April-2025
MSc maths sem-2

Seat No. ________

16SI-MSMA-EL-02-00006

MASTER OF SCIENCE MATHEMATICS Examination

MSC MATHS Semester - 2 APRIL 2025 (Regular) APRIL - 2025

CLASSICAL MECHANICS 2

Faculty Code : 003

Subject Code : 16SI-MSMA-EL-02-00006

Time : 2:30 Hours] [Total Marks : 70

Instructions: All questions are compulsary

Q.1 Answer Briefly any seven of the following (Out of ten) 14

1. State the Hamilton's canonical equations.
2. The half-life of a radioactive particle is $10^{-7}sec$ when it is at rest. What will be the half-life when it is travelling with the speed of $0.5\,c$?
3. Define, Cyclic co-ordinates. Which equations are satisfied by cyclic co-ordinates in Routh's procedure?
4. State only the Lorentz transformation equations when the reference frame S' is moving in the direction of positive X – axis.
5. State Lorentz – Fitzgerald contraction hypothesis.
6. State only the transformation equations when the generating function is of the type $F_1(q_i, Q_i, t)$ and $F_2(q_i, P_i, t)$.
7. Are Poisson brackets commutative? Justify your answer.
8. State minimum two differences each between Lagrange's formulation and Hamilton's formulation.
9. State only the Hamilton – Jacobi equation.
10. For the Poisson brackets of two function show that $[au + bv, w] = a[u, w] + b[v, w]$.

Q.2 Answer the following (Any Two) 14

1. Express the components of angular velocity ω of a rigid body along the space set of axes in terms of Euler angles.
2. Derive Hamilton's canonical equations of motion from Lagrange's equations of motion.
3. Define moment of inertia of a rigid body about some axis. Prove that the moment of inertia about a given axis is equal to the moment of inertia about a parallel axis through the C.M. plus the moment of inertia of the body as if concentrated at the C.M. with respect to the original axis.

Q.3 Answer the following 14

1. Explain in detail the phenomenon of time dilation.
2. Discuss in detail the motion of a heavy symmetrical top.

OR

Answer the following

1 Prove in the usual notation the relation $E = mc^2$.

2 For the Poisson brackets of two function prove that, (i) $[uv, w] = [u, w]v + u[v, w]$

(ii) $\frac{\partial}{\partial t}[u, v] = \left[\frac{\partial u}{\partial t}, v\right] + \left[u, \frac{\partial v}{\partial t}\right]$.

Q.4 Answer the following questions (Any Two)

Discuss in detail the principle of least action.

Discuss in detail the Routh's procedure.

Q.5 Answer the following (Any Two)

Define Hamilton's principal function and show that, the Hamilton's principal function differs from the indefinite time integral of Lagrangian only by a constant.

Prove in the usual notations the relation $L = I\omega$.

For the problem of simple harmonic oscillator prove that $q = \sqrt{\frac{2\alpha}{m\omega^2}}\sin(\omega t + \beta)$.

4 Show that, the transformations $Q = 2\sqrt{p}\sin q$ and $P = \sqrt{p}\cos q$ is canonical. Also find, the suitable generating function.