

Physics

Course Syllabus

The Text

Physics, by Cutnell and Johnson, 3rd ed., John Wiley and Sons Publishing. It is a calculus free study of Physics but the math requires highly developed algebra skills since the book is an entry level college text.

Topics Covered

I. Background

- how to read the textbook
- significant digits
- order of magnitude and estimation
- problem solving methodology
- dimensional analysis
- systems of units/unit conversions
- graphing
- right triangle trigonometry
- *ACTIVITIES: Using the tools of the lab
- *LAB: Direct and indirect measurement

II. Vectors

- head to tail method of addition
- vector components
- component method of addition
- LAB: The vector nature of forces

III. Kinematics in 1D and 2D (two units)

- displacement, velocity, acceleration
- graphs of distance vs. time and velocity vs. time
- equations of kinematics in two dimensions
- projectile motion
- relative velocity
- *LAB: Measuring speed and acceleration (tape timers)
- *ACTIVITY: Graphs of position, velocity, and acceleration (DS)
- *LAB: Acceleration of Gravity (DS)
- LAB: Target practice with a projectile launcher

IV. Newton's Laws

- fundamental forces
- law of inertia, law of acceleration, law of action-reaction
- law of universal gravitation
- weight, tension, and normal forces
- static and kinetic frictional forces
- equilibrium applications - $\Sigma F = 0$
- nonequilibrium applications - $\Sigma F = ma$
- *LAB: Newton's laws with Dynamics Carts

V. Uniform Circular Motion

- centripetal and centrifugal

- problem-solving - $\Sigma F = mv^2/r$
- satellites orbits
- banked turns
- apparent weightlessness and artificial gravity
- vertical circles
- LAB: How Fast Can You Take That Turn?

VI. Work and Energy

- work and energy
- kinetic energy
- gravitational and elastic potential energy
- the Work-Energy theorem
- conservation of energy
- problem-solving with conservation of energy
- power
- work done by a variable force
- *LAB: Pulleys and Mechanical Advantage
- *LAB: Conservation of Energy in a Spring-Mass System

VII. Impulse and Momentum

- impulse and momentum
- the Impulse-Momentum Theorem
- conservation of linear momentum
- elastic and inelastic collisions
- collisions in one dimension
- collisions in two dimensions
- *LAB: The Ballistic Pendulum
- *LAB: Collisions on a Dynamic Track

VIII. Electric Forces and Fields

- atomic particles and properties
- interaction of charge
- conductors and insulators
- methods of charging
- Coulomb's law
- electric fields
- electric potential energy
- voltage (potential difference)
- *ACTIVITY: The Van de Graff Generator
- *LAB: Mapping an electric field

IX. DC Circuits

- voltage and current
- alternating and direct current
- series and parallel circuits
- electrical resistance
- using Ohm's law
- measuring voltage and current in simple circuits
- drawing circuit diagrams
- applying Kirchhoff's laws to simple circuits
- *LAB: Building and Analyzing Series and Parallel Circuits

X. Magnets and Electromagnetism

- magnetic materials
- magnetic fields and charges
- forces on currents in a magnetic field
- Ampere's law
- inducing current and Faraday's law
- Motors and generators
- Transformers
- *LAB: Electromagnetic Induction with a Motor & Generator

XIII. Special Relativity

- inertial reference frames and events
- the postulates of relativity
- time dilation
- length contraction
- the equivalence of mass and energy
- relativistic velocity addition
- *ACTIVITY: Modeling the "Big Bang"
- *LAB: How old is our Universe?

XI. Temperature, Heat Transfer, and Thermodynamics (if time)

- common temperature scales
- thermal expansion
- heat and internal energy
- conduction, convection, and radiation
- applications of heat transfer
- isobaric and isothermal processes
- the first and 2nd laws of thermodynamics
- efficiency of a heat engine
- entropy and disorder
- *LAB: Heat Transfer (DS)
- *LAB: thermal expansion

XII. Waves and Sound (if Time)

- Types of waves
- The speed of a wave
- The nature of sound
- Properties of sound
- The decibel
- The Doppler effect
- *LAB: Speed of Sound (DS)

TECHNOLOGY:

Use of technology such as graphing calculators, computer software (Microsoft Office), and lab interfaces are an important part of the Physics curriculum. All students will have access to such technology and will be expected to learn to use it and apply it to their Physics study. Students are required to have an up-to-date student ID and password on the school web server. Students should own a USB flash drive for transferring files.