Point Loma Nazarene University PHY3004 & PHY3004L -- Modern Physics 3+1=4 Units Spring 2021

POINT LOMA NAZARENE UNIVERSITY	**Physics and Engineering Department** **PHY 3004 Modern Physics + 3004L Modern Phys Lab** **Units: 3 + 1** **Prerequisite(s):** PHY 1054 with a grade of C- or higher or PHY 2054 with a grade of C- or higher. **Corequisite(s):** PHY 3004L (Units: 1)
Spring 2021 | March 1- June 4	

Instructor: Dr. Heide Doss, Ph.D.
Phone: **619.840.4559** (cell) **619.849.2219** (office)
Email: hdoss@pointloma.edu
Office hours: MWF 11AM-1PM, MW 4-5 **Zoom Info: Meeting ID: 915 5520 2403** **Passcode: DossOffice**

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.

Prerequisite(s): PHY 1054 with a grade of C- or higher or PHY 2054 with a grade of C- or higher.
Corequisite(s): PHY 3004L

COURSE LEARNING OUTCOMES
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.)
9. Articulate issues of diversity and equity in STEM.

REQUIRED TEXTS AND RECOMMENDED STUDY RESOURCES

- Text: Krane, Kenneth S., *Modern Physics*, 4th edition, Wiley (2020)
- Calculator: A scientific calculator
- Bound lab notebook (e.g. a composition book)
- Laptop or computer access (canvas assignments, zoom meetings, labs, creating presentations, etc.)

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 3 unit class delivered over fifteen weeks and the lab portion meets the PLNU credit hour policy for a 1 unit class delivered over fifteen weeksand the lab course. Specific details about how the class meets the credit hour requirement can be provided upon request. (Based on 37.5 hours of student engagement per credit hour.)

Distribution of Student Learning Hours

Category	Time Expectation in Hours
Online Participation in Discussions, Groups, etc.	21
Reading Assignments	30
Written Assignments	30
Synchronous class activities	21.5
Laboratory Assignments	37.5
Exams and Finals	10
Total Hours	150

ASSESSMENT AND GRADING

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 preformed 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. 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.

Class Activities & Projects: Each class will have an assessed activity. These class activities cannot be made up. There will also be assigned projects.

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 take all the exams, and the final in order to pass the class.

Exams: There will be three "in-class" exams during the semester, each worth 10% of your grade. Exams make a total of 30% of your grade. You must take all exams to pass the course.

Final Exam: Date and Time: Friday 11 June 2021, 1:30 PM to 4:30 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.

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

- **Examinations and the Final Examination**. 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. 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.
- **Late work will not be accepted** without prior consent or a well-documented emergency. Up to a maximum of one homework assignment will be accepted up to 3 days late provided that consent is received from the professor before it is due. Homework assignments that are submitted late without prior consent will be recorded with a score of zero. If more than half of the homework assignments are submitted on time, then the lowest homework score will be dropped from the calculations of the homework grade.
- The examination schedule is included in the daily schedule so that you may plan accordingly for other events without conflict.

Component	Weight
Preclasses	5%
Homework	10%
Class Activities/Projects	10%
Lab	25%
Tests (3)	30% (equally weighted)
Final Exam	20%

Grading Scale

Grades are based on the number of points accumulated throughout the course with the following exception. A student must take all exams, complete all labs, and take the final. Approximate minimal percentages required to obtain a given grade are: This table is fairly standard in the department, but not uniform.

Standard Grade Scale Based on Percentages					
	A	**B**	**C**	**D**	**F**
+		87.5 - 89.4	77.5 - 79.4	67.5 - 69.4	
	92.5 - 100	82.5 - 87.4	72.5 - 77.4	62.5 - 67.4	0- 59.4
-	89.5 - 92.4	79.5 - 82.4	69.5 - 72.4	59.5 - 62.4	

INCOMPLETES AND LATE ASSIGNMENTS
All assignments are to be submitted/turned in by the beginning of the class session when they are due—including assignments posted in Canvas. Incompletes will only be assigned in extremely unusual circumstances.

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.

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
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 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.

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 for further information about class **PLNU ATTENDANCE AND PARTICIPATION POLICY**

Regular and punctual attendance at all **synchronous** class sessions is considered essential to optimum academic achievement. If the student is absent for more than 10 percent of class sessions (virtual or face-to-face), the faculty member will issue a written warning of 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. In some courses, a portion of the credit hour content will be delivered **asynchronously** and attendance will be determined by submitting the assignments by the posted due dates. See Academic Policies in the Undergraduate Academic Catalog. If absences exceed these limits but are due to university excused health issues, an exception will be granted.

Asynchronous Attendance/Participation Definition

A day of attendance in asynchronous content is determined as contributing a substantive note, assignment, discussion, or submission by the posted due date. Failure to meet these standards will result in an absence for that day. Instructors will determine how many asynchronous attendance days are required each week.

SPRING 2021 CHANGE OF MODALITY REQUEST POLICY
In order to be approved for a modality change the course must be taught in the modality you are requesting and must be approved by your instructor. For in-person courses, the classroom must be verified to meet the social distancing standards.

Note the following policy items regarding the Change of Modality Request.

- You may request to change the modality of a Quad 1, Quad 2, and Semester course(s) within the first two weeks of the semester, **with a firm deadline of Friday, March 12.**
- Submitting a request to change the modality of one or more courses for the Spring 2021 semester does not guarantee approval.
- You must maintain your current assigned modality until a change of modality is approved.
- Attempting to change the modality without approval (i.e., showing up to class in person or appearing on a Zoom call) will (a) count as an absence from that class session and (b) will result in you being removed from the class session.

Students may submit a request to change the modality of a course(s) using the Google Forms below. Students will be shared these links in an email on March 1. The links will also be provided on the PLNU COVID-19 Website beginning March 1.

- Spring 2021 Change of Modality Request Form: Remote to In-Person Experience
- Spring 2021 Change of Modality Request Form: In-Person to Remote Learning

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

Tentative Syllabus – subject to updates, Due dates on Canvas. Generaly Class Video & Readings prior to class, Preclasses prior to class, Labs the following Fri, HWs Sat 11:59 PM

Date	Topics and Readings	Assignments due	Labs (F)
Week 1	**Ch 1, Ch 2.1-4**		**L1: Working with data uncertainty**
3/1 M	Ch 1.1-1.4, Ch 2.1-2.4	PC1	
3/3 W	Ch 2.5-2.6	PC2	
3/5 F	Lab intro, lab notebook check	LNB, HW1 (S)	Remote lab involving excel
Week 2	**Ch 2.5-9, Ch 3.1-3.3**		**L2: Intro to LaTeX, Intro to Lab Write-Ups, Michelson Interferometer**
3/8 M	Ch 2.7-2.9	PC3	
3/10 W	Ch 3.1-3.3	PC4	
3/12 F	Lab 2: Intro to LaTeX Intro to Lab Write-Ups, Michelson Interferometer	L1, HW2 (S)	Groups come in at scheduled times during lab to collect data, when not collecting data you will be working on LaTeX
Week 3	**Ch 3.3-6, Ch 4**		**L3: Lab Write-Ups, Michelson Interferometer**
3/15 M	Ch 3.3-3.6	PC5	
3/17 W	Ch 4.1-4.4	PC6	
3/19 F	Ch 4.5-4.7 Lab 3: Lab Write-Ups, Michelson Interferometer	L2, HW3 (S)	We'll complete chapter 4 and continue working on the Michelson Lab and LaTeX
Week 4	**Ch 5**		**L4: Lab Rotations 1a**
3/22 M	Ch 4.5-4.7	PC7	
3/24 W	Ch 5.1-5.3	PC8	
3/26 F	Lab 4: Lab Rotations 1a	L3, NB, HW4 (S)	Begin lab rotations 1
Week 5	**Exam 1**		**Lab 5: Lab Rotations 1b**
3/29 M	**Exam 1 (Chapters 2-5)**	PC8	
3/31 W	No classes		
4/2 F	Lab 5: Rotations 1b	L4, HW5 (S), RP1	All groups are in to collect data for the lab they are conducting.
Week 6	**Ch 6**		**Lab 6: Lab Rotations 1c**
4/5 M	Ch 6.1-6.4	PC9	
4/7 W	Ch 6.5-6.8	PC10	
4/9 F	Lab 6: Rotations 1c	L5, HW6 (S)	All groups are in to collect data for the lab they are conducting.

Week 7	**Ch 7**		**Lab 7: Lab Rotations 2a**
4/12 M	Ch 7.1-7.4	PC11	
4/14 W	Ch 7.5-7.9	PC12	
4/16 F	Lab 7: Rotations 2a	L6, HW7 (S)	All groups are in to collect data for the lab they are conducting.
Week 8	**Ch 8**		**Lab 8: Lab Rotations 2b**
4/19 M	Ch 8.1-4	PC13	
4/21 W	Ch 8.5-7	PC14	
4/23 F	Lab 8: Rotations 2b	L7, HW8 (S)	All groups are in to collect data for the lab they are conducting.
Week 9	**Ch 9**		**Lab 9: Lab Rotations 2c**
4/26 M	Ch 9.1-3	PC15	
4/28 W	Ch 9.4-6	PC 16	
4/30 F	Lab 9: Rotations 2c	L8, HW9 (S)	All groups are in to collect data for the lab they are conducting.
Week 10	**Exam 2**		**Lab 10: Lab Rotations 3a**
5/3 M	**Exam 2 (Ch 6-9)** Ch 10.1-10.3	PC 19	
5/5 W	No classes		
5/7 F	Lab 10: Rotations 3a	L9, HW10(S), RP2	All groups are in to collect data for the lab they are conducting.
Week 11	**Ch 10**		**Lab 11: Lab Rotations 3b**
5/10 M	Ch 10.1-10.3	PC 20	
5/12 W	Ch 10.4-10.7	PC 31	
5/14 F	Lab 11: Rotations 3b	L10, HW11 (S)	All groups are in to collect data for the lab they are conducting, if needed.
Week 12	**Ch 11**		**Lab 12: Lab Rotations 3c**
5/17 M	Ch 11.1-4	PC 33	
5/19 W	Ch 11.4-8	PC 34	
5/21 F	Lab 12: Rotations 3c	L11, HW12 (S)	All groups are in to collect data for the lab they are conducting, if needed.
Week 13	**Ch 12**		**Lab 13: Lab Rotations 4**
5/24 M	Ch 12.1-12.5	PC 35	
5/26 W	Ch 12.6-12.10	PC 36	
5/28 F	Lab 13: Rotations 4	L12, HW6 (S)	All groups are in to collect data for the lab they are conducting, if needed.

Week 14	**Ch 14, Exam 3**		**Lab 14: Lab Practicum**
5/31 M	Ch 14	PC 37	
6/2 W	**Exam 3 Ch 10-12,14**	**PC41**	
6/4 F	Lab Practicum	L13, HW14 (S)	Lab Practicum, students come in at scheduled time.
Week 15	**Final Exam**		
6/11 F	**FINAL EXAM 1:30 PM - 4:00 PM**		
	Grades by June 20		

Tentative Lab Rotations

Lab Rotations 1	**Lab Rotations 2**	**Lab Rotations 3**	**Lab Rotations 4, Individual Work**
Photoelectric effect	Hydrogen Spectra	QuVis	Report on an experiment in a physics area of interest to you
Solar Spectrum	Na doublet	Millikan	quantum lab
Compton Scattering	Frank-Hertz	Molecular spectra	Summary of a current research paper