

# Topics list for PHYS 1405, based on Hewitt

## Required topics in **red**

Suggested topics are in *italics*; instructors should cover the majority of these topics, depending on their focus for the course

1. About Science
  - 1.1 Scientific Measurements
  - 1.2 Scientific Methods**
  - 1.3 Science, Art, and Religion
  - 1.4 Science and Technology
  - 1.5 Physics – The Basic Science**
  - 1.6 In Perspective

## I. MECHANICS

2. Newton's First Law of Motion: Inertia
  - 2.1 *Aristotle on Motion*
  - 2.2 *Galileo's Experiments*
  - 2.3 Newton's First Law of Motion**
  - 2.4 Net Force and Vectors**
  - 2.5 The Equilibrium Rule**
  - 2.6 *Support Force*
  - 2.7 Equilibrium of Moving Things**
  - 2.8 *The Moving Earth*
3. Linear Motion
  - 3.1 *Motion is Relative*
  - 3.2 Speed**
  - 3.3 Velocity**
  - 3.4 Acceleration**
  - 3.5 Free Fall**
  - 3.6 *Velocity Vectors*
4. Newton's Second Law of Motion
  - 4.1 Force Causes Acceleration**
  - 4.2 Friction**
  - 4.3 Mass and Weight**
  - 4.4 Newton's Second Law of Motion**
  - 4.5 When Acceleration is  $g$  – Free Fall**
  - 4.6 *When Acceleration is less than  $g$  – Nonfree Fall*
5. Newton's Third Law of Motion
  - 5.1 Forces and Interactions**
  - 5.2 Newton's Third Law of Motion**

- 5.3 **Action and Reaction on Different Masses**
- 5.4 **Vectors and the Third Law**
- 5.5 **Summary of Newton's Three Laws**

## 6. Momentum

- 6.1 **Momentum**
- 6.2 **Impulse**
- 6.3 **Impulse Changes Momentum**
- 6.4 *Bouncing*
- 6.5 **Conservation of Momentum**
- 6.6 **Collisions**
- 6.7 More Complicated Collisions

## 7. Energy

- 7.1 **Work**
- 7.2 **Potential Energy**
- 7.3 **Kinetic Energy**
- 7.4 **Work-Energy Theorem**
- 7.5 **Conservation of Energy**
- 7.6 *Machines*
- 7.7 *Efficiency*
- 7.8 *Sources of Energy*

## 8. Rotational Motion

- 8.1 *Circular Motion*
- 8.2 *Rotational Motion*
- 8.3 *Torque*
- 8.4 Center of Mass and Center of Gravity
- 8.5 *Centripetal Force*
- 8.6 Centrifugal Force
- 8.7 *Angular Momentum*
- 8.8 *Conservation of Angular Momentum*

## 9. Gravity

- 9.1 **The Universal Law of Gravity**
- 9.2 *The Universal Gravitational Constant  $G$*
- 9.3 **Gravity and Distance: The Inverse-Square Law**
- 9.4 **Weight and Weightlessness**
- 9.5 *Ocean Tides*
- 9.6 Gravitational Fields
- 9.7 *Black Holes*
- 9.8 Universal Gravitation

## 10. Projectile and Satellite Motion

- 10.1 **Projectile Motion**
- 10.2 *Fast-Moving Projectiles – Satellites*

- 10.3 *Circular Satellite Orbits*
- 10.4 *Elliptical Orbits*
- 10.5 Kepler's Laws of Planetary Motion
- 10.6 Energy Conservation and Satellite Motion
- 10.7 *Escape Speed*

## II. PROPERTIES OF MATTER

### 11. The Atomic Nature of Matter

- 11.1 **The Atomic Hypothesis**
- 11.2 **Characteristics of Atoms**
- 11.3 Atomic Imagery
- 11.4 **Atomic Structure**
- 11.5 **The Periodic Table of the Elements**
- 11.6 *Isotopes*
- 11.7 *Compounds and Mixtures*
- 11.8 *Molecules*
- 11.9 *Antimatter*

### 12. Solids

- 12.1 Crystal Structure
- 12.2 **Density**
- 12.3 *Elasticity*
- 12.4 *Tension and Compression*
- 12.5 *Arches*
- 12.6 Scaling

### 13. Liquids

- 13.1 **Pressure**
- 13.2 **Pressure in a Liquid**
- 13.3 **Buoyancy**
- 13.4 **Archimedes' Principle**
- 13.5 **What Makes an Object Sink or Float?**
- 13.6 **Flotation**
- 13.7 *Pascal's Principle*
- 13.8 Surface Tension
- 13.9 Capillarity

### 14. Gases

- 14.1 The Atmosphere
- 14.2 **Atmospheric Pressure**
- 14.3 Boyle's Law
- 14.4 **Buoyancy of Air**
- 14.5 **Bernoulli's Principle**
- 14.6 Plasma

### III. HEAT

#### 15. Temperature, Heat, and Expansion

- 15.1 **Temperature**
- 15.2 **Heat**
- 15.3 **Specific Heat Capacity**
- 15.4 **The High Specific Heat Capacity of Water**
- 15.5 **Thermal Expansion**

#### 16. Heat Transfer

- 16.1 **Conduction**
- 16.2 **Convection**
- 16.3 **Radiation**
- 16.4 Newton's Law of Cooling
- 16.5 **The Greenhouse Effect**
- 16.6 **Climate Change**
- 16.7 *Solar Power*
- 16.8 Controlling Heat Transfer

#### 17. Change of Phase

- 17.1 **Phases of Matter**
- 17.2 **Evaporation**
- 17.3 **Condensation**
- 17.4 **Boiling**
- 17.5 **Melting and Freezing**
- 17.6 **Energy and Changes of Phase**

#### 18. Thermodynamics

- 18.1 *Thermodynamics*
- 18.2 *Absolute Zero*
- 18.3 *First Law of Thermodynamics*
- 18.4 Adiabatic Processes
- 18.5 Meteorology and the First Law
- 18.6 *Second Law of Thermodynamics*
- 18.7 *Energy Tends to Disperse*
- 18.8 *Entropy*

### IV. SOUND

#### 19. Vibration and Waves

- 19.1 **Good Vibrations**
- 19.2 **Wave Description**
- 19.3 **Wave Motion**
- 19.4 **Wave Speed**
- 19.5 **Wave Interference**
- 19.6 **Doppler Effect**

- 19.7 Bow Waves
- 19.8 Shock Waves

## 20. Sound

- 20.1 **Nature of Sound**
- 20.2 **Sound in Air**
- 20.3 *Reflection of Sound*
- 20.4 *Refraction of Sound*
- 20.5 *Forced Vibrations*
- 20.6 *Resonance*
- 20.7 **Interference**
- 20.8 Beats

## 21. Musical Sounds

- 21.1 **Noise and Music**
- 21.2 **Pitch**
- 21.3 **Sound Intensity and Loudness**
- 21.4 *Quality*
- 21.5 *Musical Instruments*
- 21.6 Fourier Analysis
- 21.7 From Analog to Digital