Physics 2170: Foundations of Modern Physics
Spring 1995

Professor: Steven J. Pollock

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Office: F419 in the Gamow Tower

Office Hours (tentative): Tues. 1-3, or by appointment

Grader: S. Gay

Computer Help: Barry Bruce G0060b **Office Hours**: T-Th. 1:30-3:30

Lectures: MWF 1-1:50 PM in Muen E131

Texts:

Required: *"An Introduction to Quantum Physics* " - A.P. French and E. F. Taylor.
(The primary textbook, and source of some homework problems)

Highly recommended: *"Concepts of Modern Physics"* - A. Beiser
(This is written at a slightly more basic level than F+T, and you may find it very useful as a reference. I will point out "where we are" in Beiser throughout the course to help orient you.) There will also be two copies on reserve in the physics library.

Other references:
On occasion we will have computer assignments. *"Mathematica: A system for Doing Mathematics by Computer"* - (Stephen Wolfram) is a useful reference.

S. Gasiorowicz:*"Quantum Physics"*, and "*Structure of Matter*"
R. Eisberg and R. Resnick: "*Quantum Physics*"
Taylor and Zafiratos: "*Modern Physics for Scientists and Engineers*" (for an even more broad but qualitative overview of the material.)
Feynman, Leighton, and Sands: "*The Feynman Lectures on Physics, part III.*"
(The latter is part of a truly wonderful series of 3 "introductory" physics books.)

Physics 2170 is an introduction to quantum mechanics, the foundation and explanatory framework of much of modern physics. We will learn some of the history and motivation of quantum theory, and study ways in which "classical" laws of physics must be modified - or even replaced - in order to account for the behavior of atoms and subatomic particles. The emphasis will be on learning the essential concepts of quantum mechanics, through the study of a variety of physical problems.

Required Work: Problem sets are an essential part of this class. No one questions that mastering a musical instrument or playing a sport well requires repetition of exercises designed to increase skill (if not always designed to be beautiful or fun). The study of physics is not so different! One problem set will be assigned every week, (usually) on Wednesdays, due at the *start* of class the following Wednesday. Because solutions will be posted, late homeworks *can not* be accepted. Homeworks will on occasion contain computer assignments.

My homework solutions will be posted by my office, with a copy in the library. These may be borrowed *briefly* for copying. (Please be considerate of your classmates.)

Grades and Exams:

Short quizzes will be given during lectures roughly every 2-3 weeks.

Quiz dates: Fridays: Jan. 27, Feb. 10, Mar. 3, Mar. 17, Apr. 14

Exams are tentatively scheduled for Thursday evenings (7:30 PM), Feb. 16 and Mar 23

Final exam will be Sat., May 6, 7:30 PM-10:30 PM.

The total grade weighting will be approximately:

Problem sets:	30-35%
Quizzes:	5-10%
Mid Terms:	16.5% each => 33%
Final Exam:	25%

Accounts for the NeXT lab: Computer accounts will be set up for you in the NeXT lab (Duane 0060a). For people without an account from last semester, an application/policy form *must* be read and completed for the accounts to be activated. You may solve problems in Fortran, Basic, C, or Mathematica ("Mma"). I encourage you to use the latter, will design the problems with Mma in mind, and will provide you with a brief written tutorial. We will not spend class time learning programming. If you have no computer experience, let me know, and I can help you get started. Nothing very sophisticated will be required. (You are also welcome to use home computers)

Reading Assignments: The attached syllabus describes the material which will be covered in this course. Reading the textbook *before* class is highly encouraged. It will allow you to concentrate on understanding the lecture instead of taking lots of notes and trying to make sense of them later... (Each homework will also have a required reading assignment)

Drop-Add deadlines: Prior to Jan. 27, you may drop the course without the instructor's permission. Between Jan. 27 and Feb. 21 you may withdraw with a passing grade only with written permission of the instructor. After Feb. 21, you may drop the course only by petitioning your dean.

Approximate course outline for Physics 2170, Spring 1995:

Section 1: Particle Properties of Waves

		[Beiser, 4th ed]	[[5th ed]]
E+M Waves	lecture notes	[or Beiser 2.1]	
Photons	F+T start of 1.6	[Beiser 2.2 - 2.4]	[[2.3, 2.4]]
X Rays	F+T rest of 1.6	[Beiser 2.5, 2.6]	
Compton effect	lecture notes	[Beiser 2.7, 2.8]	
Blackbody Radiation	lecture notes	[Beiser 9.5-9.7]	[[2.2, 9.5, 9.6]]

Section 2: Models of the Atom

Intro to the classical atom	F+T 1.1, 1.2, 1.3	[Beiser 4.1]	
Thomson atom	F+T 1.4		
Rutherford Scattering	F+T 1.7	[Beiser 4.2-4.4]	[[Ch. 4 app.]]
Line Spectra, Electron orbits	F+T 1.5	[Beiser 4.5, 4.6]	[[4.2, 4.3, 4.5]]
Bohr Atom	F+T 1.7, 1.8	[Beiser 4.7, 4.8]	[[4.4]]
Correspondence	lecture notes	[Beiser 4.9]	[[4.6]]
Experimental evidence	F+T 1.9-1.11	[Beiser 4.11, 7.13]	[[4.8, 7.9]]

Section 3: Wave Properties of Particles

de Broglie waves	F+T 2.1	[Beiser 3.1, 3.2]
Phase/group velocity	F+T 2.2, 2.3	[Beiser 3.3, 3.4]
Davisson-Germer exp't	F+T 2.4, 2.5	[Beiser 3.5]
More experiments	F+T 2.6-2.8	
Wave-particle duality, double slits	F+T 2.9-2.11	

Section 4: Quantum Mechanics

More on wave particle duality	F+T 3.1	[Beiser 3.6]
Uncertainty principle	F+T 3.6	[Beiser 3.7-3.9]
To a particle-wave equation	F+T 3.2	[Beiser 5.1, 5.2]
The Schrödinger equation	F+T 3.3	[Beiser 5.3]
Stationary States	F+T 3.4	[Beiser 5.4, 5.5]
Particle in a box	F+T 3.5, 3.6	[Beiser 5.6]
Interpretations	F+T 3.7	
Square wells, qualitative	F+T 3.8-3.11	
Square wells, quantitative	F+T 4.1, 4.2	
Harmonic oscillators	F+T 4.3-4.5	[Beiser 5.9]

Section 5: Applications

3-d Schrödinger equation	F+T 5.1-5.5	[Beiser 6.1, 6.2]
Probabilities and expectations	F+T 5.6, 5.7	
Barriers	F+T 9.1-9.3	[Beiser 5.7]
Scattering and tunneling	F+T 9.4, 9.5	[Beiser 5.8]

Cool topics of modern physics -- we'll see!