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Total number of printed pages – 2

B. Tech
PCEE 4302

Sixth Semester Examination – 2013

ELECTROMAGNETIC THEORY

BRANCH : ELECTRICAL

QUESTION CODE : A 175

Full Marks – 70

Time : 3 Hours

Answer Question No. 1 which is compulsory and any **five** from the rest.

The figures in the right-hand margin indicate marks.

1. Answer the following questions : 2 × 10
- (a) What is the significance of $\text{div}(\mathbf{B}) = 0$?
 - (b) Why is the electric field intensity not zero in a steady current carrying conductor ?
 - (c) What do you mean by vector magnetic potential ?
 - (d) What is the difference between the conduction and conventional current ?
 - (e) What is continuity equation ? Write down the continuity equation for steady currents.
 - (f) What is a Poynting vector and what is its physical significance ?
 - (g) Determine whether or not the field with $\mathbf{B} = 4a_x$ and $\mathbf{E} = 2a_y$ satisfy Maxwell's equation in a linear isotropic homogeneous material for which $\epsilon_r = 8$, $\mu_r = 2$ and $\sigma = 0$.
 - (h) Show that the capacitor of an isolated metallic sphere of radius R is $4\pi\epsilon_0 R$ Farad.
 - (i) What is the value of the electric field inside a good conductor ? Why ?
 - (j) Write the Poisson's and Laplace equations for homogeneous and non-homogeneous fields.
2. (a) Express the Position vector $\mathbf{r} = xa_x + ya_y + za_z$ in the spherical co-ordinate system. 5

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- (b) Using rectangular co-ordinate system verify that 5
- (i) $\text{div}(\text{curl } A) = 0$
- (ii) $\text{curl}(\text{grad } f) = 0$
3. (a) Derive the boundary conditions between a conductor and a dielectric. 4
- (b) Region -1 ($z < 0$) contains a dielectric for which $\epsilon_r = 2.5$ while region -2 ($z > 0$) is characterized by $\epsilon_r = 4$. Let $E_1 = -30a_x + 50a_y + 70a_z$ v/m. Find D_2 , P_2 and the angle between E_1 and the normal to the surface. 6
4. Derive an expression for electric field due to an electric dipole placed d meters apart on the z -axis. 10
5. (a) Write down Maxwell's field equations and explain their significance. Deduce the wave equation in time varying field for a lossless dielectric medium. 4
- (b) The magnetic field component of a wave is given by
- $H = 30 \cos(10^8 t - 6x)a_x$ mA/m. Determine 6
- (i) The direction of wave propagation
- (ii) The wavelength
- (iii) The wave velocity
6. (a) What is magnetic vector potential ? Write down its physical significance. How is it different from magnetic scalar potential ? 6
- (b) Derive the expression for electric field intensity due to a infinite line charge. 4
7. (a) Explain the wave propagation in lossy dielectric with necessary equations. 5
- (b) A uniform plane wave propagating in a medium has
- $E = 2e^{-\alpha z} \sin(10^8 t - \beta z)a_y$ v/m. If the medium is characterized by $\epsilon_r = 1$, $\mu_r = 20$ and $\sigma = 3$ s/m, find α , β and H . 5
8. Write short notes on : 5×2
- a) Boundary conditions in magnetic field
- b) Biot Savart law.