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BIEL-006

B.Tech. – VIEP – ELECTRONICS AND COMMUNICATION ENGINEERING (BTECVI)

00657

Term-End Examination

June, 2014

BIEL-006 : ELECTROMAGNETIC FIELD THEORY

Time : 3 hours *Maximum Marks : 70*

Note : *Attempt any **seven** questions. Each question carries equal marks.*

1. (a) Express the vector

$$B = \frac{10}{r}\hat{a}_r + r\cos\theta\,\hat{a}_\theta + \hat{a}_\phi$$

in Cartesian and cylindrical coordinates.

(b) Determine the divergence of the following vector field :

$$\vec{P} = x^2yz\,\hat{a}_x + xz\,\hat{a}_z$$ *2×5=10*

2. (a) State and prove Gauss's law for electrostatic fields.

(b) A charge distribution with spherical symmetry has density

$$\rho_v = \begin{cases} \dfrac{\rho_o\, r}{R} & 0 \le r \le R \\ 0, & r > R \end{cases}$$

Determine $\vec{E}$ everywhere. *2×5=10*

3. (a) Write the Maxwell's equations in integral form.

(b) Given the magnetic vector potential $\vec{A} = \dfrac{-\rho^2}{4}\hat{a}_z$ Wb/m, calculate the total magnetic flux crossing the surface $\phi = \pi/2$, $1 \le \rho \le 2m$, $0 \le z \le 5m$. *2×5=10*

4. (a) Derive the wave equations for lossless medium.

(b) State and prove Poynting theorem. *2×5=10*

5. (a) An electric vector $\vec{E}$ of an EM wave in free space is given by $E_x = E_z = 0$ and

$$E_y = A\, e^{j\omega (t - z/v)}$$

Using Maxwell's equations, determine $\vec{H}$.

(b) Deduce the equation of continuity. *2×5=10*

6. (a) What are the various methods of impedance matching ? Explain any one of them.

(b) Show that VSWR on a terminated transmission line is $S = \frac{1+|\rho|}{1-|\rho|}$ where ρ is the reflection coefficient. *2×5=10*

7. (a) A parallel-plate capacitor with plate area of 5 cm^2 and plate separation of 3 mm has a voltage (50 sin 10^3 t) V applied to its plates. Calculate the displacement current. Assume $\varepsilon = 2\varepsilon_0$.

(b) Find the reflection coefficient and transmission coefficient of an electric field wave travelling in air and incident normally on a boundary between air and dielectric having $\mu = \mu_0$ and $\varepsilon_r = 4$ i.e. $\varepsilon = 4\varepsilon_0$. *2×5=10*

8. (a) In free space

$$\vec{H}(z, t) = 1 \cdot e^{j(1\cdot5\times10^8 t+\beta z)} \cdot \hat{a}_x \text{ A/m.}$$

Calculate the expression for $\vec{E}(z, t)$.

(b) Using Maxwell's equation, show that the free space wave equation in E is

$$\nabla^2 \vec{E} - \mu_0 \varepsilon_0 \frac{\partial^2 E}{\partial t^2} = 0$$ *2×5=10*

9. (a) Calculate the characteristic impedance, propagation constant at 400 kHz for a transmission line having L = 0·5 mH/km, C = 0·08 μF/km and negligible R and G.

(b) Derive the expressions for the attenuation and phase shift constants of the line in terms of the primary constants of transmission line. *2×5=10*

10. Write short notes on any ***two*** of the following : *2×5=10*

(a) Boundary conditions

(b) Single stub matching

(c) Skin effect