

Physics 405 Syllabus

Fall 2016

Lectures: Monday, Wednesdays, and Fridays, 10 – 10:53 am, Frey Hall 328

Contact Information

Lecturer: Professor Christopher Herzog
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Math Building 6116b, 632-7985
Office hours: Tuesdays 2–4 pm, drop by or email for other times

Schedule

Week	Dates	Topic
1	8/29–9/2	Review of Phys 308, Gr1–5
2	9/7–9/9	Review of Phys 308, Gr1–5 (Labor Day, no class Monday, HW1 due 9/7))
3	9/12–9/16	<i>t</i> Ind Pert Theory, Gr6 (HW2 due 9/14)
4	9/19–9/23	<i>t</i> Ind Pert Theory, Gr6
5	9/26–9/30	Variational Principle, Gr7 (HW3 due 9/28)
6	10/3–10/7	WKB, Gr8, LL7 (HW4 due 10/5)
7	10/10–10/12	<i>t</i> Dep Pert Theory, Gr9 (HW5 due 10/12, in class midterm on 10/14)
8	10/17–10/21	<i>t</i> Dep Pert Theory, Gr9, BJ9, S18
9	10/24–10/28	<i>t</i> Dep Pert Theory, Gr9, BJ9, S18 (HW6 due 10/26)
10	10/31–11/4	Aharonov-Bohm Effect and Berry's Phase, Gr10
11	11/7–11/11	Scattering, Gr11 (HW7 due 11/9)
12	11/14–11/18	Scattering, Gr11 (HW8 due 11/16)
13	11/21	Scattering, Gr11 (Thanksgiving week)
14	11/28–12/2	Quantum Computation (HW9 due 11/30)
15	12/5–12/9	Quantum Computation (HW10 due 12/9)

Textbooks

- Gr ≡ Griffiths, *Introduction to Quantum Mechanics* (required)
- LL ≡ Landau and Lifshitz, *Quantum Mechanics* (optional)
- S ≡ Shankar, *Principles of Quantum Mechanics* (optional)
- BJ ≡ Bransden and Joachain, *Introduction to Quantum Mechanics* (optional)
- SF ≡ Susskind and Friedman, *Quantum Mechanics: The Theoretical Minimum* (optional)

These books are on reserve at the library.

Some other useful quantum mechanics text books are Liboff's *Introductory Quantum Mechanics*, and the lengthy and very complete two volume *Quantum Mechanics* by Cohen-Tannoudji et al. This physicist's favorite quantum mechanics text book is the more advanced and aging *Mécanique quantique* of Albert Messiah.

Course Outline (Tentative)

1. Review of Physics 308 (five lectures)
2. Time Independent Perturbation Theory (six lectures)
 - First and second order theory
 - Degenerate perturbation theory
 - Fine structure, hyperfine structure, Zeeman and Stark effects
 - Band structure in metals
3. Variational principle (three lectures)
 - The helium atom revisited
 - The hydrogen molecule
4. WKB (three lectures)
 - Connection formulae
 - Bohr-Sommerfeld quantization
 - Tunneling
5. Aharonov-Bohm effect and Berry's phase (three lectures)
6. Time dependent perturbation theory (eight lectures)
 - First order formalism — sudden, adiabatic, and periodic perturbations
 - Fermi's Golden Rule
 - Interaction with electromagnetic radiation
7. Scattering (seven lectures)
 - Partial wave expansion
 - Born approximation
8. Quantum computation (six lectures)

Homework

There will be about ten homework assignments due in class on Wednesdays. At the discretion of the lecturer, late homework assignments may be accepted for partial credit. Homeworks will be posted on Blackboard at least ten days prior to their due date.

Grade Weighting

Homeworks	45%
Midterm	15%
Final	40%