Roll No. 2231123220007 Hari Exam Code : D-22

Subject Code—58379

B. Sc. EXAMINATION

(Batch 2018 Onwards) (Main/Re-appear)

(First Semester)

PHYSICS

CPL-102

Mechanics-I

Time : 3 *Hours* *Maximum Marks :* 80

Note : Attempt *Five* questions in all, selecting *one* question from each Unit. Q. No. **1** is compulsory. Use of simple calculator is allowed.

1. (a) The Laplacian Operator $\nabla^2 = \nabla.\nabla$. Why do we not have another operator $\nabla \times \nabla$? **2**

(b) Write the importance of Gauss Divergence Theorem. **2**

(c) Why do we need co-ordinate systems ? 2

(d) Define energy. What is its unit ? 2

(e) What is theorem of perpendicular axis for moment of inertia ? 2

(f) Define angular momentum. 2

(g) Explain the concept of reduced mass. 2

(h) What is elastic stress ? 2

Unit I

2. (a) Show that the gradient at any point of the scalar field $\phi(\vec{r})$ is a vector field of magnitude equal to the maximum rate of change of ϕ in the direction along which the rate of change is most rapid. 12

(b) Prove that : 4

$$\vec{A}\times\left(\vec{B}\times\vec{C}\right)+\vec{B}\times\left(\vec{C}\times\vec{A}\right)+\vec{C}\times\left(\vec{A}\times\vec{B}\right)=0$$

3. (a) State and prove Stokes' Theorem. Hence show that : 12

$$\nabla\times\vec{E}=0$$

(b) Show that :

$$\iint_S \vec{F}.\,ds = 6V$$

where S is enclosed surface, enclosing the volume V and $\vec{F} = x\hat{i} + 2y\hat{j} + 3z\hat{k}$. 4

Unit II

4. (a) Derive expression for velocity and acceleration in plane polar co-ordinate. 10

(b) Derive a relation between cartesian co-ordinate and spherical polar coordinates. 6

5. (a) Define and discuss centre of mass for *n*-particles system. Also derive expression for position vector for *n*-particles system. 12

(b) State and prove Work-Energy theorem. 4

Unit III

6. (a) Show that in centre of mass system the magnitude of the velocities of remain unaltered in an elastic collision. 12

(b) Derive an expression for moment of inertia of a ring about an axis passing through its centre and normal to ring. 4

7. (a) What is Coriolis force ? Derive an expression for it. Discuss the effect of Coriolis force. 12

(b) Prove that $J^2 = 2EI$, where J, E and I are the angular momentum, kinetic energy of rotation and moment of inertia respectively. 4

Unit IV

8. (a) Define escape velocity. Prove that : 10

$$V_R = \sqrt{2gR}$$

(b) State Kepler's laws of planetary motion. Prove second law of planetary motion. 6

9. (a) What is bending moment ? Derive an expression for bending moment of a cantilever. 12

(b) Calculate the work done in twisting a steel wire of diameter 2 mm and length 0.5 m through 45°, the modulus of rigidity of steel wire is 2×10^{11} Nm^{-2}. 4