

Seat No. : _____

ZO-126

May-2014

M.Sc. Sem.-II

408 : Physics

(Classical Mechanics, Plasma Physics & Electrodynamics)

Time : 3 Hours]

[Max. Marks : 70

Instructions : (1) Attempt **all** questions.

(2) Symbols and terminology have their usual meanings.

1. (a) Explain in detail with necessary mathematical steps, how 2nd order linear differential equation can be solved ? Also explain terms phase plane, phase trajectory, representative point, singular point and ordinary point. Show that phase trajectory of simple harmonic oscillator is ellipse. 7

OR

Discuss damped simple harmonic motion and explain focal point and nodal point.

- (b) Write Van-der-Pol's differential equation. Discuss phase trajectory in case of different values of parameter. What do you mean by limit cycle and attractors ? 7

OR

Discuss phase trajectory of simple pendulum (non-linear motion) with necessary equation.

2. (a) How transition can be done from discrete to continuous system ? Derive Langrangian density in terms of Young's modulus in case of linear chain. 7

OR

Discuss the motion of particle under the constant force and show that graph of position versus time is parabola in case of classical mechanics but in case of relativistic motion it is hyperbola.

- (b) Find out position as a function of time when particle starts motion from rest at the origin. When particle moving under the effect of Minkowshi force. 7

OR

Write transformation equations for the components of electric and magnetic fields and show that

- (1) $\vec{E} \cdot \vec{B}$ is relativistically invariant.
- (2) $\vec{E}^2 - c^2 \vec{B}^2$ is relativistically invariant.

3. (a) Use the continuity equation in the presence of a collision term and derive the Boltzman equation. 7

OR

Derive second momentum equation.

- (b) Show that for isothermal process $\vec{\nabla}P = mV_0^2 \vec{\nabla}n_1$ and for adiabatic process $\vec{\nabla}P = \gamma kT_0^2 \vec{\nabla}n_1$. 7

OR

- (1) Show that $\left(\frac{\partial P}{\partial T}\right)_V = \left(\frac{\partial S}{\partial V}\right)_T$
- (2) Show that perpendicular velocity to magnetic field is independent of the charge.

4. (a) Derive an expression for scattering of radiation by bound charge. Discuss its application.

Show that $\sigma_{\text{bound}} = \frac{\omega^4}{(\omega_0^2 - \omega^2)^2 + l^2 \omega^2} \sigma_T$. 7

OR

- (1) Show that two charge particle with masses m_1 and m_2 and having charges e_1 and e_2 respectively. They are separated by a fixed distance 'r' in a centre of mass system, then show that dipole moment of a system is given by $\vec{P} = \mu \left(\frac{e_1}{m_1} - \frac{e_2}{m_2} \right) \vec{r}$, where μ = reduced mass. And also find the value of dipole radiation for identical particles.
- (2) Show that the value of $n = 1 + A \left[1 + \frac{B}{\lambda^2} \right]$ where A and B are Cauchy's constant. Under assumptions that damping is negligible.

- (b) Show that dipole moment per unit volume is given by $\vec{P} = 3\epsilon_0 \vec{E}$. Obtain Lorentz-Lorentz formula for the atomic and molecular refractivity of the medium. 7

OR

Derive an expression for media containing free electron in the system. Find the value of conductivity for the copper metal for the condition $1_\alpha \gg i\omega$ and $1_\alpha \ll i\omega$.

5. Write short answers :

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- (1) In plasma, state the criteria of a system of charged and neutral particles.
- (2) Write Boltzman-Vlasov equation for the particle having thermal as well as external electric and magnetic fields, the change of particle velocity distribution function due to collision.
- (3) What do you mean by moment equations ?
- (4) In the case of single fluid model plasma, the fluid will be _____ and _____.
 (a) Homogeneous-anisotropic (b) Isotropic-inhomogeneous
 (c) Homogeneous-isotropic (d) Inhomogeneous-anisotropic
- (5) How many energy is released in the case of thermonuclear reaction ?
- (6) Why sky is black ?
- (7) Define radiation damping.
- (8) What is Chaos ?
- (9) Give example of random motion.
- (10) Write the range of control parameter 'μ' in case of logistic map.
- (11) Define strange attractor.
- (12) What do you mean by vortex point ?
- (13) What is the unit of proper acceleration ?
- (14) Write Lorentz transformation matrix for magnetic field.

