**Point Loma Nazarene University**
**EGR3083/PHY3083: Electricity, Magnetism and Waves I (3 hr)** Spring 2020


Department of Physics and Engineering

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| Instructor: Dr. Paul D. Schmelzenbach | Meeting: MWF 8:30-9:25 (RS265) |
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| Office Hours: 7-8 MWF; R 1-2:30, by appt. | Office Location: RS 258 |


**Materials** – *Introduction to Electrodynamics* by David Griffiths, 4rd edition. Published by Prentice Hall, 1999.

**Description** – Electrodynamics with an emphasis on application of Maxwell's equations particularly to electromagnetic radiation.

**Learning Outcomes** – This course supports the overall learning objectives of the physics and engineering programs to: develop an understanding of the fundamental principles of physics and apply physical principles, mathematical reasoning, and computational techniques to solve real-world problems

Within these broader outcomes, in this course you will

1. Translate a physical description of a junior-level E&M problem to a math equation necessary to solve it.
2. explain the physical meaning of the mathematical formulation
3. articulate the big ideas from each section
4. justify and explain your thinking and approach to a problem or physical situation in written or oral form
5. when appropriate for a given problem you should be able to predict your expectations of a problem (such as the direction of a field or dependence on distance) and in all cases evaluate the reasonableness of a solution.
6. be able to sketch the physical parameters of a system (such as the E or B field)
7. apply computational techniques to help in solving E&M problems
8. correctly apply problem solving techniques such as approximations, symmetries, integration and superposition

**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 itself that is the true 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. It is also important to keep up in the class, and as such 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. Diagrams were applicable, but sloppy, unclear, or mislabeled.

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. Diagrams were adequate and may have a few errors.

3: A correct approach was presented with few errors. Diagrams were clear and correctly labeled.

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. Diagrams were neat, accurate, and cleanly illustrated the physics and engineering concepts.

**Preclass questions** Each class day there will be preclass questions to answer electronically. These will be due by midnight the evening before class. Your responses to preclass questions are graded on the following scale: 2=demonstrates reading/thinking; 1=room for improvement or late but before class, 0=unsatisfactory or submitted after class. For credit preclass questions must be submitted prior to class.

**Exams** – Four exams will follow chapter 8, chapter 9, chapter 10/11 and chapter 12. The final examination is scheduled for Monday, May 4 at 7:30 am. Exams cannot be made up, unless under extreme circumstances discussed and arrangements made with the professor before the exam.

**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:

- Homework/Activities: 30%
- Preclass: 5%
- Tests (4): 40%
- Final Exam: 25%

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| 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.

**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.

**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 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.

**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=2136#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 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 DRCs 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 a 3 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.

| Course Calendar | | | |
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| | Topics | Reading | Hmk |
| 1/14 | Review – volume integrals revisted | | |
| 1/15 | Review – surface and line integrals revisited | | |
| 1/17 | Maxwell's Equations Reviewed | (7) | Hmk 1 |
| 1/20 | Martin Luther King Jr Day | | |
| 1/22 | Charge and Poynting Vector | 8.1 | |
| 1/24 | Maxwell Stress Tensor | 8.2.1-8.2.2 | Hmk 2 |
| 1/27 | Conservation of Momentum | 8.2.3-8.2-4 | |
| 1/29 | Wrap up momentum | 8.3 | |
| 1/31 | Exam 1 | | Hmk 3 |
| 2/3 | 1-D waves | 9.1.1-9.1.2 | |
| 2/5 | BC and polarization | 9.1.3-9.1.4 | |
| 2/7 | EM plane waves | 9.2.1-9.2.2 | Hmk 4 |
| 2/10 | Energy and Momentum in EM waves | 9.2.3 | |
| 2/12 | EM waves in matter I | 9.3.1-9.3.2 | |
| 2/14 | EM waves in matter II | 9.3.3 | Hmk 5 |
| 2/17 | EM waves in conductors | 9.4 | |
| 2/19 | EM waves in conductors II | 9.4 | |
| 2/21 | Waves Guides | 9.5 | |
| 2/24 | Wave Guides II | 9.5 | Hmk 6 |
| 2/26 | Exam 2 | | |
| 2/28 | Review of Potentials | 10.1.1 | |
| 3/2 | Gauge Transformations | 10.1.2-10.1.3 | |
| 3/4 | Retarded Potentials | 10.2.1 | |
| 3/6 | Jefimenko's Equation | 10.2.2 | Hmk 7 |
| 3/9 | Spring break | | |
| 3/11 | Spring break | | |
| 3/13 | Spring break | | |
| 3/16 | Lienard-Wiechert Potentials | 10.3.1 | |
| 3/18 | Review of Potentials | 10.1.1 | |
| 3/20 | Gauge Transformations | 10.1.2-10.1.3 | Hmk 8 |
| 3/23 | Retarded Potentials | 10.2.1 | |
| 3/25 | Jefimenko's Equation | 10.2.2 | |
| 3/27 | Lienard-Wiechert Potentials | 10.3.1 | |
| 3/30 | Wrap up and Review | | Hmk 9 |
| 4/1 | Exam 3 | | |
| 4/3 | Special Relativity Part 1 | 12.1.1-12.1.3 | |
| 4/6 | Lorentz Transformations and Spacetime | 12.1.3-12.1.4 | |
| 4/8 | Special Relativity, 4 Vectors | 12.1.4 | |
| 4/10 | Easter Break | | |
| 4/13 | Easter Break | | |
| 4/15 | Additional Topic 1 | | |
| 4/17 | Additional Topic 2 | | Hmk 10 |
| 4/20 | Additional Topic 3 | | |
| 4/22 | Additional Topic 4 | | |
| 4/24 | Exam 4 | | Hmk 11 |
| 4/27 | Wrap Up - Oral Exam Practice | | |
| 4/29 | Wrap Up - Oral Exam Practice | | |
| 5/1 | Wrap Up - Oral Exam Practice | | |
| 5/4 | Final Exam 7:30-10:00 | | |