Physics 330

Physics 330 - Atomic & Nuclear Physics

Syllabus (Spring 2020)

1311 HN, Tu, Th: 14:10-16:00

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Webpage: http://www.hunter.cuny.edu/physics/courses/physics330/physics-330

Homework will be handed in at the beginning of class every Tuesday. It will not be accepted late without prior approval from me.

Tests: The first midterm for the class will be on Thursday, March 12. The second will be on Tuesday, April 21. Our final will be on May 19 (2:00 - 4:00 pm).

Grading:

Final: 40%

Midterms: 20 % each

Homework: 20%

Texts:

Modern Physics for Scientists and Engineers, by Taylor, Zafiratos, Dubson,

Prentice-Hall, Second Edition © 2004 ISBN0-13-805715-X

Other Texts:

There are many "standard" textbooks for this class, all called Modern Physics. Three examples have authors Bernstein, Fishbane and Gasiorowicz; Thornton and Rex; Tipler and Llewellyn. We will study roughly the same topics, so you will probably find it useful to consult any or all of these books. They are all OK, but the approach we will take is to reduce the number of topics but try to go into a little more depth. But I believe it will be worth your time to look through these as well as reading the texts. I'll try to indicate where you should look. In

addition, I will post the lecture notes on the web after I give the lectures. However, I advise you not to rely on these over your own notes and the textbooks.

Index of Lectures

When	Lectures	Textbook Reading	Homework
Week 1: January 28 -30	**Relativity** Michelson-Morley Expt; Postulates of Relativity; Time Dilation; Particle Lifetimes	1.1, 1.2, 1.3, 1.4 , 1.5 2.1 2.2, 2.3, 2.4 (13.3 optional)	1.14, 1.16, 2.3, 2.4, 2.8
Week 2: Feb. 4 - 6	Length Contraction; Lorentz Tranformation; Velocity Addition	2.5, 2.6, 2.7, 2.8	2.12, 2.15, 2.18, 2.26
Week 3: Feb. 11 - 13	Doppler Effect; Relativistic Mass; Relativistic Momentum; Relativistic Energy; Massless Particles	2.9, 3.2, 3.3, 3.4, 3,5, 3,6 3.8	2.30, 3.4, 3.8, 3.16, 3.20, 3.34
Week 4: Feb. 18 - 20	**Basic Atomic Physics** Electron; Quantization of Light; Black Body Radiation; Photoelectric Effect; X-rays, Bragg Diffraction; Compton Effect	4.1, 4.2, 4.3, 4.7, 5.1, 5.2, 5.3, 5.4, 5.6, 5.7	3.36, 4.19, 5.3, 5.4, 5.8, 5.10, 5.18
Week 5: Feb. 25 - 27	Atomic Spectra; Balmer/Rydberg Formulae; Bohr Model of Atom; X-ray Spectra; de Broglie Waves	6.1, 6.2, 6.3, 6.5, 6.6, 6.7, 6.9, 7.2	6.2, 6.5, 6.8, 6.10, 6.13, 6.17
Week 6: March 03 - 05	**Quantum Mechanics** Particle/Wave Duality; Wave Function; Two-Slit Experiment; Waves; Uncertainty Principle;	7.3, 7.4, 7.5, 7.6, 7.7, 7.8, 7.9	7.6, 7.10, 7.20, 7.24, 7.28, 7.40, 7.43

Week 7: Mar. 10 -17	Standing Waves; Particle in a Box; Schrodinger Equation and its Solutions	8.2, 8.3, 8.4, 8.5, 8.6, 8.7	8.9, 8.12, 8.14 8.18, 8.26, 8.28
March 12	**First Midterm**		
Week 8: Mar. 19 - 24	**Quantum Mechanical Description of Atoms** 3-d Schrodinger Eq.; Central Force Problem; Quantized Ang. Mom.	9.2, 9.5, 9.6	9.2, 9.18
Week 9: Mar. 26 - 31	Hydrogenic Energy Levels and Wave Functions; Shells and Ions;	9.7, 9.8, 9.9, 9.10	9.20, 9.22, 9.26, 9.28
Week 10: April 02 - 23	Spin of Electrons Independent Electrons; Pauli Exclusion; Low-Z Elements; Periodic Table	10.2 , 11.2, 11.3, 11.4 11.5, 11.6, 11.7	9.29, 9.31 (see Ex. 9.4), 9.34, 9.42, 9.44, 9.46, 10.4
April 21	**Second Midterm**		
Week 11: April 28 - 30	Excited States of Atoms; Stationary States; Absorption/Emission; Lifetimes/Selection Rules; Lasers	11.8, 15.3, 15.4, 15.5, 15.6, 15.7	10.6, 11.5, 11.8, 11.14, 11.16, 11.34, 15.2
Week 12: May 05 - 07	**Nuclear Physics** Nuclear Force; Binding Energy Formula; Radioactive Decays	12.2 12,3 12.6, 12.7 13.2, 13.3, 13.4	15.5, 15.12, 15.19, 15.20, 12.10, 12.19, 12.30
Week 13: May 12-14	Nuclear Reactions; **Molecules and Solids** Chemical Bonds; Solid Matter;	13.6, 13.7, 13.8 16.2 16.3, 16.4, 16.5 17.1, 17.2	12.32, 12.37, 12.38, 12.44, 13.4, 13.11, 13.15
Exam Week May 19	**Final Exam (2:00 - 4:00 pm)**		

Learning Outcomes:

In this course, you will learn the essential quantum properties, models, and methods important to understand the structure of multi-electron atoms and of nuclei. By the end of the course, you will be able to (i) identify phenomena and experiments where classical theory fails and which can only be explained with quantum theory; (ii) explain and apply basic models of both atoms and nuclei; (iii) analyze and predict the behavior of the wavefunction for one-dimensional problems, understanding when the quantum-mechanical phenomena of tunneling, energy quantization, and above-barrier reflection occur; (iv) solve for the quantum mechanical wavefunction for simple model systems; (v) demonstrate solutions of the Schrödinger equation for the hydrogen atom, including angular momentum properties, and spin. The outcomes will be developed and achieved throughout the course, and tested via the quiz, homework, midterm, and final exam problems.

Academic Integrity Statement

Academic Integrity Statement Hunter College regards acts of academic dishonesty (e.g., plagiarism, cheating on examinations, obtaining unfair advantage, and falsification of records and official documents) as serious offenses against the values of intellectual honesty. The college is committed to enforcing the CUNY Policy on Academic Integrity and will pursue cases of academic dishonesty according to the Hunter College Academic Integrity Procedures.

ADA Policy

In compliance with the American Disability Act of 1990 (ADA) and with Section 504 of the Rehabilitation Act of 1973, Hunter College is committed to ensuring educational parity and accommodations for all students with documented disabilities and/or medical conditions. It is recommended that all students with documented disabilities (Emotional, Medical, Physical, and/or Learning) consult the Office of AccessABILITY, located in Room E1214B, to secure necessary academic accommodations. For further information and assistance, please call: (212) 772- 4857 or (212) 650-3230

Hunter College Policy on Sexual Misconduct

In compliance with the CUNY Policy on Sexual Misconduct, Hunter College reaffirms the prohibition of any sexual misconduct, which includes sexual violence, sexual harassment, and gender-based harassment retaliation against students, employees, or visitors, as well as certain intimate relationships. Students who have experienced any form of sexual violence on or off campus (including CUNY-sponsored trips and events) are entitled to the rights outlined in the Bill of Rights for Hunter College.

a. Sexual Violence: Students are strongly encouraged to immediately report the incident by calling 911, contacting NYPD Special Victims Division Hotline (646-610-7272) or their local police precinct, or contacting the College's Public Safety Office (212-772-4444).

b. All Other Forms of Sexual Misconduct: Students are also encouraged to contact the College's Title IX Campus Coordinator, Dean John Rose (jtrose@hunter.cuny.edu or 212-650-3262) or Colleen Barry (colleen.barry@hunter.cuny.edu or 212-772-4534) and seek complimentary services through the Counseling and Wellness Services Office, Hunter East 1123.

CUNY Policy on Sexual Misconduct Link:

http://www.cuny.edu/about/administration/offices/la/Policy-on-Sexual-Misconduct-12-1-14-with-links.pdf