



Basic Physics for Science & Engineering 1

PHYS 0174

4 Credits

Description: This is the first term of a two-term introductory sequence in physics for science and engineering students.

Prerequisite: Calculus is needed and should be taken at least concurrently. The laboratory course associated with this sequence is taken after Physics 0174.

Grading: The grade is determined primarily by three exams during the term and a cumulative final exam. Other work, such as quizzes and homework, may make some contribution to the grade. Approximately half of the class time each week is spent in covering new material. The remaining time is devoted to activities such as problem solving, demonstrating experiments, questions, and discussion.

Textbook: At the University of Pittsburgh, the latest edition of *Fundamentals of Physics* by Halliday, Resnick, and Walker is used. Any comparable, calculus-based text that covers all of the material in this course outline is acceptable as an alternative.

The following topics should be covered. The order of topics may be altered as long as all of the material listed before each exam is covered before that exam is given.

1. Measurement

- Units of length, time, mass; in particular the SI system
- Unit checking
- Changing units
- Systems of coordinates

2. Vectors

- Vectors vs. scalars
- Magnitude, direction, Cartesian components
- Unit vectors **i**, **j**, **k**
- Addition and subtraction by geometric and algebraic methods
- Multiplication by a scalar
- Scalar (dot) product
- Vector (cross) product

3. Motion along a straight line

- Position and displacement
- Average velocity and average speed
- Instantaneous velocity and instantaneous speed
- Average acceleration and instantaneous acceleration
- Kinematics of constant acceleration
- Freely falling bodies

4. Motion in two and three dimensions

- Position and displacement
- Average velocity and average speed
- Instantaneous velocity and instantaneous speed
- Average acceleration and instantaneous acceleration
- Projectile motion
- Uniform circular motion
- Relative velocity and acceleration (it is sufficient to do only the one-dimensional case)

5. Newton's laws of motion

- Newton's First Law and inertial frames of reference
- Newton's Second Law and concepts of force and mass
- Newton's Third Law

6. Applications of Newton's laws

- Free-body diagrams
- Tension and pulleys
- Static and kinetic friction
- Inclined planes
- Uniform circular motion and centripetal force

EXAM I



7. Work and Kinetic Energy

- Work as a scalar product
- Work done by weight
- Work done by a variable force
- Hooke's law and work done by a spring
- Kinetic energy and the work-energy theorem
- Power

8. Potential energy & conservation of energy

- Conservative forces and potential energy
- Examples: mgh and $(1/2)kx^2$
- Conservation of mechanical energy
- Work done by nonconservative forces and $W_{\text{noncon}} = \Delta E$
- Conservation of energy (including internal energy)

9. Systems of particles

- Center of mass
- Newton's second law for a system of particles
- Linear momentum of a particle and of a system
- Conservation of momentum

10. Collisions

- Impulse and the impulse-momentum theorem
- Elastic and inelastic collisions in one dimension
- Collisions in two dimensions

11. Rotation

- Kinematics of fixed-axis rotation
- Linear and angular variables
- Moment of inertia and rotational kinetic energy
- Torque (including definition as a cross product) and rotational dynamics
- Rolling; translational and rotational kinetic energy; conservation of energy
- Angular momentum of a particle, a system of particles, and a rigid body
- Conservation of angular momentum

EXAM II

12. Gravitation

- Newton's law of universal gravitation
- Gravitational potential energy and escape speed
- Planets and satellites
- Kepler's laws and their relation to conservation laws

13. Oscillations

- Simple harmonic motion resulting from Newton's second law and Hooke's law
- Position, velocity, and acceleration in simple harmonic motion
- Energy considerations in simple harmonic motion
- Simple pendulum

14. Mechanical Waves

- Transverse and longitudinal waves
- Wavelength and frequency
- Speed of a traveling wave
- Waves on a stretched string
- Speed, energy, and power of a traveling wave on a stretched string
- Principle of superposition; interference
- Standing waves
- Sound waves
- Speed of sound
- Interference of sound waves

EXAM III

15. Doppler effect

FINAL EXAM (Cumulative)



Academic Integrity: All College in High School teachers, students, and their parents/guardians are required to review and be familiar with the University of Pittsburgh's Academic Integrity Policy located online at www.as.pitt.edu/fac/policies/academic-integrity.

Grades: Grade criteria in the high school course may differ slightly from University of Pittsburgh standards. A CHS student could receive two course grades: one for high school and one for the University transcript. In most cases the grades are the same. These grading standards are explained at the beginning of each course.

Transfer Credit: University of Pittsburgh grades earned in CHS courses appear on an official University of Pittsburgh transcript, and the course credits are likely to be eligible for transfer to other colleges and universities. Students are encouraged to contact potential colleges and universities in advance to ensure their CHS credits would be accepted. If students decide to attend any University of Pittsburgh campuses, the University of Pittsburgh grade earned in the course will count toward the student grade point average at the University. At the University of Pittsburgh, the CHS course supersedes any equivalent AP credit.

Drops and Withdrawals: Students should monitor progress in a course. CHS teacher can obtain a Course Drop/Withdrawal Request form from the CHS office or Aspire. The form must be completed by the student, teacher and parent/guardian and returned to teacher by deadlines listed. Dropping and withdrawing from the CHS course has no effect on enrollment in the high school credits for the course.