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Name.....

Reg. No.....

**FIRST SEMESTER M.Sc. DEGREE EXAMINATION  
FEBRUARY 2013**

(CUCSS)

Physics

PHY 1C 03-ELECTRODYNAMICS AND PLASMA PHYSICS

(2010 Admissions)

Time : Three Hours

Maximum : 36 Weightage

**Section A**

Answer all questions.

Weightage 1 each.

1. Discuss the solution of wave equation.
2. Write down the four Maxwell's equation and explain their significance.
3. What do you mean by time harmonic fields?
4. Distinguish between phase velocity and group velocity.
5. State and explain Poynting's theorem.
6. Which are the three most common types of guiding structures that support TEM waves?
7. What are the essential differences between a transmission line and an ordinary electric network?
8. What are four-vector potentials?
9. Give the expressions for the electric and electric fields of a moving point charge.
10. Explain magnetism as a relativistic phenomenon.
11. What are plasma oscillations?
12. What is Debye shielding? Obtain the expression for the Debye length.

(12 × 1 = 12 weightage)

**Section B**

Answer any two questions.

Weightage 6 each.

13. Derive the relation connecting the three electric vectors E, P and D and discuss the electromagnetic boundary conditions.

Turn over

14. Define Poynting vector. Deduce the Poynting's theorem for the flow of energy in electromagnetic field.
15. Derive the expression for the cut-off frequency for TM waves in a rectangular waveguide.
16. Formulate Maxwell's equations in terms of field tensors.

(2 × 6 = 12 weight)

### Section C

Answer any four questions.

Weightage 3 each.

17.  $(\mathbf{E}, \mathbf{H})$  are solutions to source-free Maxwell's equations in a simple medium characterized by  $(\epsilon, \mu)$ . Show that  $(\mathbf{E}', \mathbf{H}')$  are also the solutions of Maxwell's equations if  $\mathbf{E}' = \eta \mathbf{H}$  and  $\mathbf{H}' = -\mathbf{E}/\eta$ , where  $\eta$  is the characteristic impedance of the medium.
18. Show that when uniform plane waves propagate in a good conductor, the magnetic field lags behind the electric field by  $45^\circ$ .
19. A rectangular waveguide has breadth 10 cm. Find the wavelength for a signal of frequency 2.5 GHz for the dominant mode.
20. Discuss the motion of charged particles in uniform electric and magnetic fields and obtain an expression for drift velocity.
21. Explain Debye shielding and discuss its importance.
22. The dispersion relation for a low density plasma is given by  $\omega^2 = \omega_0^2 + c^2 k^2$ , where  $k$  is the wave vector and  $\omega_0$  the plasma frequency. Obtain a relation between group velocity and phase velocity of the plasma.

(4 × 3 = 12 weight)