ST.JOSEPH'S COLLEGE (AUTONOMOUS), BANGALORE-27
B.Sc. – I SEMESTER
SEMESTER EXAMINATION – December 2020
PH: 118 : Mechanics, Heat and Thermodynamics

Time : 2½ hrs

Max. Marks: 70

*This question paper has **two** printed pages and **three** parts.*

PART – A

Answer any **four** of the following:

(4X10=40)

1. a. If (r, θ, ø) are the polar co-ordinates of a particle P at any instant and (x,y,z) the corresponding Cartesian co-ordinates, then write the relationship between them.
   b. A particle is moving along a curve in a plane. Derive expressions for its radial and transverse components of velocity and acceleration. [2+8]

2. a. Derive the equation for the motion of centre of mass of a two body system. Explain the term reduced mass of system.
   b. In the phenomenon of inelastic collision in one dimension between two particles find the expression for decrease in energy. [4+7]

3. a. State and prove the perpendicular axis theorem.
   b. Obtain the expression for the acceleration of a body rolling down an inclined plane. [4+6]

4. a. From Maxwell's velocity distribution law derive an expression for r.m.s. speed. Given $\int_0^\infty e^{-bc^2} c^4 dc = \frac{3}{8b^2}\sqrt{\frac{\pi}{b}}$
   b. Based on the transport of momentum arrive at an expression for coefficient of viscosity. [4+6] .

5. a. Show that work done is equal to the area of the rectangle in the T-S diagram of Carnot cycle.
   b. Write and explain the four thermodynamic potentials. [4+6]

6. a. Deduce the expressions for the critical constants of a gas.
   b. Distinguish between Joule-Thomson expansion and adiabatic expansion.

[8+2]