MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
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III SEMESTER B.TECH (ELECTRICAL & ELECTRONICS ENGINEERING)
END SEMESTER PROCTORED ON-LINE EXAMINATIONS JANUARY 2022

ELECTROMAGNETIC THEORY [ELE 2155]

REVISED CREDIT SYSTEM

Time: 75 Minutes + 10 Minutes **Date: 29th January 2022** **Max. Marks: 20**

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitably assumed.
- Time: 75 minutes for writing + 10 minutes for uploading.

1A. Through appropriate analysis, determine the potential between two points $P(1,-1,0)$ and $Q(2,1,3)$ in a given electric field of $\overline{E} = 20xya_x + 40x^2a_y + 10a_z\ V/m$. **(03)**

1B. The relative permittivity of a dielectric in a parallel plate capacitor varies linearly from $\varepsilon_{r1} = 2$ to $\varepsilon_{r2} = 10$. If the plate separation (t) distance is 0.5 cm while the cross sectional area of the plates (A) is 14 cm^2. Through appropriate assumptions, prove that the developed potential is:

$$V = \frac{Q}{\varepsilon_0 A}\left[\frac{t}{(\varepsilon_{r2} - \varepsilon_{r1})}\right]\left[\ln\left(\frac{\varepsilon_{r2}}{\varepsilon_{r1}}\right)\right]$$

Further, compute its capacitance. **(03)**

1C. Region 1 where μ_{r1}=4 is side of the plane y + z = 1 containing the origin. In region 2, μ_{r2}=6. $\boldsymbol{B_1} = 2a_x + a_y$ T. Through appropriate analysis, determine:

- $\boldsymbol{B_2}$
- $\boldsymbol{H_2}$ *and*
- The angle $\boldsymbol{B_2}$ makes with interface **(04)**

2A. In the region $0 \le \rho \le 0.5m$ in cylindrical coordinates, the current density is $J = 4.5e^{-2\rho}a_z$ A/m^2. Elsewhere, J =0. Through the application of Ampere's law, determine the magnetic field intensity. **(03)**

2B. In a nonmagnetic material,

$$\boldsymbol{H} = 30\cos(2\pi \times 10^8 t - 6x)\,\boldsymbol{a_y}\ mA/m$$

Find,

- The intrinsic impedance
- The Poynting vector
- The time-average power crossing the surface $x = 1, 0 < y < 2, 0 < z < 3\ m$ **(03)**

2C. A uniform plane wave in air is normally incident on an infinite lossless dielectric material having $\varepsilon = 3\varepsilon_0$ and $\mu = \mu_0$. If the incident wave is $\boldsymbol{E_i} = 10\cos(\omega t - z)\,\boldsymbol{a_y}\,V/m$

Find

i. The incident $\boldsymbol{H_i}$ field
ii. The reflection and transmission coefficients
iii. The total electric field in both regions
iv. The time-average power density in both the regions **(04)**