Point Loma Nazarene University
PHY311: Nuclear Physics I (3 hr) Fall 2016

Department of Physics and Engineering

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Office Hours: 12-1:15 MWF, 1-3 T & by appt.

Meeting: 8:30-9:30 MWF (RS 219)
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Materials – Nuclear Physics: Principles and Applications, by J. S. Lilley (available in paperback)

Description – A survey of nuclear physics including nuclear models, laws of radioactive decay, radiation detection, and applications of nuclear science in engineering and medicine.

Learning Outcomes – This course supports the overall learning objectives of the physics and engineering programs to: apply physical principles, mathematical reasoning, and computational techniques to solve real-world problems , design and conduct experiments or complete engineering design projects as well as analyze and interpret data , effectively communicate complicated technical information , and effectively collaborate in teams

Within these broader outcomes, in this course you will

1. use and describe the meaning of terminology of nuclear physics and engineering
2. be aware of and practice ALARA
3. collect and analyze data of basic experiments in nuclear physics
4. sketch and explain features of common plots and graphical representations used in nuclear physics
5. understand the basic theory of α, β, and γ radiation and how each type of radiation interacts with matter
6. describe the essential features of the operation of a nuclear reactor and the interaction between the various important parameters
7. justify and explain your thinking and approach to a problem or physical situation in written or oral form
8. when appropriate for a given problem you should be able to predict your expectations of a problem and in all cases evaluate the reasonableness of a solution.
9. use appropriate data bases and computational tools to solve problems in nuclear physics.

Before Class: In preparation for each class meeting there is a reading assignment. To complete the reading assignment answer three questions and submit them electronically by the evening before class (due at midnight). This electronic communication is so important because it is your voice in what material we emphasize during class meetings and provides me constant feedback of your understanding of the material. These submissions will be graded on the following scale: 2=demonstrates reading, 1=room for improvement, 0=unsatisfactory. These points are accumulated and are worth 5% of the final grade.

Homework – Problems will be assigned about a week in advance

Guidelines for submission:

-Work the problem in clear logical steps. Solutions should be clear enough one of your peers could easily follow your steps if they had not worked the problem before.

-Draw diagrams where appropriate, labeling items as necessary.

-Does your answer make sense? Box your final answer.

Collaboration: I expect and encourage collaboration between you and your peers while working on your homework, but your work should be **your own original solutions**. Allow adequate time to work and think about problems by yourself first before you work together with your peers or ask questions of me. When you sit down to write up a problem, you should not use notes copied from someone else. The guideline is that you should have no trouble explaining or repeating work that you turn in. Never copy a solution directly from anywhere! (Even if it seems like you are following the steps it really doesn't help and its called plagiarism!)

Late Submission Policy: Up to four assignments will be accepted late with a 10% reduction in grade for each 24 hour period it is late (not counting Sunday). This begins with a 10% reduction for an assignment turned in after the deadline. This policy holds for both lab submissions and for homework sets.

Lab – Lab provides you the opportunity for: a hands-on experience of topics from class meetings, developing lab technique, understanding of basic equipment from the nuclear lab, and data analysis. Labs will be preformed in small groups, but each individual is responsible for submitting their lab report.

Exams – Three examinations will be given during the semester on September 28, October 31 and November 30. The final examination is on Monday, December 12 at 7:30 am. Exams will be about half multiple-choice or short answer conceptual questions, and about half problems to solve. The final examination will be comprehensive. 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. Exams are to be taken at the time indicated in the syllabus unless other arrangements are made in advance with the professor for some unavoidable circumstance and otherwise cannot be made up.

Final Grades – The grade you earn in this course is based on the scale shown to the right. The points you receive during the course are weighted accordingly:

- Preclass: 5%
- Homework/Activities: 25%
- Lab: 20%
- Tests (3): 30%
- Final Exam: 20%

A	100 - 91.0
A-	91.0 - 89.5
B+	89.5 - 87.5
B	87.5 - 81.0
B-	81.0 - 79.5
C+	79.5 - 77.5
C	77.5 - 71.0
C-	71.0 - 69.5
D+	69.5 - 67.5
D	67.0 - 61.0
D-	61.0 - 57.0

University Mission: As with all courses at PLNU, this course supports the cause to provide higher education in a vital Christian community where minds are engaged and challenged, character is modeled and formed, and service becomes an expression of faith. Being of Wesleyan heritage, we aspire to be a learning community where grace is foundational, truth is pursued, and holiness is a way of life.

Department Mission: Within this broader 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.

Attendance: 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 http://catalog.pointloma.edu/content.php?catoid=24&navoid=1581#Class Attendance in the Undergraduate Academic Catalog.

Academic Honesty – 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 http://catalog.pointloma.edu/content.php?catoid=24&navoid=1581#Academic Honesty for definitions of kinds of academic dishonesty and for further policy information.

Academic Accommodations – If you have a diagnosed disability, please contact PLNU's Disability Resource Center (DRC) within the first two weeks of class to demonstrate need and to register for accommodation by phone at 619-849-2486 or by e-mail at DRC@pointloma.edu. See Disability Resource Center for additional information. For more details see the PLNU catalog. Students with learning disabilities who may need accommodations should discuss options with the instructor during the first two weeks of class. For more details see the PLNU catalog: http://catalog.pointloma.edu/content.php?catoid=24&navoid=1581#Academic Accommodations

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.

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 an 4 unit class delivered over 16 weeks. Specific details about how the class meets the credit hour requirements can be provided upon request.

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 th 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.

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Course Calendar			
	Topics	Reading	Hmk
8/30	Introductions		
8/31	Nuclear Basics; QM review	1.1-1.4.1	
9/2	Energy Levels	1.4.1-1.4.2	Hmk 1
9/5	No class meeting		
9/7	Overview of Decay	1.4.3-1.5.4	
9/9	Radioactive Decay; Geiger Counters	1.5.5-1.5.7	Hmk 2
9/12	Wrap up Decay Chains; Cross Sections	1.6-1.6.3	
9/14	Nuclear Reactions	1.6.4-1.6.5	
9/16	SEMF	2.1-2.2	Hmk 3
9/19	The Shell Model	2.3-2.4	
9/21	The Shell Model; Single Particle	2.3-2.4	
9/23	Collective States	2.5	
9/26	Wrap-up and Catchup		Hmk 4
9/28	Exam I		
9/30	Gamma Decay I	3.1-3.2	
10/3	Gamma Decay II	3.1-3.2	
10/5	Beta Decay I	3.3	Hmk 5
10/7	Beta Decay II	3.3	
10/10	Alpha Decay I	3.4	Hmk 6
10/12	Alpha Decay II	3.4	
10/14	Heavy Charged Particles and Matter	5.1-5.2	
10/17	Heavy Charged Particles and Electrons	5.3	
10/19	Gamma Rays I	5.4	Hmk 7
10/21	Fall Break		
10/24	Gamma Rays II	5.4	
10/26	Neutrons	5.5	
10/28	Wrap-up and Catch-up		Hmk 8
10/31	Exam II		
11/2	Detectors: Gas and Scintillation	6.1-6.4	
11/4	Detectors	6.4-6.7	
11/7	Detectors and Accelerators	6.7-6.8	
11/9	Biological Effects 1	7.1-7.3	Hmk 9
11/11	Biological Effects 2	7.4-7.6	
11/14	Applications	8.1-8.3	Hmk 10
11/16	Applications	8.4-8.7	
11/18	Medical Applications	9.1-9.4	Hmk 11
11/21	Medical Applications	9.5-9.6	
11/23	Thanksgiving Break		
11/25	Thanksgiving Break		
11/28	Wrap-up and Catch-up		Hmk 12
11/30	Exam III		
12/2	Fission 1	10.1-10.3	
12/5	Fission 2	10.3	
12/7	Fission 3	10.5-10.7	
12/9	Fusion		Hmk 13
12/12	Final Exam: Monday 7:30 am		