CBCS SCHEME

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15EE45

Fourth Semester B.E. Degree Examination, July/August 2021
Electro Magnetic Field Theory

Time: 3 hrs. Max. Marks:80

Note: ***Answer any FIVE full questions.***

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

1 a. What are scalars and vectors? Explain dof product and cross product. Give the relationship between Cartesian and cylindrical coordinate system. **(08 Marks)**

b. Derive an expression for electric field intensity for an infinite line charge lying on z – axis. **(08 Marks)**

2 a. State and explain Gauss law and hence drive an expression for divergence theorem. **(08 Marks)**

b. If $\overline{D} = xy^2z^2\hat{a}_x + x^2yz^2\hat{a}_y + x^2y^2z\hat{a}_z\, c/m^2$. Find :

i) An expression for ρ_v (volume charge density)

ii) Total charge within the cube defined by $0 \le x \le 2;\ 0 \le y \le 2,\ 0 \le z \le 2m$. **(08 Marks)**

3 a. Derive energy expanded or work done in moving a point charge in an electric field. With usual notation prove that $\overline{E} = -\overline{\nabla}V$. **(08 Marks)**

b. Find the electric field strength at a point M(1, 2, –1)m given the potential, $V = 3x^2y + 2y^2z + 3xyz$ volts. **(08 Marks)**

4 a. Discuss the boundary conditions at the interface between two dielectric of different permutivities. **(08 Marks)**

b. Determine the capacitance of capacitor consisting of two parallel plates 30mm × 30cm surface area separates by 5mm in air. What is the total energy stored by the capacitor. If potential is charged to a potential difference of 500V? What is the energy density? **(08 Marks)**

5 a. Derive Poisson's and Laplace equations starting from point form of Gauss law. **(08 Marks)**

b. Determine whether the following potential field satisfy the laplace equation or not?

i) $V = x^2 - y^2 + z^2$ ii) $V = r\cos\phi + z$. **(08 Marks)**

6 a. State and explain Biot – Savart law and Amperes circuital law. **(08 Marks)**

b. Find the magnetic field intensity and flux density at a point 'P' for the current circuit show in Fig.Q6(b).

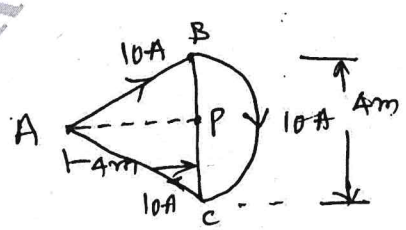

Fig.Q6(b) **(08 Marks)**

7 a. State and explain Lorentz force equation. **(08 Marks)**

b. A point charge Q = –50nc is moving in a magnetic field of density, $\overline{B} = 2\hat{a}_x - 3\hat{a}_y + 5\hat{a}_z$ mT with a velocity of 6×10^6m/sec. Calculate the force in the direction specified by the unit vector $= -0.48\hat{a}_x - 0.6\hat{a}_y + 0.64\hat{a}_z$. **(08 Marks)**

8 a. Obtain the relationship between α_1 and α_2 interns of relative permeabilities of the two media μ_{r_1} and μ_{r_2}. **(08 Marks)**

b. Calculate the inductance of a solenoid of 600 turns wound on a cylindrical tube 6cm in diameter. The length of the tube is 60cm and the medium is air. **(08 Marks)**

9 a. Write Maxwell's equation is point form and integral form for time varying fields. **(08 Marks)**

b. Derive an expression for Maxwell's 2nd equation for time varying field from Ampers Circuital Law. $\overline{\nabla} \times \overline{H} = \overline{J} + \frac{\partial \overline{D}}{\partial t}$. **(08 Marks)**

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10 a. State and explain pointing theorem. **(08 Marks)**

b. The electric field of uniform plane wave is given by

$\overline{E} = 40\sin(30\pi \times 10^6 t - 2\pi z)\hat{a}_x + 40\cos(30\pi \times 10^6 t - 2\pi z)\hat{a}_y$ v/m

Find :

i) Frequency of operation
ii) Wave length
iii) Direction of propagation of wave
iv) Associated magnetic field. **(08 Marks)**

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