

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

**M. SC. DEGREE END SEMESTER EXAMINATION NOVEMBER
2016**

SEMESTER - 1: PHYSICS

COURSE: 16P1PHYT02 -: CLASSICAL MECHANICS

Time: Three Hours

Max. Marks: 75

PART A

(Each question carries one mark. Answer **all**)

1. Find the cyclic coordinate of a particle of mass **m** executing circular motion. The Lagrangian of

$$\text{the system is } L = \frac{1}{2}(m\dot{r}^2 + mr^2\dot{\theta}^2) + V(r).$$

a. r , b. θ , c. both r & θ , d. Φ

2. Isotropy of space is related to

a. Conservation of angular momentum, b. Conservation of linear momentum,
c. Conservation of energy, d. Conservation of force.

3. In Poisson bracket formulation $[F, G+S] = i$

a. $[F, G] + [F, S]$, b. $[G, F] + [F, S]$, c. $[G, F] + [S, F]$, d. $[F, G] + [G, S]$

4. The length of a spaceship is measured to be exactly half of its proper length. The speed of the spaceship relative to the observer on earth is

a. c , b. $0.87c$, c. $0.50c$, d. $0.66c$

5. E & ϵ represent the energy and eccentricity of an object under inverse square force. The conditions $\epsilon = 1$ & $E = 0$ represents an orbit of shape

a. elliptical, b. circular, c. Parabolic, d. Hyperbolic

(1x5=5)

PART B

Each question carries two marks. Answer **any seven**

6. What are generalized coordinates?
7. Explain the significance of generating function of a canonical transformation
8. How constraints can be classified?
9. State and explain *least action* principle
10. Explain Jacobi identity in the Poisson Bracket formulation
11. Show that in central force motion angular momentum is a constant of motion.
12. Describe the properties of Coriolis force?
13. What are normal coordinates?

14. Distinguish between stable and unstable equilibrium in the case of small oscillations.
15. Explain *Lyapunov exponent* of a chaotic system

(10x2=20)

PART C

(Each question carries five marks. Answer **any four**.)

Masses m and $2m$ are connected by a light in extensible string that passes over a pulley of mass $2m$ and radius a . Write the Lagrangian and find the acceleration of the system?

16. Derive Hamilton's equations of motion (canonical equations of motion) from variational principle?
17. Show that the transformation $p = mq \cot Q$ and $P = \frac{mq^2}{2 \sin^2 Q}$ is canonical. Obtain the generator of the transformation .
18. Discuss the one dimensional harmonic oscillator problem using Hamilton-Jacobi method.
19. Derive equations of motion and first integrals in two body central force problem.
20. Explain logistic map in chaos.

(5x4=20)

PART D

(Each question carries twelve marks. Answer **any three**.)

21. Derive Lagrange's equation from Hamilton's principle using calculus of variation. Explain the physical significance of Hamilton's equations.
22. Discuss in detail the vibration of a linear triatomic molecule.
23. Derive Hamilton- Jacobi equation. Explain the physical significance of Hamilton's principal function and Hamilton's characteristic function.
24. What is inertia tensor of a rigid body? Derive the Euler's geometrical equations of a rigid body.
25. Discuss the phase plane analysis of a dynamical system. Discuss the phase curves of a simple harmonic oscillator and draw its phase portrait.
26. Explain principle of equivalence and principle of general covariance. Describe the motion of mass point in a gravitational field.

(12x3=36)
