahyun
Office:	Upham Hall 157
Phone:	Ext. 5113
E-mail:	sahyuns@uww.edu
Class Home page:	http://sahyun.net/courses/physcs344/index.html
Canvas:	The Canvas site is linked from the UW-W and class Web sites (www.uww.edu) and select Canvas.
Class Meetings:	Class: M, W 12:30 p.m. – 1:45 p.m. Lab: F 9:00 a.m. - 11:50 a.m.
Office Hours:	M W 11:00 am – 12:00 noon; M 3:30 – 4:30 pm; T 12:30 – 1:30 pm and 3:00 – 4:00 pm or by appointment.
Webex Office:	https://uww.webex.com/meet/sahyuns
Required Text:	Krane: <i>Modern Physics</i> , 3 rd ed. (available at the UWW bookstore)
Supplemental text:	Openstax University Physics, Vol. 3 (free download) https://openstax.org/details/books/university-physics-volume-3
Pre-requisite:	Physics 181 or Physics 141, and Math 254.
Course modality:	Face-to-Face. This course will be offered face-to-face. Laboratory is Face-to-Face.

Other required materials:

LabArchives <https://www.labarchives.com> account for laboratories. This will be discussed in class.

You are also expected to have a **bound laboratory notebook** (not a spiral), these are available at the bookstore. Also bring paper, a scientific calculator (one with trigonometric and logarithmic functions, scientific notation, etc. These are available for **less than** \$20), and a USB data storage device. Although there are computers in the classroom to access Web based applets we will use in class, if you have one, you may bring a laptop to class as well.

Recommended Items:

- MATLAB Student edition (\$100)
 - MATLAB is available on Physics Department computers and via remote access. Alternative #1: OCTAVE (<https://www.gnu.org/software/octave/> free) may substitute for most MATLAB project items.
 - Alternative #2: Python (free!) Python programming language may be used as an alternative for any MATLAB items. I will attempt to convert MATLAB items to Python programs but there may be some unforeseen challenges. You may complete Homework, Class activities, and Laboratory data analysis and reports using Python whenever MATLAB is mentioned or used.

Course Description: Topics covered include relativity, selected topics of 20th century physics, atomic and molecular structure, elementary quantum physics and its applications in modern technology, elementary nuclear physics and fundamental particles. Laboratory experiments complement material presented in lectures.

Course Learning Outcomes:

[These outcomes are an edited version from:

https://www.uab.edu/cas/physics/images/Documents/PH351_syllabus_Catledge.pdf]

Learning outcomes: Students successfully completing this course will demonstrate knowledge of fundamental concepts in modern physics including special relativity and quantum mechanics and will be able to apply this knowledge to solve problems. Students will also demonstrate a working knowledge of physics-related technical and laboratory skills including data analysis.

Course learning objectives: By successfully completing this course a student should be able to:

General

- Identify the major 20th and 21st century developments in Physics.
- Apply Special Relativity to the solution of problems involving time dilation, length contraction, simultaneity, relativistic momentum, and relativistic energy.
- Define the experimental basis of the Quantum Theory of Matter.
- Apply quantum methods in the solution of problems such as involving atomic spectra, blackbody radiation, the photoelectric effect, X-ray emission, the structure of the atom, and one-dimensional potentials.
- Communicate scientific ideas and physical concepts in writing clearly and effectively.

Experimental Procedures and Analysis of Experimental Data

- Organize & assemble modern physics laboratory experiments.
- Explain in own words how specific modern physics experiments work.
- Perform data acquisition using assembled experiment.
- Work with a team of researchers
- Maintain a laboratory notebook with detailed entries on everything performed in the lab.
- Distinguish between theoretical predications & experiment measurements.
- Provide computational analysis and presentation of acquired data by constructing graphs based on acquired data.
- Analyze, interpret, and draw conclusions from data and corresponding uncertainties presented in graphs.
- Perform curve fitting to graphical data exhibiting various relationships and interpret the physical meaning of fitting parameters.
- Explain the difference between values predicted by a theory and values measured in an experiment in light of the experimental uncertainties.

Course Policies and Expectations:

Assigned reading: You are expected to read the assigned pages before coming to class in order to make the best use of the day's activities. **You will be expected to submit a paragraph summary at the beginning of the class on each of the assigned readings.**

Homework: There are two categories of homework. **Assigned Homework** will be assigned one week prior to the due date. In general, assigned homework will not be accepted late. If the schedule is modified, I will post the changed schedule on the course Web site. The answers to homework and in class problems will be posted on the course D2L site. Sometimes the assigned homework will be gone over and discussed during the class period when it is due. **Late** homework will generally **not be accepted** for credit.

The second category of homework is additional recommended problems. Recommended problems are for you to work on specific concepts. These problems are found at the end of the chapter. You are encouraged to work on as many problems as you are able. These problems will generally not be gone over in class unless there are specific question, solutions to the problems will be posted on D2L. Questions similar to the recommended problems may show up on the exams.

Classroom activities: There will usually be some sort of activity during the class. You are expected to fully participate and complete these activities. Activities are to be worked on in small groups, but you are expected to maintain your own notes for the activity. Activity participation will be checked for completeness the day of the activity. If you miss a class, you are expected to make-up the missed activity (complete and submit). **Activities are a graded item.**

MATLAB/Python activities: There will be three MATLAB/Python assignments to be completed. These will have written reports showing your solutions to several assigned projects.

Exams: There will be two mid-term exams as well as a comprehensive final. See the attached schedule (current schedule posted at: <http://sahyun.net/courses/physcs344/schedule.pdf>) for dates.

Laboratory: There will be 10 laboratory experiments, each will have regular (weekly) written reports. The laboratory reports will be typed and follow a grading rubric style. Laboratory reports are due one week after the lab completion. Reports are to be submitted on LabArchives. Reports will be reduced by 2 pts. for each day they are late. **You MUST complete 9 of the 10 regular laboratory experiments** (assuming there are no technical problems with the experiments and that there are 10 experiments offered) **to pass the course.** If you complete fewer than 9 regular laboratory experiments (assumption as noted above) your grade will be impacted accordingly. A bound lab notebook is to be kept for recording your experiments and data, and will be evaluated (for part of the lab grade) in lab for good record keeping. Your lab notes will be scanned in and submitted to LabArchives and will be part of your lab grade.

Physics 344: Modern Physics Laboratory Report Guidelines

(2 pts.) Lab Book: Your laboratory procedure is clearly outlined and easy to follow. There is an accurate index at the start of the lab book. Each page is numbered and dated. The laboratory experiment and objective are clearly stated. It is clear what you did and why you did it. There are drawings, diagrams, and notations for each experiment. Filenames and locations of data files are recorded. The data and results are clearly At the end of each day, there is a short, clear preliminary analysis and commentary of the results obtained for the day.

The purpose of the report is to create a clear communication of your laboratory experience and contains information so that others can reproduce what you have accomplished. Your report must have your name and the experiment title. In addition, your report will have:

(2 pts.) I. Objective/Introduction (future tense) – A couple paragraphs that provide an explanation about the purpose of the experiment and why it is of interest.

(4 pts.) II. Theory – This section details the physics behind the experiment. Any equations that you will use will be *explained* in the theory section.

(2 pt) III. Set-up (Past tense) – This section describes what equipment was used and *diagrams* of any apparatus. This section is NOT a restatement of laboratory instruction handouts.

(4 pts) IV. Data Results (Past tense) – This section shows the data from your experiment. Data may be presented in tables, charts, or graphs and is referred to in the analysis section.

(4 pts.) V. Analysis and Interpretation (Past tense) – Manipulation of the data and interpretation of what it means. This section shows your theoretical modeling and correlation to data results.

(2 pt.) VI. Conclusion (Past tense) – Final statement of what you found and any experimental uncertainties. For example, for part of your conclusion you will state: We determined the electron's mass to be xxxxx with an uncertainty of yyyy. This result differs from the accepted value of aaaaa by zzz%.

A good report has the following items: Your project shows a very good analysis and conclusions. It is a well-written paper with a clear summary of your laboratory experiments.

- The introduction shows why this experiment is of interest and the experimental objective is clearly stated.
- The experimental set-up clearly described and any necessary figures included.
- There is a coherent THEORY section that clearly shows how the theory relates to the experiment. Application of the equations are clearly shown.
- The method of how the data was acquired and results are clearly noted. Graphs of acquired data or other presentation of your work are shown.
- There is a clear and correct analysis and interpretation of what your data indicates and commentary of the results,
- There is a **useful** summary and conclusions of the experiment (including your final results). Your final results are clearly stated as well as a discussion of the implications of your experiment or activity.
- The paper has good grammar, complete sentences and paragraphs, and a logical structure.

Notes:

There will be up to a 2 pt. deduction for a poorly written (grammar/spelling) report.

There is a late fee of 1 pt. per day.

Grading:

Course grades will be determined by the percentage of total points assigned for the course.

93% = A,	80% = B-,	67% = D+,
90% = A-,	77% = C+,	63% = D,
87% = B+,	73% = C,	60% = D-,
83% = B,	70% = C-,	< 60% = F.

The **approximate** assignment of points will be as follows:

Item	Score	~%
Exam 1: See schedule	50	9%
Exam 2: See schedule	50	9%
Final: See schedule	100	18%
Reading Summaries (21 @ 1 each)	21	4%
Class activities (21 @ 1 each)	21	4%
Homework (78 @ 1 pt. each.)	78	14%
MATLAB/Python projects.	15	3%
Laboratory reports (11 @ 20 pts.)	230	41%
Total	500	100

I reserve the right to adjust grades slightly based on class participation. There may be occasional opportunities for extra credit.

Inclusive Learning Environment Statement: The University of Wisconsin-Whitewater is dedicated to a safe, supportive, and non-discriminatory learning environment. It is the responsibility of all students to familiarize themselves with UWW policies regarding: Special Accommodations, Academic Misconduct, Religious Beliefs Accommodation, Absence for University Sponsored Events, the "Rights and Responsibilities" section of the Undergraduate Catalog or the "Academic Requirements and Policies" section of the Graduate Catalog, the "Student Academic Disciplinary Procedures" (UWS Chapter 14), and the "Student Non-academic Disciplinary Procedures" (UWS Chapter 17).

Mandatory Reporting Statement: Federal law requires all university employees to report information obtained during the course of their duties regarding sexual misconduct, including domestic and dating violence, unless otherwise exempt by state law. For more information, including on how to report an incident, see <http://www.uww.edu/sexual-misconduct-information>.

FINAL EXAM SCHEDULE

All instructional staff of on- and off-campus classes are expected to meet during their scheduled final exam times. All comprehensive final exams shall be administered at the prescribed time during the final exam times. For those classes where there is no final exam, the time prescribed during the final exam times shall be used as a regular class meeting. Exception to meeting classes during the exam times requires specific written approval in advance from the college dean.

The general schedule will be available via PDF around the beginning of the given term. Due to the amount of department requested changes, the specific final exam schedule in WINS will not be available to view until after the tenth day of classes for the term.

No student shall be required to take more than two comprehensive final exams on the same day. Any student with more than two comprehensive final exams scheduled on the same day who want to reschedule the excessive exam(s) must make arrangements with the instructors involved. If the student and instructors are unable to reach mutual agreement about alternate arrangements, the student must notify the Chair of Department by end of week 7. The Chair of the Department shall arrange times as necessary with instructors involved and shall notify the student of the arrangements by end of week 11. This policy covers only comprehensive final exams given during the final exam times. Common exams cannot be rescheduled.

- Final exams for web-based and arranged classes are to be held during final exam week at the discretion of the instructor.
- Final exams for off-campus classes are to be held at the regular class meeting time that falls during the final exam week.
- Classes offered at times not listed below do not have designated final exam times. Instructors are to make arrangements by the end of week 11 to administer these exams during the standard final exam times*.
- Instructors needing an alternative time or location, different than the one assigned, must work with their department associate to request an alternative.
- 0.5 - 1 unit courses will not be assigned a final exam time. However, if instructors would like to host a final exam, please contact the Registrar's Office by the tenth day of classes to ensure proper time and room assignments occur.

Monday

7:45-9:45 am MW, MW/R, MW/F, MTW/R, MF or WF classes beginning between 7:00-8:50 am
 10:00-12 Noon TR, MTR, MTW/R or TWR classes beginning between 10:00-10:50 am
 12:15-2:15 pm MW, MW/R, MW/F, MTW/R, MF or WF classes beginning between 12:00-12:50 pm
 2:30-4:30 pm M, MW, MW/R, MW/F, MTW/R or TWR classes beginning between 2:00-2:50 pm
 4:45-6:45 pm M, MW, MW/R, MW/F, MTW/R or MF classes beginning between 4:00-6:25 pm
 7:00-9:00 pm M, MW, MW/R, MW/F, MTW/R or MF classes beginning 6:30 pm or later

Thursday

7:45-9:45 am TR, MTR, MTW/R or TWR classes beginning between 9:00-9:50 am
 10:00-12 Noon TR, MTR, MTW/R or TWR classes beginning between 11:00-11:50 am
 12:15-2:15 pm TR, MTR, MTW/R or TWR classes beginning between 1:00-1:50 pm
 2:30-4:30 pm TR, MTR, MTW/R or TWR classes beginning between 3:00-3:50 pm
 4:45-6:45 pm R or TWR classes beginning between 4:00-6:25 pm
 7:00-9:00 pm R or TWR classes beginning 6:30 pm or later and Common Exam 2

Tuesday

7:45-9:45 am TR, MTR, MTW/R or TWR classes beginning between 7:00-8:50 am
 10:00-12 Noon TR, MTR, MTW/R or TWR classes beginning between 10:00-10:50 am
 12:15-2:15 pm TR, MTR, MTW/R or TWR classes beginning between 12:00-12:50 pm
 2:30-4:30 pm TR, MTR, MTW/R or TWR classes beginning between 2:00-2:50 pm
 4:45-6:45 pm T, TR, MTR or MTW/R classes beginning between 4:00-6:25 pm
 7:00-9:00 pm T, TR, MTR or MTW/R classes beginning 6:30 pm or later
 and Common Exam 1

Friday*

7:45-9:45 am F only classes beginning between 7:00-9:55 am
 10:00-12 Noon F only classes beginning between 10:00-11:55 am
 12:15-2:15 pm F only classes beginning between 12:00-1:55 pm
 2:30-4:30 pm F only classes beginning between 2:00-3:55 pm
 4:45-6:45 pm F only classes beginning between 4:00 pm or later

*Friday will also include courses offered at a non-standard start time and special makeup exams for on-campus students if authorized by instructor.

Wednesday

7:45-9:45 am MW, MW/R, MW/F, MTW/R, MF or WF classes beginning between 9:00-9:50 am
 10:00-12 Noon MW, MW/R, MW/F, MTW/R, MF or WF classes beginning between 11:00-11:50 am
 12:15-2:15 pm MW, MW/R, MW/F, MTW/R, MF or WF classes beginning between 1:00-1:50 pm
 2:30-4:30 pm MW, MW/R, MW/F, MTW/R, MF or WF classes beginning between 3:00-3:50 pm
 4:45-6:45 pm W or WF classes beginning between 4:00-6:25 pm
 7:00-9:00 pm W or WF classes beginning 6:30 pm or later

Saturday

Saturday classes should hold exams during the meeting time that falls during exam week.

Sunday

Sunday classes should hold exams during the meeting time that falls during exam week.