Spring 2-1-2022

PHSX 462.01: Quantum Mechanics II

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PHSX 462 -- Quantum Mechanics II Spring 2022

Instructor: Paul Janzen
Office: CHCB 121
Office hours: W 1:00 - 3:00, and by appointment
Phone: 243-2374
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Text: *Introduction to Quantum Mechanics, 3rd Ed.*,Griffiths and Schroeter
Lecture: MWF 12:00 - 12:50 PM in CHCB 231
Prerequisites: PHSX 461
Credits: 3

Description:

This course covers advanced topics in quantum mechanics, with applications from contemporary atomic physics. Rather than concentrating on formalism, as in the first semester, this course introduces approximation methods necessary to analyze real systems. Topics include non-degenerate, degenerate, and time-dependent perturbation theory, multi-particle systems, interactions of light with matter, and topics such as scattering theory and an introduction to relativistic quantum mechanics.

Learning Outcomes:

- Will have acquired thorough and coherent understanding of time-independent perturbation theory and how it applies to physical systems such as the hydrogen atom
- Will have acquired understanding of time-dependent perturbation theory and how it applies to physical situations such as the interaction of light with atoms
- Will have acquired experience in applying quantum mechanics principles to problems such as scattering and/or multi-particle systems (e.g., solids, degenerate stars)
- Will have studied the usefulness of the variational principle as an approximation method

Grading:

Problem sets will be assigned roughly weekly. Homework will be due by 5:00 pm on the specified date, likely Fridays. Late submissions will incur a penalty of 10% per day (excluding weekends and holidays). If you have a conflict with the due date, either turn the assignment in early or discuss with me ahead of time (not after the fact)

to see if other arrangements can be made. You are encouraged to work together on the homework and to see me if you need hints. However, the work you turn in must be your own.

There will be two midterm exams: Monday February 21, and Wednesday April 6. The final (10:10 am, May 9) will be comprehensive but strongly emphasize material in the last part of the course. Exams will be two hours (we'll figure out the scheduling). You may bring one 8.5x11" sheet of paper with anything written on it you'd like.

Grading:

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

This course can be taken for a traditional letter grade only.

Tentative Course Outline

Week	**Topic**
1 (Jan 19, 21)	Introduction, Time-Independent Perturbation Theory
2 (Jan 24-28)	Degenerate Perturbation Theory
3 (Jan 31-Feb 4)	Stark Effect, Addition of Angular Momentum
4 (Feb 7-11)	Hydrogen Fine Structure, Zeeman Effect
5 (Feb 14-18)	Hyperfine Splitting, 2-particle Systems and the Periodic Table
6 (Feb 21-25)	Exam 1, Periodic Table
7 (Feb 28-Mar 4)	Variational Principle, Helium
8 (Mar 7-11)	Time-Dependent PT, Emission/Absorption of Radiation
9 (Mar 14-18)	Selection Rules
10 (Mar 28-Apr 1)	Radiative Transitions in Astrophysics
11 (Apr 4-8)	Exam 2, Topics in Atomic Physics (atomic clocks, laser cooling)
12 (Apr 11-15)	Intro to Solid State
13 (Apr 18-22)	Special Topics: TBD
14 (Apr 25-29)	TBD: likely Scattering; Partial Waves
15 (May 2-6)	TBD: likely Phase Shifts; Born Approximation

Notes:

All students must practise academic honesty. Academic misconduct is subject to an academic penalty by the course instructor and/or a disciplinary sanction by the University. All students need to be familiar with the Student Conduct Code. The Code is available for review online, though the URL changes frequently.

The University of Montana assures equal access to instruction through collaboration between students with disabilities, instructors, and the Office for Disability Equity (ODE). If you anticipate or experience barriers based on disability, please contact the ODE at (406) 243-2243, `ode@umontana.edu`*, or visit* `www.umt.edu/disability` *for more information. Retroactive accommodation requests will not be honored, so please, do not delay. As your instructor, I will work with you and the ODE to implement an effective accommodation, and you are welcome to contact me privately if you wish.*

Paul Janzen 2022-01-26