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Question Paper Code : 11286

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2026

Third Semester

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Electrical and Electronics Engineering

EE3301 – 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. Define gradient of a scalar field.
2. Define the equation for force from Coulomb's law.
3. Define dielectric breakdown.
4. Mention the relationship between electric charge and capacitance.
5. What does quasi-static condition imply?
6. Show the relationship between magnetic force and magnetic flux density.
7. Write the relationship between coupling coefficient and mutual inductance.
8. Define flux cutting EMF.
9. Interpret the relationship between phase velocity and phase constant.
10. Mention the homogeneous vector wave equations.

PART B — (5 × 13 = 65 marks)

11. (a) Explain a differential volume in

(i) Cartesian coordinates (6)

(ii) Cylindrical coordinates (7)

Or

(b) Explain the divergence of a vector field. State and prove Stokes' theorem.

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12. (a) (i) Derive the expression for electric potential due to a system of discrete point charges. (9)

(ii) The charge distribution on the surface of a conductor depends on the shape of the surface. Justify this statement. (4)

Or

(b) Explain the equivalent charge distributions of polarised dielectrics.

13. (a) (i) Derive the equation for describing Biot-Savart law. (7)

(ii) Summarize the procedure for determining the self-inductance of an inductor. (6)

Or

(b) With suitable diagrams, analyze the behaviour of magnetic materials.

14. (a) Analyse a magnetic circuit based on two basic equations for magneto statics.

Or

(b) Explain the following

(i) Fundamental postulate for electromagnetic induction. (6)

(ii) Stationary circuit in time varying magnetic field. (7)

15. (a) Derive the solution of wave equations for potentials.

Or

(b) Explain the following.

(i) Plane waves in low loss dielectrics. (6)

(ii) Plane waves in good conductors. (7)

PART C — (1 × 15 = 15 marks)

16. (a) (i) Convert the points $P(-4, 2, 1), T(1, -2, 3)$ and $S(5, 8, 2)$ from Cartesian to Spherical and Cylindrical coordinate systems. (7)

(ii) Using (i) transform the vectors, $\vec{Q}$ to spherical coordinate.

$$\vec{Q} = \frac{\sqrt{y^2+z^2}}{x^2+y^2+z^2}\vec{a}_x - \frac{yz}{x^2+y^2+z^2}\vec{a}_y + \frac{z}{x^2+y^2+z^2}\vec{a}_z . \quad (8)$$

Or

(b) The region $x < 0$ contains a dielectric material having $\varepsilon r_1 = 2.2$, while the region $x > 0$ is characterized by $\varepsilon r_2 = 4$. Given that $E_1 = 10\vec{a}_x + 20\vec{a}_y + 50\vec{a}_z$ V/m. Find E_2, D_2, angle of incidence and reflection along the boundary, $x = 0$.

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