PG (CBCS) ODD SEMESTER EXAMINATION, 2022

PHYSICS

1st Semester

Course No. : PHYCC - 101

(Classical Mechanics)

Full Marks : 70

Pass Marks : 28

Time : 3 hours

The figures in the margin indicate full marks for the questions

(Answer any five questions, taking one from each unit)

UNIT - I

1. (a) Show that in absence of external forces the velocity of center of mass remains constant.

   (b) If $F=(2xy+z^2)\,\hat{\imath} + x^2\hat{\jmath} + 2xz\hat{k}$ newton, then show that the given force is conservative.

   (c) State and derive the work-energy theorem for a system of particles. 4+4+6=14

2. (a) Considering the generalized coordinates deduce an expression for kinetic energy of a system of particles.

   (b) Construct the Lagrangian of a charged particle moving in an electromagnetic field. 2+12=14

UNIT - II

3. (a) What is δ-variation? Show that the integral: $I=\int_{x1}^{x2} f(y,y',x)dx$ is stationary when $\frac{d}{dx}[\frac{\partial f}{\partial y'}] - \frac{df}{dy} = 0$, where $y' = \frac{dy}{dx}$.

   (b) Show that the shortest distance between two points in a plane is a straight line. 10+4=14

4. (a) Derive Lagrange's equations from Hamilton's principle for non-conservative system.

   (b) Considering the motion of a particle in inverse square central force field deduce the equations of motion and from it also interpret the Kepler's second law. 8+6=14

UNIT - III

5. (a) Derive Hamilton's canonical equations from variational principle.

   (b) Using Hamilton's equations describe the motion of a harmonic oscillator. 8+6 =14

6. (a) Derive a condition for a transformation to be canonical.

   (b) Discuss the properties of Poisson's bracket.

   (c) Show that the Poisson's bracket is invariant under canonical transformation. 5+3+6 =14

UNIT - IV

7. (a) Show that the same integral involving Lagrangian of system in definite form shapes Hamilton's principle while in indefinite form it shapes 'Hamilton's Principal Function'.

   (b) Solve the equation of motion of a simple harmonic oscillator using Hamilton – Jacobi method. 7+7=14

8. (a) Define action-angle variables. Show that the application of action angle variables provides an elegant procedure to determine the frequency of a periodic motion without going into its detail solutions.

   (b) Derive the frequency of a simple harmonic oscillator using action and angle variables method. 9+5 = 14

UNIT - V

9. (a) What are Eulerian angles? Express the co-ordinate transformation equations in terms of Eulerian angles for rotation of a rigid body.

   (b) Write the expressions for angular velocities along the body set of axes for such rotation of a rigid body. 2+8+4=14

10. What do you mean by stable and unstable equilibria? Show that in a coupled oscillator system of N-oscillators with transverse oscillations there exists N-independent modes of vibrations. 2+12=14

★★★