DECEMBER 2023 **P/ID 37519/PMA4V**

Time : Three hours Maximum : 80 marks

PART A — ($10 \times 2 = 20$ marks)

Answer any TEN questions.

1. Define non-holonomic constraint.

2. Define virtual work.

3. Define Routhian function.

4. Discuss Liouville's system.

5. Write the necessary and sufficient condition that a function f have a stationary value at q_0.

6. State Hamilton's principle.

7. Write the modified Hamilton-Jacobi equation.

8. Write the Pfaffian differential form.

9. Define point transformation.

10. Write down the Poisson bracket expression.

11. State the principle of conservation of energy.

12. Define canonical transformation.

PART B — ($5 \times 6 = 30$ marks)

Answer any FIVE questions.

13. Discuss D'Alembert's principle.

14. 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. Write the differential equation for this motion.

15. Find the equations of motion for a charged particle in an electromagnetic field.

16. (a) State Stackel's theorem.

    (b) Write down the two Stackel conditions.

17. Check whether the transformation

    $Q = \sqrt{2q}\, e^{t} \cos p$, $P = \sqrt{2q}\, e^{-t} \sin p$ is canonical.

18. Consider a particle which is constrained to move on a fixed circular path of radius a. The equation of constraint is $\left(x_1^2 + x_2^2\right)^{\frac{1}{2}} = a$. Transform from cartesian to generalized coordinates for the above.

19. Use Poisson bracket to show the transformation $Q = \sqrt{e^{-2q} - p^2}$, $P = \cos^{-1}\left(pe^{q}\right)$ is canonical.

PART C — ($3 \times 10 = 30$ marks)

Answer any THREE questions.

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

21. Derive Lagrange's equations.

22. Discuss geodesic problem.

23. Analyze the Kepler's problem by using Hamilton-Jacobi method.

24. Discuss about Poisson brackets.

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