

(6 pages)

Reg. No. :

Code No. : 6373

Sub. Code : HPHM 11

M.Sc. (CBCS) DEGREE EXAMINATION,
NOVEMBER 2014.

First Semester

Physics

CLASSICAL MECHANICS AND RELATIVITY

(For those who joined in July 2012 onwards)

Time : Three hours

Maximum : 75 marks

SECTION A — (10 × 1 = 10 marks)

Answer ALL questions.

Choose the correct answer :

1. A rigid body moving freely in space has degrees of freedom
(a) 3 (b) 6
(c) 9 (d) 4
2. Constraint in a rigid body is
(a) Holonomic (b) Nonholonomic
(c) Nonscleronomic (d) Rheonomic

3. The maximum and minimum velocities of a satellite are v_1 and v_2 . The eccentricity of the orbit of the satellite is
(a) $E = v_1/v_2$ (b) $e = v_2/v_1$
(c) $e = (v_1 - v_2)/(v_1 + v_2)$ (d) $e = (v_1 + v_2)/(v_1 - v_2)$
4. A particle is moving under central force about a fixed center of force. The path of the particle is
(a) Circular (b) Elliptical
(c) Parabola (d) Plane
5. In case of a linear triatomic molecule the eigen frequencies represented as
(a) $\omega_1 = \omega_2 = \omega_3$ (b) $\omega_1 = 0, \omega_2 = \omega_3$
(c) $\omega_1 = 0, \omega_2 \neq \omega_3$ (d) $\omega_1 < \omega_2 < \omega_3$
6. In Δ variation, which coordinates are allowed to vary
(a) Time and position (b) Time and energy
(c) Time alone (d) Time and mass
7. If Poisson bracket of a function with Hamiltonian vanishes, the function is constant of
(a) Time (b) Motion
(c) Angular momentum (d) Acceleration

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8. The action and angle variables have the dimensions of angle and
 (a) Force (b) Energy
 (c) Angular momentum (d) Mass
9. The law of conservation of momentum, is valid at nonrelativistic
 (a) Mass (b) Speed
 (c) Velocity (d) Time
10. The rest mass of a photon of frequency ν is
 (a) $h\nu$ (b) $h\nu/c$
 (c) $h\nu/c^2$ (d) zero

SECTION B — (5 × 5 = 25 marks)

Answer ALL questions, choosing either (a) or (b), each answer should not exceed 250 words.

11. (a) What are generalized coordinates and generalized velocities? Set up the Lagrangian for a spherical pendulum.

Or

- (b) Obtain the equation of motion of a system of two masses, connected by an inextensible string passing over a small smooth pulley.

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12. (a) State and prove Bertrand's theorem.

Or

- (b) Discuss the Keplers problem in terms of Laplace-Runge-Lenz vector.

13. (a) Discuss the properties of transformation matrix.

Or

- (b) Explain about Coriolis force and its significance.

14. (a) Show that the transformation $P = \frac{1}{2}(p^2 + q^2)$, $Q = \tan^{-1} q/p$ is canonical.

Or

- (b) Show that the Poisson bracket of two constants of motion is itself a constant of motion?

15. (a) What is relativistic energy? Prove the relation $E^2 - p^2 c^2 = m_0^2 c^4$.

Or

- (b) Discuss space-like and time-like intervals.

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 [P.T.O.]



SECTION C — ($5 \times 8 = 40$ marks)

Answer ALL questions, choosing either (a) or (b),
each answer should not exceed 600 words.

16. (a) What is D'Alembert's principle? Derive Lagrange's equations of motion from it for conservation system. How will the result be modified for non-conservative system?

Or

- (b) Derive Hamilton's equations from the variational principle. Deduce Hamilton's principle.
17. (a) What do you mean by the reduced mass of a two-particle system? If the motion of the hydrogen nucleus is neglected, calculate the percentage error in the wavelength of any line in hydrogen spectrum determined by Bohr's theory.

Or

- (b) What is Kepler's law of planetary motion? Give the proof of Kepler's law of planetary motion and hence deduce that the areal velocity is constant.

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18. (a) Discuss the free vibration of a linear tri atomic molecule and get the eigen vectors general solutions.

Or

- (b) Explain and discuss in detail about the torque free motion of a rigid body.
19. (a) Discuss in detail about the separation of variables in the Hamilton's Jacobi equation.

Or

- (b) Explain how action angle variables are used in systems of one degree of freedom.
20. (a) Explain with example the Lagrangian formulation of relativistic mechanics.

Or

- (b) Explain the meaning of Minkowski force and discuss the equilibrium of a right handed lever in a moving inertial frame.

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