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

Question Paper Code : 90986

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2025.

Fourth Semester

Electronics and Communication Engineering

EC 3452 — ELECTROMAGNETIC FIELDS

(Common to : Electronics and Telecommunication Engineering)

(Regulations 2021)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define the Curl of a vector field.
2. What is the divergence theorem?
3. State Coulomb's Law.
4. Define Electric Potential.
5. State the principle of ampere's law.
6. Define Magnetic Field Intensity.
7. What is displacement current?
8. Define time-harmonic fields.
9. What is Phase velocity of EM waves in free space?
10. Define Skin depth.

PART B — (5 × 13 = 65 marks)

11. (a) Given a vector, A, in a cylindrical coordinate system by the following expression:

$A = \rho z \sin\varphi\alpha_\rho + 3\rho\cos\varphi\alpha_\varphi + \rho\cos\varphi\sin\varphi\alpha_z$.

Express the above vector, A, in a Cartesian coordinate system.

Or

(b) State and explain Stoke's Theorem using an example.

12. (a) Given an E-field whose electric flux density is given by

$$D = 4x^2 y a_x - 7y^2 z a_y + 6xyz\, a_z c/m^2$$

Find the flux crossing through the surface formed by the following:

$y = 1, -1 \le x \le 1$ and $0 \le z \le 2$.

Or

(b) Define Gauss's Law and hence, determine the electric field intensity at a distance of r due to a volume charge with charge density of ρ_v distributed uniformly in a sphere of radius R. Consider

(i) $R > r$ and (7)

(ii) $R < r$. (6)

13. (a) Determine the magnetic field intensity inside and outside the conductor due to a solid cylindrical conductor of radius R carrying a current I with uniform current density.

Or

(b) A current-carrying wire has 8A current flowing along the +Y axis and also along the +X axis with the current flowing from Y to the X axis. Calculate the magnetic field intensity at (3, 4, 0).

14. (a) Explain Maxwell's Equation in detail for static and time-varying fields.

Or

(b) Derive the EM wave equations in free space with proper illustration.

15. (a) Explain and derive the Poynting Theorem.

Or

(b) Derive the relation for

(i) phase constant, (5)

(ii) intrinsic impedance and (4)

(iii) phase velocity of an EM wave propagating in an ideal dielectric with dielectric constant, ε. (4)

PART C — (1 × 15 = 15 marks)

16. (a) Find the magnetic field intensity, H and hence, magnetic flux density, B at the centre of the circular loop carries a current of I Amperes in the anti-clockwise direction at z = 0 plane. Assume the diameter of the circular loop is 2a. (12 + 3)

Or

(b) Derive the relation of E-field reflection and transmission coefficients of the wave incidents normally at a plane dielectric boundary from medium 1 to medium 2. Considering that medium 1 and medium 2 have a dielectric constant of ε_1 and ε_2 and intrinsic impedance of η_1 and η_2 respectively.