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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

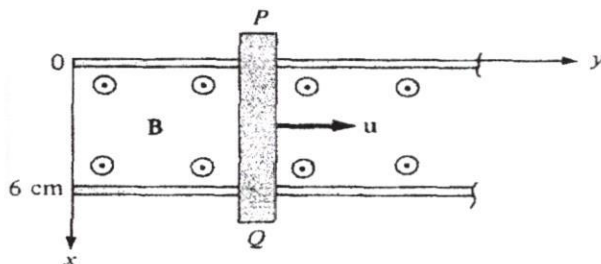
Note: Answer ALL questions in Part-A and any FIVE from Part-B

Part-A (10 × 2 = 20 Marks)

1. State Coloumb's Law.
2. Find the total charge inside the volume $\rho_v = \rho_0/r$ C/m³ enclosed in a sphere of radius $r=3$ units.
3. A vector field $\mathbf{E} = y\mathbf{a}_y + x\mathbf{a}_x$. Verify whether E represents an electrostatic field or not.
4. Write the two Maxwell's equations for electrostatic fields.
5. 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.
6. Magnetic field intensity $\mathbf{H} = 3\mathbf{a}_x + 7y\mathbf{a}_y + 2x\mathbf{a}_z$ A/m. Evaluate conduction current.
7. State Poynting Theorem and write its mathematical form.
8. 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.
9. Explain the significance of insertion loss.
10. Define the term electromagnetic compatibility.

Part-B (5 × 8 = 40 Marks)

11. a) 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]
- b) Derive Maxwell's second equation for electrostatic fields. [3]
12. a) Find the potential and volume charge density at $(1,2,3)$ in free space for given potential field $V = 4yz/x^2 + 1$. [4]
- b) Obtain the conductor-dielectric boundary conditions for an interface in static electric field. [4]
13. a) Deduce an expression for inductance of a coaxial cable using Ampere's law. [4]
- b) 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]
14. a) 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]



- b) Derive the expression for three dimensional wave equation. [5]
15. a) Discuss in detail grounding method to control EMI. [4]
- b) Explain the importance of achieving Electromagnetic compatibility. [4]
16. a) Prove that potential between points A and B is independent of the path taken between the points A and B. [3]
- b) Prove that electric field intensity on either side of the parallel plates is zero. [5]
17. Answer any *two* of the following:
 - a) Force between two current carrying conductors carrying current in the same direction. [4]
 - b) 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]
 - c) List the Sources of Electro Magnetic Interference. [4]