No. of Printed Papers: 02 SARDAR PATEL UNIVERSITY M.Sc. (Physics) 2nd Semester Examination Saturday, 23rd March, 2019 Subject: PS02CPHY03 (Electrodynamics and Plasma Physics) Total Marks: 70 Time: 02:00 pm to 05:00 pm [01 mark each] Q-1 Eight multiple choice questions. (MCQ) 1. Total energy density of the electromagnetic field is given by (a) $\epsilon_0 E^2 + \mu_0 H^2$ (b) $1/2[\epsilon_0 E^2 + \mu_0 H^2]$ (c) $1/2[\epsilon_0 E + \mu_0 H]$ (d) None 2. For the interior of the hollow rectangular waveguide, ____ is zero (a) Curl of E (b) divergence of E (c) curl of B (d) None 3. "Magnetic monopoles do not exist" statement is expressed as (a) $\nabla \times B = \mu_0 J + \mu_0 \varepsilon_0 dE/dt$ (b) $\nabla \cdot E = 0$ (c) $\nabla \times E = -dB/dt$ (d) $\nabla \cdot B = 0$ 4. The dominant mode of EM transmission through a rectangular waveguide is (a) TE_{11} (b) TM_{11} (c) TM_{10} (d) TE_{10} 5. What would be the length of a half wave dipole antenna operating in air at 50 MHZ? (a) 3 m (b) 6 m (c) 50 m (d) 25 m equation is a differential equation describing time evolution of the distribution function of plasma with long-range interaction. (a) Vlasov (b) Boltzman (c) Landau (d) Van Kampen 7. The Lorentz gauge condition is expressed as_____ (a) $\nabla . A = 0$ (b) $\nabla . A + \frac{\partial \phi}{\partial t} = 0$ (c) $\nabla . B = 0$ (d) r.A = 08. In the case of planar sheath, the mach number, ____ is called the Bohm sheath criterion (a) $m^2 < 1$ (b) $m^2 > 1$ (c) 1/m > 1 (d) $1/m^3 > 1$ [02 marks each] O -2 Attempt any 7 of the following 9 question briefly.

1. What are retarded potentials? How are they computed?

2. Explain the different field zones of an extended radiating source.

3. Explain Poynting theorem.

4. Describe three fundamental laws of Optics.

(P.T.O)

- 5. What is radiation reaction? Explain briefly
- 6. Explain the D-T reaction for nuclear fusion energy. Why is it advantageous?
- 7. Describe advantages of the kinetic theory over fluid dynamics for the study of plasma.
- 8. What are TE, TM and TEM waves?

Q-5

9. Define cutoff frequency of a wave guide and give an expression for the cutoff wavelength of the dominant TE wave in a rectangular wave guide.

Q-3 (a) Derive electromagnetic force on the charge in terms of Maxwell stress tensor. [06] (b) Derive Fresnel's equations for oblique incidence in linear media. [06] OR (b) Define skin depth and derive skin depth equation for EM wave traveling in conductor. [06] Q-4 (a) Using retarded potentials derive the generalized Coulomb's law. [06] (b) Prove "The power radiated by a point charge is proportional to the square of its acceleration" [06]

- (b) What are synchrotron, Bremsstrahlung and Cerenkov radiations? How are they produced? Compare their radiation patterns. [06]
- (a) Obtain electric and magnetic field components for TM mode in rectangular waveguide.

 [06]

 (b) Show that the total radiated power of the Hertzian dipole antenna is proportional to the square of the normalized length of the dipole. Find out the radiation resistance of Hertzian dipole antenna.

 [06]
- OR

 (b) Derive the power radiated by a center-fed dipole linear antenna. Draw angular distribution of its power.

 [06]
- Q-6
 (a) Using kinetic theory of plasma derive dispersion relation for plasma oscillation and explain Landau damping.
 [06]
 (b) Derive the child-Langmuir law near the sheath of a cold plasma
 [06]
 - OR
 (b) Discuss in detail the problem of controlled fusion and derive the Lawson criterion. [06]

