Roll No.:.....

National Institute of Technology, Delhi

Name of the Examination: B. Tech.

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

Time: 3 Hours **Maximum Marks: 50**

Note : Read the given instructions for each section

Section A: Attempt all questions, each question is of one (01) mark

Q1. Maxwell's first equation is the differential form of ..... (1)

Q2. The speed of EM waves in free space (or vacuum) can be expressed as ..... (1)

Q3. Poynting vector 'S' in terms of field vectors 'E' and 'H' can be expressed as ..... (1)

Q4. A unit normal vector to the cone $\theta = 30^0$ is

(i) a_r (ii) a_θ (iii) a_ϕ (iv) none of these (1)

Q5. Which of the following is a mathematically incorrect expression?

(i) grad div (ii) div curl (iii) grad curl (iv) curl grad (1)

Q6. Which of the following is zero?

(i) grad div (ii) div grad (iii) curl grad (iv) curl curl (1)

Q7. Plane $z = 10$ m carries charge 20 nC/m^2. The electric field intensity at the origin is

(i) -10 a_z V/m (ii) -18πa_z V/m (iii) -72πa_z V/m (iv) -360πa_z V/m (1)

Q8. Both ε_o and χ_e are dimensionless -

(i) True (ii) False (1)

Q9. The unit of the permittivity of free space is

(i) F/m; (ii) C^2/Nm^2; (iii) C^{2}Jm; (iv) None (1)

Q10. Two identical coaxial circular coils carry the same current 'I' but in opposite directions. The magnitude of the magnetic field 'B' at a point on the axis midway between the coil is -

(i) Zero (ii) Twice that produced by one coil (iii) The same as that produced by one coil (iv) Half that produced by one coil. (1)

Section B: Attempt any four (04) questions. Each question is of 5 marks

Q11. (a) Two point charges -4 μC and 5μC are located at (2, -1, 3) and (0, 4, -2) respectively. Find the potential at (1, 0, 1) assuming zero potential at infinity. (3)

(b) State Divergence and Stokes theorem along with mathematical expression. (2)

Q12. (a) Find the force on a square loop placed as shown in figure 2, near an infinite straight wire. Both the loop and the wire carry a steady current *I*. (2)

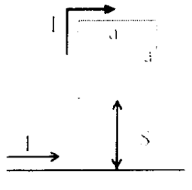

Figure 2

(b) Let plane $z = 0$ and $z = 4$ carry current $K = -10a_x$ A/m and $K = 10a_x$ A/m respectively. Determine $\boldsymbol{H}$ at $(1, 1, 1)$ and $(0, -3, 10)$. (3)

Q13. (a) Find the magnetic field a distance 's' from a long straight wire carrying a steady current 'I'. (3)
(b) Define all Maxwell's equations in differential and integral form. (2)

Q14. (a) A circular loop located on x2 · y2 9, z 0 carries a direct current of 10 A along ao. Determine H at (0, 0, 4) and (0, 0, -4) (3)
(b) State Biot-Savart law and Ampere's circuit law. (2)

Q15. In a medium characterized by σ 0, μ μo, ε $4\varepsilon_o$, and E $20\sin(10^8 t - \beta z)a_y$ V/m, calculate β and H. (5)

Section C: Attempt any two (02) questions. Each question is of 10 marks

Q16. (a) Conducting spherical shells with radii *a* *10 cm* and *b* *30 cm* are maintained at a potential difference of 100 V such that *V(r b)* and *V(r a)* *100V*. Determine V and E in the region between the shells. If ε_r 2.5 in the region, determine the total charge induced on the shells and the capacitance of the capacitor. (5)
(b) Derive the expression of continuity equation. Also determine the boundary conditions in between two different dielectric media. (5)

Q17. Derive the wave propagation in lossy and lossless dielectrics. (10)

Q18. (a) Derive the boundary conditions between two magnetic media. (6)
(b) Given that H_1 $-2a_x \cdot 6a_y \cdot 4a_z$ A/m in region y x 2 < 0, where μ_1 $5\mu_o$, calculate
(i) M_1 and B_1
(ii) H_2 and B_2 in region y x 2 > 0, where μ_2 $2\mu_o$ (4)