

**FOURTH SEMESTER B.Sc. DEGREE EXAMINATION MAY 2011**

(CCSS)

Physics Core

PH 4B 07 – ELECTRODYNAMICS – I

Time : Three Hours

Maximum : 30 Weightage

*Symbols used in this question paper have their usual meanings.***Section A**I. Objective type questions. Each questions carries a weightage of  $\frac{1}{4}$ .

Questions 1-4: Choose the correct alternative from the given list.

1. Electrostatic field (E) is...

- (a) Solenoidal
- (b) Proportional to the square of distance from a point charge
- (c) Irrotational
- (d) None above.

2. In the equation  $p = \alpha E$ ,  $\alpha$  is

- (a) atomic polarizability
- (b) polarization
- (c) a dimension less constant
- (d) dipole moment

3. Volume current density J is equivalent to

- (a) current per unit volume
- (b) current per unit area
- (c) current per unit length
- (d) charge per unit area

4. The concept of magnetic vector potential A is introduced on the basis of

- (a) Biot-Savart law
- (b) Ampere's law
- (c) non-existence of magnetic monopoles
- (d) all above

Question 5-8 : Fill in blanks

5. Laplace's equation is given by \_\_\_\_\_.

6. Refractive index of a medium is directly proportional to the \_\_\_\_\_ of dielectric constant

Turn over

7. According to magneto static boundary conditions normal components are \_\_\_\_\_
8. The ferromagnetic property can be explained on the basis of formation of \_\_\_\_\_
- Questions 9-12 : Give very brief answers :

9. What is the flux through one face of a cube carrying a charge  $=q$  at its centre?
10. Write down Del ( $\nabla$ ) operator in Spherical polar co-ordinates
11. What is the relation ship between electric potential and field ?
12. Write down the integral form of Gauss' law in Magnetostatics. (12  $\times$   $\frac{1}{4}$  = 3 weightage)

### Section B

II. Questions 13-21 : Answer all *nine* questions. Each question carries a weightage of 1

13. Show that the electrostatic field inside a charged hollow sphere is zero
14. Explain why capacitance gets added up when two capacitors are connected in parallel
15. Write down Laplace's equation in Cylindrical polar co-ordinates and explain symbols
16. State the first Uniqueness theorem.
17. What is a linear dielectric?
18. A charged particle at origin is subjected to a uniform electric field along X-axis and uniform magnetic field along z-axis. Sketch the trajectory of the particle
19. Write down any one contrasting feature of electrostatics and Magnetostatics
20. Classify materials on the basis of magnetic susceptibility
21. What is the physical significance of H

(9  $\times$  1 = 9 weightage)

### Section C

III. Questions 22-28 : Answer any *five* questions. Each question carries a weightage of 2.

22. Derive the expression for the energy of a system of point charges.
23. Find an expression for surface charge density on a grounded conducting plane due to the presence of a point charge  $q$  above the plane at a distance  $r$  from it.
24. A potential difference 100 V is applied to a 1 and 5  $\mu\text{F}$  capacitors connected parallel. Find the charge and potential across each other.
25. Define volume bound charge density  $\rho_b$  and free charge density  $\rho_f$ . Derive a relation between them
26. A hydrogen atom consists of a proton and a an electron separated by a distance of  $5 \times 10^{-10}$  m assuming the electron to be moving in a circular orbit around the proton with a frequency  $10^{13}$  Hz find the magnetic field at the nucleus due to the moving electron.
27. Derive Ampere's law in magnetized materials.

28. An iron ring has a radius of 5 cm and area of cross-section of  $2 \text{ cm}^2$ ,  $\mu_r = 1000$ . If there are 1500 turns with a current 5 Amperes calculate (a) Magnetic field intensity H (b) Surface current density of the coil (c) Magnetization M

(5 × 2 = 10 weightage)

#### Section D

Questions 29-31: Answer any *two* questions. Each question carries a weightage of 4.

29. Explain the electrostatic properties of a conductor. Derive an expression for force on surface of a charged conductor.
30. Derive equations for div and curl of B due to a volume distribution of current.
31. Define bound current densities  $J_b$  and  $K_b$ . Explain their physical significance.

(2 × 4 = 8 weightage)