Point Loma Nazarene University

Department of Physics and Engineering

Fall 2026

PHY 3014/L Modern Physics and Lab (3 + 1 units)

Class meetings: MWF 7:25–8:20 pm in RS 365

Lab meetings: T 2:25–5:45 pm in RS 365

Final Exam: Monday, December 14, 7:30–10:00 am

Instructor: Dr. Paul D. Schmelzenbach

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Office hours: RS258 by appointment

PLNU Mission: To Teach ~ To Shape ~ To Send

Point Loma Nazarene University exists to provide higher education in a vital Christian community where minds are engaged and challenged, character is modeled and formed, and service is an expression of faith. Being of Wesleyan heritage, we strive to be a learning community where grace is foundational, truth is pursued, and holiness is a way of life.

Department Mission

The Physics and Engineering Department at PLNU provides strong programs of study in the fields of Physics and Engineering. Our students are well prepared for graduate studies and careers in scientific and engineering fields. We emphasize a collaborative learning environment which allows students to thrive academically, build personal confidence, and develop interpersonal skills. We provide a Christian environment for students to learn values and judgment, and pursue integration of modern scientific knowledge and Christian faith.

General Education Mission

PLNU provides a foundational course of study in the liberal arts informed by the life, death, and resurrection of Jesus Christ. In keeping with the Wesleyan tradition, the curriculum equips students with a broad range of knowledge and skills within and across disciplines to enrich major study, lifelong learning, and vocational service as Christ-like participants in the world's diverse societies and culture.

Course Description

An introduction to concepts of modern physics including relativity, quantum theory, atomic physics, and high energy physics. Letter Grade

Course Learning Outcomes

After completing this course, students can

1. list the basic postulates of relativity, and be able to describe some of the basic implications of these that go against our usual intuition (and explain how experimental evidence supports these)
2. analyze simple dynamical processes using relativistic dynamics
3. provide evidence for quantum mechanics and describe its relevance to modern science and technology
4. apply basic quantum mechanical principles to several introductory situations and explain the physical meaning of the mathematical formulation
5. articulate the big ideas from each section

6. justify and explain your thinking and approach to a problem or physical situation; sketch and interpret relevant diagrams (such as energy level diagrams or sketches of wavefunctions)
7. conduct experiments and analyze and interpret data
8. develop effective communication skills in writing technical information

Additionally this course supports the Engineering program through supporting and assessment of ABET requirements:

- ABET 1: an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
- ABET 3: an ability to communicate effectively with a range of audiences
- ABET 6: an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions

General Education Learning Outcomes

This course is one of the components of the Foundational Experience program at Point Loma Nazarene University, through which students will acquire knowledge of human cultures and the physical and natural world while developing skills and habits that foster life-long learning. Specifically, this course supports this broader context in developing GELO 1e. Quantitative Reasoning: Students will be able to solve problems that are quantitative in nature. Assessment of this learning outcome will be demonstrated on the final exam embedded in questions typical of introductory physics.

General Education Course Tags

Course tags give general education credit for a wide range of upper-division course options, including those that overlap with a major, minor, elective, or other GE courses. These tags demonstrate that the skills, competencies, and values explored through general education courses are interconnected with students' vocational pursuits and career paths at the upper-division level and beyond.

GE Course Tag: Writing Instructive

Required Texts and Materials

Felder, G. & Felder, K., Modern Physics, 2nd Edition, Cambridge University Press, 2022. Calculator, lab notebook.

Course Credit Hour Information

In the interest of providing sufficient time to accomplish the stated course learning outcomes, this class meets the PLNU credit hour policy for a 4-unit class delivered over 15 weeks. Specific details about how the class meets the credit hour requirements can be provided upon request.

Assessment and Grading

The grade you earn in this course is based on the scale below. The points you receive during the course are weighted accordingly:

(15%) Preparation and Practice

- Preclass (3%): 2–3 short questions on the reading, due 10pm the night before.
- Homework and Activities (12%): on-paper practice of what we have been learning. The lowest two scores will be dropped.

(10%) Quizzes

In class, roughly weekly, drawn directly from the homework and preclass questions. Lowest two dropped.

(25%) Lab

Lab provides you the opportunity for a hands-on experience of topics from class and important experiments in modern physics. You will be developing lab techniques, furthering your understanding and operation of lab equipment, applying data analysis techniques, and learning to better communicate findings. Labs will be performed in small groups.

(30%) Exams

Three exams will be given during the semester. Exams will include both multiple-choice or short answer conceptual questions, and problems to solve. Exams will be closed book, but a sheet of formulas will be provided. Partial credit will be given for correct reasoning at any step of a problem, but only if it is communicated clearly enough for me to understand.

(20%) Final Exam

The final examination will be comprehensive, with a slight emphasis on the final section of material in the course.

A	B	C	D	F
92–100 (A)	87–89 (B+)	77–79 (C+)	67–69 (D+)	< 59
90–91 (A−)	83–86 (B)	73–76 (C)	63–66 (D)	
	80–82 (B−)	70–72 (C−)	60–62 (D−)	

Late Assignments

Activities, Quizzes, and homework and pre-class must be submitted on-time for credit. Lab reports submitted late will receive a 10 percent deduction per day. If an emergency occurs, please be in contact with me as soon as you are able.

Exams and Missing Exam Policy

Examinations and the Final Examination will include problems and questions over material assigned in the text, explored in homework, as well as material presented in class. Distributed specific learning outcomes for the section, or for the entire class, will provide a good means of study. No examination shall be missed without prior consent or a well-documented emergency beyond your control. A score of zero will be assigned for an examination that is missed without prior consent or a well-documented emergency beyond your control. If such an event arises, please ensure that you communicate with the professor as soon as possible so other arrangements can be made.

Final Exam

Successful completion of this class requires taking the final examination on its scheduled day. The final examination schedule is posted on the Traditional Undergraduate Records: Final Exam Schedules site. If you find yourself scheduled for three (3) or more final examinations on the same day, you are authorized to contact each professor to arrange a different time for one of those exams. However, unless you have three (3) or more exams on the same day, no requests for alternative final examinations will be granted.

Incomplete Grade

A grade of incomplete will only be assigned in extremely unusual circumstances. If you believe that your particular circumstances qualify, be in clear communication with the professor as soon as you are able.

Artificial Intelligence (AI) Policy

You are allowed to use Large Language Models (like ChatGPT, NotebookLM, Claude, etc.) as a study tool, but not on any exams. Work that utilizes AI-based tools should be identified as such, including the tool used. Specific use cases will be clarified in class.

PLNU Academic Accommodations Policy

PLNU is committed to providing equal opportunity for participation in all its programs, services, and activities in accordance with the Americans with Disabilities Act (ADA). Students with disabilities may request course-related accommodations by contacting the Educational Access Center (EAC), located in the Bond Academic Center, by email or phone at 619-849-2533. Once a student's eligibility for an accommodation has been determined, the EAC will work with the student to create an Accommodation Plan (AP) that outlines approved accommodations. Professors are able to view a student's approved accommodations through Accommodate.

PLNU highly recommends that students speak with their professors during the first two weeks of each semester/term about the implementation of their approved accommodations in that particular course. Accommodations are not retroactive; as such, clarifying with the professor at the outset is one of the best ways to promote positive academic outcomes.

Students who need accommodations for a disability-related need should contact the EAC as early as possible (i.e., ideally before the beginning of the semester) to assure appropriate accommodations can be provided. In accordance with ADA, accommodations cannot constitute a fundamental alteration to course outcomes; therefore, planning ahead is vital in establishing appropriate accommodations for equal access to this course. It is the student's responsibility to make the first contact with the EAC. Students cannot assume that because they had accommodations in the past, their eligibility at PLNU is automatic. All determinations at PLNU must go through the EAC eligibility process. This is to protect the privacy of students with disabilities who may not want to disclose this information and are not asking for any accommodations.

Additional Course Information

Additional PLNU policies and practices that apply to this course can be found at the following link: https://docs.google.com/document/d/1SoL5YMfCv_5cobhBwrDjbcZJzNKKTCfM/edit?usp=sharing&ouid=104297418648613020764&rtpof=true&sd=true

LomaBooks Instructions for Students

This course is part of our course material delivery program, LomaBooks. The bookstore will provide each student with a convenient package containing all required physical materials; all digitally delivered materials will be integrated into Canvas.

You should have received an email from the bookstore confirming the list of materials that will be provided for each of your courses and asking you to select how you would like to receive any printed components (in-store pick up or home delivery). If you have not done so already, please confirm your fulfillment preference so the bookstore can prepare your LomaBooks materials.

Class Meeting Calendar

Date	Topic	Reading	Hmk
8/31	Intro and Galilean Transformation	1.1	
9/02	Einstein's Postulates and Time Dilation	1.2	
9/04	Length Contraction and Simultaneity	1.3	Hmk1
9/09	The Lorentz Transformations (Q1)	1.4	
9/11	Velocity Transformations and the Doppler Effect	1.5	
9/14	Spacetime Diagrams	2.1	Hmk2a
9/16	Momentum and Energy (Q2)	2.2	
9/18	Mass and Energy ($E=mc^2$)	2.3	
9/21	Wrap up and Review (Q3)		Hmk2b
9/22	**Exam 1**		
9/23	Interference / Young Double-Slit	3.1–3.2	
9/25	One Photon at a Time	3.3	
9/28	Blackbody Radiation and UV Catastrophe	3.4	Hmk3a
9/30	The Photoelectric Effect (Q4)	3.5	

Date	Topic	Reading	Hmk
10/02	Further Photon Phenomena	3.6	
10/05	Atomic Spectra and the Bohr Model	4.1	Hmk3b
10/07	Matter Waves (Q5)	4.2	
10/09	Wavefunctions and Position Probabilities	4.3	
10/12	Heisenberg Uncertainty Principle	4.4	Hmk4
10/14	Force & Potential Energy / Energy Eigenstates (Q6)	5.1–5.2	
10/16	The Infinite Square Well	5.3	
10/19	Other Bound States	5.4	Hmk5a
10/21	Complex Numbers / Time Evolution of a Wavefunction	5.5–5.6	
10/26	Wrap-up and Review (Q7)		Hmk5b
10/27	**Exam 2**		
10/28	Standing/Traveling Waves; Free Particles & Fourier	6.1–6.2	
10/30	Scattering and Tunneling	6.5	
11/02	Hydrogen Atom: Quantum Numbers / 3D Schrödinger Eq	7.1–7.2	Hmk6
11/04	Spin / Spin and the Problem of Measurement (Q8)	7.5–7.6	
11/06	Pauli Exclusion / Energy Levels and Atomic States	8.1–8.2	
11/09	The Periodic Table	8.3	Hmk7-8
11/11	Ionic and Covalent Bonds (Q9)	9.1	
11/13	Bonding and Antibonding States	9.2	
11/16	Crystals	11.1	Hmk9
11/18	Band Structure and Conduction (Q10)	11.2	
11/20	Valence-electron bridge + Semiconductors and Diodes	11.3	
11/23	Transistors	11.4	
11/30	Wrap up and Review		Hmk11
12/01	**Exam 3**		
12/02	What's in a Nucleus? / Experimental Evidence (Q11)	12.1–12.2	
12/04	Nuclear Models	12.3	
12/07	Nuclear Decay	12.4	Hmk12
12/09	Nuclear Fission and Fusion / course synthesis (Q12)	12.5	
12/11	Wrap up and Review		
12/14	**Final Exam**		