Physics 4307

Introduction to Quantum Mechanics

Course Outline for Fall Semester 2015

Instructor: Thomas L. Gibson Office: Sc 27 Hours: 10:00-11:00 (TTH) & 1:00-2:30 (MW)
Text: *Understanding Quantum Physics: A User's Manual*, by Michael A. Morrison

1 What's It All About? A Qualitative Introduction

- Classical versus Quantum Points of View
- Waves versus Particles
- Duality and the Double Slit

2 Starting from Scratch

- Introduction to the Mathematics of Dirac Bra and Ket Notation
- The State Function and Its Interpretation
- Wave Packets in One Dimension
- Observables in Quantum Physics
- A Quantum Equation of Motion: The Time-Dependent Schrödinger Equation
- The Time-Independent Schrödinger Equation

3 Examples, Examples, Examples

- States of a Particle in One Dimension I: Piecewise-Constant Potentials
    1. Bound versus Unbound States
    2. Tunneling for Fun and Profit
    3. Bound States of the Finite Square Well
- States of a Particle in One Dimension II: Continuous Potentials
    1. Curvature is the Key
    2. The Stationary States of an Arbitrary Potential
    3. The Quantum Simple Harmonic Oscillator
    4. The Incredible Sloshing Oscillator

4 Tools of the Trade: More Formalism

- Operators in Quantum Mechanics I: The Importance of Being Hermitian
  1. Mathematics of Quantum-Mechanical Operators
  2. All About Eigenvalue Equations
  3. Consequences of Hermiticity
- Operators in Quantum Mechanics II: To Commute or not to Commute
  1. Simultaneous Eigenstates and the Commutator
  2. Matrix Representations of Operators
  3. Commutators and Uncertainty Principles
  4. Constants of the Motion in Classical and Quantum Physics
- Eigenfunction Expansions: How to Solve Any Problem in Quantum Mechanics
- Altered States: The Great Measurement Mystery

5 Final Topics

- The Hydrogen Atom
- An Introduction to Perturbation Theory
- Why You Need a Second Semester of Quantum Mechanics

Grading Policy

Homework & Quizzes	40%
Midterm EXAM	30%
Final EXAM	30%

"Typical" Grading Scale

92–100	A
82–91	B
66–81	C
55–65	D

Late homework will be penalized at a rate of 2%/day late up to 5 days. Homework that is more than 5 days late will not be accepted.

Important Notes:

- Any student who, because of a disability, may require special arrangements in order to meet the course requirements should contact the instructor as soon as possible to make any necessary arrangements. Students should present appropriate verification from Student Disability Services during the instructor's office hours. Please note instructors are not allowed to provide classroom accommodations to a student until appropriate verification from Student Disability Services has been provided. For additional information, you may contact the Student Disability Services office in 335 West Hall or 806-742-2405.
- The faculty is strongly committed to upholding standards of academic integrity. These standards, at the minimum, require that students never present the work of others as their own.

Strategy for Success:

- Be prepared! Study your notes and read the text as well as other, appropriate materials before you come to class.
- Begin all homework assignments as soon as possible. The assigned problems take time and thought—never wait until the night before an assignment is due. These problems may be longer, if not necessarily harder, than any that you have been asked to do before. Thus, you will need to organize your work and make intermediate checks on the correctness of your solutions. This can not be done in a big hurry.
- Do your own work. Although you are free to discuss the homework with other members of the class, always try to think a problem through on your own before consulting reference material or a classmate. Do not "team up" on the homework by distributing a few problems to each member of the team. This is not an effective way to learn the material when you will be individually graded on quizzes and exams. You should always reference the work of others if you use it in a problem—this includes integral tables.
- See your instructor if you are stuck—that's why they pay me the big bucks!

Other Texts on Quantum Mechanics and Related Topics

1. E.E. Anderson, *Modern Physics and Quantum Mechanics* (Philadelphia: Saunders, 1971).
2. W.H. Cropper, *The Quantum Physicists and an Introduction to Their Physics* (New York: Oxford University Press, 1970).
3. R.M. Eisberg and R. Resnick, *Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles*, 3rd ed. (New York: Wiley, 1985).
4. R.P. Feynman, *The Character of Physical Law* (Cambridge, Mass.: M.I.T. Press, 1965).

5. R.P. Feynman, R.B. Leighton, and M. Sands, *The Feynman Lectures on Physics, Vol. III: Quantum Mechanics* (Reading, Mass.: Addison-Wesley, 1965).

6. R.P. Feynman, *QED: The Strange Story of Light and Matter* (Princeton: Princeton University Press, 1985).

7. R.L. Liboff, *Introductory Quantum Mechanics* (San Francisco: Holden-Day, 1980).

8. M.A. Morrison, T.L. Estle, and N.F. Lane, *Quantum States of Atoms, Molecules, and Solids* (Englewood Cliffs, New Jersey: Prentice Hall, 1976).

9. L. Pauling and E.B. Wilson, *Introduction to Quantum Mechanics* (New York: McGraw Hill, 1935).

10. D.S. Saxon, *Elementary Quantum Mechanics* (San Francisco: Holden-Day, 1968).

11. R.G. Winter, *Quantum Physics* (Belmont, CA: Wadsworth, 1979).

12. R.W. Robinett, *Quantum Mechanics* (New York: Oxford, 1997).

13. D.J. Griffiths, *Introduction to Quantum Mechanics*, 2nd Ed., Upper Saddle River, NJ: Pearson Prentice-Hall, 2005).