19P1018

Reg. No ..... Name .....

M. Sc DEGREE END SEMESTER EXAMINATION - OCTOBER 2019

SEMESTER 1 : PHYSICS

COURSE : **16P1PHYT02 : CLASSICAL MECHANICS**

(For Regular - 2019 Admission and Supplementary - 2016/2017/2018 Admissions)

Time : Three Hours Max. Marks: 75

Section A
Answer all Questions (1 marks each)

1. The Lagrangian for a non -conservative system is
   (a) $T - q(\phi + v.A)$ (b) $T + q(\phi - v.A)$ (c) $T - q(\phi - v.A)$ (d) $T + \dot{q}(\phi + v.A)$
2. The Hamiltonian of a simple pendulum consisting of a mass 'm' attached to a massless string of length 'l' is, $H = \frac{P_\theta^2}{2ml^2} + mgl(1 - \cos\theta)$. If 'L' denotes the Lagrangian, the value of $\frac{dL}{dt}$ is
   (a) $\frac{-2g}{l} p_\theta \sin\theta$ (b) $\frac{-g}{l} p_\theta \sin 2\theta$ (c) $\frac{g}{l} p_\theta \cos\theta$ (d) $l p_\theta^2 \cos\theta$
3. For a one dimensional harmonic oscillator, the representative point in two dimensional phase space traces
   (a) an ellipse (b) a parabola (c) a hyperbola (d) helix
4. For a particle moving in an elliptical path under inverse-square law force, the critical value of energy for a circular orbit is
   (a) $\frac{-2L^2}{\mu k^2}$ (b) $\frac{-\mu k^2}{2L^2}$ (c) $\frac{2L^2}{\mu k^2}$ (d) $\frac{\mu k^2}{2L^2}$
5. The law of conservation of momentum is
   (a) Valid at relativistic speeds
   (b) not valid at relativistic speeds
   (c) not valid at non-relativistic speeds
   (d) All of these

(1 x 5 = 5)

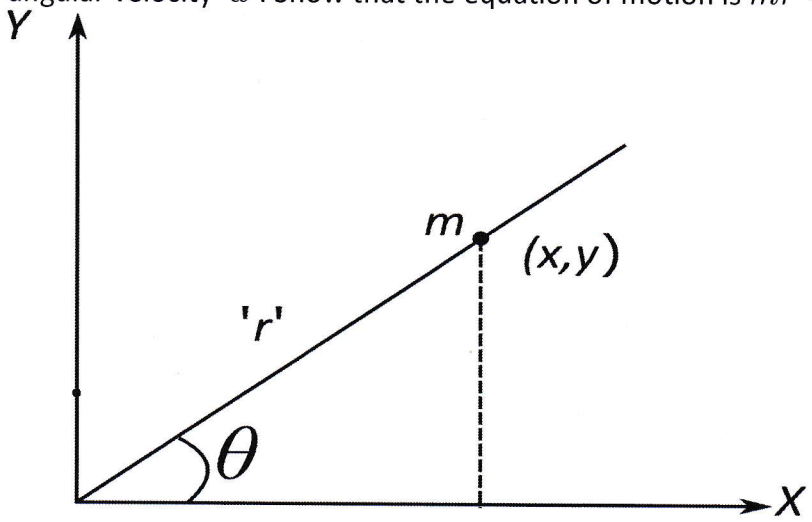
Section B
Answer any 7 (2 marks each)

6. What are Legendre transformations?
7. Explain the physical significance of dissipation function.
8. Explain the physical significance of Euler-Lagrange's equations.
9. Poisson brackets provide a bridge between classical and quantum mechanics. Substantiate.
10. Sketch the normal modes of vibration of a CO_2 molecule in the increasing order of frequency.
11. Explain the significance of reducing a two body problem in to an equivallent one body problem.
12. Show that the angular accelerartion is same in fixed and rotating frames of reference.
13. Distinguish between centrifugal and Coriolis forces.
14. Distinguish between geodesic equations of motion and Newton's equations of motion.
15. State and explain time dilation.

(2 x 7 = 14)

Section C
Answer any 4 (5 marks each)

16. A bead slides on a smooth rod which is rotatiing about one end in a vertical plane with uniform angular velocity 'w'. Show that the equation of motion is $m\ddot{r} = mrw^2 - mg\sin wt$.



17. Prove that Poisson brackets are invariant under canonical transformations.
18. Prove that for any function F, G and K of 'q' and 'p', the following relation holds true. $[F,[G,K]]+[G,[K,F]]+[K,[F,G]]=0$.
19. A rigid body is rotating under the influence of an external torque 'N' acting on it. If 'w' is the angular velocity and T is the kinetic energy, show that $\frac{dT}{dt} = N.w$, in the principal axes system.
20. A particle moves in a circular orbit of diameter 'b' in central force field. If the centre of attraction is on the circumference itself, find the law of force.
21. Explain logistic map in chaos.

(5 x 4 = 20)

Section D
Answer any 3 (12 marks each)

22.1. Obtain Lagrange's equation for a charged particle moving in an electromagnetic field.

OR

2. What do you mean by the Hamiltonian of a system? Obtain the Hamiltonian of a simple pendulum with a moving support.

23.1. Explain angular momentum Poisson brackets. Show that the components L_x, L_y and L_z of L cannot be simultaneously canonical.

OR

2. Obtain the equations of motion and first integrals of a particle moving in a central force field.

24.1. Explain the rate of change of a vector and derive an expression for the Coriolis force.

OR

2. Obtain the pendulum equation by considering it as a non-linear system. Obtain the phase portrait of the pendulum also.

(12 x 3 = 36)