**Course title: Physics I** Full marks: 100 (80T + 20P)

Course No. : Sc. Ed. 417 Pass marks: 28T + 8P

Nature of course: Theory (T) + Practical(P) Periods per week: 6(T)x6(P)-3pds/day/week/gr

Level: B. Ed Four Year Total periods: 150

Year: First Time per period : 55 minutes

**1. Course Description**

This course is an introductory course designed for the students specializing Science Education. It is divided into two parts: theory and practical. The first part deals with scalars and vectors, motion, gravity and gravitation, surface tension, elasticity, fluid flow, thermal properties of matter, geometric optics and astronomy. The second part deals with practical activities.

**2. General Objectives**

The general objectives of this course are as follows:

* To develop in-depth knowledge of scalars, vectors, motion, gravity and gravitation, surface tension, elasticity and fluid flow.
* To provide the students with a broader understanding of the different aspects of thermal properties of matter and geometrical optics.
* To impart the basic knowledge of astronomical phenomena.
* To make the students able in solving numerical problems related to the content.

1. **Specific Objectives and Contents**

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| **Specific Objectives** | **Contents** |
| * Distinguish between scalars and vectors. * State and explain the triangle and polygon law of vector addition. * State and explain parallelogram laws of vector addition and derive its magnitude and direction. * Explain subtraction of vectors. * Explain resolution of vector quantity and resolve a vector into rectangular components. * Explain scalar and vector products. | **Unit I: Scalars and Vectors (10)**   * 1. Addition of vectors   1.1.1 Triangle law of vector  1.1.2 Parallelogram law of vector  1.1.3 Polygon law of vector   * 1. Subtraction of vector   2. Components of vectors   3. Scalar and vector product |
| * Define and explain elastic and inelastic collision and its properties. * Describe coefficient of restitution. * Define and verify principle of moment. * Describe moment of inertia, torque and couple. * Classify the equilibrium with conditions. * Describe circular motion. * Define angular displacement, angular velocity, angular acceleration, time period and frequency. * Distinguish between the linear and angular velocity and derive the relation between them. * Define centripetal acceleration and centripetal force and derive its expression. * Derive the relation of rotational kinetic energy. * State and prove the principle of conservation of angular momentum. * Determine the moment of inertia of flywheel. * State and prove simple harmonic motion. * Determine the total energy of SHM. * Define compound pendulum and determine the value of ‘g’. * Define torsion pendulum and derive time period for it. | **Unit II: Motion (30)**   * 1. Elastic and inelastic collisions   2.1.1. Properties  2.1.2 Coefficient of restitution   * 1. Principle of moment   2. Moment of inertia   3. Torque   4. Work done by a torque   5. Couple   6. Equilibrium   7. Circular motion      1. Angular displacement, angular velocity, angular acceleration, time period and frequency      2. Centripetal acceleration and centripetal force   8. Rotational kinetic energy   9. Angular momentum and its principle: Moment of inertia in flywheel   10. Simple harmonic motion (SHM).       1. Total energy in SHM       2. Compound pendulum and determination of ‘g’ using bar pendulum in laboratory       3. Torsion pendulum and its time period |
| * Distinguish between gravity and gravitation. * State Kepler’s laws. * State and explain Newton’s law of gravitation. * Prove that Kepler’s third law is consistent with Newton’s Law of gravitation. * Define gravitational potential and derive its expression. * Define gravitational energy and derive its expression. * Define escape velocity and derive its expression. * Define orbital velocity and obtain its expression. * Define parking orbit and find out total energy of the satellite. * Define and explain geostationary satellite. * Deduce the value of **'g'** due to rotation of earth. | **Unit III: Gravity and Gravitation (10)**   * 1. Introduction to gravity and gravitation   2. Newton’s Law   3. Kepler’s Laws   4. Kepler’s third law and gravitation   5. Relation between Kepler’s third law and Newton’s Law of gravitation   6. Gravitational potential on the surface of the earth   7. Gravitational energy on the surface of the earth   8. Escape velocity on the surface of the earth   9. Orbital velocity on the earth’s satellite   10. Parking orbit and its total energy of satellite   11. Geostationary satellite   12. Variation of **'g'** with latitude |
| * Define surface tension. * Explain the molecular theory of surface tension. * Prove surface tension is numerically equal to the free surface energy. * Explain surface tension phenomenon. * Define angle of contact, and capillarity. * Explain the capillary rise and measurement of surface tension. * Explain the forces and deduce the relation for soap bubble and air bubble interface. * Deduce pressure difference across a spherical. | **Unit IV: Surface Tension (10)**  4.1 Molecular Theory of surface tension  4.2 Surface tension and free surface energy  4.3 Surface tension phenomena  4.3.1 Floating needles  4.3.2 Thread on a soap film  4.3.3 Camphor boat  4.4 Angle of contact  4.5 Capillarity  4.6 Capillary rise and its measurement  4.7 Forces in air bubble and relation for soap bubble and air bubble  4.8 Pressure difference across a spherical interface |
| * Define elasticity and plasticity. * State Hooke’s Law. * Define young’s modulus and explain its determination. * Deduce the expression for the work done in stretching a wire with suitable example. * Define bulk and shear modulus. * Explain properties of rubber by stress-strain curve. | **Unit V: Elasticity (10)**   * 1. Introduction to elasticity and plasticity   2. Hooke’s law   3. Young’s modulus and its experimental determination   4. Work done in stretching wire   5. Bulk and shear modulus   6. Properties of rubber: stress-strain curve |
| * Define viscosity. * Derive Newton’s formula for viscous force. * Define co-efficient of viscosity. * Differentiate between streamlined flow and turbulent flow. * State and derive the equation of continuity. * State and derive Bernoulli’s equation. * Deduce Poiseuille’s formula by method of dimension. * Write Stoke’s formula and derive it from method of dimension. * Determine the terminal velocity by using Stoke’s law. | **Unit VI: Fluid Flow (10)**   * 1. Viscosity and Newton’s formula for viscous force   6.1.1 Streamlined flow  6.1.2 Turbulent flow  6.1.3 Coefficient of viscosity  6.2 Equation of continuity   1. Bernoulli’s equation and its consequences   6.4 Poiseuille’s formula and its uses  6.5 Stoke’s law and terminal velocity  6.5.1 Derivation  6.5.2 Measurement |
| * Explain the working principle of gas thermometer. * Explain the working principle of platinum resistance thermometer and thermocouple thermometer. * Explain the experimental determination of the specific heat of solid and liquid. * Explain the experimental determination of specific latent heat of fusion of ice by method of mixture. * Explain the thermal equilibrium and zeroth law of thermodynamics. * Differentiate between isothermal and adiabatic process. * Explain work done during isothermal process. * Explain equation of adiabatic process and isothermal process. * Explain the work done by a gas. * Derive an equation of state. * State and explain first and second law of thermodynamics. * Define enthalpy and entropy. * Define molar heat capacities of gas and obtain relation between them. * Derive thermal efficiency of heat engine. | **Unit VII: Thermal Properties of Matter (25)**   * 1. Different temperature scales   2. Constant volume gas thermometer   3. Thermocouple thermometer   4. Platinum resistance thermometer   5. Specific heat of solid and liquid, and specific latent heat of fusion of ice   6. Thermal equilibrium and zeroth law of thermodynamics   7. Equation of state   8. Isothermal and adiabatic process, their equation and their work   9. Work done by a gas   10. First law and second law of thermodynamics   11. Enthalpy and entropy   12. Molar heat capacities of gas: Relation between Cp and Cv for an ideal gas   13. Thermal efficiency of heat engine |
| * Define parallax. * Define concave and convex mirror. * Derive mirror formula in concave mirror and convex mirror. * Explain image formed when object is placed at various distances in concave and convex mirror. * Determine focal length of concave and convex mirrors. * Define refractive index and determine refractive index using different methods. * Ray tracing method. * Real and apparent depth method * Define the total internal reflection and critical angle. * Derive refractive index by using prism. * Derive the expression by a small angled prism. * Define concave and convex lens. * Derive lens formula and maker’s formula. * Demonstrate the images formed by a convex lens when object is placed at different distances. * Determine the focal length of convex lens. * Derive focal length of two thin lenses in contact. * Define lateral magnification. * Define dispersion and derive dispersive power. * Define chromatic aberration. | **Unit VIII: Geometric Optics (25 )**   * 1. Parallax   2. Image location by no parallax   3. Spherical mirrors and their formula      1. Concave      2. Convex   4. Image formed in concave mirror and convex mirror   5. Determination of focal length of convex and concave mirror   6. Refractive index and its determination   7. Total internal reflection and critical angle   8. Refraction through prism   9. Small angled prism and its expression   10. Lens and their types       1. Convex lens       2. Concave lens   11. Lens formula and lens maker’s formula   12. Image formed in a convex lens.   13. Determination of focal length of concave and convex lens   14. Two thin lenses in contact   15. Lateral magnification   16. Dispersion and its power   17. Chromatic aberration |
| * List down the general assumption related to the origin of solar system. * Explain the chief contribution to the knowledge of planetary motions made by various scientists. * Demonstrate solar eclipse * Discuss types, occurrence and importance of eclipses. * Explain the lunar eclipses with diagram. * Explain galaxies and its types. * Discuss the role of optical instruments in astronomy. * Determine the distance, size, mass and surface temperature of astronomical objects. | **Unit IX: Astronomy (20 )**   * 1. Origin of solar system   2. Solar system and its members   9.3 Contribution to planetary motion by Copernicus, Tycho, Kepler, Galilee and Newton  9.4 Solar and lunar eclipse: Occurrence and types  9.5 Astronomical instruments  9.5.1 Optical telescope  9.5.2 Radio telescope  9.5.3 Photocell  9.5.4 Artificial satellites  9.5.5 Sextant  9.6 Astronomical objects  9.6.1 Distance  9.6.2 Size  9.6.2 Mass  9.6.3 Surface temperature |

**Part II: Practical**

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| **Specific Objectives** | **Contents** |
| * To determine of fly wheel. * To determine and compare the value of '**g'** by bar pendulum. | **Motion**   * Moment of inertia * The value of **'g'** |
| * To determine the surface tension of water by capillary rise method. | **Surface Tension**   * Surface tension of water |
| * To determine the Young’s modules of elasticity of given wire | **Elasticity**   * Young’s modules of elasticity |
| * To determine the coefficient of viscosity by stoke’s method of different medium. (At least three media) | **Fluid Flow**   * Coefficient of viscosity |
| * To determine specific heat capacity of solid and liquid. * To determine the specific latent heat of fusion of ice. | **Thermal Properties of Matter**   * Specific heat capacity of solid and liquid * Specific latent heat of fusion of ice. |
| * To determine the focal length of concave and convex lens. | **Geometric Optics**   * Focal length of concave and convex lens |
| * To Conduct at least, two projects, prepare their reports and present in the class. | **Project**.  1. Observation of phases of moon  2. Study the nature and size of image formed by convex lens by using a candle and a screen.  3. Study on turbulent and streamlined matters of the Narayani river with its neighboring rivers. |

Note: The figures in the parentheses indicate the approximate periods for the respective units

**4. Instructional techniques**

The instructional techniques divided into two groups. First group consists of general instructional techniques applicable to most of the units. The second group consists of specific instructional techniques applicable to specific units.

**4.1 General Instructional Techniques**

* Lecture method.
* Discussion method
* Problem solving method.
* Collaborative method

**4.2 Specific Instructional Techniques**

**Unit VIII:** Demonstration

**Unit IX:**  Demonstration and project work

**5. Evaluation**

**Theory part**

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| --- | --- | --- | --- |
| **Types of questions** | **Total questions to be asked** | **Number of questions to be answered and marks allocated** | **Total marks** |
| Group A: Multiple choice items | 14 questions | 14 × 1 mark | 14 |
| Group B: Short answer questions | 6 with 2 or questions | 6 × 7 marks | 42 |
| Group C: Long answer questions | 2 with 1 or question | 2 × 12 marks | 24 |

**Evaluation : Practical Part**

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| --- | --- | --- |
| **S.No.** | **Practical work** | **Marks allocated** |
| 1 | * Practical record | 4 |
| 2 | * Experiment * Viva | 12  4 |
| **Total** | | **20** |

**Recommended Books and References**

**Recommended Books**

Bajaj, N.K. (2000). *Physics*. Delhi: Tata MC Graw- Hill Publishing Com. Ltd.  **(For all units)**

Huffer, C. M., Trinklein, F.E. & Bunge, M. (1973). *An introduction to astronomy*. New York: Holt, Rinehart and Winston, Inc. **(For all units)**

Sears, F.W., Zemansky, M.W., Young, H.D., Freedman, R.A. & Ford, A.L. (2009). *University physics*. Singapore: Pears on Education. **(For all units)**

**References**

Gupta, S.K. & Pradhan, J.M. (2009). *A textbook of physics*. Jalandhar: Surya publication.

Halliday, D., Resnick, R. & Walker, J. (2009). *Fundamentals of physics*. New York: John Wiley and Sons.

Lal, V. & Subrahmanyam, N. (2009). *Principle of physics.* New Delhi: S. Chand and Company Ltd.

Shipman, J. T., & Wilson, J. D. (1990). *An introduction to physical science*. Lexington: D.C.Heath and Company.