studentBoul Code: AE63 Subject: ELECTROMAGNETICS & RADIATION

AMIETE – ET

Time: 3 Hours

DECEMBER 2013

Max. Marks: 10

 (2×10)

ROLL NO.

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.

0.1 Choose the correct or the best alternative in the following:

a. Which one of the following is a scalar quantity?

(A) Electric field strength	(B) Electric potential
(C) Electric displacement density	(D) Force

- b. The equation $\overline{\nabla} \cdot \overline{J} = 0$ is called
 - (B) Kirchoff's node equation (A) Laplacian equation (C) Poisson's equation (D) Equation of continuity for direct current
- c. An electric field of 50 V/m has charges of 0.3μ C what is the force on that charge

(A) 15 μN	(B) 12.5 μN
(C) 18 µN	(D) 10.5 µN

d. Intrinsic or Characteristic impedance of free space has a value of

(A) Zero	(B) <i>π</i> ohm
(C) 73 ohm	(D) 120 <i>π</i> ohm

e. For normal incidence, the angle of incidence is

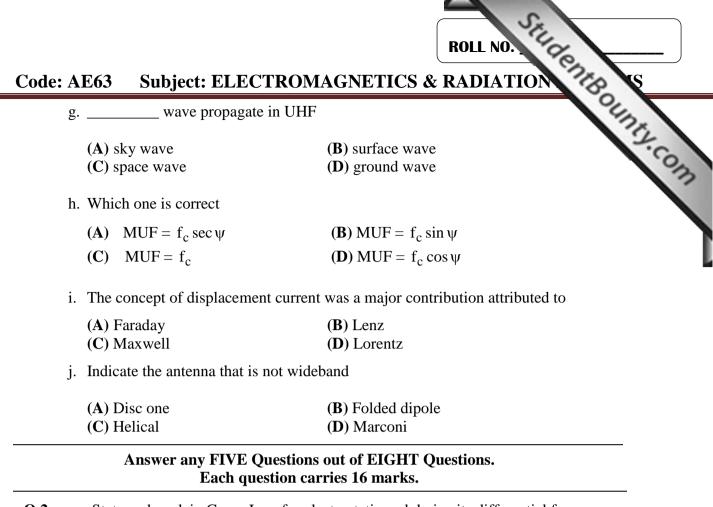
(A) 90°	(B) 180°
(C) 0°	(D) 45°

f. The direction of propagation of electromagnetic wave, is given by

(A) $\overline{\mathrm{E}}$	(B) H
$(\mathbf{C}) \ \left(\overline{\mathbf{E}} \times \overline{\mathbf{H}}\right)$	$(\mathbf{D}) \ \overline{\mathrm{E}} \cdot \overline{\mathrm{H}}$

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Q.2 a. State and explain Gauss Law for electrostatic and derive its differential form.(8)

- b. Define potential and electric flux density. Also derive expression for a point charge in electric field. Point charges 1 mC and -2 mC are located at (3, 2, -1) and (-1, -1, 4), respectively. Calculate the electric force on a 10-nC charge located at (0, 3, 1) and the electric field intensity at that point. (8)
- Q.3 a. Derive the relationship between normal and tangential components at the boundary region in case of perfect dielectrics. (10)
 - b. A wire of diameter 1 mm and conductivity 5×10^7 S/m has 10^{29} free electron s/m³ when an electric field of 10 mV/m is applied. Determine
 - (i) The charge density of free electrons
 - (ii) The current density
 - (iii) The current in the wire
 - (iv) The drift velocity of the electrons. Take the electronic charge as $e = -1.6 \times 10^{-19} C$. (6)
- Q.4 a. Derive the Poisson's and Laplace Equation. Represent Laplace Equation in all three co-ordinate systems. (10)
 - b. Given potential field $V = \left[A\rho^4 + B\rho^{-4}\right]\sin 4\phi$
 - (i) show that $\nabla^2 V = 0$
 - (ii) find A and B so that V = 100 volts and $\left|\overline{E}\right| = 500 \frac{V}{m}$ at $P(\rho = 1, \phi = 22.5^{\circ}, z = 2)$. (6)

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