ROLL NO. _____

Code: AE63/AE114 Subject: ELECTROMAGNETICS & RADIATION SYSTEMS

AMIETE – ET (Current & New Scheme)

Time: 3 Hours **June 2018** **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. The electric field intensity **E** due to infinite sheet charges is
(A) Inversely proportional to distance
(B) Directly proportional to distance square
(C) Independent of the distance
(D) None of these

b. The point form of Gauss law (∇ . **D**) = ρ is valid for
(A) All types of charge distributions
(B) Volume charge distributions only
(C) Surface charge distributions only
(D) Point charge distributions only

c. When the field **E** is normal, its magnitude on the Gaussian surface
(A) Must be constant over that portion
(B) Can be variable over that portion
(C) No restrictions on the magnitude
(D) None of these

d. Identify the wrong combination
(A) $\nabla^2 V = -\rho_v / \varepsilon$ ----------Poission's law
(B) $\nabla^2 V = 0$----------Laplace Equation
(C) ∇ . **D** = ρ ----------Gauss Law
(D) All the combinations are correct

e. An isolated conducting sphere of 50 cm radius is located in air. The sphere is charged with a potential of 10000 V. The surface charge density in C/m^2 on surface of the sphere is nearest to
(A) 17.7×10^{-8} **(B)** 1.77×10^{-8}
(C) 8.85×10^{-8} **(D)** 88.5×10^{-8}

f. If the current density in a conductor is J and its conductivity is σ then power dissipated per unit volume of the conductor is
(A) σJ **(B)** $\sigma^2 J$
(C) σJ^2 **(D)** J^2/σ

g. The Ampere's circuital law is valid
(A) Always
(B) Only under highly symmetrical conditions
(C) Only under some special conditions
(D) None of these

h. The Maxwell's correction is to
(A) Gauss law **(B)** Ampere's law
(C) Faraday's law **(D)** None of these

i. The depth of penetration δ and α are related as
(A) $\alpha\delta = 1$ **(B)** $\alpha = \delta$
(C) $\delta = \alpha^2$ **(D)** None of these

j. It is possible to reduce the EMI generated due to lightning by
(A) Using fuse wire **(B)** Filtering
(C) Grounding **(D)** shielding

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

Q.2 a. Describe linear, surface and volume charge distributions. State the units used to describe these charge distributions. How are the charge densities for non-uniform charge distributions defined? **(8)**

b. Two large sheets of charge with densities ρ_{S1} and $-\rho_{S2}$ are located at x = 0 and x = a. Find field intensities in all the regions. Assume free space. **(8)**

Q.3 a. Derive the expression for the energy stored per unit volume in an electric field. **(8)**

b. Find the energy stored in a system of three equal point charges Q = 2 nC arranged in a line with 0.5 m separation between them. **(8)**

Q.4 a. Derive the Poisson's and Laplace's equation from Gauss's law **(8)**

b. Prove that the potential for a point charge given by an equation $V = Q / (4\pi\varepsilon r)$ satisfies Poisson's equation. **(8)**

Q.5 a. State and explain the Biot-Savart law with mathematical expression. **(8)**

b. Evaluate both sides of the Stoke's theorem for the field $\mathbf{H} = 6xy\,\mathbf{a_x} - 3y^2\,\mathbf{a_y}$ A/m and the rectangular path around the region,

$$2 \le x \le 5, -1 \le y \le 1, z = 0.$$

Let the positive direction of **dS** be $\mathbf{a}_z$ **(8)**

Q.6 a. Write a note on: Force on a moving point charge and Lorentz force equation **(8)**

b. Derive the magnetic boundary conditions at an interface between two magnetic medium with permeability μ_1 and μ_2. **(8)**

Q.7 a. Explain following: (i) Motional EMF (ii) Transformer EMF **(8)**

b. Write the Maxwell's equation in differential form. Derive the integral form of the Maxwell's equation from the differential form. **(8)**

Q.8 a. Briefly describe the following terms connected with sky wave propagation: virtual height, critical frequency, maximum usable frequency, skip distance **(8)**

b. Draw the radiation patterns of wire radiators in free space for the following lengths: **(8)**
$\lambda/2$, λ, $3\lambda/2$, 3λ

Q.9 a. With the aid of appropriate sketches, explain fully the operation of a Yagi-uda array. List its applications. Why is it called a supergain antenna? **(8)**

b. What is horn antenna? How is it fed? What are its applications? **(8)**