Reg. No. | | | | | | | | | | |

Question Paper Code: 53119

B.E./B.Tech.Degree Examinations,Novomber/December 2010
Regulations 2008

Fourth Semester

Electronics and Communication Engineering

EC 2253 Electromagnetic Fields

Time: Three Hours Maximum: 100 Marks

Answer ALL Questions

Part A - (10 x 2 = 20 Marks)

1. Convert the given rectangular coordinate $A(x = 2, y = 3, z = 1)$ into the corresponding cylindrical coordinate.
2. What is an electric dipole? Write down the potential due to an electric dipole.
3. Write Lorentz's force equation for a moving charge.
4. Find the magnetic field intensity at a point $P(0.01, 0, 0)$ m, if the current through a co-axial cable is 6A, which is along the z axis and $a = 3$ mm, $b = 9$ mm and $c = 11$ mm.
5. State the difference between Poisson's equation and Laplace's equation.
6. Draw the B-H curve for classifying Magnetic materials.
7. Write down the Maxwell's equation derived from Faraday's law.
8. Write down instantaneous, average and complex poynting vectors.
9. Write the point form of four Maxwell's equations in the Phasor form.
10. What is meant by polarization of a uniform plane wave?

Part B - (5 x 16 = 80 Marks)

11. (a) (i) Find the electric field intensity at a point P located at $(0, 0, h)$ m due to charge of surface charge density σ C/m^2 uniformly distributed over the circular disc $r \leq a, z = 0$ m. (10)

(ii) Determine the divergence and curl of the given field $F = 30a_x + 2xya_y + 5xz^2 a_z$ at $(1, 1, -0.2)$ and hence state the nature of the field. (6)

OR

11. (b) (i) Derive the expression for potential due to an electric dipole at any point P. Also find electric field intensity at the same point. (10)

(ii) Two point charges, 1.5 nC at (0, 0, 0.1) and -1.5 nC at (0, 0, -0.1), are in free space. Treat the two charges as a dipole at the origin and find potential at $P(0.3, 0, 0.4)$. (6)

12. (a) (i) Derive an expression for magnetic field intensity due to a linear conductor of infinite length carrying current I at a distant point P. Assume R to be the distance between conductor and point P. Use Biot Savart's law. (8)

(ii) Derive an expression for magnetic field intensity on the axis of a circular loop of radius 'a' carrying current I. (8)

OR

12. (b) (i) Obtain the expressions for scalar and vector magnetic potential. (8)

(ii) The vector magnetic potential $\vec{A} = (3y - 3)\vec{a}_x + 2xy\vec{a}_y$ Wb/m in a certain region of free space.

(1) Show that $\nabla \cdot \vec{A} = 0$ (3)

(2) Find the magnetic flux density $\vec{B}$ and the magnetic field intensity $\vec{H}$ at $P(2, -1, 3)$. (5)

13. (a) (i) Write down the Poisson's and Laplace's equations. State their significance in electrostatic problems. (4)

(ii) Two parallel conducting plates are separated by distance 'd' apart and filled with dielectric medium having 'ε_r' as relative permittivity. Using Laplace's equation, derive an expression for capacitance per unit length of parallel plate capacitor, if it is connected to a DC source supplying 'V' volts. (12)

OR

13. (b) (i) Derive the expression for inductance of a toroidal coil carrying current. (8)

(ii) A solenoid is 50 cm long, 2 cm in diameter and contains 1500 turns. The cylindrical core has a diameter of 2 cm and a relative permeability of 75. This coil is co-axial with a second solenoid, also 50 cm long, but 3 cm diameter and 1200 turns. Calculate L for the inner solenoid; and L for the outer solenoid. (8)

14. (a) (i) Generalise Ampere's law for time varying fields. (8)

(ii) List the Maxwell's equations in integral and point form for free space conditions. (8)

OR

14. (b) (i) Explain the following: Poynting vector, average power and instantaneous power. (8)

(ii) In free space, $H = 0.2\cos(\omega t - \beta x)a_z$ A/m. Find the total power passing through a circular disc of radius 5 cm. (8)

15. (a) (i) From the Maxwell's equation, derive the electromagnetic wave equation in conducting medium for E and H fields. (10)

(ii) The Electric fields associated with a plane wave traveling in a perfect dielectric medium is given by $E_x(z, t) = 10\cos[2\pi \times 10^7\ t - 0.1\pi\ x]$ V/m. Find the velocity of propagation, and intrinsic impedance. Assume $\mu = \mu_0$. (6)

OR

15. (b) (i) Explain different types of polarizations of uniform plane waves. (8)

(ii) $\vec{E}$ and $\vec{H}$ waves, traveling in free space, are normally incident on the interface with perfect dielectric with $\varepsilon_r = 3$. Compute the magnitudes of incident, reflected and transmitted $\vec{E}$ and $\vec{H}$ waves at the surface. (8)

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Question Paper Code: 11285

B.E./B.Tech.Degree Examinations, April/May 2011
Regulations 2008

Fourth Semester

Electronics and Communication Engineering

EC 2253 Electromagnetic Fields

Time: Three Hours Maximum: 100 marks

Answer ALL Questions

Part A - (10 x 2 = 20 marks)

1. State Divergence theorem.
2. A point charge +2 nC is located at the origin. What is the value of potential at P (1, 0, 0) m?
3. State Ampere's circuital law.
4. A loop with magnetic dipole moment 8×10^{-3} $\mathbf{a}_z$ $A.m^2$, lies in a uniform magnetic field $a_x + 0.4$ $\mathbf{a}_z$ Wb/m^2. Calculate the torque.
5. What do you understand from current continuity equation?
6. Draw the B-H curve for classifying Magnetic materials.
7. Give the situations, when the rate of change of flux results in a non-zero value.
8. Define complex poynting vector.
9. What is meant by skin effect? Mention its significance.
10. What is meant by polarization of a uniform plane wave?

Part B - (5 x 16 = 80 marks)

11. (a) (i) Find the total electric field at the origin due to 10^{-8} C charge located at P (0, 4, 4) m and a -0.5×10^{-8} C charge at P(4, 0, 2) m. (8)

(ii) Derive an expression for the electric field intensity at any point due to a uniformly charged sheet with density ρ_S C/m^2. (8)

OR

11. (b) (i) Point charges Q and $-Q$ are located at (0, 0, $d/2$) and (0, 0, $-d/2$). Show that the potential at a point (r, θ, φ) is inversely proportional to r^2, noting that $r \gg d$. (8)

(ii) Given a field $E = \frac{-6y}{x^2}a_x + \frac{6}{x}a_y + 5a_z$ V/m, find the potential difference V_{AB} between $A(-7, 2, 1)$ and $B(4, 1, 2)$. (8)

12. (a) (i) Using Biot-Savart's law, derive the magnetic field intensity on the axis of a circular loop carrying a steady current I. (8)

(ii) Using Ampere's circuital law, derive the magnetic field intensity due to a co-axial cable carrying a steady current I. (8)

OR

12. (b) (i) Derive an expression for a torque on a closed rectangular loop carrying current. (8)

(ii) In cylindrical co-ordinates, $\overline{A} = 50\rho^2\,\overline{a}_z$ Wb/m is a vector magnetic potential in a certain region of free space. Find the magnetic field intensity (H), magnetic flux density (B) and current density (J). (8)

13. (a) (i) Determine whether or not the following potential fields satisfy the Laplace's equation.

(1) $V = x^2 - y^2 + z^2$ (2)

(2) $V = r\cos\phi + z$ (3)

(3) $V = r\cos\theta + \phi$ (3)

(ii) Solve the Laplace's equation for the potential field in the homogenous region between the two concentric conducting spheres with radius 'a' and 'b' where $b > a$, $V = 0$ at $r = b$ and $V = V_0$ at $r = a$. Find the capacitance between the two concentric spheres. (8)

OR

13. (b) (i) Find the permeability of the material whose magnetic susceptibility is 49. (4)

(ii) The inner and outer conductors of a co-axial cable are having radii 'a' and 'b' respectively. If the inner conductor is carrying current 'I' and outer conductor is carrying the return current 'I' in the opposite direction. Derive the expressions for (1) the internal inductance and (2) the external inductance. (12)

$\overline{\quad}$ $a_x + 5y\ \mathbf{a}_y +$ $kz^2\ \mathbf{a}_z\ \mu C/m^2$, find the constant k. (6)

(ii) If electric field intensity in free space is given by $\overline{E} = \frac{50}{\rho}\cos(10^8 t - 10z)\ \mathbf{a}_\rho\ V/m$. Find the magnetic field intensity $\overline{H}$. (10)

OR

14. (b) (i) State and prove Poynting theorem. (8)

(ii) Derive the expression for total power flow in co-axial cable. (8)

15. (a) (i) From the Maxwell's equation, derive the electromagnetic wave equation in conducting medium for E and H fields. (10)

(ii) Calculate the attenuation constant and phase constant for the uniform plane wave with the frequency of 100 GHz in a conducting medium for which $\mu_r = 1$ and $\sigma = 58 \times 10^6$ S/m. (6)

OR

15. (b) (i) Explain different types of polarizations of uniform plane waves. (8)

(ii) $\vec{E}$ and $\vec{H}$ waves, traveling in free space, are normally incident on the interface with perfect dielectric with $\varepsilon_r = 3$. Compute the magnitudes of incident, reflected and transmitted $\vec{E}$ and $\vec{H}$ waves at the surface. (8)

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B.E./B.Tech.Degree Examinations, April/May 2011
Regulations 2008

Fourth Semester

Electronics and Communication Engineering

EC 2253 Electromagnetic Fields

Time: Three Hours Maximum: 100 marks

Answer ALL Questions

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4. A loop with magnetic dipole moment 8×10^{-3} $\mathbf{a}_z$ $A.m^2$, lies in a uniform magnetic field $a_x + 0.4$ $\mathbf{a}_z$ Wb/m^2. Calculate the torque.
5. What do you understand from current continuity equation?
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11. (b) (i) Point charges Q and $-Q$ are located at (0, 0, $d/2$) and (0, 0, $-d/2$). Show that the potential at a point (r, θ, φ) is inversely proportional to r^2, noting that $r \gg d$. (8)

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