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

Question Paper Code : 81279

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

Third Semester

Electrical and Electronics Engineering

EE 3301 – ELECTROMAGNETIC FIELDS

(Common to Electrical and Computer Engineering)

(Regulations 2021)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What are the sources of electromagnetic fields?

2. A $4\mu C$ positive charge is located in vacuum at $P_1(3, -2, -4)$ and a $5\mu C$ negative charge is at $P_2(1, -4,2)$. Find the force vector on the negative charge?

3. Find the polarization in a field of $\vec{E}$ = 10,000 V/m in polysterene having relative permittivity of 2.5.

4. Express dielectric boundary conditions.

5. What do you mean by energy density?

6. What is the relation between magnetic field intensity and magnetic flux density?

7. State Faraday's law.

8. What is motional emf?

9. Define skin depth.

10. What is a Poynting vector?

PART B — (5 × 13 = 65 marks)

11. (a) Find the divergence of the field $\vec{D}$ given in cylindrical coordinates $\vec{D} = 2r\cos^2\phi\vec{a}_r + 3r^2\sin z\vec{a}_\phi + 4z\sin^2\phi\vec{a}_z$.

Or

(b) Derive the expression for electric field intensity due to a continuous surface charge.

12. (a) Derive Poisson's and Laplace equation.

Or

(b) If there is a potential difference of 1000 V between the two points $A(0,1,0)$, and $B(0,2,0)$ in an electric field near a high voltage electrode, find a point $C(0,C,0)$ such that $V_{BC} = 500\,V$ and the electrode is an infinitely long line on the z-axis.

13. (a) State Ampere's law. Using Ampere's law, derive the expression for magnetic field intensity due to a circular current loop. (3+10)

Or

(b) (i) Write short note on magnetic materials. (4)

(ii) Distinguish between scalar and vector potentials. (4)

(iii) Derive Lorentz force equation. (5)

14. (a) Derive Maxwell's equations in differential and integral forms.

Or

(b) Discuss the relation between field theory and circuit theory.

15. (a) Derive the expression for the wave parameters namely velocity, intrinsic impedance, propagation constant when the medium is a pure dielectric material.

Or

(b) Derive the wave equation for a conducting medium.

PART C — (1 × 15 = 15 marks)

16. (a) (i) Two wires carrying current in the same direction 500 A and 100 A are placed with their axis separated by 5 cm. Calculate the force between them. (5)

(ii) In a cylindrical conductor of radius 5 mm, the current density $\vec{J} = 10e^{-100\,r}$ A/m^2 varies with distance from the axis. Find the total current I. (10)

Or

(b) In free space $\vec{D} = D_m \sin(\omega t + \beta z)\overrightarrow{a_x}$. Determine displacement current density and magnetic flux density.