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Question Paper Code : 80120

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2019.

Fourth Semester

Electronics and Communication Engineering

EC 8451 – ELECTROMAGNETIC FIELDS

(Common to Electronics and Telecommunication Engineering)

(Regulation 2017)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Write Stoke's theorem in integral form.

2. Define infinitesimal volume element in spherical polar coordinates.

3. Write coulomb's law.

4. Find the energy of a uniformly charged spherical shell of total charge q with a radius R.

5. Write Lorentz force equation.

6. Find the magnetic field a distance s from a long straight wire carrying a steady current I.

7. What is meant by displacement current?

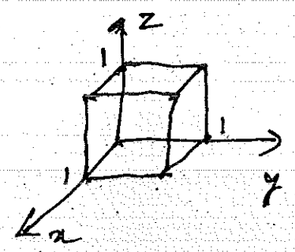
8. Write electromagnetic boundary conditions.

9. What is meant by Brewster's angle?

10. Define phase velocity and group velocity.

PART B — (5 × 13 = 65 marks)

11. (a) Check the divergence theorem using the function $V = y^2\hat{i} + (2xy + z^2)\hat{j} + (2yz)\hat{k}$ and the unit cube situated at the origin.



Or

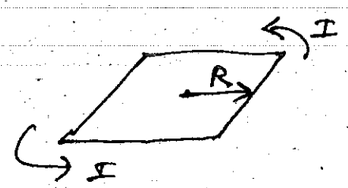
(b) Write the infinite simal displacement, surface and volume elements is spherical and cylindrical coordinates.

12. (a) Find the electric field a distance Z above the center of a square loop of side 'a' carrying uniform line charge λ.

Or

(b) Derive the expressions for the energy of a (i) point charge distribution (ii) continuous charge distributions.

13. (a) Find the magnetic field at the center of a square loop, which carries a steady current I. Let 'R' be the distance from center to side (fig.). Find the field at the center of an n-sided polygon, carrying a steady current I. Again, let R be the distance from the center to any side. Find the formula in the limit n (number of sides) tends to infinity.



Or

(b) Define (i) the mutual inductance between two circuits, and (ii) self inductance of a single coil. Also explain how the self inductance of a wire-wound inductor depends on its number of turns.

14. (a) Write Maxwell's equations in differential form and integral form. Examine them and give its physical interpretation.

Or

(b) Derive wave equations for electric and magnetic fields.

15. (a) Derive Poynting theorem.

Or

(b) Analyse the wave reflection and transmission at normal incidence at the boundary between two linear media.

PART C — (1 × 15 = 15 marks)

16. (a) A 1.8 KHz wave propagates in a medium characterized by $\mu_r = 1.6$, $\epsilon r = 25$ and conductivity $\sigma = 2.5$ s/m. The electric field intensity in the region is given by $\vec{E} = 0.1e^{-\alpha z}\cos(2\pi f t - \beta z)\,\hat{i}$ V/m. Determine the attenuation constant, propagation constant, intrinsic impedance, phase velocity, skin depth, and wave length of the wave.

Or

(b) Two grounded conducting planes ($y = 0$ and $x = 0$) are intersecting at 90°. A charge of 100 nC is placed at (3, 4, 0). Find the electric potential and electric field intensity at (3, 5, 0).