

**B.E. DEGREE EXAMINATIONS: NOV/DEC 2010**

Fourth Semester

**ELECTRONICS AND COMMUNICATION ENGINEERING**

U07EC403: Electromagnetic Fields

**Time: Three Hours****Maximum Marks: 100****Answer ALL Questions:-****PART A (10 x 1 = 10 Marks)**

- Curl –free vector is \_\_\_\_\_  
 a) Solenoidal      b) Conservative      c) Harmonic      d) Irrotational
- The co-ordinates of Q are (0, 0, z) and the co-ordinates of P are (0, r, 0). The distance vector is \_\_\_\_\_  
 a)  $r\vec{a}_z + z\vec{a}_x$       b)  $r\vec{a}_z - z\vec{a}_y$       c)  $r\vec{a}_y - z\vec{a}_z$       d)  $-r\vec{a}_y + z\vec{a}_z$
- Which of these statements is not characteristic of a static magnetic field?  
 a) It is solenoidal      b) It has no sinks and sources  
 c) It is conservative      d) Magnetic flux lines are always closed
- Two thin parallel wires carry currents along the same direction. The force experienced by one due to the other is \_\_\_\_\_  
 a) Parallel to the lines and attractive      b) Parallel to the lines and repulsive  
 c) Perpendicular to the lines and attractive      d) Perpendicular to the lines and repulsive
- The \_\_\_\_\_ is defined as the tangential force times the radial distance at which it acts.  
 a) Magnetic Flux density      b) Magnetic Field Intensity  
 c) Magnetic Torque      d) Magnetic Moment
- If N is total number of turns, I is the current passing through the coil, l is mean length of the path, the magnetic field intensity of solenoid is given as \_\_\_\_\_  
 a)  $H = \frac{NI}{l}$       b)  $H = \frac{I}{NI}$       c)  $H = \frac{NI}{I}$       d)  $H = \frac{\mu N^2 A}{l}$
- The capacitance of a parallel plate capacitor having stored energy of 5μJ with the voltage between the plates of 4 V is \_\_\_\_\_  
 a) 0.625 F      b) 6.25 F      c) 0.625 μF      d) 6.25 μF
- The unit of propagation constant is \_\_\_\_\_  
 a) Np/m      b)  $m^{-1}$       c) m      d) Np-m

9. The intrinsic impedance  $\eta$  is given as \_\_\_\_\_

- a)  $\sqrt{\frac{j\omega\mu}{\sigma + j\omega\epsilon}}$       b)  $\sqrt{\frac{j\omega\mu}{\epsilon + j\omega\sigma}}$       c)  $\frac{j\omega\mu}{\sqrt{(\sigma + j\omega\epsilon)}}$       d)  $\frac{\omega\mu}{\sqrt{(\sigma + j\omega\epsilon)}}$

10. The angle at which there is no reflection of wave, when an incident wave is vertically polarized is called \_\_\_\_\_

- a) Incident angle      b) Refraction angle      c) Critical angle      d) Brewster angle

**PART B (10 x 2 =20 Marks)**

11. Define Electric dipole.
12. State the relation between E and V.
13. State Biot-savart's law in vector form.
14. State Laplace equation for scalar magnetic potential.
15. What is a homogeneous material?
16. State the boundary conditions between conductor and free space.
17. Write Maxwell's equations for free space in point and integral form.
18. What is instantaneous, average and complex poynting vector?
19. What are Electromagnetic waves?
20. Define Depth of penetration.

**PART C (5 x 14 =70 Marks)**

21. a) Obtain the expression for Electric field intensity on the axis of uniformly charged circular disc.

**(OR)**

- b) (i) Explain Coulomb Law of force between any two point charges. (4)
- (ii) Prove that the divergence of the Electric field and that of Electric flux density in a charge free region is zero. (5)
- (iii) Derive the relationship between D and E. (5)
22. a) (i) State Ampere's Work law. (2)
- (ii) Derive Magnetic field intensity due to infinite sheet of current. (12)

(OR)

- b) (i) Derive the expression for the force on a current element. (6)  
(ii) Explain the concepts of Scalar and vector Magnetic potentials. (8)

23. a) State and derive the boundary condition between conductor and dielectric.

(OR)

- b) (i) A solenoid with  $N_1 = 2000$ ,  $r_1 = 2$  cm and  $l_1 = 100$  cm is concentric within a second coil of  $N_2 = 40000$ ,  $r_2 = 4$  cm and  $l_2 = 100$  cm. Find the mutual inductance assuming free space conditions. (6)  
(ii) Derive the expression for Energy density in an inductor. (8)

24. a) Derive the Maxwell Equation from Ampere's law and Faraday's law. Express the equations in phasor form for time harmonic fields.

(OR)

- b) (i) If the field vectors of a wave in free space are given by

$$\vec{E} = 100 \cos(\omega t + \frac{4\pi}{3} x) \vec{a}_z \text{ V/m},$$

$$\vec{H} = \frac{100}{120\pi} \cos(\omega t + \frac{4\pi}{3} x) \vec{a}_y \text{ A/m}.$$

Determine the Phasor poynting vector and calculate the power crossing  $4\text{m}^2$  patch of the YZ plane. (6 marks)

- (ii) Prove that the Electromagnetic power flow is the product of Electric and Magnetic Field intensities. (8)

25. a) (i) Derive the general wave equation. (6)  
(ii) Discuss about the plane waves in good conductor. (8)

(OR)

b) Discuss about reflection of Plane waves by a perfect dielectric.

\*\*\*\*\*