2023

B.A./B.Sc.

Fifth Semester

DISCIPLINE SPECIFIC ELECTIVE – 1

PHYSICS

Course Code: PHD 5.11

(Classical Dynamics)

Total Mark: 70 *Pass Mark: 28*

Time: 3 hours

Answer five *questions, taking* one *from each unit.*

UNIT–I

1. (a) Define constraint. Write four types of constraints. 1+2= 3
   (b) Formulate the generalised coordinates to show that the Jacobian determinant should be different from zero at all points for a transformation from a set of coordinates to another set of coordinates. 4
   (c) Derive the Lagrange equation of motion. 7

2. (a) Evaluate the Lagrangian of a charged particle under the influence of a gyroscopic force and show that a force acting on the particle is derivable from a potential dependent on velocity. 8
   (b) Apply the Lagrange equation to evaluate the time period of a compound pendulum. 6

UNIT–II

3. (a) Derive the Hamilton's canonical equations of motion. 7
   (b) Formulate the Hamiltonian of a simple pendulum and calculate its time period by applying the Hamilton's equation of motion. 7
4. (a) Write a short note on Hamilton's variational principle. 3
   (b) Explain the principle of least action. 3
   (c) Apply the Hamilton's equation of motion to evaluate the time period of a compound pendulum. 8

UNIT–III

5. (a) Write a short note on small oscillation. 3
   (b) Evaluate the solution for a physical system consisting of two equal masses joined by identical springs to each other and to fixed walls free from friction. Formulate the concept of normal coordinates from the given system. 7+ 4=11

6. (a) Explain stable and unstable equilibrium with necessary representations. Write two differences between them. 4+2=6
   (b) Evaluate the theory of small oscillation for a system consisting of two simple pendula coupled by a massless spring. 8

UNIT–IV

7. (a) Write two postulates of the special theory of relativity. 2
   (b) Formulate the Lorentz transformation equation by taking the concept of orthogonality conditions for spatial rotation. 12

8. (a) Write a short note on space like, time like and light like interval. 5
   (b) Calculate the percentage contraction of a rod moving with a velocity 0.8 times the velocity of light in a direction inclined at 60 degrees to its own length. 3
   (c) The half-life of a particle at rest is 17.8 nano seconds. What will be the half-life if its speed is 0.8 c? 3
   (d) What is the velocity that a rocket should move so that every year spend on it corresponds to 4 years on earth? 3

UNIT–V

9. (a) Evaluate relativistic Doppler's effect of light waves. Explain further the blue and red shift in relativistic Doppler effect. 6+4= 10
   (b) Calculate the hydrostatic pressure due to a liquid column. 4

10. (a) Derive the equation of continuity for liquid. 4
    (b) Deduce the Poiseuille's equation for flow of a steady liquid flowing through a pipe with the help of the concept of velocity gradient. 6
    (c) Apply the principle of dimensional analysis to obtain an expression for Reynolds number. 4
