Point Loma Nazarene University
Department of Physics and Engineering
PHY3004: Modern Physics and Lab (3 + 1 units)
MWF 8:30-9:25 RS 265; T 7:25-9:10
Spring 2022: January 11-April 29

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Office hours: Appointment as needed.

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.

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

Foundational Experience & Course Learning Outcomes
Upon completion of this course, students will be able to:

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
5. justify and explain your thinking and approach to a problem or physical situations
6. sketch and interpret relevant diagrams (such as energy level diagrams or sketches of wavefunctions)
7. demonstrate proficiency using physics equipment in the intermediate lab setting (for example lasers, oscilloscopes, working with ionizing radiation)
8. set up, perform, collect, and analyze data in modern physics experiments effectively communicate technical information
9. effectively communicate technical information

Required Texts and Materials

- Modern Physics, 4th Edition by Krane

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:

(5%) Preclass Each class day there will a few questions to answer electronically. These will typically be due by 10 pm the evening before class. Your responses to the preclass questions are graded on the following scale: 3=demonstrates reading/thinking; 2=room for improvement, 1=looks pretty last second, 0=unsatisfactory.

(25%) 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 pairs.

(20%) Homework Problems will be given throughout the course. As with upper-division physics courses, homework is essential to your learning of the material. Problems in this course are usually analytic but will be complemented by computational methods. Problems should be worked neatly in clear logical steps. Solutions should be clear enough one of your peers could easily follow what you did if they had not worked the problem before.

(30%) Exams (3): Three exams will be given during in-semester on February 4, March 2, and April 6. 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 to you to use during your exam. 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. For problems that call for a solution or explanation, no credit will be given for an answer alone; the method or reasoning must also be shown.

(20%) Final exam: The final exam is Friday May 6 at 7:30-10:00 am. The final examination will be comprehensive with an emphasis on the final material in the course.

A	B	C	D	F
A 92-100	B+ 87-89	C+ 77-79	D+ 67-69	F Less than 59
A- 90-91	B 83-86	C 73-76	D 63-66	
	B- 80-82	C- 70-72	D- 60-62	

Exams
Examinations and the Final Examination will include problems and questions over material assigned in the text, readings and handouts, as well as material presented in class. 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.

Final Exam
The final exam date and time is set by the university at the beginning of the semester and may not be changed by the instructor. This schedule can be found on the university website and in the course calendar. No requests for early examinations will be approved. Only in the case that a student is required to take three exams during the same day of finals week, is an instructor authorized to consider changing the exam date and time for that particular student.

Incompletes and Late Assignments
Each day late a homework assignment or lab is submitted will reduce the points you receive by 10 percent. After 5 days, an assignment will no longer be accepted for evaluation. Incompletes will only be assigned in extremely unusual circumstances.

PLNU Copyright Policy
Point Loma Nazarene University, as a non-profit educational institution, is entitled by law to use materials protected by the US Copyright Act for classroom education. Any use of those materials outside the class may violate the law.

PLNU Academic Honesty Policy
Students should demonstrate academic honesty by doing original work and by giving appropriate credit to the ideas of others. Academic dishonesty is the act of presenting information, ideas, and/or concepts as one's own when in reality they are the results of another person's creativity and effort. A faculty member who believes a situation involving academic dishonesty has been detected may assign a failing grade for that assignment or examination, or, depending on the seriousness of the offense, for the course. Faculty should follow and students may appeal using the procedure in the university Catalog. See Academic Policies. for definitions of kinds of academic dishonesty and for further policy information.

PLNU Academic Accommodations Policy
PLNU is committed to providing equal opportunity for participation in all its programs, services, and activities. Students with disabilities may request course-related accommodations by contacting the Educational Access Center (EAC), located in the Bond Academic Center (EAC@pointloma.edu or 619-849-2486). Once a student's eligibility for an accommodation has been determined, the EAC will issue an academic accommodation plan ("AP") to all faculty who teach courses in which the student is enrolled each semester.

PLNU highly recommends that students speak with their professors during the first two weeks of each semester/term about the implementation of their AP in that particular course and/or if they do not wish to utilize some or all of the elements of their AP in that course.

Students who need accommodations for a disability should contact the EAC as early as possible (i.e., ideally before the beginning of the semester) to assure appropriate accommodations can be provided. It is the student's responsibility to make the first contact with the EAC.

PLNU Attendance and Participation Policy
Attendance is expected at each class session. In the event of an absence you are responsible for the material covered in class and the assignments given that day. Regular and punctual attendance at all classes is considered essential to optimum academic achievement. If the student is absent from more than 10 percent of class meetings, the faculty member can file a written report which may result in de-enrollment. If the absences exceed 20 percent, the student may be de-enrolled without notice until the university drop date or, after that date, receive the appropriate grade for their work and participation. See Academic Policies site. in the Undergraduate Academic Catalog. If absences exceed these limits but are due to university excused health issues, an exception will be granted.

Class Enrollment:
It is the student's responsibility to maintain his/her class schedule. Should the need arise to drop this course (personal emergencies, poor performance, etc.), the student has the responsibility to follow through (provided the drop date meets the stated calendar deadline established by the university), not the instructor. Simply ceasing to attend this course or failing to follow through to arrange for a change of registration (drop/add) may easily result in a grade of F on the official transcript.

Spiritual Care
Please be aware PLNU strives to be a place where you grow as whole persons. To this end, we provide resources for our students to encounter God and grow in their Christian faith. If students have questions, a desire to meet with the chaplain or have prayer requests you can contact the Office of Spiritual Development Links to an external site.

Topics and Assignments at a glance:

Date	Topic	Reading	Hmk Due	Lab
1/11	Introduction and Classical Physics	1.1		
1/12	Classical Space and Time	1.1-1.2		
1/14	Classical Statistics	1.3-1.4	Hmk 1	
1/19	Classical Relativity	2.1-2.2		
1/21	Einstein's Postulates	2.3-2.4	Hmk 2	
1/24	The Lorentz Transformation	2.5		
1/26	Twin Paradox and Space-time diagrams	2.6		
1/28	Relativistic Dynamics	2.7	Hmk 3	
1/31	Conservation Laws and Experiments	2.8-2.9		

2/02	Wrap-up Relativity			
2/04	Exam #1: Relativity		Hmk 4	
2/07	Review Waves / Photoelectric Effect	3.1-3.2		
2/09	Thermal Radiation	3.3		
2/11	The Compton Effect	3.4	Hmk 5	
2/14	More Photons	3.5-3.6		
2/16	de Broglie Waves	4.1-4.2		
2/18	de Broglie Waves II	4.2	Hmk 6	
2/21	Uncertainty Relation in waves	4.3		
2/23	Heisenberg Uncertainty Relations	4.4		
2/25	Wave Packets	4.5-4.6		
2/28	Wave Packets	4.7	Hmk 7	
3/02	Exam #2 Waves and Particles			
3/04	Waves and Boundaries	5.1		
3/14	Confined Particle	5.2		
3/16	The Schrodinger Equation	5.3		
3/18	Applications of the SE	5.4	Hmk 8	
3/21	Applications of the SE	5.5		
3/23	Steps and Barriers	5.6		
3/25	Atoms and Thomspon Model	6.1-6.2	Hmk 9	
3/28	Rutherford Atom	6.3		
3/30	Line Spectra & Bohr Model	6.4		
4/01	Frank-Hertz and Bohr	6.6, 6.8		
4/04	Wrap-up		Hmk 10	
4/06	Exam #3			
4/08	1-D atom & angular momentum	7.1-7.2		

4/11	H atom Wave functions	7.3		
4/13	H atom Wave functions	7.4-7.5	Hmk 11	
4/20	Spin	7.6-7.7		
4/22	Pauli Exclusion Principle	8.1-8.2	Hmk 12	
4/25	Outer Electrons	8.3-8.4		
4/27	Inner Electrons	8.5		
4/29	Lasers	8.7	Hmk 13	