PHY 342 - Quantum Mechanics II, Fall 2021 UMass Dartmouth

Lectures: MWF 11-11:50am, Room SEng-102
Text: *Introduction to Quantum Mechanics*, D Griffiths, 2nd ed.
Instructor: Dr. Jay Wang, 2-204B, 999-9136
Office Hours: MWF 10-11am, by appointment, or just zooming-by
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Welcome to Quantum Mechanics II. The objectives of this course are to master the Schrödinger's equation and its application to simple systems, and to gain fundamental understanding of atomic and nuclear physics including many-body systems, aspects of quantum statistics, solid state and particle physics.

As in the first semester, this course emphasizes physical concepts, in-depth coverage of important topics, and promotes development of analytical, mathematical, and computational problem-solving skills. Consequently, you should not be merely a gatherer of knowledge in this course, and will not be treated as one. Rather, you are expected to develop your own set of skills as we explore the materials presented in this course. The objectives are to master fundamental quantum mechanics and its application to important physical systems.

Homework will be assigned regularly. There will be two tests and the final exam. This course values efforts like attendance, class participation, extra credit work, office visits, etc. The final grade will consist of homework, the tests and final exams, and effort indicators as follows:

Category	Percentage	Date	Grade Criteria
Homework	45%	Weekly	90≤ A <100
Test 1	15%	Oct 1, F	80≤ B <90
Test 2	15%	Nov 5, F	70≤ C <80
Final	20%	Dec 9, R	60≤ D <70
Effort	5%	Everyday	0≤ F <60

Information

1. Lectures and recitations. Lectures cover materials found in and, sometimes, out of the text. Important elements will be emphasized in the lecture. But before- and after-class reading as assigned is required for successful completion of homework and exams. A recitation period will be held on some Fridays as needed. This period will be used to go over problem solving/reviewing of covered material.

2. Homework assignments. Homework will be assigned on a regular basis. It will include problems (end-of-chapter as well as handout) on topics discussed in class. Each assignment is due at the beginning of class the week following its assignment. Changes of due dates, if any, will be confirmed in class. You will have about one week to complete each assignment. Late homework will generally not be accepted, except for occasional, non-habitual cases which may be subject to a five-day half-life rule: each period past due reduces the credits by half.

As you may have realized yourself from Quantum I, it is beneficial to do as many problems as you can (homework and extra problems you find on your own) to develop a feel for quantum mechanics. The emphasis on computation in this class is to help master the essential concepts of quantum mechanics as well as be able to *do* rather than just think physics.

3. Exams. The tests are sectional and the final exam is comprehensive. They will emphasize the material covered in lectures. Unless other arrangements are made with the instructor prior to the test date, zero points will be given if the test is not taken. A typical test includes mostly problems and concepts, but may also contain topical mini essays. Partial credit will be given for relevant steps of problem solving.

The final exam will be given only at the scheduled time.

4. Extra credit/help. Opportunities exist for extra credit up to 10% toward your final grade. They may include effort and activities such as participating in group discussions in the classroom, doing extra credit assignment and course-related projects, writing a paper on a topic relevant to this course, etc. But, extra credit will be considered for the final grade only if your core-course performance is satisfactory (60% or better).

5. Covid-19 and other information.

- This will be an in-person class, and everyone is expected to follow the covid safety protocols, including vaccination and mask-wearing requirements:
  https://www.umassd.edu/covid/

  However, despite best effort, there is always the possibility of being exposed to or even infected with covid. As a matter of public health with infectious diseases, please follow the MA isolation and quarantine (IQ) protocol:
  https://www.mass.gov/info-details/covid-19-isolation-and-quarantine-information

  According to the protocol, you must isolate if you are symptomatic or have tested positive for Covid-19, and you must quarantine if you are not sick but are a close contact to someone diagnosed with Covid-19, for a nominal of 10 days. Every effort will be made to accommodate your learning needs. For instance, if you are in IQ, zoom will be made available for you to attend class remotely if you are able, and reasonable extension of due dates will be considered. By the same token, should the instructor be in IQ, zoom will be used for class delivery for the duration of IQ (pending quantum teleportation technology being invented; someone hurry). Office hours will be conducted in-person and on zoom simultaneously whenever possible.

- From your feedback and effective use, the asynchronous part with video-recorded course material will continue, roughly once every 1.5 weeks. Once posted, *you are expected to have studied the material asynchronously before the next class.* You may ask questions about that material in class, of course, but it will not be wholly repeated in the class.

- You are expected to be familiar with and follow the policies of academic integrity as given in the student handbook
  https://www.umassd.edu/studentaffairs/studenthandbook/

Schedule

Tentative Schedule, PHY 342, Fall 2021, UMass Dartmouth			
Date	Chap	Sections to read	Topics
Sep 1, W	4	Sec 1-4	Schrödinger equation in 3D radial and angular wave functions structure of the hydrogen atom angular momentum and spin
	5	Sec 1-4	Two-particle systems, exchange symmetry Pauli exclusion principle, atoms and solids, quantum statistics
Sectional conclusion. Test 1, Ch 4,5; Oct 1, F			
Oct 4, M	6	Sec 1-5	Perturbation theory for non-solvable systems, fine structure of hydrogen atoms in B-fields, Zeeman effect, spin
	7	Sec 1-5	Variational principle, the helium atom Molecular hydrogen ion
Sectional conclusion. Test 2, Ch 6,7; Nov 5, F			
Nov 10, W	8	Sec 1-6,9	WKB approximation, classically allowed and forbidden regions, tunneling
	9		Time-dependent perturbation theory Fermi's golden rule, light emission and absorption
	11		Scattering, partial waves, phase shifts
Dec 6, M		Last class	
Dec 9, R		Final Exam 11:30-2:30pm, Comprehensive	