PHYS 274 - General Physics III

(Modern Physics w/ calculus)

Department of Physics & Astronomy

University of Hawaii

Instructor: Prof. Tom Browder and Prof. Pui K. Lam (backup)

Class Meets MWF 12:30-13:20, Watanabe 112

(August 22, 2016 - December 8, 2016)

(http://www.phys.hawaii.edu/~teb/phys274/phys274.html)

- **Text:** University Physics Volume 2 (Chaps. 35 and 36) & Volume 3, 13th Edition, by Young and Freedman, Pearson Addison- Wesley, San Francisco.

  ****** an iclicker is required, please bring your iclicker to every class meeting ******
  ****** Mastering Physics is required for the homework******

- Homework Assignments (check frequently for updates, Mastering Physics course code MPBROWDER38451)
- **Daily quiz (except on midterm and exam days):** A quiz (closed book) will be given at the beginning of each class. It consists of 2 short questions on materials covered in the previous lecture and 2 short questions on the materials to be covered that day. ***You will need your iclicker for the quiz. You have one to two minutes to answer each question.***

Grading

Grading is based on an absolute scale.
Total (100%) = quizzes/iclicker questions (15%) + HW (25%) + (Midterm 1+ Midterm 2 + Final=(60%)).
The combined % for Midterm 1+ Midterm 2 + Final=60%; the highest score=25%, middle score=20%, lowest score=15%.

Approximate values:
91-100 (A), 86-90 (A-) 84-85 (B+) 72-83 (B) 70-71 (B-) 69-70 (C+) 58-69 (C) 56-57 (C-) 54-55 (D+) 41-53 (D) <40 (F)

Tests

There will be two midterms and a final.
There will be four questions on each midterm, which will be a combination of quantitative (3) and conceptual (1).

For the two midterms, you can bring a standard size notecard with formulae.

Midterm I, Monday September 26
(Problem 1: Interference; Problem 2: Diffraction; Problem 3: Special Relativity; Problem 4: Short answer conceptual questions)

Midterm II, Monday October 24
(Problem 1: Photons; Problem 2: Particles behaving like waves; Problem 3: Quantum Mechanics; Problem 4: Short answer/ conceptual questions)
Remember to study hydrogen-like atoms in the Bohr model, the QM particle in a box and the Heisenberg uncertainty principle.

For the final exam (Friday Dec 16th, 12:00-2:00 pm), you can bring a single sheet of paper with formulae.

The final exam will have 8 problems
(6 problems requiring calculation and 2 short answer/conceptual questions (including chapter 44)).
The last two problems will include some questions about energy and momentum in special relativity.

Problem 1: Interference (double and single slits)
Problem 2: Heisenberg Uncertainty Principle (Particles and/or Waves)
Problem 3: QM I: Wave Functions (study tunneling)
Problem 4: QM II: Atomic Structure
Problem 5: Molecules/Solid State
Problem 6: Nuclear Physics (rest mass differences are key)

Tutoring

Click here for updated info on tutoring at the learning emporium.

Simulations:

Cartoons that illustrate coherence length in the context of thin film interference
The java applets used for lecture demonstrations of interference, diffraction, and atomic orbitals can be found on the web site falstad.com
Segre Chart of atomic nuclei.

Quizzes

There were 34 in-class quizzes in the Fall 2016 edition of PHYS274.

Class Outlines/Learning Outcomes:

- Lecture_01- Course overview and Interference (Ch 35)
- Lecture_02 -Ch.35. More Interference (Thin films)
- Lecture_03-Ch 35. Interference (Non-reflective coatings, Michelson-Morley Experiment)
    - Clicker Questions on Interference (Chap 35)
- Lecture_04: Ch 36, Diffraction
- Lecture_05 - Ch.36. Diffraction (N slits)
- Lecture_06 -Diffraction Intensity, resolving power, Xray diffraction
- Lecture_07- Review of Diffraction
- Clicker Questions on Interference (Chap 36, part 1)
- Clicker Questions on Interference (Chap 36, part 2)

- Lecture_08- Special Relativity I (read through 37.1-37.2)
- >>>>Video on Simultaneity in Special Relativity
- Lecture-09 Special Relativity/Time Dilation (read 37.3-37.4)
- Lecture-10 Special Relativity/Lorentz Transformations, Addition of Velocities (read 37.5)
- Lecture-11 Special Relativity/Doppler Effect, Relativistic Momentum, Work and Energy (read 37.6-37.8)
- Lecture-12 Special Relativity/ E=m c^2 (read 37.8-37.9)
- Lecture-13 Special Relativity/ Examples of E=m c^2, Cherenkov radiation from relativistic particles. (read 37.8-37.9)
- Lecture-14 General Relativity, Review

- Lecture-15 Photons: the Photoelectric Effect (read 38.1-38.2)
- Lecture-16 Photons: X-ray production, Compton Scattering, Wave-Particle Duality (read 38.2-38.3)
- Lecture_17- Heisenberg Uncertainty Principle (read 38.4)

- Lecture_18- Particle behaving as waves (read 39.1, 39.2),
- Lecture_19-Energy Levels in the Bohr model of the atom (read Chap 39.3, 39.4)
- >>>>Video: How a Laser works (stimulated emission, optical pumping, population inversion, mirror cavity)
- >>>>Video: How a Laser works (Urbana Engineering professor, Bill Hammack)
- Lecture_20 - Laser, continuous spectra (read Chap 39.5, 39.6)
- Lecture_21 - continuous spectra, Heisenberg uncertainty principle, Wavefunctions, Schrodinger Equation (read Chap 40.1)

- Lecture_22 - Quantum Mechanics (read Chap 40.2)

- Lecture_23 - Quantum Mechanics (Prof. P. Lam) (read Chap 40.2, 40.3)
- Lecture_24 - Quantum Mechanics (Prof. P. Lam) (read Chap 40.4, 40.5)
- Lecture_25 - Quantum Mechanics (Prof. P. Lam) (Particle in a Finite Box)
- Lecture_26 - Quantum Mechanics (Prof. P. Lam) (tunneling, simple harmonic oscillator)
- Lecture_27 - Quantum Mechanics (review tunneling, simple harmonic oscillator)

- Lecture_28 - Ch.41- 3-D Schrodinger's Equation, Particle inside a 3-D box (read 41.3,41.4)

- Lecture_29 - Ch.41- Hydrogen atom, orbital angular momentum and spin (read 41.5, 41.6)
- Lecture_30 - Ch.41- Orbital angular momentum, counting states (read 41.5,41.6)
- Lecture_31 - Ch.41- Zeeman effect, spin 1/2, Pauli principle, 21 cm hydrogen line (read 41.7)
- Lecture_32 - Ch.41- Multi-electron atoms (read 41.7)

- Lecture_32 - Ch.42- Molecules, Solid State (Vibrational and Rotational Energy Levels of diatomic molecules)
- Lecture_33 - Ch.42- Crystals, Band gaps, Semiconductors
- Lecture_34 - Ch.42- Fermi Energy, Semiconductors
- Lecture_35 - Ch.42- p-n junctions, LED, solar cell, MOSFETs and superconductivity

- Lecture_36 - Superconductivity; Ch.43- Nuclear Structure and Nuclear Binding
- Lecture_37 - Ch.43- Nuclear spin and angular momentum
- Lecture_38 - Ch.43- Nuclear spin example. Examples of radioactive decay. Activities and half-lives.
- Lectures 39-41, Chap43; More Nuclear Physics (Professor Pui Lam)

- Lecture_42- Chapter 44, Fundamental Particles and Their Interactions
- Lecture_43- Chapter 44, Fundamental Particles and Their Interactions II