

Tribhuvan University  
2078 (Partial) / 2079 (Regular)

Bachelor Level 4 Yrs. Prog. / I<sup>st</sup> Year / Science & Tech.

Physics (PHY.101)

Full Marks: 100

(Mechanics, Thermodynamics and Statistical Physics, Electricity & Magnetism)

Time: 3 hrs.

*Candidates are required to give their answers in their own words as far as practicable.*

*The figures in the margin indicate full marks.*

**(New Course)**

Attempt ALL the questions.

1. What is torsional pendulum? Obtain an expression for its time period. Explain why, unlike a simple or a compound pendulum, the time period in this case remains unaffected even if the amplitude be large.

OR

[10]

What is cantilever? Obtain an expression for the depression at the free end of a thin light beam clamped horizontally at one end and loaded at the other.

2. Define the terms thermal conductivity, thermometric conductivity and temperature gradient. Describe a method for determining the coefficient of thermal conductivity of a bad conductor having the shape of a disc.

OR

[10]

State Stefan's law of radiation and explain how it is used to estimate the temperature of Sun's surface. How is Stefan's constant determined?

3. What is electrical dipole? Derive an expression for the electrical potential and electric intensity due to electric dipole.

OR

[10]

What do you mean by the terms, hysteresis, residual magnetism of coercive force? Obtain an expression for the energy dissipated per unit volume of the ferromagnetic material during each cycle of magnetization.

4. Derive an expression for the gravitational potential at a point inside and on the surface of a thin spherical shell. [8]

5. Deduce an expression for the change in temperature of a wire thermodynamically when it is structured adiabatically. [8]
6. Explain what do you mean by magnetic vector potential. Obtain expression for it. [8]
7. Solve any TWO questions [2×3=6]
- Explain the principle of regenerative cooling.
  - What do you mean by radius of gyration?
  - How does viscosity vary with temperature?
  - Distinguish between polarization vector & displacement vector.
8. Solve all the questions [4×2.5=10]
- How & why the concept of displacement current was introduced?
  - Why is the chock coil considered superior to a rheostat in a.c. circuit?
  - What is importance of clausius - clapeyron latent heat equation?
  - What do you mean by geo-stationary satellite?
9. A uniform solid sphere of mass 20 kg and radius 5 cm makes 5 revolutions per second about a tangent. What are the moment of inertia and angular momentum about this axis? [5]
10. Calculate the tensile stress in a wire of density  $8.0 \text{ g/cm}^3$  when the velocity of transverse waves on it is equal to 340 m/s (the velocity of sound in air). [5]
11. Calculate the change in entropy when 10 g of steam at  $100^\circ\text{C}$  cools to water at  $0^\circ\text{C}$ , assuming that the latent heat of steam is 538 cal/g and specific heat of water 1 cal/g. [5]
12. Find the temperature at which the *r.m.s* speed of hydrogen molecule is equal to that of nitrogen molecule at  $77^\circ\text{C}$ . [5]
13. Estimate the drift velocity of electrons in a copper wire of diameter 1 mm, carrying a current of 0.1 A. [5]
14. A 110V, 100 W lamp is to be run at 220V, 53 cycle mains. Calculate the inductance of the choke to be placed by series with the lamp? [5]

**(Old Course)**

Attempt ALL the questions.

1. Discuss damped and forced harmonic oscillators. Describe the oscillation of two particles connected by a spring. [10]

OR

Describe Gravitational self energy and find the expression for gravitational potential and field due to a thin spherical shell and solid sphere. Discuss the difference.

2. Discuss the meaning of radiation pressure and find its expression. Describe the pressure of diffusive radiation and hence state Stefan-Boltzmann's law. [10]

OR

Describe cooling in Joule-Thomson expansion. What do you mean by regenerative and Cascade cooling? Explain.

3. Discuss the behaviour of plane electromagnetic waves in isotropic dielectric medium and in conducting media. Point out the major differences of its behaviour in the dielectric and conducting media. [10]

OR

What do you mean by the equipotential surface? Find potential and field due to an (a) infinitely long charged wire, and (b) uniformly charged disc.

4. Explain twisting couple on a cylindrical rod or wire. Find the expression for the work done in a twisting a rod or wire. [8]

5. Describe the pressure of diffusive radiation and hence state Stefan-Boltzmann's law. [8]

6. Describe Ampere's circuital law and discuss its applications. [8]

7. Solve any TWO questions [2×3=6]

- a) Discuss kinetic energy of rotating bodies.
- b) Explain fundamental postulates of statistical mechanics
- c) Discuss work-energy theorem.
- d) Explain Reciprocity theorem.

8. Solve All the questions [4×2.5=10]

- a) Distinguish particle velocity and wave velocity.  
b) Describe Maxwell's distribution law of velocities.  
c) What do you mean by the collision cross-section? Explain.  
d) Explain Langevin Debye formula.
9. Satellite A is 4 times farther away from a planet than the satellite B. If it takes satellite A 26 weeks to complete a full orbit around the planet, how long will it take satellite B to revolve around the planet once? [5]
10. A basketball player who is standing 20 feet away from a basketball hoop is trying to make a basket. If the height of the hoop is 10 feet, and the height at which the player shoots the ball is 6 feet, at what angle and with what speed should the player shoot the ball? [5]
11. A spherical satellite orbiting Earth is lighted on one side by the Sun, with intensity  $1340 \text{ W/m}^2$ . If the radius of the satellite is 1.00 m, what power is incident upon it? Calculate the peak electric and peak magnetic field. [5]
12. A generator produces current at a frequency of 50 Hz with peak voltage and current amplitudes of 110V and 5A, respectively. What is the average power produced if they are in phase? [5]
13. For a RC parallel circuit with a supply voltage of 120 V and total watt of 9604, having a capacitor of  $1500 \mu\text{F}$ , determine: (a) The amount of current through the resistor, and (b) capacitive reactance of the capacitor. [5]
14. With a source voltage of 208-V, frequency of 60 Hz and a LC parallel circuit that has  $X_C = 16 \Omega$  and  $X_L = 8 \Omega$ , what would be: (a) impedance value be, (b) Current through the capacitor, (c) Current through the inductor, and (d) line current and the impedance. [5]

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