Seat No. : _______________

XY-109

April-2013

M.Sc. (Sem.-II)

Physics : 408

(Classical Mechanics II, Electrodynamics & Plasma Physics)

Time : 3 Hours] **[Max. Marks : 70**

1. (a) Show that phase trajectory in case of SHO with having mass 'm' and force constant 'k' is ellipse furthermore, a phase trajectory is circle if we draw graph of $\frac{y}{\omega_o} \rightarrow x$. **7**

OR

Show that the phase trajectories of the system whose equations of motion is $\overline{x} - \sigma^2 x = 0$ are hyperbolic curves with $y = \pm\sigma x$ as asymptotes.

(b) Explain limit cycle in detail. **7**

OR

Discuss motion of damped SHM and explain focal point.

2. (a) The field of charge in uniform motion is given by

$$\vec{E} = \frac{1}{4\pi\varepsilon_0} \frac{q\left(1 - \frac{v^2}{c^2}\right)}{\left(1 - \frac{v^2}{c^2}\sin^2\theta\right)^{\frac{3}{2}}} \frac{\hat{R}}{R^2}$$

Show the Gauss law is obeyed by this field of charge, when it is integrated over sphere of radius R. **7**

OR

Discuss the motion of particle under constant force and show that the graph of position against time is parabola classically, but it is hyperbola when we consider relativistic motion of particle.

(b) Discuss proper velocity and show that $\vec{E} \cdot \vec{B}$ and $E^2 - c^2 \cdot B^2$ are relativistic invariant. **7**

OR

Write Langrangian density, show that total Langrangian becomes

$$L = \int \frac{E^2 - B^2}{8\pi} dV + \frac{1}{2}\sum_i m_i V_i^2 - \sum_{i=1}^{6} q_i \left(\varnothing\left(\vec{r}_i\right) - \frac{\vec{V}_i - \vec{A}\left(\vec{r}_i\right)}{c}\right)$$

3. (a) Discuss : Scattering of radiation by a free charge. **7**

OR

Discuss in details of dispersion in liquids and solids.

(b) Obtain Rayleigh scattering expressions for bounded charges and explain why sky is blue. Which colour of sky is appear if the atmosphere is absent ? **7**

OR

Define radiation damping and derive the expression for damping coefficient ‘1’.

4. (a) Derive the expression for the 1^{st} moment equation of plasma. **7**

OR

Derive the BBGKY equation for $f^{(1)}$.

(b) Define MHD. Explain two fluid plasma in detail. **7**

OR

Show that

(1) $\vec{E}_{eff} = \vec{E} + \dfrac{\vec{P}}{3\varepsilon_0}$ and

(2) $U = g(\rho, T) = \dfrac{P}{\rho} - \dfrac{\tau}{\rho}\dfrac{\partial f}{\partial \tau}$

5. Write short answers : **14**

(1) State the example of autonomous system.

(2) A singular point represents a position of equilibrium of the system with ________. (Zero velocity, Infinite velocity)

(3) In context of stability, which point represent unstable equilibrium ? (Vortex point, Saddle Point, Focal Point, Nodal Point)

(4) Define proper velocity.

(5) What is Separatrix ?

(6) Define Attractor.

(7) Write the equation of motion for continuous elastic road ?

(8) Write B-V equation for collision.

(9) For an adiabatic propagation $\vec{\nabla}_p$ = _________.

(10) Is there moment equations are interrelated to each other ? (Yes/No/Both)

(11) 1eV = _________ °K.

(12) State the equations used in MHD.

(13) Write Abraham-Lorentz formula for radiation reaction force.

(14) State relation between $\vec{W}$, $\vec{V}$ and $\vec{U}(\vec{r}, t)$.