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

(Fall 2017 edition)

(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 or a smart phone with the Iclicker REEF app is required, please bring your iclicker (or device) to every class meeting ******

  Click here For instructions on registering your iclicker or device

  ****** Mastering Physics is required for the homework******

- Homework Assignments (check frequently for updates, Mastering Physics course code MPBROWDER26267 (Fall 2017))
- Hints for the Homework (check frequently for updates, updated by Grader Tommy Lam)

- **Daily quiz (except on midterm and exam days):** A quiz (closed book) will be given at the beginning of each class. It usually 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/or device 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:
90-100 (A), 71-89 (B) 58-70 (C) 41-57 (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, October 16
(Problem 1: Interference; Problem 2: Diffraction; Problem 3: Special Relativity (remember to study relativistic energy and momentum); Problem 4: Short answer conceptual questions)

A midterm I practice exam
Solutions for midterm I practice exam

Solutions for midterm I

*** Midterm II, Monday November 13
(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, tunneling and the Heisenberg uncertainty principle.

A midterm II practice exam

Solutions for midterm II

For the final exam (Monday, December 11th, 12:00-14:00) you can bring a single sheet of paper with formulae.

A practice exam for the final

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
Problem 4: QM II: Atomic Structure
Problem 5: Molecules/Solid State
Problem 6: Nuclear Physics

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. There will be a comparable number in the Fall 2017 edition. However, these are fully integrated into the lectures.

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)
- Lecture_04: Ch 36, Diffraction
- Lecture_05: Ch 36, Diffraction (Intensity, Two slits of finite width)
- Lecture_06: Ch 36, Diffraction (N Slits, Diffraction Grating, Diffraction Limit)
- Lecture_07: Ch 36, Rayleigh limit, Crystal Diffraction, Diffraction Limit, Holograms)

- Lecture-08 Special Relativity I (read through 37.1-37.2)
- >>>>Video on Simultaneity in Special Relativity
- >>>>Video on "Pole in a Barn"
- >>>>Video on a relativistic train in a tunnel
- Lecture-09 Special Relativity/Time Dilation (read 37.3-37.5)
- Lecture-10 Special Relativity/Length Contraction, Lorentz Transformations (read 37.5)
- Lecture-11 Special Relativity/ Lorentz Transformations, Addition of velocities in special relativity, (read 37.6-37.8)
- Lecture-12 Doppler Effect, Relativistic Momentum, Work and Energy, 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, Photons: the Photoelectric Effect (read 38.1, 38.2)
- Lecture-15 Photons: EM waves as particles, bremsstrahlung, Compton scattering bootcamp (read 38.2-38.3)
- Lecture-16 Photons: Wave-Particle Duality, Heisenberg Uncertainty Principle (read 38.4)

- Lecture_17- Heisenberg uncertainty principle, Particles as Waves (read 39.1, 39.2)
- Lecture_18- Particle behaving as waves, Bohr model, Ultraviolet Catastrophe (read 39.3,39.4),
- Lecture_19-Energy Levels in the Bohr model of the atom (read Chap 39.5)
- >>>>Video: How a Laser works (stimulated emission, optical pumping, population inversion, mirror cavity)
- >>>>Video: How a Laser works (Urbana Engineering professor, Bill Hammack)
- >>>>Video: How a Laser works, "Complete Guide".
- 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 II (read Chap 40.2, 40.3)
- Lecture_24 - Quantum Mechanics III, Review of particle in a box, Free particle and Schrodinger Equation (read Chap 40.4, 40.5)
- Lecture_25 - Quantum Mechanics IV (Particle in a Finite Box, tunneling)
- Lecture_26 - Quantum Mechanics V (conclusion of Chapter 40) (tunneling, simple harmonic oscillator)

- Lecture_27 - Ch 41. Atomic Structure (Introduction, 3-D Schrodinger's Equation, Hydrogen atom)
- Lecture_28 - Ch.41- Quantization of angular momentum, hydrogen quantum numbers, counting states and degeneracies (read 41.3,41.4)
- Lecture_29 - Ch.41- Counting states, Zeeman effect, magnetic moments (read 41.5, 41.6)
- Lecture_30 - Ch.41- Spin, Pauli Exclusion Principle, 21 cm line (read 41.7)
- Lecture_31 - Ch.41- Multi-electron atoms, X-ray spectroscopy

- Lecture_32 - Ch.42- Molecules (Binding, Vibrational and Rotational Energy Levels of

diatomic molecules) (read 42.1,42.2)

- >>> Simulation of atom-atom forces from the U Colorado PHET project
- >>> Simulation of double QM wells and covalent bonds from PHET.
- Lecture_33 - Ch.42- Crystals, Semiconductors (read 42.3, 42.4)
- >>> Simulation of band gaps from PHET.
- Lecture_34 - Ch.42- Fermi Energy, p-n junctions, LED, solar cells (read 42.5, 42.6, 42.7)

- Lecture_35 - Superconductivity; Ch.43- Nuclear Structure and Nuclear Binding (read 43.1, 43.2)
- Lecture_37 - Ch.43- Nuclear stability, nuclear spin and angular momentum (read 43.3, 43.4, 43.5)
- Lecture_38 - Ch.43- Nuclear spin example. Examples of radioactive decay. Activities and half-lives. (read 43.5, 43.6, 43.7, 43.8)

- Lecture_40- Chapter 44, Fundamental Particles and Their Interactions (read 44.1,44.2)
- Lecture_41- Chapter 44, Fundamental Particles and Their Interactions II (read 44.3, 44.4, 44.5)