ROLL NO. _____

Code: AE63 Subject: ELECTROMAGNETICS & RADIATION SYSTEMS

AMIETE – ET (Current Scheme)

Time: 3 Hours **JUNE 2015** **Max. Marks: 100**

PLEASE WRITE YOUR ROLL NO. AT THE SPACE PROVIDED ON EACH PAGE IMMEDIATELY AFTER RECEIVING THE QUESTION PAPER.

NOTE: There are 9 Questions in all.

- **Question 1 is compulsory and carries 20 marks. Answer to Q.1 must be written in the space provided for it in the answer book supplied and nowhere else.**
- **The answer sheet for the Q.1 will be collected by the invigilator after 45 Minutes of the commencement of the examination.**
- **Out of the remaining EIGHT Questions answer any FIVE Questions. Each question carries 16 marks.**
- **Any required data not explicitly given, may be suitably assumed and stated.**

Q.1 Choose the correct or the best alternative in the following: **(2×10)**

a. Electric field infinite line charge distribution ρ_L is at a point R is

(A) $\frac{\rho_L}{2\pi\varepsilon R}$ **(B)** $\frac{\rho_L}{2\pi\varepsilon R^2}$

(C) $\frac{\rho_L}{2\varepsilon}$ **(D)** 0

b. Given that $\mathbf{D = z\ r\ \cos^2\Phi}\ a_z\ C/m^2$, then the charge enclosed by the cylinder of radius 1m with $-2 \le z \le 2$ m is

(A) $\frac{2\pi}{3}c$ **(B)** 0

(C) $\frac{6\pi}{3}c$ **(D)** $\frac{4\pi}{3}c$

c. The work done to move a charge from two points a and b is against field E is

(A) $-\int_a^b E.d\ell$ **(B)** $-q\int_a^b E.d\ell$

(C) $\int_a^b E.ds$ **(D)** $q\int_a^b E.ds$

d. A coaxial cable or coaxial cylindrical capacitor having length L and having inner radius 'a' and outer radius 'b' (b > a). The capacitance of capacitor

(A) $\frac{4\pi \in L}{\ell n\, b/a}$ **(B)** 0

(C) $\frac{2\pi \in L}{\ell n\, b/a}$ **(D)** $\frac{8\pi \in L}{\ell n\, b/a}$

e. The Laplace's equation is

(A) $\nabla^2 V = -\frac{\rho}{c}$ **(B)** $\nabla^2 V = 0$

(C) $\nabla^2 \overline{D} = \rho$ **(D)** $\nabla \times \nabla \times \nabla = \rho$

f. The Scalar vector potential Vm and magnetic field H are related as

(A) $Vm = \nabla \times H$ **(B)** $H = \nabla \times Vm$
(C) $Vm = \nabla H$ **(D)** $H = \nabla Vm$

g. For an infinite sheet of current density K A/m, a_n unit normal vector directed from the current sheet to the point where field to be known. The Magnetic field intensity H is

(A) $\frac{1}{2} K \times \overline{a_n}$ **(B)** 0

(C) $K \times \overline{a_n}$ **(D)** $K.\overline{a_n}$

h. The characteristics impedance of free space is

(A) 277Ω **(B)** 377Ω
(C) 477Ω **(D)** None of these

i. For a Hertizian dipole operating wavelength is λ m, A_e is its affective aperture. The directivity D is

(A) $\frac{4}{\pi\lambda^2} A_e$ **(B)** $\frac{4\pi}{\lambda^2} A_e$

(C) 0 **(D)** $\frac{\lambda^2}{4\pi} A_e$

j. The directivity D of small loop antenna is

(A) 3 **(B)** 4
(C) 1.5 **(D)** 73

Answer any FIVE Questions out of EIGHT Questions.
Each question carries 16 marks.

Q.2 a. Find the expression for Electric field due to Infinite sheet line charge Distribution using Coulomb's Law. **(8)**

b. State Gauss's law; represent Gauss's law in Differential and Integral form. What are the limitations of Gauss Law? **(8)**

Q.3 a. Derive an expression for Energy Density in Electrostatics. **(8)**

b. Show that "Tangential Electric field component is zero and normal component of flux density is equal to surface charge density in conductor – dielectric boundary". **(8)**

Q.4 a. Show that the capacitance varies inversely as the square root of the voltage. **(7)**

b. Given the potential field $V = 2x^2y - 5z$ and a point P (-4, 3, 6). Find several numerical values at point P, the potential V, the electric field intensity E, the direction of E, the electric flux density D, and the volume charge density ρ_v. **(9)**

Q.5 a. Derive an expression for magnetic flux density at a point P due to a long straight conductor carrying current I using vector magnetic potential. **(8)**

b. The magnetic field intensity is given in certain region of free space is $H = \frac{x + 2y}{z^2}\mathbf{y} + \frac{2}{z}\mathbf{z}$ A/. Determine the total current passing through the surface z = 4, 1< x< 2 and 3 < y< 5 in z direction. **(8)**

Q.6 a. Show that $(curlH)_N = \lim_{\Delta S_N \to 0} \frac{\oint H.dh}{\Delta S_N}$ **(8)**

b. Show that Normal component of Magnetic flux is continuous and tangential component of Magnetic field is continuous for two magnetic media μ_1 and μ_2. **(8)**

Q.7 a. State Faraday's law of electromagnetic induction. Show how it leads to the Maxwell equation $\nabla x E = -\frac{\partial B}{\partial t}$ **(8)**

b. If **E** is electric field, V is scalar potential and A is vector magnetic potential then show that for time varying fields $\mathbf{E} = -\nabla V - \frac{\partial \mathbf{A}}{\partial t}$ **(8)**

Q.8 a. Explain the effects of ionosphere on rays of varying incidence. **(8)**

b. Give synthesis of resonant antenna radiation pattern. **(8)**

Q.9 a. With help of spherical coordinate system, explain the following antenna Parameters:

(i) Radiation Pattern (ii) Pattern lobes
(iii) Directivity (iv) Total efficiency **(8)**

b. Write short note on: **(8)**
(i) UHF and microwave Antennas (ii) Nonresonant Antennas