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

Question Paper Code : 27207

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2015.

Third Semester

Electrical and Electronics Engineering

EE 6302 — ELECTROMAGNETIC THEORY

(Regulation 2013)

Time : Three hours **Maximum** : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What are the practical applications of electromagnetic fields?

2. Give the differential displacement and volume in spherical co-ordinate system.

3. What is the electric field intensity at a distance of 20 cm from a charge of 2 μC in vacuum?

4. Calculate the capacitance per Km between a pair of parallel wires each of diameter 1cm at a spacing of 50cms.

5. What is the mutual inductance of the two inductively coupled coils with self inductance of 25 mH and 100 mH?

6. What is the practical significance of Lorentz's Force?

7. Find the characteristics impedance of the medium whose relative permittivity is 3 and relative permeability is 1.

8. A parallel-plate capacitor with plate area of 5 cm^2 and plate separation of 3 mm has a voltage 50 sin 10^3t V applied to its plates. Calculate the displacement current assuming $\varepsilon = 2\varepsilon_0$.

9. What is practical significance of skin depth?

10. A plane wave travelling in air is normally incident on a block of paraffins with $\varepsilon_r = 2.3$. Find the reflection co-efficient.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Verify the divergence theorem for a vector field $D = 3x^2 a_x + (3y + z)a_y + (3z - x)a_z$ in the region bounded by the cylinder $x^2 + y^2 = 9$ and the planes $x = 0$, $y = 0$, $z = 0$ and $z = 2$. (12)

(ii) A novel printing technique is based upon electrostatic deflection principle. Justify. (4)

Or

(b) (i) State and prove Coulomb's Law. (6)

(ii) Obtain an expression for electric field intensity due to a uniformly charged line of length 'l'. (10)

12. (a) (i) Derive the expressions for energy and energy density in static electric fields. (10)

(ii) State and prove the electro-static boundary conditions. (6)

Or

(b) (i) Derive an expression for capacitance of concentric spheres. (8)

(ii) Derive an expression for polarization 'P'. (8)

13. (a) (i) Obtain an expression for magnetic flux density and magnetic field intensity at any point along the axis of a circular coil. (12)

(ii) Distinguish between scalar and vector magnetic potential. (4)

Or

(b) (i) An air co-axial transmission line has a solid inner conductor of radius 'a' and a very thin outer conductor of inner radius 'b'. Determine the inductance per unit length of the line. (12)

(ii) Compare the different magnetic materials. (4)

14. (a) (i) A circular loop of wire is placed in a uniform magnetic field of flux density 0.5 wb/m^2. The wire has 200 turns and frequency of rotation of 1000 revolutions/minute. If the radius of the coil is 0.2 m, determine (1) the induced emf, when the plane of the coil is 60° to the flux lines and (2) the induced emf, when the plane of the coil is perpendicular to the field. (8)

(ii) Explain in detail about the difference between conduction and displacement currents. (8)

Or

(b) Derive the set of Maxwell's equations with solutions in integral form from fundamental laws for a free space. (16)

15. (a) Obtain the electromagnetic wave equation for free space in terms of electric field and explain the wave propagation with necessary parameters. (16)

Or

(b) (i) Derive Poynting theorem from Maxwell's equation and explain. (8)

(ii) A uniform plane wave propagating in a medium has

$E = 2e^{-\alpha x} \sin(10^8 t - \beta z) a_y V/m.$

If the medium is characterized by $\varepsilon_r = 1$, $\mu_r = 20$ and $\sigma = 3S/m$, find α, β and H. (8)