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10ES36

Third Semester B.E. Degree Examination, June/July 2018
Field Theory

Time: 3 hrs.

Max. Marks: 100

Note: Answer FIVE full questions, selecting at least TWO questions from each part.

PART - A

- State and explain Coulomb's law in vector form. (06 Marks)
 - State and prove Gauss's law for point charge. (06 Marks)
 - If a point charge $Q_1 = 25\text{nC}$ be located at $A(4, -2, 7)$ and a charge $Q_2 = 60\text{nC}$ be at $B(-3, 4, 2)$ in air. Find \vec{D} at $C(1, 2, 3)$. (08 Marks)
- Define potential and potential difference and establish the relation $\vec{E} = -\nabla V$. (06 Marks)
 - Deduce the relations for boundary conditions between two dielectrics. (06 Marks)
 - Let $V = \frac{\cos 2\phi}{r}$ in the free space. Find
 - \vec{E} at $P(2, 30^\circ, 1)$
 - ρ_v at $Q(\frac{1}{2}, 60^\circ, 1)$(08 Marks)
- Derive an expression for Poisson's and Laplace's equation in an electrostatic field. (04 Marks)
 - Derive the following for a concentric spheres filled with dielectric using Laplace's equation,
 - Potential (V)
 - Electric field intensity (\vec{E})
 - Charge density (ρ_s)
 - Capacitance (C).(08 Marks)
 - Determine whether or not the potential equations, satisfies Laplace equation,
 - $V = 2x^2 - 4y^2 + z^2$
 - $V = r \cos \phi + z$
 - $V = r^2 \cos \phi + \theta$(08 Marks)
- Explain Biot Savart law for a magnetic field. (04 Marks)
 - State and prove Ampere's circuital law. By using it derive an expression for \vec{H} due to infinite long straight conductor. (08 Marks)
 - Find the magnetic field intensity at point 'P' for the circuit shown in Fig. Q4 (c). (08 Marks)

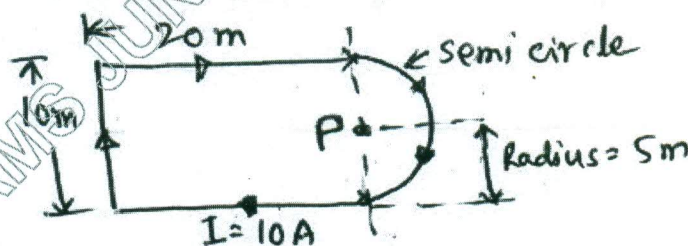


Fig. Q4 (c)

PART - B

- 5 a. Derive an expression for magnetic force on:
 (i) Moving point charge and
 (ii) Differential current element (10 Marks)
- b. A single turn circular coil 5 cm diameter carries a current of 2.8A . Determine the magnetic flux density \vec{B} at a point on the axis 10 cm from the center. Derive the formula used. (10 Marks)
- 6 a. Write the Maxwell's equations in point form. (04 Marks)
- b. For a closed stationary path in space linked with a changing magnetic field prove that,

$$\nabla \vec{E} = -\frac{\partial \vec{B}}{\partial t}$$
 (08 Marks)
- c. Determine the value of 'K' such that following pairs of fields satisfies Maxwell's equation in the region where $\sigma = 0$ and $\rho_v = 0$,

$$\vec{E} = (Kx - 100t)\vec{a}_y \text{ V/m and } \vec{H} = (x + 20t)\vec{a}_z \text{ A/m if } \mu = 0.25 \text{ H/m, } \epsilon = 0.01 \text{ F/m.}$$
 (08 Marks)
- 7 a. Derive general wave equations in terms of \vec{E} and \vec{H} in uniform medium using Maxwell's equations. (08 Marks)
- b. A 300 MHz uniform plane wave propagates through (lossless medium) fresh water for which $\sigma = 0$, $\mu_r = 1$ and $\epsilon_r = 78$. Calculate (i) α (ii) β (iii) λ (iv) η (08 Marks)
- c. Define (i) Poynting's theorem and (ii) Skin effect. (04 Marks)
- 8 a. Define and explain voltage standing wave ratio (VSWR). (04 Marks)
- b. Derive an expression for transmission co-efficient and reflection co-efficient at normal incidence of waves at plane dielectric boundary. (08 Marks)
- c. Find ratio $\left(\frac{E_r}{E_i}\right)$ and $\left(\frac{E_t}{E_i}\right)$ at the boundary for the normal incidence if for the region-1;
 $\epsilon_{r_1} = 8.5$, $\mu_{r_1} = 1$ and $\sigma_1 = 0$ and if region-2 is free space. (08 Marks)
