

CBCS SCHEME



USN

--	--	--	--	--	--	--	--	--	--

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.

- 1
 - a. What are scalars and vectors? Explain dot 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 derive an expression for divergence theorem. (08 Marks)
 - b. If $\vec{D} = xy^2z^2\hat{a}_x + x^2yz^2\hat{a}_y + x^2y^2z\hat{a}_z$ C/m². Find :
 - i) An expression for ρ_v (volume charge density)
 - ii) Total charge within the cube defined by $0 \leq x \leq 2$; $0 \leq y \leq 2$, $0 \leq z \leq 2$ m. (08 Marks)
- 3
 - a. Derive energy expended or work done in moving a point charge in an electric field. With usual notation prove that $\vec{E} = -\nabla V$. (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 permittivities. (08 Marks)
 - b. Determine the capacitance of capacitor consisting of two parallel plates $30\text{mm} \times 30\text{cm}$ surface area separated 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).

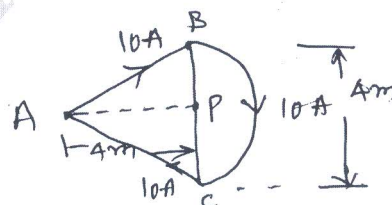


Fig.Q6(b)

(08 Marks)

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.

- 7 a. State and explain Lorentz force equation. (08 Marks)
- b. A point charge $Q = -50\text{nc}$ is moving in a magnetic field of density, $\vec{B} = 2\hat{a}_x - 3\hat{a}_y + 5\hat{a}_z$ mT with a velocity of 6×10^6 m/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 in 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. $\vec{\nabla} \times \vec{H} = \vec{J} + \frac{\partial \vec{D}}{\partial t}$. (08 Marks)
- 10 a. State and explain pointing theorem. (08 Marks)
- b. The electric field of uniform plane wave is given by $\vec{E} = 40\sin(30\pi \times 10^6 t - 2\pi z)\hat{a}_x + 40\cos(30\pi \times 10^6 t - 2\pi z)\hat{a}_y$ v/m
Find :
i) Frequency of operation
ii) Wave length
iii) Direction of propagation of wave
iv) Associated magnetic field. (08 Marks)
