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

Question Paper Code : 40992

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2018

Third Semester

Electrical and Electronics Engineering

EE 6302 – ELECTROMAGNETIC THEORY

(Regulations 2013)

Time : Three Hours | Maximum : 100 Marks

Answer ALL questions

PART – A (10×2=20 Marks)

1. Find the unit vector extending from the origin toward the point P(3, – 1, – 2).
2. Determine the electric field intensity in free space if $\vec{D} = 30\vec{a}_x \ C/m^2$.
3. Mention the properties of electric flux lines.
4. State the electrostatic boundary conditions at the interface between two dielectrics.
5. What is the total force acting on a moving charge, Q in the presence of both electric and magnetic fields.
6. Compare magnetic scalar potential and magnetic vector potential.
7. Define Reluctance and Permeability.
8. Distinguish between conduction and displacement currents.
9. Mention the practical importance of 'Skin depth'.
10. What is 'Standing Wave Ratio' ?

PART – B (5×13=65 Marks)

11. a) i) With neat diagrams, explain the spherical system with co-ordinates (R, θ, ϕ). (6)

ii) Apply Coulomb's law to find the electric field intensity at any point P due to a straight, uniformly charged wire of linear charge density + λ C/m. The point P is at a distance of 'h' m above the wire. (7)

(OR)

b) i) Explain the divergence of a vector field and divergence theorem. (6)

ii) By mean of Gauss's law, determine the electric field intensity inside and outside a spherical shell of radius R. The shell contains a total charge Q uniformly distributed over the surface. (7)

12. a) i) Two point charges – 4 μC and 5 μC are located at (2, – 1, 3) and (0, 4, – 2) respectively. Find the potential at (1, 0, 1) assuming zero potential at infinity. (6)

ii) A parallel plate capacitor has a plate separation t. The capacitance with air only between the plates is C. When a slab of thickness t' and relative permitivity ε' is placed on one of the plates, the capacitance is C′ Show that $\frac{C'}{C} = \frac{\varepsilon' t}{(t' + \varepsilon'(t - t'))}$. (7)

(OR)

b) i) Explain briefly the polarization in dielectrics. (6)

ii) Derive Laplace's and Poisson's equations from Gauss's law for a linear material medium. State the importance of these equations. (7)

13. a) i) By means of Biot-Savart's law, derive an expression for the magnetic field intensity at any point on the line through the centre at a distance 'h' from the centre and perpendicular to the plane of a circular loop of radius 'ρ' and carrying current 'I.' (6)

ii) An iron ring, 0.2 m in diameter and 10 cm^2 sectional area of the core, is uniformly wound with 250 turns of wire. The wire carries a current of 4 A. The relative permeability of iron is 500. Determine the value of self-inductance and the stored energy. (7)

(OR)

b) i) What is 'Magnetization' ? Explain the classification of magnetic materials. (6)

ii) What is the maximum torque on a square loop of 1000 turns in a field of uniform flux density of 1 Tesla ? The loop has 10 cm sides and carries a current of 3 A. What is the magnetic moment of the loop ? (7)

14. a) An iron ring with a cross-sectional area of $3cm^2$ and a mean circumference of 15 cm is wound with 250 turns of wire carrying a current of 0.3 A. The relative permeability of the ring is 1500. Calculate the flux established in the ring. (13)

(OR)

b) i) Write a technical note on 'Transformer EMF and Motional EMF'. (6)

ii) Describe the relationship between field theory and circuit theory. (7)

15. a) i) The electric field intensity associated with a plane wave travelling in a perfect dielectric medium is given by $E_x(z, t) = 10\cos(2\pi \times 10^7 t - 0.1\pi z)$ V/m. What is the velocity of propagation ? (6)

ii) Derive the Poynting theorem and state its significance. (7)

(OR)

b) Write short notes on the following : (4+4+5)

i) Plane waves in lossless dielectrics.

ii) Plane waves in free space.

iii) Plane waves in good conductors.

PART – C (1×15=15 Marks)

16. a) Step by step, develop a condition between

i) Conductor and dielectric.

ii) Dielectric and dielectric. (15)

(OR)

b) From the basics, derive the expressions for Maxwell's equation in differential and integral form. (15)
