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Question Paper Code : 40529

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2025.

Fourth Semester

Electronics and Communication Engineering

EC 8451 — ELECTROMAGNETIC FIELDS

(Common to : Electronics and Telecommunication Engineering)

(Regulations 2017)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Transform the Cartesian coordinates $x = 2$, $y = 1$, $z = 3$ in to spherical coordinates.

2. State Divergence Theorem.

3. Determine the capacitance of parallel plate capacitor composed of thin foil of sheet 25 cm, for plates separated through a glass dielectric 0.5 cm thick with $\varepsilon_r = 6$.

4. State Coulomb's law in vector form.

5. A current of 2 A flowing in an inductor of inductance 100 mH. What is the energy stored in the inductor?

6. State Point form and Integral form of Ampere's law.

7. List the properties of uniform plane wave.

8. If the vector $D = 20xa_x - 15ya_z + kza_z \mu c/m^2$. Find the value of K to satisfy the Maxwell's equation for region $\sigma = 0$, $\rho v = 0$.

9. State Poynting Theorem.

10. Differentiate : lossless medium and lossy medium.

PART B — (5 × 13 = 65 marks)

11. (a) (i) State and prove Divergence theorem. (8)

(ii) Transform the vector $A = ya_x - xa_y + za_z$ in to cylindrical coordinates. (5)

Or

(b) Why coordinate system is required? Discuss in detail about various coordinate systems and also explain how conversion can be done.

12. (a) State Gauss law. Explain how Gauss law is applicable to point charge and infinite sheet of charge.

Or

(b) (i) A cylindrical capacitor of an inner conductor of radius 'a' and an outer conductor whose inner radius is 'b' .The space between the conductors is filled with a dielectric of permittivity ε and the length of the capacitor is L. Determine the capacitance of this capacitor. (8)

(ii) Define Electric Dipole and derive an expression for potential. (5)

13. (a) Define Inductance and derive the expression for inductance of a two transmission lines.

Or

(b) Derive the expression for magnetic field intensity due to finite long conductor.

14. (a) Derive the expression for Electromagnetic wave equation in free space.

Or

(b) (i) In a material for which conductivity is 5 s/m, $\varepsilon_r = 1$ and E = 250 sin 10^{10} t V/m. Find conduction and displacement current density. (5)

(ii) Derive Maxwell's I and II equation in Point form, Integral form. (8)

15. (a) Derive Transmission and Reflection Coefficient for the Plane waves that Incident normally on Dielectric boundary.

Or

(b) Derive the expression of uniform plane waves in conducting medium

PART C — (1 × 15 = 15 marks)

16. (a) (i) Determine force per length between two long parallel wires A and B are separated by 5 cm in air and carrying current of 40A case (1) in same direction case (2) in opposite direction. (4+4)

(ii) Determine the flux over a closed surface of cylinder where $D = \rho^2 \cos^2 \Phi a_p + z \sin \Phi a_\Phi$ and $0 <= z <= 1$, $\rho = 4$. (7)

Or

(b) Three Point charges of 5 μC are placed in free space at the points (1,0,0) (–1,0,0) and (0,–1,0)m respectively. Determine Force and Electric field intensity on a point charge of 2 μC located at a point (0,0,1).