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Roll No. | | | | | | | | | | |

B.E / B.Tech (Full Time) DEGREE END SEMESTER EXAMINATIONS, NOV / DEC 2013

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

14

3rd Semester

EE8302 – ELECTROMAGNETIC THEORY

(Regulation 2012)

Time : 3 Hours | Answer ALL Questions | Max. Marks 100

PART-A (10 x 2 = 20 Marks)

1. Calculate the volume of a parallel-piped formed by vectors $\bar{A}$, $\bar{B}$ and $\bar{C}$ such that
$\bar{A} = 2\bar{a}_x + \bar{a}_y - 2\bar{a}_z$, $\bar{B} = -\bar{a}_x + 3\bar{a}_y + 5\bar{a}_z$, $\bar{C} = 5\bar{a}_x - 2\bar{a}_y - 2\bar{a}_z$
2. Write an expression for a position vector at any point in space in the rectangular co-ordinate system. Then transform the position vector into a vector in the cylindrical co-ordinate system.
3. Find $\bar{E}$ at any point 'P' due to an isolated point charge 'q' using Gauss's Law.
4. Calculate the capacitance per Km between a pair of parallel wires each of diameter 1cm at a spacing of 50cms.
5. Compare the different magnetic materials.
6. What is the practical significance of Lorentz's Force?
7. A velocity selector is used to select alpha particles of energy 200keV from a beam containing particles of several energies. The electric field strength is 800kV/m. What must be the magnetic field strength? The mass of the alpha particle is 6.68×10^{-27}kg.
8. A parallel-plate capacitor with plate area of $5cm^2$ and plate separation of 3mm has a voltage 50 sin $10^3 t$ V applied to its plates. Calculate the displacement current assuming $\varepsilon = 2\varepsilon_0$.
9. What is the skin depth of a 2mm radius aluminium round conductor operating at 50Hz and 1MHz. The conductivity of aluminium is 3.55×10^7 S/m.
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 x 16 = 80 marks)

11. Starting from the Fundamental Law, derive the set of Maxwell's Equation in Integral and Differential form. (16)

12. a) (i) Evaluate $\oint \mathbf{r.ds}$ over the closed surface of the cube bounded by
$0 \leq x \leq 1,\ 0 \leq y \leq 1,\ 0 \leq z \leq 1$
where $\bar{r}$ is the position vector of any point on the surface of the cube (10)

(ii) State and prove the Stoke's theorem (6)

(OR)

b) (i) Verify the divergence theorem for a vector field $D = 3x^2\,\bar{a}_x + (3y + z)\,\bar{a}_y + (3z - x)\,\bar{a}_z$ in the region bounded by the cylinder $x^2 + y^2 = 9$ and the planes $x = 0$, $y = 0$, $z = 0$ and $z = 2$. (10)

(ii) Explain the various sources and applications of electromagnetic fields. (6)

13. a) Explain dielectric polarization and hence obtain an expression for electric field intensity and potential of a dipole. (16)

(OR)

b) (i) A thin annular disc of inner radius 'a' and outer radius 'b; carries a uniform surface charge density ρ_s. Determine the electric field intensity at any point on the 'z' axis when $z \geq 0$. (12)

(ii) Determine the potential difference between two points due to a point charge 'q' at the origin. (4)

14. a) (i) State and prove Boundary condition in a magnetostatic field (8)

(ii) Derive an expression for magnetic vector potential. (8)

(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) Derive ohms law from field theory concept. (4)

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

$$\bar{E} = 2e^{-\alpha z} \sin(10^8 t - \beta z)\bar{a}_y \text{ V/m}$$

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

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