Spring 2-1-2018

PHSX 462.01: Quantum Mechanics II

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Physics 462 Quantum Mechanics II Spring 2018

Overview:

Instructor:	Daniel Reisenfeld
Office:	Science Complex Office SC 121
Phone:	243-6423
Text:	*Introduction to Quantum Mechanics (2nd Edition)* by David J. Griffiths (Prentice Hall, 2005)
Lectures:	MWF, 12:00 – 12:50. CHCB Room 231
Office Hours:	M: 2-3, W: 2-3; Th: 2-3, and by appointment or right after class for quick questions
Course web site:	Moodle. `https://moodle.umt.edu` The course Moodle site contains course information, selected lecture presentations, syllabus, assignments, and solutions.

Description:
This class will cover advanced topics in quantum mechanics, with applications from contemporary atomic physics. Whereas the first semester concentrates on formalism, this course introduces the approximation methods necessary to analyze real systems. Topics include non-degenerate, degenerate and time dependent perturbation theory, interactions of atoms with light, and scattering theory. Applications include atomic structure, astrophysical spectrometry, laser cooling, atomic clocks, Bose-Einstein condensates, and electron-atom collision experiments.

Prerequisites:
Physics 461 (Quantum Mechanics I) or permission of instructor.

Grading:

Midterm exams:	40% (20% each)
Homework:	30%
Final exam:	30%

Homework:
Homework will be assigned weekly. The assigned problems will be collected, graded, and returned. Homework will be due by **5:00 pm** on the specified date, typically Wednesday. If an assignment is turned in on the due date after class has started, the grade will be **10% less** than that earned, and will decrease by an **additional 10% for each day late** (excluding weekends and holidays). If you have a conflict with the due date, it is recommended that you turn in the assignment early or talk to me ahead of time to see if other arrangements can be made. You are encouraged to work together on the homework problems and to see me if you need hints; however, the work you turn in must be your own.

Exams:
There will be two midterm exams and a final exam. The midterms will last 2 hours and will be given in the evening on the days listed on the Weekly Schedule (next page). For each midterm, you may bring one 8.5" x 11" sheet of paper with anything written on the front side. Make-up exams may be given in exceptional circumstances, but only if arranged face-to-face with me in advance. The final, which will be on Friday, May 11th from 10:10 to 12:10 a.m., will be semi-comprehensive, emphasizing the material in the last part of the course.

Honor Code:
You will be asked to sign a pledge stating that you will not look online for solutions to homework problems. This is for your benefit, as the only way to learn physics is by doing it, and taking the time to sit with difficult problems. It is also a form of plagiarism to transcribe the work of others and turning it in as your own. I could just not assign problems from Griffiths, but it turns out that it is difficult to create problems in Quantum Mechanics at the undergraduate level that have analytical solutions. In addition, Griffiths does an excellent job of incorporating his problems into the text, and it would be a shame not to take advantage of this. Don't be discouraged if you find yourself having difficulty with concepts or problem sets and be sure to see me during my office hours, email me, or make an appointment. Please do this *early* rather than waiting until the last minute.

Academic misconduct is subject to an academic penalty by the course instructor and/or disciplinary sanction by the University. All students need to be familiar with the Student Conduct Code. The Code is available for review online at http://www.umt.edu/vpsa/policies/student_conduct.php

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Weekly Schedule

Week	Week of	Topics	Chapter
1	01/22	Course Introduction, Time-Independent Perturbation Theory (PT)	6.1
2	01/29	Degenerate Perturbation Theory	6.2
3	02/05	Applications of Degenerate PT, The Stark Effect	6.2
4	02/12	Addition of Angular Momentum, The *Real* Hydrogen Atom	4.4.3, 6.3
5	02/19	(*No class Monday*) Zeeman Effect, Hyperfine Splitting	6.4, 6.5
6	02/26	**Exam 1 (2/26),** Two-Particle Systems	5.1
7	03/05	Atoms, the Periodic Table	5.2
8	03/12	Solids, Electron Degeneracy in Stars	5.3
9	03/19	Variational Principle and Helium	7.1, 7.2
	03/26	*Spring Break*	
10	04/02	Time Dependent PT, Emission and Absorption of Radiation	9.1 – 9.2
11	04/09	**Exam 2 (4/9),** Spontaneous Emission, Selection Rules	9.3
12	04/16	Radiative Transitions in Astrophysics	Supplements
13	04/23	Special Topics	TBD
14	04/30	Special Topics	TBD
		Final Exam Friday, 5/11, 10:10 am – 12:10 pm	

Drop/Add/Auditing: Drop/Add can be performed online until **February 10th**, and with the instructor's and advisor's signatures until **April 2nd**. Last day to drop with petition to the Dean is **May 4th**. Students interested in **auditing** the course must choose so on or before **February 10th.**

Disability Modification:
Students with disabilities will receive reasonable modifications in this course. Your responsibilities are to request them from me with sufficient advance notice, and to be prepared to provide verification of disability and its impact from Disability Services for Students. Please speak with me after class or during my office hours to discuss the details. For more information, visit the Disability Services for Students website at http://www.umt.edu/disability

LEARNING OUTCOMES:

Upon completion of this course you should have gained and understanding of:

- the formalism of time independent perturbation theory and how it applies to physical systems such as the hydrogen atom, the Stark Effect, and the Zeeman Effect.
- the formalism of time dependent perturbation theory and how it applies to physical situations such as the interaction of light with atoms.
- multi-particle systems such as atoms, solids, and degenerate stars.
- the use of the variational principle as an approximation method.