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BT-4/M-20 **34100**

ELECTROMAGNETIC THEORY

ECE-206N

Option I

Time : Three Hours] [Maximum Marks : 75

Note : Attempt *Five* questions in all, selecting at least *one* question from each Unit.

Unit I

1. (a) Find the component of vector $\vec{A} = 10\hat{i} - 6\hat{j} + 5\hat{k}$ that is parallel to $\vec{B} = 0.1\hat{i} + 0.\hat{j} + 0.3\hat{k}$ and also find the component of $\vec{A}$ that perpendicular to $\vec{B}$. **5**

(b) Transform the field $\vec{E} = A/r^2\hat{a}_r$ into rectangular coordinate system. **5**

(c) Define Electric Potential and explain the significance of it. **5**

2. (a) Explain the continuity of current with expressions. . **5**

(b) Consider the following charge distributions in free space : a point charge of 10 nC at a point P(1, 0, 3) uniform surface charge density of 2 nC/m^2 at $x = 2$ and a uniform line charge density of 5 nC/m at $x = -2$ and $y = 1$ m. Find the electric field intensity at origin. **10**

Unit II

3. (a) Consider a boundary between two mediums such that region 1 is defined as $x + y < 1$ and $\mu_{r1} = 4$ and $\mu_{r2} = 6$ in medium 2, where $x + y > 1$. If $\vec{B}_1 = 4\hat{a}_x + 3\hat{a}_z$ Tesla, then find $\vec{B}_2$? **7**

(b) Write Maxwell's equations for static fields in point and integral form for good conductors. **8**

4. (a) How the Force and Torque can be evaluated on a closed circuit, derive expressions ? **8**

(b) Calculate the magnetic field intensity at the centre of a current (I) carrying square loop of side 'a' ? **7**

Unit III

5. (a) State and prove the Poynting's theorem. **7**

(b) Determine α, β, γ and η for a damp soil at a frequency of 1 MHz given that $\varepsilon_r = 12$, $\mu_r = 1$ and $\sigma = 20$ mS/m. **8**

6. (a) Derive the expressions for reflection of uniform plane wave by the perfect conductor under oblique incidence for horizontal polarization. **7**

(b) A 0.3 GHz plane EM wave is propagating in free space. The wave is incident normally on an infinite copper slab. For the transmitted wave inside the slab calculate : α, β, skin depth and phase velocity. **8**

Unit IV

7. (a) Derive the expressions for input impedance of the transmission line terminated by any load impedance Z_R. **8**

(b) In a certain transmission line measurement characteristic impedance is 50 ohm, VSWR is 3 and the distance from the load to the first standing wave minimum is 0.15λ. Calculate the load impedance. **7**

8. (a) Explain the excitation of waveguide in detail. **7**

(b) Consider a rectangular waveguide of dimensions 6×4 cm^2. Calculate the ratio of guided velocity to velocity in free space and the cutoff frequency for dominant mode TE_{10} if frequency of operation is $f = 2f_c$. **8**