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Question Paper Code : 86591

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2021.

Third Semester

Electrical and Electronics Engineering

EE 1201 A — ELECTROMAGNETIC THEORY

(Regulations 2008)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. State the Stoke's theorem.

2. Obtain in the cylindrical co-ordinate system the gradient of the function.

   $f(r, \theta, z) = 5r^4 z^4 \sin\theta + \cos\theta + z^2$.

3. Define electric Potential and potential difference.

4. A parallel plate capacitor has a charge of 10^{-3} on each plate while the Potential difference between the plates is 1000 V. Calculate the value of capacitance.

5. What is the total force acting on a moving charge Q in the presence of both electric and magnetic folds?

6. A coil has a self inductance of 1 Henry and a resistance of 4Q. If it is connected to a 40 V DC supply, estimate the energy stored in the magnetic field when the current has attained the final steady value.

7. A conductor of 1 m length is moved with a velocity of 100 m/sec. perpendicular to a field of 1 Tesla. What is the value of emf induced?

8. What is the significance of displacement current?

9. Define Propagation constant.

10. What is skin depth?

PART B — ($5 \times 16 = 80$ marks)

11. (a) (i) Give the physical meaning of Gradient, Divergence and Curl. (8)

(ii) State and prove Divergence theorem. (8)

Or

(b) (i) How are electromagnetic fields caused? What are its sources? What are the effects of electromagnetic fields? (8)

(ii) Why is there a need for different co-ordinate systems ? Describe any two co-ordinate systems normally used in Electromagnetic theory. (8)

12. (a) (i) State and explain Coulomb's law and deduce the vector form of force equation between two point charges. (6)

(ii) At an interface separating dielectric $1(\varepsilon_{r1})$ and dielectric $2(\varepsilon_{r2})$, show that the tangential component of E is continuous across the boundary, whereas the normal component of E is discontinuous at the boundary. (10)

Or

(b) (i) A circular disc of radius 'a' m is charged uniformly with a charge density of $\rho_s C/m^2$. Find the electric potential at a point P distant 'h' m from the disc surface along its axis. (8)

(ii) Find the value of capacitance of a capacitor consisting of two parallel metal plates 30 cm × 30 cm surface area, separated by 5 mm in air. What is the total energy stored by the capacitor if the capacitor is charged to a potential difference of 1000 V? What is the energy density? (8)

13. (a) State and explain Amper's circuital law and show that the field strength at the end of a Tong solenoid is one half of that at the centre. (16)

Or

(b) (i) State and explain Biot-Savart's law. (6)

(ii) Derive an expression for the force between two long straight parallel current carrying conductors. (10)

14. (a) (i) Explain briefly about Transformer and Motional EMFs'. (6)

(ii) By applying field theory to a RLC parallel circuit excited by an alternating current source of 'I' ampere, show that

$$I = \frac{V}{R} + \frac{1}{L}\int V dt + C\frac{dV}{dt}$$

Where, V = voltage across parallel combination R = resistance of resistor, L = inductance of inductor, C = capacitance of capacitor. (10)

Or

(b) Write down and explain the Maxwell's equations in integral and differential forms for the following cases: (8+8)

(i) General case

(ii) Free space

(iii) Harmonic variation

(iv) Static case

(v) Steady case

15. (a) (i) A transmission line having a characteristic impedance of 75 Ω is terminated in an impedance of 200 + j200 Ω. If the line is 2.1 λ long and lossless, determine its input impedance. (6)

(ii) A co-axial line has an inner conductor of radius 0.1cm and an inductance of 0.5 μH/m. Find the values of the characteristic impedance, capacitance and the radius of the outer conductor of the line at 100 MHz, if the dielectric constant of the sponge material used as insulation in between the inner and outer conductor is 3. Calculate the velocity of the propagation and wavelength and phase constant in this case. (10)

Or

(b) Derive the expression for an intrinsic impedance, propagation constant and velocity of a Plane Electromagnetic wave when propagated in

(i) A perfect medium. (8)

(ii) Conducting media and good conductor. (8)

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