(NO. OF PAGES: 2)

(FOR THE CANDIDATES ADMITTED DURING THE ACADEMIC YEAR 2025-26 ONLY)

SUBCODE 25PMS208

REG.NO. :

N.G.M.COLLEGE (AUTONOMOUS) : POLLACHI

END-OF-SEMESTER EXAMINATIONS : MAY 2026

MSc.-MATHEMATICS **MAXIMUM MARKS: 75**

SEMESTER: II **TIME : 3 HOURS**

MECHANICS

SECTION – A (10 X 1 = 10 MARKS)

ANSWER THE FOLLOWING QUESTIONS. (K1)

1._____ is the number of coordinates minus the number of independent equations of constraint

(a) Applied force (b) The number of degrees of freedom (c) equation of motion (d) Virtual

2. If the Lagrangian of the system does not contain the given co-ordinate q_j. Then the co-ordinate is said to be _____co-ordinates.

(a) Ignorable (b) Galilean (c) one dimensional (d) Generalized

3. The 2n first order equations in $\dot{q}_i = \frac{\partial H}{\partial p_i}$, $\dot{p}_i = -\frac{\partial H}{\partial q_i}$, are known as _____

(a) Hamiltonian holonomic equations of motion (b) Hamiltonian nonholonomic equations of motion

(c) Lagrange's multipliers (d) Hamilton's canonical equations of motion.

4. Canonical transformation of generating function is the solution of a partial differential equation known as ____equation.

(a) Lagrange's (b) Pfaff's (c) Hamilton-Jacobi's (d) Liouville's

5. The transformation $\sum_{i=1}^{n} p_i \delta q_i - \sum_{i=1}^{n} P_i \delta Q_i = 0$ is called_____ transformation

(a) Contact (b) Homogeneouscanonical (c) Mathieu (d) all

ANSWER THE FOLLOWING IN ONE (OR) TWO SENTENCES (K2)

6. Define virtual displacement.
7. What is known as Jacobi Integral?
8. Write the statement of Hamilton's principle
9 Write a note on first Pfaff's system.
10. What is a Homogeneous canonical transformation?

SECTION – B (5 X 5 = 25 MARKS)

ANSWER EITHER (a) OR (b) IN EACH OF THE FOLLOWING QUESTIONS. (K3)

11(a) Explain the principle of work and kinetic energy

(OR)

11 b) Explain the principle of virtual work.

12. a)Show that the generalized momentum corresponding to each ignorable coordinate is constant

(OR)

12 b)Evaluate the differential equations of motion for a spherical pendulum of length l.

13. a) Find the stationary values of the function $f = z$ subject to the constraints

$\phi_1 = x^2 + y^2 + z^2 - 4 = 0$; $\phi_2 = xy - 1 = 0$

(OR)

13 . b) Explain Brachistochrone problem.

14. a) Explain simple mass-spring system by using Hamilton-Jacobi method

(OR)

14 b) State and prove modified Hamilton-Jacobi equation

15 a) Show that the transformation $Q = \frac{1}{2}(q^2 + p^2)$, $P = -\tan^{-1}\frac{q}{p}$ is canonical.

(OR)

15 b) Show that the transformation $Q = \sqrt{e^{-2q} - p^2}$, $P = \cos^{-1}\left(Pe^q\right)$ is canonical by using Poisson bracket

SECTION – C (5 X 8 = 40 MARKS)

ANSWER EITHER (a) OR (b) IN EACH OF THE FOLLOWING QUESTIONS.(K4 (Or) K5)

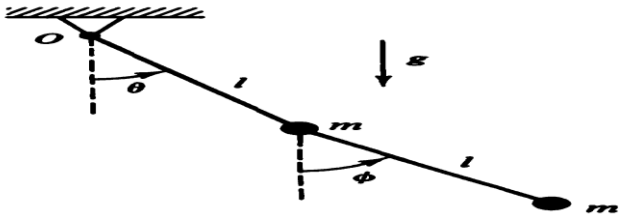
16. a) Analyze that a particle of mass m is suspended by a mass less wire of length to form a spherical pendulum. Find the equations of motion.

b) Explain a nonholonomic constraint occurs when there is rolling contact without slipping

17. a) Derive the Lagrange's form of D'Alembert's principle in terms of generalized coordinates.

(OR)

17 b) A double pendulum consists of two particles suspended by massless rods, as shown in the figure Assuming that all motion takes place in a vertical plane , Determine the differential equations of motion.

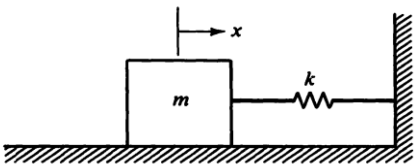


18. a) Derive Euler-Lagrange's equation.

Derivation

(OR)

18 b) Given a mass-spring system consisting of a mass m and a linear spring of stiffness k, as shown in the figure , determine the equations of motion using the Hamiltonian procedure. Assume that the displacement x is measured from the unstressed position of the spring



19. a) State and prove Jacobi's theorem

(OR)

b) Use the Hamilton-Jacobi method to analyze the Kepler's problem

20. a) State and prove Poisson's theorem.

(OR)

20 b) Obtain the four types of generating functions associated with the transformation $Q = -\log\frac{\sin P}{q}$; $p = -q\cot\ p$

****