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

(CBCS Scheme – Freshers + Repeaters – 2016-17 and onwards)

Physics

Paper 201 – MECHANICS – 2, HEAT AND THERMODYNAMICS – 2

Time : 3 Hours]

[Max. Marks : 70

Instructions to Candidates : Answer any five questions from each Part.

PART – A

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

1. (a) What is simple harmonic motion? Give an example.
(b) Obtain an expression for the velocity of a body executing SHM. (2 + 6)
2. What is a cantiliver? Obtain an expression for the depression at the free end of thin light beam clamped horizontally at one end and loaded at the other end. (8)
3. (a) What is meant by Helmholtz free energy?
(b) Deduce the following Maxwell's relations. (2 + 6)
 - (i) $\left(\frac{\partial S}{\partial V}\right)_T = \left(\frac{\partial P}{\partial T}\right)_V$
 - (ii) $\left(\frac{\partial S}{\partial P}\right)_T = -\left(\frac{\partial V}{\partial T}\right)_P$
4. (a) What is meant by triple point of water?
(b) Deduce Clausius-Clapeyron's Latent heat equation. What is the effect of pressure on boiling point of water? (1 + 7)
5. Show that under Galilean transformations, velocity is variant and acceleration is invariant. (8)



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6. (a) Define :
- (i) Proper length and
 - (ii) Proper time
- (b) Deduce the mass energy relation according to the theory of relativity. **(2 + 6)**
7. (a) State and prove the perpendicular axes theorem.
- (b) Obtain an expression for moment of inertia of a solid sphere about an axis passing through its diameter. **(3 + 5)**
8. (a) What are transverse and longitudinal wave motions? Give an example for each.
- (b) Derive the relation between group velocity and phase velocity. **(4 + 4)**

PART - B

Solve any **FIVE** problems. Each problem carries **4** marks :

(5 × 4 = 20)

9. If the potential energy of a particle performing SHM is 2.5 J, when displacement is half of amplitude, find the total energy.
10. One end of a steel wire of length 0.25 m and radius 2×10^{-3} m is fixed. If the rigidity modulus of the steel is $8 \times 10^{10} \text{ Nm}^{-2}$, find the work done in twisting the free end of the wire through 45° .
11. The Vander Waal's constants for hydrogen are
 $a = 0.00247 \text{ Nm}^4 \text{ mole}^{-2}$
 $b = 2.65 \times 10^{-5} \text{ m}^3 \text{ mole}^{-1}$
Find :
- (a) the temperature of inversion
 - (b) Joule -Thomson cooling for $5 \times 10^5 \text{ Nm}^{-2}$ fall of pressure, initial temperature being 100 K.
Given $R = 8.3 \text{ JK}^{-1} \text{ mole}^{-1}$.
12. When lead is melted at atmospheric pressure (the melting point is 600 K) the density decreases from 11010 to 10650 kgm^{-3} and the latent heat of fusion is 24500 Jkg^{-1} . What is the melting point at a pressure of 200 atmosphere?
Given : 1 atmosphere = 10^5 Nm^{-2} .

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13. A rod stationary relative to the earth is found to be 20 m long by an observer on the earth. With what velocity should it move parallel to its length so that its apparent length relative to the observer is reduced to 5 m? Given $C = 3 \times 10^8 \text{ ms}^{-1}$.
14. Find the fringe shift when effective length of earth arm is 25 m, Orbital velocity of earth about sun is $3 \times 10^4 \text{ ms}^{-1}$ and wavelength of light used is 5000 Å. Given velocity of light is $3 \times 10^8 \text{ ms}^{-1}$.
15. A circular disc of mass 1 kg and radius 0.2 m is making 120 rpm about its diameter. Calculate the moment of inertia and energy.
16. The equation of a progressive wave is $y = 20 \sin(100\pi t - 0.08\pi x)$ cm. Find the amplitude, frequency, wavelength and velocity of the wave.

PART - C

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

17. (a) Is the motion of a simple pendulum strictly simple harmonic? Explain.
- (b) A spring is made of steel and not of copper. Justify.
- (c) Does the internal energy of an ideal gas depend on mass of the gas? Explain.
- (d) Why the boiling point of water is less than 100°C in the laboratories?
- (e) Is Earth an inertial frame? Explain.
- (f) Is the moving clock moves slow or fast? Explain.
- (g) How a swimmer jumping from a height is able to increase the number of loops made in the air?
- (h) Can sound waves be polarised? Explain.

