PHY 304 -- Modern Physics 4 Units Spring 2016

Professor: Dr. Heide Doss
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Office Hours: Th 8:30-12 (RS 216), before class, and by appointment.

Regular meeting times January 12, 2015 – April 29, 2015 (NOTE: T Jan 12 is a M schedule**)**
Lecture: MWF 12:15 PM – 1:20 PM (Rohr Science 219)
Labs: T 1:30 PM – 4:00 PM (RS 213) Dr. Schmelzenbach
Final Exam: Wednesday, May 4, 10:30 AM to 1:00 PM

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

Course Description: Modern physics provides an introduction to the concepts and methods of physics from the 20th century onward. An emphasis is placed on the revolutionary developments of relativity and quantum mechanics, which have implications from the structure of atoms to understanding the evolution of the Universe. This course helps broaden your perspective before undertaking the rigors of your junior and senior level courses.

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 the mathematical formulation;
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 wavefunctions.)

Labs: Weekly lab meetings will provide you the opportunity for 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 pairs, with each individual submitting their own lab report. Labs are 25% of your total grade.

Pre-class Assignments: Each day of class there will be three questions to answer electronically. These will be due by 9:00 AM the day of class. Your responses to the pre-class questions are graded as follows: 2 = demonstrates reading of material and thinking about material; 1 = room for improvement; 0 = unsatisfactory. Pre-class comprises 5% of your grade.

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 by computational methods. Problems should be worked neatly 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 20% of your grade. HW sets are due at the beginning of class.

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.

Tests: There will be four in-class tests during the semester, each worth 8% of your grade. Tests make a total of 32% of your grade.

Final Exam: The final is set for **Thursday, May 7, 10:30 AM to 1:00 PM.** Successful completion of this class requires taking the final examination **on its scheduled day**. The final comprises 18% of your total grade.

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

Component	**Weight**
Pre-Class	5%
Homework	20%
Lab	25%
Tests (4)	32% (equally weighted)
Final Exam	18%

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≥ 91.5	91.5 >S≥ 89.5	89.5 >S≥ 86.5	86.5 >S≥ 81.5	81.5 >S≥ 79.5	79.5 >S≥ 76.5	76.5 >S≥ 71.5	71.5 >S≥ 69.5	69.5 >S≥ 66.5	66.5 >S≥ 61.5	61.5 >S≥ 59.5

Attendance and Participation: Regular and punctual attendance at all classes is considered essential. Some activities through this course occur only during class time and cannot be made-up. Let me know in advance if you must miss class. Attendance is one factor used in determining borderline grades. If absences become excessive, you will be required to meet with me and the situation will be dealt with on a case-by-case basis.

Academic Integrity and Honesty: All students are expected to uphold the highest standards of honesty and integrity in their academic work. Cheating or plagiarism may result at a minimum in failure on the assignment and may result in an automatic failure in this course. Students should demonstrate academic

honesty by doing original work and by giving appropriate credit to the ideas of others. As explained in the university catalog, 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. Violations of university academic honesty include cheating, plagiarism, falsification, aiding the academic dishonesty of others, or malicious misuse of university resources. A faculty member who believes a situation involving academic dishonesty has been detected may assign a failing grade for a) that particular assignment or examination, and/or b) the course following the procedure in the university catalog. Students may appeal also using the procedure in the university catalog. See the university catalog, Academic Policies for further information.

Academic Accommodations: While all students are expected to meet the minimum academic standards for completion of this course as established by the instructor, students with disabilities may require academic accommodations. At Point Loma Nazarene University, students requesting academic accommodations must file documentation with the Disability Resource Center (DRC), located in the Bond Academic Center. Once the student files documentation, the Disability Resource Center will contact the student's instructors and provide written recommendations for reasonable and appropriate accommodations to meet the individual needs of the student. See Academic Policies in the undergraduate academic catalog. This policy assists the university in its commitment to full compliance with Section 504 of the Rehabilitation Act of 1973, the Americans with Disabilities (ADA) Act of 1990, and ADA Amendments Act of 2008, all of which prohibit discrimination against students with disabilities and guarantees all qualified students equal access to and benefits of PLNU programs and activities.

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 between 2 and 3 hours per credit hour per week.

Pre-class assignments on Canvas by 9:00 AM, unless otherwise noted; HW due every Friday at 12:15 PM

Date	Topics and Readings	Assignments	Labs (T)
1/12/16 T = M schedule	Intro; Classical Physics and its limitations Ch 1.1-1.4	pre-class1 (due 1/12/2016-10 pm)	NO LAB FIRST WEEK
1/13/16 W	Intro; Classical Physics and its limitations Ch 1.1-1.4 Special Relativity Ch 2.1-2.2	pre-class 2 due	
1/15/16 F	Special Relativity Ch 2.3-2.4	pre-class 3 due HW 1 due	
1/18/16 M	**No Classes – Martin Luther King Day**		R1 Lab 1: Intro to Lab Working with Data and LaTex Tutorial
1/20/16 W	Special Relativity Ch 2.5-2.6 Group Work: Special Relativity Exercise	pre-class 4 due	
1/22/16 F	Special Relativity Ch 2.7-2.9	pre-class 5 due HW 2 due	
1/25/16 M	Guest Speaker **Make sure you have read chapter 3.1-3.3 before you do the preclass**	pre-class 6 (on Ch 3.1-3.2) due	**ROTATION 1 Labs –** Groups will rotate through the following 5 labs over the next 6 weeks. R1 L2: Measurement of Speed of Light R1.L3 Wavelength Measurement using a Michelson-Morely Interferometer R1 L4: Photoelectric Effect R1 L5: Compton Scattering R1 L6: Solar Spectrum
1/27/16 W	Particle like properties of EM radiation Ch 3.1-3.3	pre-class 7 due	
1/29/16 F	Particle like properties of EM radiation Ch 3.4-3.6	pre-class 8 due HW 3 due	
2/1/16 M	Wavelike properties of particles Ch 4.1-4.2	pre-class 9 due	
2/3/16 W	Wavelike properties of particles Ch 4.3-4.4	pre-class 10 due	
2/5/16 F	Wavelike properties of particles Ch 4.5-4.7	pre-class 11 due HW 4 due	
2/8/16 M	Review and catch up --de Broglie worksheet?	pre-class 12 due	
2/10/16 W	**Exam 1 (Chapters 2-4)**	pre-class 13 due (review)	
2/12/16 F	Schrödinger's Equation Ch 5.1-5.3	pre-class 14 due HW 5 due	
2/15/16 M	Schrödinger's Equation Ch 5.4	pre-class 15 due	
2/17/16 W	Schrödinger's Equation Ch 5.5-5.6 --Schrödinger Worksheet?	Pre-class 16 due	
2/19/16 F	Rutherford-Bohr Model Ch 6.1-6.3	pre-class 17 due HW 6 due	
2/22/16 M	Rutherford-Bohr Model Ch 6.4-6.6	pre-class 18 due	

Date	Topics and Readings	Assignments	Labs (T)
2/24/16 W	Rutherford-Bohr Model Ch 6.6-6.8	pre-class 19 due	
2/26/16 F	Hydrogen atom Ch 7.1-7.3	pre-class 20 due HW 7 due	
2/29/16 M	Hydrogen atom Ch 7.4-7.5	pre-class 21 due	
3/2/16 W	Hydrogen atom Ch 7.6-7.9	pre-class 22 due	
3/4/16 F	**Exam 2 (Ch 5-7)**	pre-class 23 due (review) HW 8 due	
3/7-11/16	**No Classes - Spring Break**		
3/14/16 M	Many-electron atoms Ch 8.1-3 (Mid semester grades)	pre-class 24 due	Lab 7: Quantum Tunneling Exercise
3/16/16 W	Many-electron atoms Ch 8.4-5	pre-class 25 due	
3/18/16 F	Many-electron atoms Ch 8.6-7; 9.1	pre-class 26 due HW 9 due	
3/21/16 M	Molecular Structure Ch 9.2-9.3	pre-class 27 due	**ROTATION 2 Labs** Groups will rotate through the following 5 labs over the next 6 weeks. R2 L8: Franck-Hertz Experiment R2 L9: Emission Spectrum of Hydrogen & Spectral Analysis R2 L10: Sodium Lab R2 L11: cloud chamber R2 L12: nuclear
3/23/16 W	Molecular Structure Ch 9.4-9.6	pre-class 28 due HW 10 due	
3/25-28/16	**No Classes - Easter Recess**		
3/30/16 W	Statistical physics Ch 10.1-10.3	pre-class 29 due	
4/1/16 F	Statistical physics Ch 10.4-10.7	pre-class 30 due HW 11 due	
4/4/16 M	**Exam 3 (Ch 8-10)**	pre-class 31 due	
4/6/16 W	Solid State Ch 11.1-11.4.4	pre-class 32 due	
4/8/16 F	Solid State Ch 11.4-11.8	pre-class 33 due HW 12 due	
4/11/16 M	Nuclear structure and radioactivity Ch 12.1-12.5	pre-class 34 due	
4/13/16 W	Nuclear structure and radioactivity Ch 12.6-12.9	pre-class 35 due	
4/15/16 F	Nuclear structure and radioactivity Ch 12.6-12.10	pre-class 36 due HW 13 due	
4/18/16 M	Elementary Particles Ch 14.1-3	pre-class 37 due	
4/20/16 W	Elementary Particles Ch 14.4-6	pre-class 38 due	
4/22/16 F	Elementary Particles Ch 14.6-8	pre-class 39 due HW 14 due	
4/25/16 M	Review	pre-class 40 due (review)	

Date	Topics and Readings	Assignments	Labs (T)
4/27/16 W	**EXAM 4 Ch 11,12,14**	pre-class 41 due (review)	
4/29/16 F	Review	pre-class 42 due (review) HW 15 due (review)	
5/4/16 W	**FINAL EXAM 10:30 am - 1:00 pm**		
	Grades turned in by May 15		