

**PLNU Mission Statement**  
**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.

**Professor:** Dr. Heide Doss

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**Office Hours:** M and W 8:00AM-9:30AM, 10:45AM-2:00PM, T and Th 12:00PM-12:30PM, or by appointment.

NOTE if you really need to see me, I will also be around Th (time TBD) and on M from about 9:45:00AM to 10:45AM but this is also during Chapel time – so you'll have to make up Chapel one evening.

**Regular meeting times:** January 14, 2020 – May 1, 2020 (NOTE: T Jan 14 is a M schedule)

**Lecture:** MW 2:45 AM – 4:00 PM (RS 365)

**Labs:** W 4:15 PM – 6:00 PM (RS 125)

**Final Exam: Wednesday May 6, 2020 1:30 PM – 4:00 PM**

**Required Textbook:** Modern Physics by Kenneth Krane, 3rd Edition, Wiley 2012

**Required:** bound composition book used as a lab notebook.

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

**Prerequisite(s):** PHY 142 or PHY 242.

Student Learning Outcomes: In this course there are a number of specific goals for you to meet from each chapter. These smaller goals fit into the following overall learning outcomes of the physics and engineering programs to: develop an understanding of the fundamental principles of physics and of engineering; apply physical principles, mathematical reasoning, and computational techniques to solve real-world problems; design and conduct experiments as well as analyze and interpret data; and effectively communicate complicated technical information. Once you complete this course, you should 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. Explain the physical meaning of mathematical formulations;
6. Articulate the big ideas from each section;
7. Justify and explain your thinking and approach to a problem or physical situation; and
8. Sketch and interpret relevant diagrams (such as energy level diagrams or sketches of wave functions.)

**Labs:** Weekly lab meetings will provide hands-on experience of topics from class and important experiments in modern physics. You will be developing a lab technique, 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. Some lab reports will require each individual's write up, others will be co-authored by group members. There will also be lab practicum. Labs are 25% of your total grade.

You must carry out and turn in lab reports for ALL assigned labs in order to pass the class.

**Preclass Assignments:** Each day of class there will questions to answer electronically. These will be due by 11:59 PM the night before class. Your responses to the PC questions are graded as follows: 2 = demonstrates reading of material and thinking about material; 1 = room for improvement; 0 = unsatisfactory. PC comprises 5% of your grade. There are preclass assignments due the day before a test day and are part of the review for the exam.

**Homework:** Problems will be assigned throughout the course, and is essential to your learning the material. Problems in this course are largely analytic but will be complemented at times with computational methods. Problems should be worked neatly and in clear logical steps. Solutions should be clear enough that one of your peers could easily follow what you did if they had not worked the problem before. Homework comprises 10% of your grade. HW sets are due at the beginning of class and will not be accepted late.

**Classwork:** Classwork cannot be made up. Any grade given for classwork may be embedded in the HW grade, the preclass grade, exam grade, or lab grade depending on which category it best fits with.

**Collaboration:** Scientists and engineers collaborate, and I expect and encourage you to collaborate with your peers while working on homework and labs, however your work should be your own. The guideline is that you should have no trouble explaining or repeating the work you turn in. No homework solutions should look identical.

**Late Work:** Late work will not be accepted unless there is a documented emergency. Assignments are due as noted on the syllabus, in class, and on Canvas. Incompletes are only assigned in extremely unusual circumstances.

**You must turn in all assigned labs, take all the exams, and the final in order to pass the class.**

**Exams:** There will be four in-class exams during the semester, each worth 10% of your grade. Exams make a total of 40% of your grade. You must take all exams to pass the course.

**Missed Exam Policy:** No make-up exams are allowed except for warranted circumstances. Arrangements must be made with me as soon as possible.

**Final Exam - Wednesday May 6, 2019 1:30 pm – 4:00 pm:** 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.

The final is set for **Wednesday May 6, 2019 1:30 pm – 4:00 pm**. Successful completion of this class requires taking the final examination **on its scheduled day**. The final examination schedule is posted on the [Class Schedules](#) site. No requests for early examinations or alternative days will be approved. The final exam is worth 20% of your grade.

**Course Grade:** The points you receive during the course are weighted accordingly:

Component	Weight
PC	5%
Homework	10%
Lab	25%
Tests (4)	40% (equally weighted)
Final Exam	20%

The grade you earn in this course is based on the following scale:

A	A-	B+	B	B-	C+	C	C-	D+	D	D-
S $\geq$ 91.5	91.5 >S $\geq$ 89.5	89.5 >S $\geq$ 86.5	86.5 >S $\geq$ 81.5	81.5 >S $\geq$ 79.5	79.5 >S $\geq$ 76.5	76.5 >S $\geq$ 71.5	71.5 >S $\geq$ 69.5	69.5 >S $\geq$ 66.5	66.5 >S $\geq$ 61.5	61.5 >S $\geq$ 59.5

**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.

**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 the Undergraduate Academic Catalog [Class Attendance](#).

**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.

### **Academic Accommodations:**

While all students are expected to meet the minimum standards for completion of this course as established by the instructor, students with disabilities may require academic adjustments, modifications or auxiliary aids/services. At Point Loma Nazarene University (PLNU), these students are requested to register with the Disability Resource Center (DRC), located in the Bond Academic Center.

([DRC@pointloma.edu](mailto:DRC@pointloma.edu) or 619-849-2486). The DRC's policies and procedures for assisting such students in the development of an appropriate academic adjustment plan (AP) allows PLNU to comply with Section 504 of the Rehabilitation Act and the Americans with Disabilities Act. Section 504 (a) prohibits discrimination against students with special needs and guarantees all qualified students equal access to and benefits of PLNU programs and activities. After the student files the required documentation, the DRC, in conjunction with the student, will develop an AP to meet that student's specific learning needs. The DRC will thereafter email the student's AP to all faculty who teach courses in which the student is enrolled each semester. The AP must be implemented in all such courses.

If students do not wish to avail themselves of some or all of the elements of their AP in a particular course, it is the responsibility of those students to notify their professor in that course. PLNU highly recommends that DRC students speak with their professors during the first two weeks of each semester about the applicability of their AP in that particular course and/or if they do not desire to take advantage of some or all of the elements of their AP in that course.

### **Credit Hour:**

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

### **Copyright Protected Materials:**

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 Honesty](#) for definitions of kinds of academic dishonesty and for further policy information.

**FERPA Policy:** In compliance with federal law, neither PLNU student ID nor social security number should be used in publicly posted grades or returned sets of assignments without student written permission. This class will meet the federal requirements by distributing grades and papers individually. Also, in compliance with FERPA, you will be the only person given information about your progress in this class unless you have designated others to receive it in the "Information Release" section of the student portal. See Policy Statements in the undergrad academic catalog.

**Tentative Syllabus – subject to updates**

**Note: time spent outside of class should be  $\approx$  3 hours per credit hour per week.**

Preclasses due in Canvas by 11:59 PM the night before class; HWs due at the start of class.

Date	Topics and Readings	Assignments due	Labs (W)
1/14 T = M schedule	Intro; Classical Physics and its limitations Ch 1.1-1.4	PC1 (due 1/14 11:59 PM)	
1/15 W	Special Relativity Ch 2.1-2.4	PC2 (due 1/14 11:59 PM)	Lab 1: Intro to Lab, Working with data Uncertainty.
1/20 M	No Classes – Martin Luther King Day		
1/22 W	Special Relativity Ch 2.5-2.6 Group Work: Special Relativity	PC3 HW1	Lab 2: Intro to LaTeX Intro to Lab Write-Ups, Michelson Interferometer
1/27 M	Special Relativity Ch 2.7-2.9 Particle like properties of EM radiation Ch 3.1-3.3	PC4 HW2	
1/29 W	Particle like properties of EM radiation Ch 3.3-3.6	PC5 HW 3 due Friday	Lab 3: Lab Write-Ups, Michelson Interferometer
2/3 M	Wavelike properties of particles Ch 4.1-4.4	PC6	
2/5 W	Wavelike properties of particles Ch 4.5-4.7	PC7 HW4 due Friday	Lab 4: Michelson Interferometer
<b>2/10 M</b>	<b>Exam 1 (Chapters 2-4)</b> Schrödinger's Equation Ch 5.1-5.2	PC8	
2/12 W	Schrödinger's Equation Ch 5.3-5.4	PC8 HW5 due Friday	Lab 5: Lab Rotations
2/17 M	Schrödinger's Equation Ch 5.5-5.6 --Schrödinger Worksheet?	PC10	
2/19 W	Rutherford-Bohr Model Ch 6.1-6.4	PC11 HW6 due Friday	Lab 6: Lab Rotations (possible spill over ch6)
2/24 M	Rutherford-Bohr Model Ch 6.5-6.8	PC12	
2/26 W	Hydrogen atom Ch 7.1-7.9	PC13 HW7 due Friday	Hydrogen atom Ch 7.4-7.9
3/2 M	Lab 7: Lab - work on computer lab given to you last wed.	PC14	
3/4 W	<b>Exam 2 (Ch 5-7)</b>	PC15	Lab 8: Lab Rotations
3/9-13	No Classes - Spring Break		
3/16 M	Many-electron atoms Ch 8.4-5	PC16	
3/18 W	Many-electron atoms Ch 8.6-7; Molecular Structure Ch 9.1 semester grades distributed	PC17 HW8 due Friday	Lab 9: Lab Rotations

<b>Date</b>	<b>Topics and Readings</b>	<b>Assignments</b>	<b>Labs (W)</b>
3/23 M	Molecular Structure Ch 9.2-9.6	PC 28	
3/25 W	Statistical physics Ch 10.1-10.3	PC 29 HW9 due Friday	Lab 10: Lab Rotations
3/30 M	Statistical physics Ch 10.4-10.7	PC 30	
<b>4/1 W</b>	<b>Exam 3 (Ch 8-10)</b> Last day to drop March 27	PC 31 HW 10 due today	Lab 11: Lab Rotations
4/6 M	Solid State Ch 11.1-11.4.4	PC 32	
4/8 W	Solid State Ch 11.4-11.8	PC 33 HW 11 due Friday	Lab 12: Lab Rotations
4/9-13	No Classes - Easter Recess		
4/13 M	Nuclear structure and radioactivity Ch 12.1-12.6	PC 34	
4/15 W	Nuclear structure and radioactivity Ch 12.6-12.10	PC 35 HW 12 due Friday	Lab 13: Lab Rotations
4/20 M	Elementary Particles Ch 14.1-8	PC 36	
4/22 W	Elementary Particles Ch 14.1-8	PC 37 HW 14 due Friday	Lab 14: Lab Rotations
<b>4/27 M</b>	<b>EXAM 4 Ch 11,12,14</b>	PC41	
4/29 W	Catch up/Review	PC42 HW15 due today	Lab Practicum
<b>5/6/20 W</b>	<b>FINAL EXAM 1:30 PM - 4:00 PM</b>		
	Grades turned in by May 17		

**Possible Labs for Lab Rotation – this will be updated – possible labs may change.**

1. Speed of Light ??
2. Photoelectric effect
3. Hydrogen Spectra
4. Compton Scattering
5. Na doublet
6. Frank-Hertz
7. Solar-Spectrum
- 8a. Oil-Drop Theory (separate week for this)
- 8b. Oil-Drop Data (maybe extra credit ??)
9. Molecular spectra ?? (at least analyzing data)
10. QuVis
11. Schrödinger Worksheet/DeBroglie Worksheet/Special Relativity Worksheet
12. PhET lab