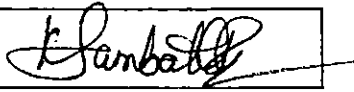


5/12/24

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. Recognised by UGC Under Section 12 B
Coimbatore - 641 043, Tamil Nadu, India

Master's Degree Examination – November 2024
III Semester

Class : II PG
Major : Mathematics

Time : 3 Hours
Max. Marks: 100

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

10 x 1 = 10

Choose the Correct Answer

1. A particle is constrained to move along any curve on a given surface is _____ constraint CO1K1
a. holonomic b. non-holonomic c. rheonomous d. acleronomous
2. In the equation $L=T-U$, Identify the term U CO1K1
a. kinetic energy b. momentum c. potential energy d. torque
3. _____ equation is derived by considering the motion of a fluid element along a stream line CO2K1
a. Newton's b. Stoke's c. Lagrange's d. Euler's
4. The Lagrangian equation of motion are _____ order differential equations CO2K1
a. first b. second c. third d. fourth
5. Curves that give the shortest distance between two points on a given surface are called the _____ of the surface. CO3K1
a. perpendicular b. geodesics c. torque d. mass
6. For monogenic system, Hamilton's principle I= _____ CO3K1
a. $\int_{t_1}^{t_2} (T + V) dt$ b. $\int_{t_1}^{t_2} (TV) dt$ c. 0 d. $\int_{t_1}^{t_2} (T - V) dt$
7. Hamilton's equations of motion are _____ CO4K1
a. $dq_i/dt = \partial H/\partial p_i$; $dp_i/dt = -\partial H/\partial q_i$ b. $dq_i/dt = \partial H/\partial p_i$; $dp_i/dt = \partial H/\partial q_i$
c. $dq_i/dt = -\partial H/\partial p_i$; $dp_i/dt = \partial H/\partial q_i$ d. $dr_i/dt = \partial H/\partial p_i$; $dr_i/dt = -\partial H/\partial q_i$
8. All point transformations are _____. CO4K1
a. canonical b. non-canonical c. both a and b d. none of the above
9. The potential force under inverse square law of force is CO5K1
a. $-\frac{K}{r^2}$ b. $-\frac{K}{r}$ c. Kr d. Kr^2
10. The nature of orbit when $e=1$ and $E=0$ is _____ CO5K1
a. elliptic b. parabola c. hyperbola d. circle

Part B**5 x 6 = 30****Answer ALL questions****Each answer should not exceed 400 words or two pages**

- 11.a. Examine the D' Alemberts principle. CO1K3
 (or)
- 11.b. Derive the equation of motion of a single particle using plane polar coordinates. CO1K3
- 12.a. Calculate the differential equations of motion for a double pendulum consists of two particles suspended by mass less rods and all motion take place in vertical plane. CO2K3
 (or)
- 12.b. Explain the 'Kepler problem'. CO2K3
- 13.a. Determine the Hamilton's equation of motion using variational principle. CO3K3
 (or)
- 13.b. Describe the Legendre transformation. CO3K3
- 14.a. Describe the Hamilton-Jacobi method to analyze the Kepler problem. CO4K4
 (or)
- 14.b. Explain the Liouville's system. CO4K4
- 15.a. Show that the transformation $Q = \frac{1}{2}(q^2 + p^2), P = -\tan^{-1}\frac{q}{p}$ is canonical. CO5K4
 (or)
- 15.b. Examine that the Poisson brackets can be used to identify constants of motion. CO5K4

Part C**5 x 12 = 60****Answer ALL questions****Each answer should not exceed 800 words or four pages**

- 16.a. Explain generalized coordinates with example. CO1K5
 (or)
- 16.b. Estimate the equation of motion when 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. CO1K5
- 17.a. Determine the Euler-Lagrange differential equations. CO2K3
 (or)
- 17.b. Estimate the conservative system. CO2K5
- 18.a. Explain the Hamilton's principle from the Legendre transformation. CO3K4
 (or)
- 18.b. Find by applying Hamilton's equations in the description of a system having a velocity dependent potential $U(q, \dot{q}, t)$. CO3K5
- 19.a. Illustrate Hamilton-Jacobi method to a simple mass – spring system. CO4K4
 (or)
- 19.b. Summarize Stackel's theorem. CO4K5
- 20.a. Explain in detail the differential forms and generating functions relating to canonical transformation. CO5K3
 (or)
- 20.b. Estimate that the following transformation is canonical or not by using Poisson brackets where $Q = \sqrt{e^{-2q} - p^2}P = \cos^{-1}(pe^q)$. CO5K3
