

FACULTY OF ENGINEERING
B.E. 2/4 (ECE) I Sem. (New) (Main) Examination, Dec. 2011/Jan. 2012
ELECTROMAGNETIC THEORY

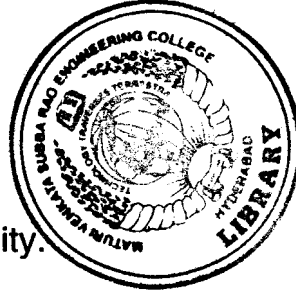
Time: 3 Hours]

[Max. Marks: 75

Note: Answer all questions from Part A, answer any five questions from Part B.

PART – A

(25 Marks)



1. State Coulomb's law. 2
2. Describe the salient feature of electric flux density. 2
3. Explain equation of continuity. 3
4. Distinguish between internal inductance, self inductance and mutual inductance. 3
5. State uniqueness theorem. 3
6. Write short notes on solenoid. 3
7. Write Maxwell equations in integral and differential form. 2
8. At what frequencies may earth be considered a perfect dielectric of $\sigma = 5 \times 10^{-3} \text{ s/m}$, $\mu_r = 1$ and $\epsilon_r = 8$? 3
9. Find gradient of scalar field $A = 10r \sin^2 \theta$. 2
10. What is the propagation constant of EM wave in free space ? 2

PART – B

(50 Marks)

11. a) Verify divergence theorem for the vector field $D = r^2 \cos^2 \phi \mathbf{a}_r + z \sin \phi \mathbf{a}_\phi$ over a closed surface bounded by $r = 4$, $0 \leq z \leq 1$. 7
 b) State Guass law. 3
12. a) Derive the dielectric-dielectric boundary conditions in static electric field. 5
 b) Find the charge in volume define by $0 \leq x \leq 1$, $0 \leq y \leq 1$, $0 \leq z \leq 1$,
 $\rho = 30x^2y \text{ } \mu\text{C/m}^3$. 5

13. a) Obtain the capacitance of two conductor system of infinite length. 5
- b) Given the current density $J = \frac{10^3}{r^2} \cos \theta a_\theta$ A/m² in spherical co-ordinate system. Find current crossing conical strip $\theta = \pi/4$ and $0.001 \leq r \leq 0.8$. 5
14. a) Explain the physical interpretation of divergence, gradient and curl. 5
- b) A point charge $Q_1 = 300 \mu\text{C}$ located at $P_1 (1, -1, -3)$ experience a force $F_1 = 8a_x - 8a_y + 4a_z$ N due to a point charge Q_2 at $(3, -3, -2)$ m, determine Q_2 . 5
15. a) Show that energy density in a magnetic field is $\frac{1}{2} BH$. 5
- b) A radial field $H = \frac{2.39 \times 10^6}{r} \cos \phi a_r$ A/m exist in free space. Find the magnetic flux ϕ crossing the surface defined by $-\pi/4 \leq \phi \leq \pi/4$ and $0 \leq z \leq 1$ m. 5
16. a) Distinguish between linear, circular and elliptical polarization. 5
- b) Prove that for parallel polarization $\frac{E_r}{E_i} = \frac{\tan(\theta_1 - \theta_2)}{\tan(\theta_1 + \theta_2)}$. 5
17. Write short notes on :
- a) Poisson's equation. 3
- b) Magnetic boundary conditions. 4
- c) Instantaneous, average and complex Poynting vector. 3