Point Loma Nazarene University
PHY311/PHY311L: Nuclear Physics I (3 hr) Fall 2018

Department of Physics and Engineering

Instructor: Dr. Paul D. Schmelzenbach
e-mail: PaulSchmelzenbach@pointloma.edu
Office Hours: 10:45-11:50 MWF, 9-11 R; by appt.

Meeting: TR 11:00-12:15 LA101
Lab: T 12:30-2:25 (LA102)
Office Phone: 849-2933
Office Location: Trailer 02 below Gym

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. Lecture and laboratory. Not repeatable. Letter grade.

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 databases 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 – Homework is exceedingly important for developing an understanding of the course material, not to mention building skills in complex physical and mathematical problem solving. Remember that it is not just a "correct solution" that is the goal, it is the process to the solution that will develop your skill as a physicist or engineer. I encourage you to work together on the homework sets, but you must participate in the process of obtaining the solution to each problem. The guideline is that you should have no trouble explaining or repeating work that you turn in. Late homework will not be accepted unless their is a documented emergency.

Homework Grading: I will be using the following grading rubric for your homework:

0: Work shows little knowledge of physics relevant to the problem.

1: There is clear evidence in the work that a reasonable approach to the problem was attempted, but there are errors in units, formulas, or fundamental physics.

2: Either a reasonable, but incorrect, approach was attempted with few other errors; or a correct approach was presented with errors in units or math.

3: A correct approach was presented with few errors.

4: A correct approach was presented with no more than one minor error. Words were used at times to clearly indicate how and why the derivation was performed.

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 Oct. 2, Oct. 30 and Nov. 29. The final examination is on Tuesday, Dec. 11 at 10:30 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: 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.

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 – 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 accommodations. At Point Loma Nazarene University, these students are requested to file documentation during the first two weeks of the semester with the Disability Resource Center (DRC), located in the Bond Academic Center. This policy assists the University in its commitment to full compliance 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. Once the student files documentation, the DRC will contact the student's instructors and provide written recommendations for reasonable and appropriate accommodations to meet the individual learning needs of the student.

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 a 3 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		
9/4	Introductory Concepts	1.1-1.4	
9/6	Radioactivity	1.5	Hmk 1
9/11	Nuclear Collisions	1.6	
9/13	Nuclear Mass	2.1-2.2	Hmk 2
9/18	Nuclear Shell Model	2.3	
9/20	Single Particle States	2.4	Hmk 3
9/25	Collective States	2.5	
9/27	Wrap-Up and Review		Hmk 4
10/2	Exam 1		
10/4	Gamma Decay	3.1-3.2	
10/9	Beta Decay	3.3	
10/11	Alpha Decay	3.4	Hmk 5
10/16	Heavy Charged Particles	5.1-5.2	
10/18	Electrons	5.3-5.4	Hmk 6
10/23	Neutrons	5.5	
10/25	Wrap up and Review		Hmk 7
10/30	Exam 2		
11/1	Detectors 1	6.1-6.2	
11/6	Detectors 2	6.3-6.5	
11/8	Detectors and acclerators	6.6-6.8	Hmk 8
11/13	Fission	10.1-10.2	
11/15	Fission 2	10.3-10.4	Hmk 9
11/20	Fission 3	10.5-10.7	
11/22	Thanksgiving		
11/27	Wrap-up and Review		Hmk 10
11/29	Exam 3		
12/4	Fusion 1	11.1-11.3	
12/6	Fusion 2	11.4-11.6	Hmk 11
12/11	Final Exam at 10:30		