Q.P. Code : 11221

Second Semester B.Sc. Degree Examination, May/June 2019

(CBCS Scheme – Freshers)

Physics

Paper II — MECHANICS – 2, HEAT AND THERMODYNAMICS – 2

Time : 3 Hours] *[Max. Marks : 70*

Instructions to Candidates :

1. *Answer any **FIVE** questions from each Part.*
2. *Candidate is permitted to use non-programmable Scientific Calculator.*

PART – A

Answer any **FIVE** questions. Each question carries **8** marks : (5 × 8 = 40)

1. (a) Arrive at the expression for the time period of a compound pendulum.

   (b) Explain coupled oscillations. (6 + 2)

2. Obtain the relation between the three moduli of elasticity. (8)

3. (a) Arrive at the energy equation $\left(\frac{\partial U}{\partial V}\right)_T = T\left(\frac{\partial P}{\partial T}\right)_V - P$ where symbols have their usual meaning.

   (b) Write the expressions for thermodynamic potentials and explain the symbols. (4 + 4)

4. (a) Explain porous plug experiment.

   (b) Arrive at an expression for the Joule-Thomson coefficient of a gas. (3 + 5)

5. (a) Show that length is an invariant under Galelian transformation for inertial frames.

   (b) Write the Lorentz transformation equations. (4 + 4)

6. (a) Explain the concept of time dilation with the necessary equation.

   (b) Derive the expression for the relativistic addition of velocities. (3 + 5)

7. (a) Arrive at an expression for the kinetic energy of rotation for a rigid body.

   (b) Obtain an expression for the moment of inertia of a solid sphere about its diameter. **(3 + 5)**

8. (a) State and explain the law of conservation of angular momentum.

   (b) Define group velocity and phase velocity and derive the relation between them. **(2 + 6)**

PART – B

Solve any **FIVE** problems. Each problem carries **4** marks. **(5 × 4 = 20)**

9. A block of mass 2.7×10^{-3} kg is designed to oscillate at a frequency of 25 Hz and amplitude 26 cm. What is the total mechanical energy of the system?

10. A wire of diameter 1.10 mm and 2 m long fixed at one end is stretched by 0.5 mm when a load of 4 kg is attached at the other end. Calculate Young's modulus of the material of the wire. Acceleration due to gravity = 9.8 ms^{-2}.

11. Calculate the change in pressure required to lower the melting point of ice by 0.5 K given

    Latent heat of fusion of ice at 0°C = 3.34×10^5 JKg^{-1}

    Specific volume of water at 0°C = 1.0×10^{-3} m^3 kg^{-1}

    Specific volume of ice at 0°C = 1.1×10^{-3} m^3 kg^{-1}

12. Van der Wall's constants for oxygen are $a = 0.1382$ Nm^4 mol^{-2}, $b = 3.2 \times 10^{-5}$ m^3 mol^{-1}. Calculate the temperature of inversion and critical temperature of oxygen given gas constant $R = 8.3$ $JK^{-1}mol^{-1}$.

13. Calculate the fringe shift in Michelson-Morley experiment if effective length of each path is 8 m. Velocity of earth 3×10^4 ms^{-1} and wavelength of light is 625 nm.

14. A proton of rest mass 1.67×10^{-27} kg is moving with speed 0.92°C. What is its total energy?

15. A circular disc of mass 0.9 kg and radius 6 cm is oscillating about an axis (a) passing through its centre (b) about a diameter. Calculate moment of inertia of the disc in both the cases.

16. Calculate the speed of transverse wave on a wire stretched by a weight of 400 gm given mass per unit length of the wire is 0.0018 kg m^{-1}.

PART – C

Answer any **FIVE** questions. Each question carries **2** marks : **(5 × 2 = 10)**

17. (a) A damped oscillator of mass m has a force constant 'k' and damping coefficient 'b'. Does the decrease in mechanical energy depend on 'k'? Explain.

(b) A hollow shaft is stronger than a solid shaft of same material, mass and length. Explain.

(c) How the internal energy changes during isothermal expansion? Explain.

(d) Does adiabatic demagnetization produce cooling in a specimen? Explain.

(e) To whom does an object seem shorter in length, an observer moving with object or an observer moving relative to object? Explain.

(f) Is law of inertia valid in linearly accelerated frame? Explain.

(g) What happens to the kinetic energy, when a person on turn table out stretches her hands? Explain.

(h) Does the velocity of sound in gaseous medium depend on pressure of the medium at constant temperature? Explain.

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