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M. Sc. Physics (Sem.-II) Examination September - 2025

Physics - PH-423 : Classical Elctrodynamics and Plasma Physics

સૂચના : / Instructions

(1) ઉપરોક્ત દર્શાવેલ વિગતો ઉત્તરવહી પર અવશ્ય લખવી.
Fill up strictly the above details on your answer book

Seat No.:

Student's Signature

Q.1. **Attempt any two.** **(18)**

(A) Obtain an expression for the multiple potential due to a charge distribution. Write description quadruple moment tensor. Write the application of them. **(9)**

(B) (i) Find the relation between electrical displacement (D), electric field (E) and polarization (P) with physical significance. **(4)**

(ii) Show that boundary conditions of normal component of magnetic induction B are continuous across the boundary. **(5)**

(C) (i) Describe Lorentz gauge using Lorentz condition .why should Lorentz gauge commonly used? **(5)**

(ii) Explain the significance of retarded potential and advanced potential. **(4)**

Q.2. **(18)**

(A) (i) Derive continuity equation and discussion of its, significance. **(4)**

(ii) Obtain the Poynting theorem for conservation of energy in an electromagnetic field. **(5)**

(B) (i) Derive plane electromagnetic wave propagation in conducting media. **(5)**

(ii) Discuss the depth of penetration and find for sea water at 10 KHz having conductivity 4.0×10^{7} mho / meter and free space permeability $4\pi \times 10^{-7}$ Henry/meter. **(4)**

(C) (i) What is a wave guide , discuss detail the theory waveguide with reference TE mode of propagation of electromagnetic wave, **(6)**

(ii) Calculate the cutoff wavelength of rectangular wave guide has A= 6cm and b=4cm for TE_{10} mode. **(3)**

Q.3. **Attempt any two.** **(18)**

(A) Obtain expressions for the electric and magnetic fields of an oscillating electric dipole . Hence calculate poynting vector and total radiated power interpret the results. **(9)**

(B) What is an antenna array? Explain its working and properties end fire array. **(9)**

(C) (i) Explain basic concept differential scattering cross section and total scattering cross section. **(5)**

(ii) Write the equation of motion of bound electron in Rayleigh Scattering. Explain red color of sun set and rise. **(4)**

Q.4. **Attempt any two.** **(16)**

(A) What do you mean by quasi-neutrality of plasma? Derive Debye length and write conditions for existence of plasma compared with linear dimension occupied by gas. **(8)**

(B) (i) Discuss the motion of a charged particle in a uniform electric field. **(4)**

(ii) What is magneto=hydrodynamics ? Write hydrodynamic equation for plasma. **(4)**

(C) Write a short note on Magnetic confinement and pinch effect. **(8)**
