Physics 322-01: Advanced Quantum Mechanics

Spring 2020 | Department of Physics, Loyola Marymount University

Lecturer: J. R. Mureika
Class meetings: TR 9:40-11:10, Seaver 109
Office (hours): Seaver 102A (T 14:30-15:30; W 11:30-12:30; R 10:20-11:20 or by appt.)
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Outline:

This course is the sequential continuation of PHYS 321. Now armed with the tools and basic principles of quantum mechanics, we are now in a position to discuss one of the most fundamental concepts of physics: the quantization of angular momentum. From here, the world is our quantum oyster, and we will be in a position to discuss the following topics:

- The quantization of orbital angular momentum in three dimensions
- The hydrogen wavefunction and hydrogenic atoms
- Stern-Gerlach experiments and quantum spin
- Spin statistics: Fermions and bosons; multiparticle systems (distinguishable and indistinguishable)
- The Standard Model of Particle Physics
- Symmetry and supersymmetry in quantum mechanics
- Perturbation theory
- The Einstein-Podolsky-Rosen paradox and Bell's Inequalities
- Entanglement, quantum computation and teleportation
- Relativistic quantum mechanics and a sneak peek at quantum field theory

This course serves as a pre-requisite for PHYS 411, 451, 461, and 471.

Learning Outcomes: By the end of this course, you will:

- Learn the fundamental nature of quantized spin and angular momentum
- Understand the difference between fermions and bosons
- Appreciate the modern applications of entanglement
- Grasp the implications of perturbation theory in quantum and particle physics
- Derive the fundamental equations of relativistic quantum mechanics from first principles

Math background: As with PHYS 321, you will require MAT 133, 245, 250. It is also assumed that you have a working knowledge of Maple and can implement it in problem-solving.

Textbook and readings:

- *Introduction to Quantum Mechanics,* David J. Griffiths, ISBN: 0-13-111892-7

Other relevant material will be distributed in handout form and/or as a downloadable document on the website.

Grading scheme:

Assignments	8 @ 5%	40%
Midterm exam (take-home)	1 @ 30%	30%
Final exam (take-home)	1 @ 30%	30%
Total Grade:		100%

A	93-100%	C+	76-79%
A-	90-92%	C	73-75%
B+	86-89%	C-	70-72%
B	83-85%	D	60-69%
B-	80-82%	F	0-59%

Assignments: There will be eight (8) assignments distributed at regular intervals. In addition to usual problem solving, we will also be focusing on numerical and symbolic solution techniques using Maple. Assignments must be submitted in class on the due date indicated, and will not be accepted for credit beyond that time.

Take-home midterm: Issued on **TUESDAY 17 MARCH,** due **48 hours after pickup**.

Final Exam: The final will also be a take-home exam, available during finals week in **May**. Details will be forthcoming. *Late exams will not be accepted for credit!*

Attendance: Class attendance is strongly encouraged in order for you to master the material. Three unexcused absences will result in a full letter grade reduction, as will each subsequent unexcused absence. A maximum of six unexcused absences will result in ***failure of the course***. Any medical-related absence must be documented by appropriate documentation from the attending physician.

Class conduct advisory: The use of cellular phones, PDAs, MP3 players and other electronic equipment is not allowed during class time. Cell phones must be set to vibrate before entering the classroom and must be kept inside a backpack, purse or pocket. Bluetooth earpieces must be removed and music players must be put away before entering the classroom. Emergency communications are exempted.

Statement of Academic Honesty: Academic dishonesty will be treated as an extremely serious matter, with serious consequences that can range from receiving no credit for assignments/tests to expulsion. It is never permissible to turn in any work that has been copied from another student or copied from a source without properly acknowledging the source. It is your responsibility to make sure that your work meets the standard of academic honesty set forth in the "LMU Honor Code and Process" in the Undergraduate Bulletin 2008-2010 pages 61 – 64.

THIS SYLLABUS AND ITS CONTENTS ARE SUBJECT TO REVISION; STUDENTS ARE RESPONSIBLE FOR ANY CHANGES OR MODIFICATIONS ANNOUNCED IN CLASS, ON THE CLASS WEBSITE, OR VIA EMAIL.