

DECEMBER 2014

P/ID 40002/PPHB

Time : Three hours

Maximum : 100 marks

PART A — (10 × 2 = 20 marks)

Answer ALL the questions.

1. What is meant by Cyclic coordinate?
2. State the Kepler's law.
3. Mention the coefficients of moment of inertia.
4. What is sleeping top?
5. If $[\varphi, \psi]$ be the Poisson brackets of φ and ψ then prove that $\frac{\partial}{\partial t}[\varphi, \psi] = \left[\frac{\partial \varphi}{\partial t}, \psi \right] + \left[\varphi, \frac{\partial \psi}{\partial t} \right]$.
6. State Hamilton's principle.
7. Distinguish between stable and unstable equilibrium.
8. What do you mean by normal modes of motion?
9. What do you understand from invariance of Maxwell's equation?
10. What is world space?

PART B — (5 × 6 = 30 marks)

Answer ALL questions.

11. (a) Obtain Hamilton's canonical equations of motion.

Or

- (b) Show that for any repulsive central force a formal solution for the angle of scattering is

given by $\Theta = \pi + 2 \int_0^{u_0} \frac{sdu}{\sqrt{\left(1 - \frac{V(u)}{E} S^2 u^2\right)}}$ where V is

the potential energy, $u = I/r$ and u_0 corresponding to the turning point. What is the corresponding expression for a force k/r^3 ?

12. (a) Explain the inertia tensor and the moment of inertia.

Or

- (b) Describe the angular momentum and kinetic energy of motion about a point.

13. (a) Describe the harmonic oscillator problem Using Hamilton Jacobi method.

Or

- (b) For a certain canonical transformation it is known that $Q = \sqrt{q^2 + p^2}$, $F = \frac{1}{2}(q^2 + p^2)$

$\tan^{-1} \frac{q}{p} + \frac{1}{2}qp$. Find $P(q,p)$ and $F(q,Q)$.

14. (a) Explain the normal coordinates and normal frequencies of vibration.

Or

- (b) Obtain the Lagrange's equations of motion for a small Oscillation of a system.

15. (a) Derive the relativistic law of addition of velocities.

Or

- (b) Prove that

(i) The four dimensional Volume element "dx dy dz dt" is a invariant under Lorentz transformation.

(ii) The Lorentz transformation may be regarded as a rotation of axes through an imaginary angle.

PART C — (5 × 10 = 50 marks)

Answer ALL questions.

16. (a) Using D'Alembert's Principle derive Lagrange's equations for conservative systems.

Or

- (b) Discuss the problem of scattering of charged particles by a Coulomb field and obtain Rutherford's formula for the scattering cross section.

17. (a) Derive the Euler's equations of motion in terms of Euler's angle.

Or

- (b) Give the theory of symmetric top moving under gravity.

18. (a) State and prove the Principle of least of action.

Or

- (b) Obtain the generating function of canonical transformation.

19. (a) Derive the energy eigenvalue equation and the principal axis transformation.

Or

- (b) Describe the free vibrations of a linear triatomic molecule.

20. (a) Obtain Lorentz transformation equations.

Or

- (b) Explain the Hamiltonian formulation of relativistic mechanics.
-