

PHYS 4320-01: INTRODUCTION TO QUANTUM MECHANICS

INSTRUCTOR: Jim Drachenberg, Ph.D. Office: Archer 100E
Phone: 409-880-8243 E-mail: James.Drachenberg@lamar.edu
Office Hours: W 10:00 AM – 12:00 PM (or by appointment)

TEXTBOOK: *Quantum Mechanics* (2nd edition) by B. H. Bransden and C. J. Joachain

LECTURE: MWF 8:00-8:55 AM in Archer 107

CLASS WEB SITE: <https://luonline.blackboard.com/>

STUDENT LEARNING OUTCOMES: During the course of this semester, students will

1. Learn the basic concepts of quantum mechanics, Schrödinger's equation, and wave functions
2. Apply these concepts to calculate the properties of bound-state systems
3. Learn the basic underpinning mathematical formalism

GRADE: Course grades will be based on the following measures with the **approximate weights** as shown.

Exams (2)	20% each for a total of	40%
Homework		15%
Independent Project		15%
Final Exam		30%

Course letter grades will be assigned using the following **approximate** scale:

A: 90 – 100% B: 80 – 89% C: 70 – 80% D: 60 – 70% F: < 60%

INCOMPLETE GRADES: The grade of "I" may be given when any requirement of the course, including the final examination, is not completed. Arrangements to complete deficiencies in a course should be made with the instructor prior to the end of the semester or term. Incomplete work must be finished during the next long semester or the Records Office will change the "I" to the grade of "F." While the extension may be granted by the instructor with the approval of his/her Department Chair and Academic Dean, once the "I" is changed to an "F" it cannot be changed back to an "I." In this case, either a "change of grade" procedure must be initiated or the course must then be repeated if credit is desired. The instructor may record the grade of "F" for a student who is absent from the final examinations and is not passing the course.

DROP POLICY:	Please make note of the three dates indicated in this drop policy. Any drop will be your responsibility; I will not drop a student from the course. September 20, 2017: (Census Date-Six Drop Rule does not apply) A student may drop or withdraw without consulting with the instructor. The Six Drop Rule does not apply to a drop before 5:00 PM. October 6, 2017: (Six Drop Rule applies) A student may drop or withdraw from the course without academic penalty and receive a Q, however, the Six Drop Rule applies. The student will consult with the instructor and the Records Office to initiate a drop. November 10, 2017: (Six Drop Rule applies) Last day to drop or withdraw with academic penalty; the student must be passing the course at the time of the requested drop in order to receive a Q. The drop form, including all required signatures, must arrive in the Records Office by no later than 4:00 PM. No drop is allowed after this date except in extreme extenuating circumstances. Any “late drop” must be approved by the instructor, department chair, college dean, and provost.
ACCOMMODATIONS THROUGH THE DISABILITY RESOURCE CENTER:	Lamar University is committed to providing equitable access to learning opportunities for all students. The Disability Resource Center (DRC) is located in the Communications building room 105. Office staff collaborate with students who have disabilities to provide and/or arrange reasonable accommodations. If you have, or think you may have, a disability (e.g., mental health, attentional, learning, chronic health, sensory, or physical), please contact the DRC at 409-880-8347 or drc@lamar.edu to arrange a confidential appointment with the Director of the DRC to explore possible options regarding equitable access and reasonable accommodations. If you are registered with DRC and have a current letter requesting reasonable accommodations, we encourage you to contact your instructor early in the semester to review how the accommodations will be applied in the course. http://www.lamar.edu/disability-resource-center/
HOMEWORK:	By this point in your academic career, you have figured out that practical understanding of physics benefits incalculably from working problems. Approximately weekly assignments will be given throughout the semester. By this point in your academic career, you have also figured out that you should not expect late assignments to be graded.
INDEPENDENT PROJECT:	Early in the semester you will select a topic outside of our regular sequence. As the fall progresses, you will research the topic, ultimately drafting a paper to turn in near the end of the semester. As a part of the project, you will develop a poster to present your work to your peers and the faculty as part of the Lamar Physics “Quantapalooza.”
EXAMS:	There will be two exams during the semester. There will be a comprehensive final exam also emphasizing material covered since the second examination. The final examination will be Monday, December 11, from 8 – 8:55 AM in Archer 107. Make-up exams may be administered only for university-approved absences (e.g. university-sponsored activity), provided written notification and documentation are provided to the instructor <i>prior to the absence</i>. There will be no make-up final exam.
ATTENDANCE:	Attendance in class, daily, is essential. If a student is unable to attend class, the instructor must be informed by e-mail, telephone, voice mail, or in person before the class. If such is impossible, the student is expected to contact the instructor after the absence to offer an explanation and obtain any information distributed during class. Attendance will be taken during class and will be considered in the final grade assessment at the instructor’s discretion. Despite absence, students are fully responsible for material discussed in class. If a student is absent from a quiz or examination, the student’s grade for the quiz or examination will be zero (0) unless prior approval is given by the instructor.

**ACADEMIC
INTEGRITY:**

Students are expected to maintain complete honesty and integrity in their academic experiences both in and out of the classroom. Any student found guilty of dishonesty in any phase of academic work will be subject to disciplinary action. Students are specifically warned against all forms of cheating and plagiarism. The *Lamar University Student Handbook* clearly reads: "Any student found guilty of academic dishonesty in any phase of academic work will be subjected to disciplinary action. Punishable offenses include, but are not limited to, cheating on an examination or academic work which is to be submitted, plagiarism, collusion, and the abuse of source materials." One aspect of the *Handbook's* definition of cheating includes "purchasing or otherwise acquiring and submitting as one's own work any research paper or other writing assignment prepared by an individual or firm." Plagiarism is defined as "the appropriation and the unacknowledged incorporation of another's work or ideas into one's own and submitted for credit." Faculty members in the College of arts and Sciences investigate all cases of suspected plagiarism. Any student who is found cheating in this course will receive a course grade of F.

<http://students.lamar.edu/student-handbook.html>

For tests and quizzes, students will be given specific instructions concerning authorized resources. Students are encouraged to study and discuss homework assignments with classmates if such arrangements are mutually beneficial. Students are strongly encouraged and welcomed to consult the instructor for assistance on assignments. However, assignments submitted in a student's name must reflect work original to the student.

Copying the work of students *past or present* is considered a violation of the Academic Integrity Policy and will lead to disciplinary action including but not limited to loss of credit, course grade reduction, and automatic course failure.

For quizzes and exams, only a pencil, blank paper, and a calculator are permitted. Books, notes, and other electronic devices (e.g. cell phones) are considered unauthorized aid and the use thereof constitutes violation of the Academic Honesty Policy. Calculators may be used only for simple numerical and trigonometric calculations. Students may not use calculators to store formulae. Students are not permitted to discuss the quizzes or exams with anyone who has not yet taken it.

**COURSE
EVALUATIONS:**

You will have an opportunity to evaluate all aspects of this course in a formal process to be completed online near the end of the term. You will receive an email reminder through your LU account.

CAMPUS CLOSURE: In the event of an announced campus closure in excess of four days due to a hurricane or other disaster, students are expected to login to Lamar University's website's homepage for instructions about continuing courses remotely. <http://lamar.edu>

EMERGENCY PROCEDURES: Many types of emergencies can occur on campus; instructions for severe weather or violence/active shooter, fire, or chemical release can be found at:

<http://www.lamar.edu/about-lu/administration/risk-management/index.html>.

Following are procedures for the first two:

Severe Weather

- Follow the directions of the instructor or emergency personnel.
- Seek shelter in an interior room or hallway on the lowest floor, putting as many walls as possible between you and the outside.
- If you are in a multi-story building, and you cannot get to the lowest floor, pick a hallway in the center of the building.
- Stay in the center of the room, away from exterior walls, windows, and doors.

Violence/Active Shooter (CADD)

- **CALL** - 8-3-1-1 from a campus phone (880-8311 from a cell phone). Note: Calling 9-1-1 from either a campus phone or cell phone will contact Beaumont City Police Dispatch rather than University Police.
- **AVOID** - If possible, self-evacuate to a safe area outside the building. Follow directions of police officers.
- **DENY** - Barricade the door with desks, chairs, bookcases or any other items. Move to a place inside the room where you are not visible. Turn off the lights and remain quiet. Remain there until told by police it is safe.

DEFEND - Use chairs, desks, cell phones or whatever is immediately available to distract and/or defend yourself and others from attack.

Lamar University expressly prohibits intimidation and harassment of students, faculty, staff, or applicants.

<http://students.lamar.edu/academic-support/code-of-conduct.html>

COURSE SCHEDULE: Tentative schedule indicates topics and exam dates, all of which are subject to change.

UNIT 1: INTRODUCTION

09/06 Unexplained Phenomena; Wave-particle Duality; Free Particles and Wave Packets

UNIT 2: FORMALISM

09/08 Statistics and Linear Algebra

09/11 Linear Algebra

09/13 The Classical Interpretation

UNIT 3: SYSTEMS AND SOLUTIONS TO THE SCHRÖDINGER EQUATION

09/15 Stationary States and Energy Eigenfunctions

09/18 Quantization of Energy

09/20 Free Particle Revisited

09/22 Step Potential

09/25 Barrier Potential

09/27 **Exam #1 (Unit 1-2)**

09/29 Finite Square Well

10/02 Finite Square Well

10/04 Harmonic Oscillator

10/06 Harmonic Oscillator

10/09 Harmonic Oscillator

UNIT 4: THREE-DIMENSIONAL SYSTEMS

10/11 3-D Systems in Cartesian Coordinates

10/13 Central Potentials

10/16 Central Potentials

10/18 Central Potentials

10/20 Central Potentials

10/23 Central Potentials

UNIT 5: ANGULAR MOMENTUM AND CO.

10/25 Rotations

10/27 Linear Algebra

10/30 Intrinsic Angular Momentum

11/01 **Exam #2 (Units 3-4)**

11/03 Intrinsic Angular Momentum

11/06 Intrinsic Angular Momentum

11/08 Intrinsic Angular Momentum

11/10 Total Angular Momentum

11/13 Angular Momentum Addition

11/15 Angular Momentum Addition

UNIT 6: APPROXIMATION METHODS

11/17 Perturbation Theory

11/20 Perturbation Theory

11/22 Perturbation Theory

11/23-24: Thanksgiving Holiday (No Classes)

11/27 Perturbation Theory

11/29 Variational Method

12/01 Variational Method

12/04 Variational Method

12/06 Multi-particle Systems

12/08 Multi-particle Systems

12/11 **Final Exam for 4320, 8 - 8:55 AM in Archer 107**