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

Question Paper Code : 40984

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2024.

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. Transform the cartesian coordinates $(1, 2, 3)$ into spherical coordinates.

2. State Helmholtz's theorem.

3. Find the value of k, if the electric flux density in a charge free region is given by $D = 5x\bar{a}_x + 10y\bar{a}_y - kz^2\bar{a}_z$.

4. Determine the energy stored in parallel plate capacitor of 10cm by 10cm has a separation of 1 cm and a voltage difference of 10V.

5. State Biot Savart's law.

6. Distinguish between magnetic scalar potential and magnetic vector potential.

7. In a material for which σ = 5 s/m, ε_r = 1 and E = 100 $\sin 10^6$ t v/m. Find its displacement current density.

8. State Guass's law for magnetic field and express in integral form.

9. Define group velocity. Write its expression.

10. Calculate the characteristic impedance of free space.

PART B — (5 × 13 = 65 marks)

11. (a) State and verify Divergence theorem for its vector $A = 4x\overline{a}_x - 2y^2\overline{a}_y + z^2\overline{a}_z$ taken over the cube bounded by x=0, x=1, y=0 and y=1.

Or

(b) State and verify Stoke's theorem. Give its application.

12. (a) Derive

(i) Laplace equation (7)

(ii) Equation of continuity. (6)

Or

(b) Calculate the capacitance of a parallel plate capacitor with two dielectrics (ε_{r1} = 2 of thickness 1 mm, ε_{r2} = 1 of thickness 2 mm) kept parallel to the plates of area of 50 cm². What is the voltage gradient in each dielectric if 100 V is applied across its plates.

13. (a) Derive an expression for the magnetic field intensity on the axis of solenoid.

Or

(b) Derive expression for inductance of

(i) solenoid (7)

(ii) toroid (6)

14. (a) State and derive Maxwell's equation in integral form.

Or

(b) Derive wave equation for conducting medium.

15. (a) Obtain the expression for reflection coefficient and transmission coefficient when a wave incident normally at a dielectric boundary.

Or

(b) State and prove Poynting theorem.

PART C — ($1 \times 15 = 15$ marks)

16. (a) Show that the displacement current through the parallel plate capacitor of capacitance C is equal to the conduction current I if a supply voltage $V = V_m \sin \omega t$ is applied across the capacitor.

Or

(b) A uniform plane wave is travelling at a velocity of 2.5×10^8 m/s having a wavelength of 0.5 mm in a non-magnetic good conductor. Calculate the frequency of wave and conductivity of the medium.