Mmmmmk.

**Avinashilingam Institute for Home Science and Higher Education for Women**
**Deemed to be University Estd.u/s 3 of UGC Act 1956, Category A by MHRD**
**Re-accredited with 'A++' Grade by NAAC. CGPA 3.65/4, Category I by UGC**
**Coimbatore-641 043, Tamil Nadu, India**

**Continuous Internal Assessment Test I – August 2024**

**Semester - III**

**Class: II PG** **Time: 2Hrs**

**Major: Mathematics** **Max. Marks: 60**

**23MMAC17 – Advanced Mechanics**

**Course Outcomes:**

**CO1:** Identify the static and dynamic characteristics of mechanical systems.

**CO2:** Analyze different systems in integrals of motion.

**CO3:** Apply Lagrange's and Hamilton's equations in relevant fields.

**CO4:** Utilize Hamilton-Jacobi Method in physical science.

**CO5:** Explore the theory of canonical transformations and its application to dynamical theory.

**Part – A 6 x 1 = 6**

**Circle the correct answer**

1. In the presence of constraints, the force component Fi are expressed as functions of _____ .**CO1K1**

   (a)position and time (b) position and velocity

   (c)velocity and time (d) position , velocity and time

2. The unilateral or inequality form of constraint is _____ in nature.**CO1K2**

   (a)holomonic (b)non-holonomic

   (c)scleronomic (d)rheonomic

3. The virtual work expressions are defined ro be _____ in the virtual displacement. **CO2K1**

   (a) linear (b)quadractic (c) cubic (d) degree n, n>3

4. When the equation of motion of the system is can be expressed as quadratures, then the system is called **CO2K2**

   (a)Holonomic System (b)Rheonomic system

   (c) Separable System (d) Orthogonal System

5. The Lagrange's function L = **CO3K1**

(a) T-V (b) V-T (c) T + V (d) 2T-V

6. For natural system, the Jacobi's integral h = **CO3K2**

(a)Total energy (b) Kinetic energy

(c)Potential energy (d)difference of kinetic and potential energy.

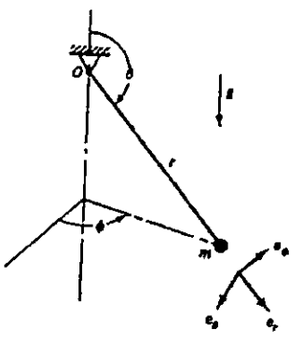
**Part – B** **3 x 6 =18**

**Answer all questions**

7. (a) State and prove principal of virtual work. **CO1K3**

(or)

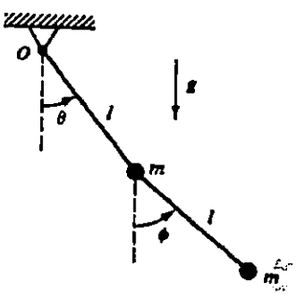
7.(b)A particle of mass m is suspended by a massless wire of length $r = a + b\cos\omega t$ $(a > b > 0)$to form a spherical pendulum. Find the equations of motion.**CO1K3**



8. (a) Explain the equilibrium and stability of a system. **CO2K3**

(or)

8. (b) A double pendulum consists of two particles suspended by the massless rods, as shown in figure below. Assuming that all motion takes place in a vertical planefFind the equations of motion. **CO2K3**



9. (a) State and prove Konig's theorem. (or)

9. (b) Derive Hamilton's equation. **CO3K4**

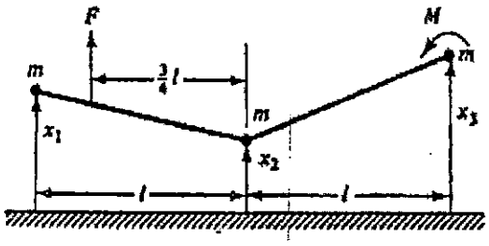
**Part – C** **3 x 12 =36**

10. (a) Explain in detail the classification and mathematical description of constraints.

**CO1K4**

(or)

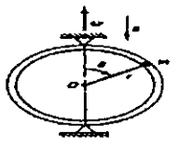
10. (b) Three particles are connected by two rigid rods having a joint between them to form the system as shown. A vertical force F and a moment M are applied as shown. The configuration of the system if given by $x_1 = q_1 + q_2 + \frac{1}{2}q_3$, $x_2 = q_1 - q_2$, $x_3 = q_1 - q_2 + \frac{1}{2}q_3$. Assume small motions. Find the generalized forces $Q_1$, $Q_2$ and $Q_3$. **CO1 K4**




11. (a) Derive the standard form of Lagrange's equation for a holomonic system.**CO2K4**

(or)

11.(b) A particle of mass m can slide without friction on the inside of a small tube which is bent inthe form of a circle of radius r. The tube rotates about a vertical diameter with a constant angular velocity as shown in figure. Find the differential equation of motion and Jacobi's integral.



**CO2K5**

12. (a)(i) Find the stationery values of the function f=z, subject to the constraints **CO3K4**

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

(ii) For Brachistochrone problem find a curve Y(x) between the origin and the point (x1,y1) such that a particle starting from the rest at O, and sliding down the curve without friction under the influence of a uniform gravitational field, will reach the end of the curve in a minimum time

(or)

. (b) Obtain the necessary and sufficient condition for stationary value of the definite integral I = $\int_{x_0}^{x_1} f[y(x), y'(x), x]\, dx$.**CO3K4**

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