

Physics 405 Syllabus

Fall 2017

Lectures: Monday, Wednesdays, and Fridays, 10 – 10:53 am, E&S 079

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 | 8/28–9/1 | Review of Phys 308, Gr1–5 |
| 2 | 9/6–9/8 | Review of Phys 308, Gr1–5 (Labor Day, no class Monday, HW1 due 9/6) |
| 3 | 9/11–9/15 | Identical particles, Gr5 (HW2 due 9/13) |
| 4 | 9/18–9/22 | Identical particles, Gr5 |
| 5 | 9/25–9/29 | t Ind Pert Theory, Gr6 (HW3 due 9/27) |
| 6 | 10/2–10/6 | WKB, Gr8, LL7 (HW4 due 10/4) |
| 7 | 10/9–10/11 | t Dep Pert Theory, Gr9 (HW5 due 10/11, in class midterm on 10/13) |
| 8 | 10/16–10/20 | t Dep Pert Theory, Gr9, BJ9, S18 |
| 9 | 10/23–10/27 | t Dep Pert Theory, Gr9, BJ9, S18 (HW6 due 10/25) |
| 10 | 10/30–11/3 | Aharonov-Bohm Effect and Berry's Phase, Gr10 |
| 11 | 11/6–11/10 | Scattering, Gr11 (HW7 due 11/8) |
| 12 | 11/13–11/17 | Scattering, Gr11 (HW8 due 11/15) |
| 13 | 11/20 | Scattering, Gr11 (Thanksgiving week) |
| 14 | 11/27–12/1 | Quantum Computation (HW9 due 11/29) |
| 15 | 12/4–12/8 | Quantum Computation (HW10 due 12/8) |

Textbooks

- Gr \equiv Griffiths, *Introduction to Quantum Mechanics* (required)
- LL \equiv Landau and Lifshitz, *Quantum Mechanics* (optional)
- S \equiv Shankar, *Principles of Quantum Mechanics* (optional)
- BJ \equiv Bransden and Joachain, *Introduction to Quantum Mechanics* (optional)
- SF \equiv 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. Identical Particles (six lectures)
 - Fermions and bosons
 - The helium atom
 - Free electron gas and band structure
 - Photon gas
3. Time Independent Perturbation Theory (three lectures)
 - Fine structure, hyperfine structure, Zeeman and Stark effects
 - Band structure in metals
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

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| Homeworks | 45% |
| Midterm | 15% |
| Final | 40% |