

P.G. 1st Semester - 2016

PHYSICS

[Old Syllabus]

Paper : 102

Full Marks : 40

Time : 2 Hours

*The figures in the right-hand margin indicate marks.**Candidates are required to give their answers in their own words as far as practicable.**Use separate answer scripts for each Unit.*

UNIT-I

(Classical Electrodynamics)

(Marks : 20)

Answer Q. No. 1 and any two from the rest.

1. Answer any **three** questions: $2 \times 3 = 6$
- Express Lorentz force in terms of electromagnetic potentials.
 - Show that Lorentz gauge is invariant to Lorentz transformation.
 - Why TEM wave is not possible inside wave guide?

*[Turn Over]

d) What do radio waves (e.g. FM radio at ~100MHz) have in common with visible light? In what respects do the waves differ?

e) What is meant by radiative reaction?

2. Hertz potential $\bar{\pi}$ is defined by $\varphi = -\bar{\nabla} \cdot \bar{\pi}$ and $\bar{A} = \frac{1}{c^2} \frac{d\bar{\pi}}{dt}$. Obtain the electric and magnetic field in terms of the Hertz potential. 7
3. Explain retarded potentials. Find the expression for Leinard-Weichart potentials. 2+5
4. Find the potentials of a point charge moving with constant velocity. 7

UNIT-II

(Classical Mech.)

(Marks : 20)

Answer Q. No. 5 and any two from the rest.

5. Answer any **three** questions: $2 \times 3 = 6$
- A particle is constrained to move on the plane curve $xy = c$ under gravity. Obtain Lagranges equation.
 - What is meant by "Sleeping top"?
 - Is the transformation $Q = \log\left(\frac{1}{q} \sin p\right)$, $P = q \cot p$ canonical?

165/Phs.

[2]

d) The Hamiltonian of a system is given by $ap^2 + bq^2 + cpq$ where a, b, c are constants. Find the condition for which $F = kp + lq$ will be the constant of Motion. Here k and l are real numbers and p and q represent the momentum and position respectively.

e) The potential energy of a particle is given by $V(x) = x^4 - 4x^3 - 8x^2 + 48x$.

Find the points of stable and unstable equilibrium.

6. a) Derive the equation of motion for the vertically driven pendulum. Solve the system.

b) Evaluate the Poisson bracket of the Hamiltonian H and time t . Are H and t canonically conjugate variables? Explain.

4+3

7. a) Prove that the transformation

$$q = \sqrt{\frac{2P}{KM}} \sin \theta, \quad p = \sqrt{2P\sqrt{KM}} \cos \theta$$

is canonical.

b) Deduce Euler's equation of motion of a rigid body which is constrained to rotate about a fixed point.

3+4

8. a) Explain the physical significance of Hamilton's principal function.

b) Derive Hamilton-Jacobi equation. 3+4