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VASAVI COLLEGE OF ENGINEERING (Autonomous), HYDERABAD
B.E. (EEE: CBCS) III-Semester Supplementary Examinations, June-2019

Electromagnetic Field Theory

Time: 3 hours

Max. Marks: 60

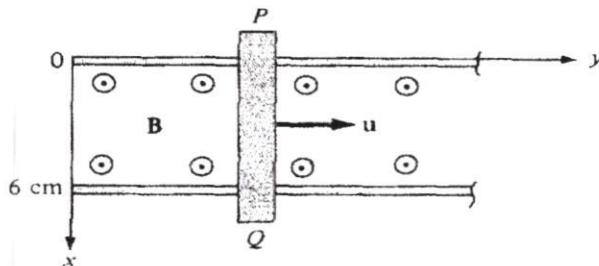
Note: Answer ALL questions in Part-A and any FIVE from Part-B

Part-A (10 × 2 = 20 Marks)

- State Coloumb's Law.
- Find the total charge inside the volume $\rho_v = \rho_0/r$ C/m³ enclosed in a sphere of radius $r=3$ units.
- A vector field $\mathbf{E} = y\mathbf{a}_y + x\mathbf{a}_x$. Verify whether E represents an electrostatic field or not.
- Write the two Maxwell's equations for electrostatic fields.
- If the vector $\mathbf{B} = x^2\mathbf{a}_x - xy\mathbf{a}_y - Kxz\mathbf{a}_z$ represents a magnetic field. Find the value of the constant K.
- Magnetic field intensity $\mathbf{H} = 3\mathbf{a}_x + 7y\mathbf{a}_y + 2x\mathbf{a}_z$ A/m. Evaluate conduction current.
- State Poynting Theorem and write its mathematical form.
- Find the Conduction and Displacement current densities in a material having conductivity of 10^{-3} S/m and $\epsilon_r = 2.5$ if the electric field in the material is $\mathbf{E} = 5 \times 10^{-6} \sin 9 \times 10^9 t$ V/m.
- Explain the significance of insertion loss.
- Define the term electromagnetic compatibility.

Part-B (5 × 8 = 40 Marks)

- A charge $Q_2 = 10 \mu\text{C}$ located at appoint $P_2(0,1,2)$ and another charge $Q_1 = 50 \mu\text{C}$ located at a point $P_1(1,0,2)$ in free space. Find the Force on Q_2 . [5]
 - Derive Maxwell's second equation for electrostatic fields. [3]
- Find the potential and volume charge density at (1,2,3) in free space for given potential field $V = 4yz/x^2 + 1$. [4]
 - Obtain the conductor-dielectric boundary conditions for an interface in static electric field. [4]
- Deduce an expression for inductance of a coaxial cable using Ampere's law. [4]
 - The point charge $Q = 18$ nC has a velocity of 5×10^6 m/s in the direction $\mathbf{a}_v = 0.04\mathbf{a}_x - 0.05\mathbf{a}_y + 0.2\mathbf{a}_z$. Calculate the magnitude of force exerted on the charge be the field (i) $\mathbf{B} = -3\mathbf{a}_x + 4\mathbf{a}_y + 6\mathbf{a}_z$ mT (ii) $\mathbf{E} = -3\mathbf{a}_x + 4\mathbf{a}_y + 6\mathbf{a}_z$ kV/m (iii) \mathbf{B} and \mathbf{E} acting together. [4]
- A conduction bar can slide freely over two conducting rails as shown in figure. Calculate the induced voltage in the bar if the bar slides at a velocity of $\mathbf{u} = 5\mathbf{a}_y$ m/s and $\mathbf{B} = 20\mathbf{a}_z$ mT. [3]



- Derive the expression for three dimensional wave equation. [5]
- Discuss in detail grounding method to control EMI. [4]
 - Explain the importance of achieving Electromagnetic compatibility. [4]
- Prove that potential between points A and B is independent of the path taken between the points A and B. [3]
 - Prove that electric field intensity on either side of the parallel plates is zero. [5]
- Answer any **two** of the following:
 - Force between two current carrying conductors carrying current in the same direction. [4]
 - A plane electromagnetic wave travelling in the positive z direction in an unbounded lossless dielectric medium with $\mu_r = 1$ and $\epsilon_r = 3$ has peak electric intensity E of 16 V/m. Find i) velocity ii) η iii) \mathbf{H} iv) Poynting Vector. [4]
 - List the Sources of Electro Magnetic Interference. [4]