

# Physics - Syllabus

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## Introduction

**About.** The goal of this course is to equip students with the ability to understand, appreciate, and apply core concepts in both classical and modern physics. It is expected that students enrolling in this course will have a solid mathematical background in algebra, including trigonometry.

## Unit 1: Force & Motion (September - October)

1.1 | *Position & displacement, velocity & speed, acceleration*

1.2 | *One-dimensional kinematics & falling objects*

1.3 | *Two-dimensional kinematics & projectile motion*

1.4 | *Force ( $F=ma$ ), tension, friction*

1.5 | *Centripetal force, Coriolis force*

## Unit 2: Energy (October)

2.1 | *Work-energy theorem*

2.2 | *Gravitational potential energy*

2.3 | *Nonconservative forces*

2.4 | *Conservation of energy*

## Unit 3: Collisions (October - November)

3.1 | *Conservation of momentum; rocket propulsion*

3.2 | *Elastic & inelastic collisions in one dimension*

3.3 | *Collisions in two dimensions*

3.4 | *Egg drop*

## Unit 4: Gravitational, Electric, and Magnetic Fields (November - December)

4.1 | *Universal Law of Gravitation; Coulomb's Law*

4.2 | *Gravitational fields; electric fields; electric potential*

4.3 | *Conductors and insulators*

4.4 | *Magnetic force; magnetic fields; Ampere's law*

4.5 | *Oersted's experiment; the ordinary Hall effect, Helmholtz coils*

### **Unit 5: Circuits (December)**

5.1 | *Current; resistance; Ohm's law*

5.2 | *AC vs DC current*

5.3 | *Dielectrics & capacitors*

5.4 | *Kirchhoff's rules*

5.5 | *Electric hazards*

5.6 | *Electromagnetic induction*

### **Unit 6: Molecular Level (January)**

6.1 | *Temperature; thermal expansion*

6.2 | *Phase changes; pressure*

6.3 | *Heat transfer*

6.4 | *Malleability; conductivity; reflectivity*

6.5 | *Emerging technologies in materials science*

### **Unit 7: Oscillations & Matter Waves (January - February)**

7.1 | *Period & frequency; simple harmonic motion; damped harmonic motion*

7.2 | *Forced oscillations; resonance*

7.3 | *Superposition & interference*

7.4 | *Sound*

7.5 | *Doppler effect; sonic booms*

**Unit 8: Electromagnetic Waves (February)**

8.1 | *Electromagnetic radiation; electromagnetic spectrum*

8.2 | *Reflection; refraction; dispersion*

8.3 | *Lenses; mirrors; microscopes; telescopes*

**Unit 9: Modern Physics (February - April)**

9.1 | *Double-slit experiment; photoelectric effect; particle-wave duality*

9.2 | *Quantum states & wavefunctions*

9.3 | *Philosophical implications of quantum mechanics*

9.4 | *Applications of quantum mechanics; superconductors*

9.5 | *Special relativity & consequences*

9.6 | *Cosmology & general relativity*

9.7 | *Particle detectors & the Standard Model*

9.8 | *Dark matter & dark energy*

9.9 | *Loop quantum gravity; superstrings*

9.10 | *Complex systems; dimensionality reduction*

**Unit 10: Climate Change (May - June)**

10.1 | *Radiative forcing & climate change feedbacks*

10.2 | *Evidence*

10.3 | *Effects & forecasts*

10.4 | *Controversy*

10.5 | *Corrective measures*

