BIEL-006

B.Tech. IN ELECTRONICS AND COMMUNICATION ENGINEERING (BTECVI)

Term-End Examination

June, 2012

BIEL-006 : ELECTROMAGNETIC FIELD THEORY

Time : 3 Hours   *Maximum Marks : 70*

Note : *Attempt any seven questions.*

All questions carry equal marks.

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1. (a) What do you mean by Scalar and Vector Fields ? Show the difference between the two.   5

   (b) Explain the physical interpretation of gradient and Curl of a Vector field.   5

2. (a) Transform the vector   5

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

   in Cartesian and cylindrical coordinate system ?

   (b) State and prove Gauss Divergence Theorem in electromagnetics.   5

3. (a) State and prove Gauss's Law ? Give one application of Gauss's law.   5

   (b) Discuss the solution of Poisson's and Laplace's equation in one dimension.   5

4. (a) Given the potential $V = \dfrac{10}{r^2} \sin \theta \cos \phi$ 5

      (i) Find the electric flux density $\vec{D}$ at $\left(2, \dfrac{\pi}{2}, 0 \right)$

     (ii) Calculate the work done in moving a 10 μC charge from point A (1, 30°, 120°) to point B (4, 90°, 60°).

  (b) State Biot-Savart's law and derive magnetic field intensity due to infinite long straight conductor.   5

5. (a) Show that the stored energy density in a magnetic field of strength $\vec{H}$ is $\dfrac{1}{2} \mu \vec{H}^2$.   5

  (b) Write the Maxwell's equation in the differential and integral form and explain the physical significance.   5

6. (a) A lossy dielectric is characterized by $\epsilon_r = 2.5$, $\mu_r = 4$ and $\sigma = 10^{-3}$ ℧/m   5

     at a frequency 10 MHz. Find :

     (i) Attenuation Constant

     (ii) Phase Constant

     (iii) Velocity of Propagation

     (iv) Wavelength and

     (v) Intrinsic Impedance

(b) What is skin effect ? What is its relation 5
with attenuation constant, conductivity and
frequency ?

7. (a) Derive the expression for average Poynting 5
vector ?

(b) In free space ($Z \leq 0$), a plane wave with 5
$\overrightarrow{H_i} = 10 \cos (10^8 t - \beta z) \, \hat{a}_x \, mA/m.$

is incident normally on a lossless medium
($\epsilon = 2\epsilon_0$, $\mu = 8\mu_0$) in region $Z \geq 0$. Determine
the reflected wave H_r, E_r and the transmitted
wave H_t, E_t.

8. (a) Derive transmission line differential 5
equation. Derive the condition of lossless
transmission from it.

(b) Explain the role of Smith Chart in 5
measurement of various parameters in
transmission line.

9. (a) What are TE and TM modes of propagation 5
of electromagnetic waves in waveguide ?
Obtain the relation between the guide
wavelength, the free space wavelength and
the cut-off wavelength.

(b) What is waveguide ? Discuss in detail the 5
theory of waveguides with reference to TM
mode of propagation of electromagnetic
waves.

10. Write short notes on the following (*any two*) : **5x2=10**

    (a)   Cavity Resonators

    (b)   Wave Polarization

    (c)   Magnetic Dipole.