Lib. 29/09 (E)

National Institute of Technology, Delhi

Name of the Examination: B. Tech.

Branch	**: ECE**	**Semester**	**: 3rd**
Title of the Course	**: Electromagnetic Theory**	**Course Code**	**: ECL203**

Time: 2 Hours **Maximum Marks: 25**

Note : All questions are compulsory

Section A (Attempt all questions. All questions have 1 mark each)

1. Plane wave in a dielectric show that:

(a) The electric and magnetic vectors are both perpendicular to the direction of propagation

(b) The electric and magnetic vectors are in phase

(c) Both (a) and (b)

(d) None of these

2. Ampere's circuital law is valid for

(a) Varying current only (b) steady current only (c) alternative current only (d)none of these

3. $\nabla . B = 0$ signifies that

(a) B is a conservative field (b) magnetic monopole doesn't exist

(c) B=0 (d) there exists a magnetic monopole

4. In a dielectric medium, the phase difference between E and B is

(a) zero (b)pi/2 (c) pi (d) any non zero value

5. The equation of continuity explains

(a) non-conservative nature of charge (b) conservation of charge for a static electric field

(c) conservation of charge for a non-static electric field (d) non-destructive nature of charge

6. The capacitance of a capacitor filled by a linear dielectric is independent of the charge on the plates and the potential difference between the plates.

(a) True (b) False

7. Seawater has $\varepsilon_r = 80$. Its permittivity is

(a) 81 (b) 79 (c) 5.162×10^{-10} F/m (d) 7.074×10^{-10} F/m

8. Find the angle between the face diagonals of a cube.

9. Define the terms of gradient, divergence, and curl.

Section B (Attempt all questions. Each question carries 2 marks each)

10. Determine the dot product of the position vectors of the following two points: A(5, 53.13°, 1) and B(2, 90°, -5).

11. A charge distribution with spherical symmetry has density

$$\rho_v = \begin{cases} \frac{\rho_o r}{R}, & 0 \le r \le R \\ 0, & r > R \end{cases}$$

Determine **E** everywhere.

12. Two extensive homogeneous isotropic dielectrics meet on plane $z = 0$. For $z > 0$, $\varepsilon_{r1} = 4$ and for $z < 0$, $\varepsilon_{r2} = 3$. A uniform electric field $E_1 = 5a_x - 2a_y + 3a_z$ kV/m exists for $z \geq 0$. Find

(a) E_2 for $z \leq 0$

(b) The angles E_1 and E_2 make with the interface

(c) The energy densities (in J/m^3) in both dielectrics

(d) The energy within a cube of side 2m centered at (3, 4, -5)

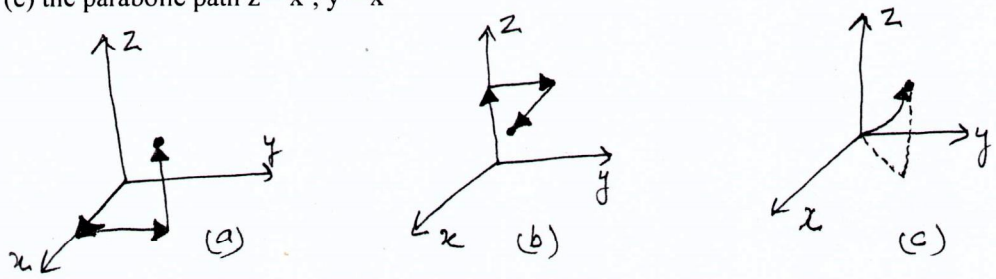
13. Semi infinite conducting planes at $\phi = 0$ and $\phi = \pi/6$ are separated by an infinitesimal insulating gap. If $V(\phi = 0) = 0$ and $V(\phi = \pi/6) = 100V$, calculate V and E in the region between the planes.

14. Check the fundamental theorem for gradients, using $T = x^2 + 4xy + 2yz^3$, the points a = (0,0,0), b = (1,1,1) and the three paths

(a) (0,0,0) ➔(1,0,0) ➔ (1,1,0) ➔ (1,1,1,)

(b) (0,0,0) ➔(0,0,1) ➔ (0,1,1) ➔ (1,1,1,)

(c) the parabolic path $z = x^2$; $y = x$



Section C (Attempt all questions. Each question carries 3 marks each)

15. Explain the term polarization. Derive the expression for the potential in-terms of volume bound charge density and surface bound charge density.

16. A hollow spherical shell carries charge density $\rho = k/r^2$ in the region $a \leq r \leq b$. Find the electric field in the three regions: (i) $r < a$, (ii) $a < r < b$ (iii) $r > b$. Plot $|E|$ as a function of 'r'.