(6 pages)

DECEMBER 2014 **P/ID 37456/PMAG**

Time : Three hours Maximum : 100 marks

PART A — (10 × 2 = 20 marks)

Answer ALL questions.

1. Define absolute system and give the fundamental units of an absolute system.

2. Define the term degree of freedom.

3. Write down the standard form of Lagrange's equation for a nonholonomic system.

4. Define cyclic coordinates.

5. State the modified Hamilton's principle.

6. State the principle of Least action.

7. Define canonical transformation.

8. Define generating function of a transformation.

9. When do you say that two events are simultaneous with respect to a given inertial frame?

10. Define time dilation.

PART B — (5 × 6 = 30 marks)

Answer ALL questions.

11. (a) State and prove that principle of work and kinetic energy.

Or

(b) State and prove the principle of angular momentum.

12. (a) A particle of mass m can slide without friction on the inside of a small tube which is bent in the form of a circle of radius *r*. The tube rotates about a vertical diameter with a constant angular velocity *w*. Derive the differential equation of motion.

Or

(b) If a conservative holonomic system does not have a sufficient number of ignorable coordinates, show that, it is separable if it is an orthogonal system.

13. (a) State Brachistochrone problem and obtain its solution.

Or

(b) Explain the Lagrange's multiplier method for finding stationary values of a function subject to constraints.

14. (a) Discuss the transformation which results in a translation in phase space.

Or

(b) Discuss the homogeneous point transformation.

15. (a) A rigid rod of rest length l_0 makes an angle ϕ' with the x' axis and is fixed in I' as it translates with a constant velocity V relative to I. Find the length of the rod and the angle between the rod and the x-axis as viewed by an observer in the inertial frame I.

Or

(b) Explain the relativistic dopler effect.

PART C — (5 × 10 = 50 marks)

Answer ALL questions.

16. (a) Show that the total kinetic energy is the sum of three parts :

(i) The kinetic energy due to a particle having a mass m and moving with the reference point p.

(ii) The kinetic energy of the system due to its motion relative to p and

(iii) The scalar product of the velocity of the reference point and the linear momentum of the system relative to the reference point.

Or

(b) A particle of mass m is suspended by a mass less wire of length $r = a + b \cos wt \ (a > b > 0)$ to form a spherical pendulum. Find the equation of motion.

17. (a) Derive the standard form of Lagrange's equation for a holonomic system.

Or

(b) A double pendulum consists of two particles suspended by mass less rods. Assuming that all motion takes place in a vertical plane, find the differential equations of motion. Also linearise these equation assuming small motion.

18. (a) Apply the Hamilton - Jacobi method to a simple mass-spring system.

Or

(b) State and prove the Stackel's theorem.

19. (a) Describe the principal form of Generating function.

Or

(b) Define Bilinear covariant and show that it is invariant under canonical transformation.

20. (a) Define force four vector and obtain the expression for longitudinal and transverse masses. Also obtain the expression for the Minkowski force.

Or

(b) Discuss the addition of velocities in relativity.

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