M.Sc DEGREE EXAMINATION,APRIL 2019
I Year I Semester
Classical Mechanics And Relativity

Time : 3 Hours **Max.marks :75**

Section A $(10 \times 2 = 20)$ Marks

Answer any **TEN** questions

1. State Hamilton's variational principle.
2. What do you understand by cyclic coordinates?
3. What is coriolis force?
4. What are principle axes and principal moments of inertia?
5. Distinguish between point transformation and canonical transformation.
6. Define Poisson bracket.
7. What is unstable equilibrium?
8. What is normal modes of vibrations?
9. What are four vectors?
10. Show that $x^2+y^2+z^2-c^2t^2$ is invariant under Lorentz transformation.
11. What are holonomic and non-holonomic constrains?
12. What do you understand by nutation?

Section B $(5 \times 5 = 25)$ Marks

Answer any **FIVE** questions

13. Derive Hamilton's equation from variational principle.
14. An infinitesimal rotation can be represented by a vector along the instantaneous axis of rotation. Substantiate.
15. Show that the transformation $\mathbf{P}= \frac{\mathbf{1}}{\mathbf{2}} \left(\mathbf{p^2}+\mathbf{q^2}\right)$, $\mathbf{Q}= \mathbf{t}an^{-1} \left(\frac{\mathbf{Q}}{\mathbf{P}}\right)$ is canonical.
16. A simple pendulum has a bob of mass *m* with a mass m_1 at the moving support. Mass $m_1$moves on a horizontal line in the vertical plane in which the pendulum oscillates. Find the normal frequencies and normal modes of vibrations.
17. State clearly the Lorentz transformation equations.
18. Consider a dumb-bell formed by two point masses *m* and the ends of mass less rod of length 2*a*. It is constrained to rotate with constant angular velocity ω about an axis that makes an angle $\alpha$with the rod. Calculate the angular momentum and the torque that is applied to the system.

19. State and explain Kepler's third law.

Section C $(3 \times 10 = 30)$ Marks

Answer any **THREE** questions

20. Derive the Lagrange's equation of motion using Hamilton's principle.
21. Define Euler angles and derive the Euler's equations of motion in terms of Euler's angles.
22. Derive Hamilton Jacobi equation and apply it to solve the harmonic oscillator problem.
23. Discuss the vibration of a linear triatomic molecule by applying the theory of small oscillations
24. What is a four vector potential? Express Maxwell's field equations in the four-vector form.

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