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

Question Paper Code : 80444

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2021.

Fourth Semester

Electronics and Communication Engineering

EC 2253/EC 43/10144 EC 404/EC 1253/080290021 — ELECTROMAGNETIC FIELDS

(Regulations 2008/2010)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. State Divergence theorem.

2. What is the significance of electric flux density?

3. What is meant by magnetic field intensity?

4. Write down the expression for the torque experienced by a current carrying loop situated in a magnetic field.

5. State Poisson's and Laplace equations.

6. What is mutual Inductance?

7. State Faraday's law.

8. Define dissipation factor.

9. Find the skin depth at a frequency of 3 MHZ is aluminium where $\sigma = 38.2\, M\, s / m$ and $\mu_r = 1$.

10. What is Brewster angle?

PART B — (5 × 16 = 80 marks)

11. (a) Apply Gauss law to find charge enclosed in hollow sphere whose surface is uniformly charged. Derive the equation for potential due to a system of point charges. (16)

Or

(b) State and prove Stoke's theorem and divergence theorem. (16)

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

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

(ii) At a point $P(x, y, z)$ the components of vector magnetic potential $\overline{A}$ are given as $A_x = 4x + 3y + 2z$, $A_y = 5x + 6y + 3z$ and $A_z = 2x + 3y + 5z$. Determine the magnetic flux density $\overline{B}$ at the point P. (4)

(iii) Given the magnetic flux density $\overline{B} = 2.5\left(\sin\frac{\pi x}{2}\right)e^{-2y}\overline{a_z} Wb/m^2$, find the total magnetic flux crossing the strip defined by $z = 0, y \geq 0, 0 \leq x \leq 2m$. (4)

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

(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) From basic principles derive Maxwell's four equations in integral-form and differential form. (12)

(ii) State the modified form of Ampere's circuital law. Why was it modified? Justify. (4)

Or

(b) (i) Derive expressions for Instantaneous, Average and Complex Poynting Vector. (12)

(ii) Interpret $E \times H$. (4)

15. (a) A plane sinusoidal electromagnetic wave traveling in space has $E_{max} = 150\mu V / m$. (16)

(i) Find the accompanying H_{max}.

(ii) Propagation is in X direction and H is oriented in Y direction. What is the direction of E?

(iii) Compute the average power transmitted.

Or

(b) Explain in detail on what happens when the wave is incident

(i) Normally on perfect conductor (8)

(ii) Obliquely to the surface of perfect dielectrics. (8)

———————