C A M O S U N C O L L E G E

PHYSICS DEPARTMENT

PHYS 114 FUNDAMENTALS OF PHYSICS 1

A survey of physics, using calculus, designed to provide a foundation for further study in the physical sciences. Students will develop skills in laboratory procedures, data analysis and problem solving through investigation of the topics of geometric optics, thermal energy, fluid motion, forces and statics, particle kinematics and dynamics, curvilinear motion, atomic structure and nuclear energy.

OFFERED:	Fall, Winter
CREDIT:	4
IN-CLASS WORKLOAD:	4 lec, 2 lab
OUT-OF-CLASS WORKLOAD:	6
PREREQUISITES:	Physics 12 or PHYS 104 and Algebra 12 or MATH 115
COREQUISITES:	MATH 100

OUTLINE

1. **Light**

   1.1 Nature of light
   - 1.1.1 Wave nature
   - 1.1.2 Particle nature
   - 1.1.3 Speed of light
   - 1.1.4 Rays

   1.2 Light at an interface
   - 1.2.1 Interface
   - 1.2.2 Reflected ray
   - 1.2.3 Refracted ray
   - 1.2.4 Laws of reflection
   - 1.2.5 Laws of refraction
   - 1.2.6 Index of refraction
   - 1.2.7 Prisms
   - 1.2.8 Dispersion
   - 1.2.9 Minimum angle of deviation
   - 1.2.10 Total internal reflection
   - 1.2.11 Fibre optics

2. **Lenses and mirrors**

   2.1 Image formation

   2.2 Images in plane mirror
   - 2.2.1 Ray diagrams
   - 2.2.2 Image characteristics

2.3 Images in spherical mirrors
- 2.3.1 Concave and convex surfaces
- 2.3.2 Ray diagrams
- 2.3.3 Image characteristics
- 2.3.4 Mirror equation
- 2.3.5 Sign convention
- 2.3.6 Magnification
- 2.3.7 Spherical aberration
- 2.3.8 Parabolic mirrors

2.4 Images by refraction
- 2.4.1 Refraction at a curved surface
- 2.4.2 Refraction at a plane surface
- 2.4.3 Refraction at two surfaces
- 2.4.4 Thin lens
- 2.4.5 Ray diagrams
- 2.4.6 Lens equation
- 2.4.7 Sign convention
- 2.4.8 Magnification
- 2.4.9 Lens aberrations

2.5 Optical systems
- 2.5.1 The eye
- 2.5.2 The camera
- 2.5.3 The simple magnifier
- 2.5.4 The compound microscope
- 2.5.5 The telescope

3. **Thermal Energy**

3.1 Temperature
- 3.1.1 Concept of temperature
- 3.1.2 Thermal equilibrium
- 3.1.3 Temperature scales
- 3.1.4 Thermometers
- 3.1.5 Absolute scales

3.2 Thermal expansion
- 3.2.1 Mechanical model of materials
- 3.2.2 Coefficient of linear expansion
- 3.2.3 Coefficient of volume expansion
- 3.2.4 Capacity problems

3.3 Heat
- 3.3.1 Heat and thermal energy
- 3.3.2 Units of heat
- 3.3.3 Heat and mechanical work
- 3.3.4 Heat and temperature change
- 3.3.5 Specific heat capacity
- 3.3.6 Change of phase
- 3.3.7 Latent heat of fusion and vaporization
- 3.3.8 Calorimetry

4. **Equilibrium**

4.1 Forces and torques
- 4.1.1 Definitions
- 4.1.2 Moment arm
- 4.1.3 Cross (vector) product
- 4.1.4 Couple

4.2 Conditions of equilibrium
- 4.1.1 First condition - translational equilibrium
- 4.1.2 Second condition - rotational equilibrium
- 4.1.3 Types of equilibrium
- 4.1.4 Center of gravity
- 4.1.5 Problems involving static equilibrium

5. **Vectors**

5.1 Vectors and scalars

5.2 Coordinate systems
- 5.2.1 Rectangular
- 5.2.2 Polar
- 5.2.3 Conversion between systems
- 5.2.4 Unit vector notation

5.3 Properties of vectors
- 5.3.1 Equality
- 5.3.2 Addition
- 5.3.3 Negative of a vector
- 5.3.4 Commutative property
- 5.3.5 Associative property
- 5.3.6 Subtraction
- 5.3.7 Multiplication by scalar
- 5.3.8 Scalar (dot) product
- 5.3.9 Vector (cross) product

6. **Particle kinematics**

6.1 Terminology
- 6.1.1 Position
- 6.1.2 Average velocity/speed
- 6.1.3 Instantaneous velocity/speed
- 6.1.4 Use of calculus
- 6.1.5 Average and instantaneous acceleration

6.2 One-dimensional motion
- 6.2.1 Constant acceleration
- 6.2.2 Free fall motion
- 6.2.3 One-dimensional motion problems
- 6.2.4 Kinematics using calculus

6.3 Motion in two and three dimensions
- 6.3.1 Position, displacement, velocity, and acceleration using unit vectors
- 6.3.2 Projectile motion
- 6.3.3 Curvilinear motion
- 6.3.4 Uniform circular motion
- 6.3.5 Tangential and radial acceleration
- 6.3.6 Relative velocity and acceleration
- 6.3.7 Relative motion at high speeds

7. Particle dynamics

7.1 Newton's first law of motion
- 7.1.1 Statement of the law
- 7.1.2 Concept of inertia
- 7.1.3 Inertial mass
- 7.1.4 Inertial frames of reference

7.2 Newton's second law of motion
- 7.2.1 Statement of the law
- 7.2.2 Units of force
- 7.2.3 Concept of weight

7.3 Newton's third law of motion
- 7.3.1 Statement of the law
- 7.3.2 Descriptive situations

7.4 Applications of laws of motion
- 7.4.1 Free-body diagrams
- 7.4.2 Determining net force
- 7.4.3 Force of friction
- 7.4.4 Kinetic and static friction
- 7.8.5 Problems involving multiple objects

8. Atomic structure

8.1 Pre-twentieth century models

8.2 The basis for change
- 8.2.1 Blackbody radiation
- 8.2.2 Quantization of energy
- 8.2.3 Photoelectric effect
- 8.2.4 Compton effect
- 8.2.5 Atomic spectra

8.3 Bohr atom
- 8.3.1 Rutherford experiment
- 8.3.2 Bohr's postulates
- 8.3.3 Energy levels
- 8.3.4 Atomic spectra

9. **Nuclear energy**

9.1 Properties of nucleus
- 9.1.1 Components
- 9.1.2 Relative size
- 9.1.3 Atomic number
- 9.1.4 Mass number
- 9.1.5 Isotopes
- 9.1.6 Binding energy

9.2 Radioactivity
- 9.2.1 Types of decays
- 9.2.2 Half life
- 9.2.3 Carbon dating

9.3 Nuclear energy
- 9.3.1 Nuclear fission
- 9.3.2 Nuclear reactors
- 9.3.3 Nuclear fusion
- 9.3.4 Fusion technology
- 9.3.5 Nuclear safety

Text and materials

Text: Similar to Physics for Scientists and Engineers - Serway

Lab manual
Scientific calculator
Graph paper

It is the policy of the physics department that instructors are not required to give make-up tests. At their discretion , instructors may give make-up tests in the case of documented excuses.