ROLL NO. _____

Code: AE63/AE114 Subject: ELECTROMAGNETICS & RADIATION SYSTEMS

AMIETE – ET (Current & New Scheme)

Time: 3 Hours **December - 2017** **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. A charge is distributed uniformly over the plane z=10cm with a density $\rho_s=(1/3\pi)$ nC/m^2. The value of E becomes
(A) 2V/m **(B)** 6V/m
(C) 8V/M **(D)** 2V/m

b. Two point charges Q1 = 50μC and Q2 = 10μC are located at(-1,1,-3) m and (3,1,0) m, respectively. The force on Q1 becomes
(A) 0.23 N **(B)** 0.45N
(C) 0.18N **(D)** 0.08N

c. When a potential difference is applied across human heart, its behavior can be modeled as that of electric dipole. Abnormal hearts can be detected by mapping
(A) equi potential surfaces **(B)** electric flux lines
(C) electric fields **(D)** All of these

d. Usually a collection of positive charges is considered for constructing a Gaussian surface. If a Gaussian surface encloses a collection of negative charges, then for such a surface
(A) the normal component of D becomes zero
(B) the normal component of D point inwards
(C) the normal component of D will point outwards
(D) the normal component of D will become zero

e. In a cylindrical conductor of radius 2mm, the current density varies with the distance from the axis according to J = 10^3 e^{-400r}(A/m^2). The total current I become
(A) 7.51 mA **(B)** 3.4mA
(C) 6mA **(D)** 9.1mA

f. Tropospheric scatter is used with frequencies in the following range
(A) HF **(B)** VHF
(C) UHF **(D)** VLF

g. The absorption of radio waves by atmosphere depends on
(A) their frequency **(B)** distance from transmitter
(C) the polarization of the wave **(D)** the polarization of the atmosphere

h. The lowest layer in Ionosphere is
(A) F1 layer **(B)** F2 layer
(C) D layer **(D)** None of these

i. If the actual area of paraboloid reflector is $10m^2$, its capture area is
(A) 5.5 m^2 **(B)** 6.5 m^2
(C) 2 m^2 **(D)** 4 m^2

j. What is the effective area of a half wave dipole operating at 500 MHz?
(A) 0.047 m^2 **(B)** 0.02 m^2
(C) 3 m^2 **(D)** None of these

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

Q.2 a. Explain the following charge distributions (with diagram) **(4+3)**
(i) Volume charge (ii) Sheet charge
(iii) Line charge

b. Find E at the origin due to a point charge of 64.4nc located at (-4,3,2) m, in Cartesian co- Ordinates **(3)**

c. (i) A charge configuration in cylindrical co-ordinates is given by ρ = $5re^{-2r}$ (C/m^3).
Use Gauss's law to find D.
(ii) Develop the expression for divergence in cylindrical co-ordinates. **(6)**

Q3 a. Find the potential at R_a = 5m with respect to R_b = 15 m due to point charge Q = 500pC at the origin and zero reference at infinity. **(4)**

b. Two thin conducting half planes at $\varphi = 0$ and $\varphi = \pi/6$, are insulated from each other along the z axis. Given that the potential function for $0 \leq \varphi \geq \pi/6$ is V = $(-60\ \varphi/\pi)$V. Find the Energy stored between the half planes for $0.1 \leq r \leq 0.6$m and $0 \leq z \leq 1$m. Assume free space. **(4)**

c. Derive the expression for equation of continuity for current and relaxation time. What is the significance of relaxation time? **(8)**

Q.4 **a.** Write down the explicit form of laplace's equation (in three different co-ordinates system). In spherical co-ordinates, V = 0 for r = 0.10m and V = 100v for r = 2.0m. Assuming free space between these concentric spherical shells find E and D. **(8)**

b. The region between two concentric right circular cylinders contains a uniform charge density ρ. Use Poisson's equation to find V. **(4)**

c. A coaxial transmission has two dielectric layers between the conductors with the interface with the inner conductor. In addition to the given potential of the conductors, what other boundary conditions are needed to find the solution of Laplace's equation in the region between the conductors? **(4)**

Q.5 a. Define the following terms. **(4)**
Vector Magnetic Potential and Write down the expression of Vector Magnetic potential for current filament, volume current, sheet current.

b. An air –core solenoid of circular section has 260 turns. Its radius and length are 8.0 cm and 30 cm respectively. Calculate the magnetic flux density at the mid point on the axis of solenoid when its current is 0.75A. **(4)**

c. A circular loop consists of 25 turns of very fine wire, the average radius of the loop is 20cm and it carries a current of 1.6A. Find the magnetic field intensity at the centre of the loop. **(4)**

d. State and explain Ampere's magnetic circuital law. **(4)**

Q6 a. State and prove the boundary conditions in a magnetic field. **(8)**

b. A coili with a ferromagnetic core has a certain value of inductance. If the magnetic circuit now has an air gap, the inductance decreases. Explain Why? **(4)**

c. A rectangular coil of length 15.0 cm and width 10 cm has 60 turns. It rotates at a constant speed of 10.0 revolutions per second (rps) in a uniform magnetic field of 0.8T. Calculate the maximum voltage induced in the coil and frequency of the voltage. **(4)**

Q.7 a. Write down the Maxwell's equations in integral form. Explain the significance of each law. **(6)**

b. Distinguish between conduction, convection and displacement current densities. **(5)**

c. Interpret the continuity equation for time varying fields. **(5)**

Q.8 a. Explain the significance of EM wave attenuation due to power density and electric intensity. Also mention, how absorption takes place in free space and atmosphere? **(6)**

b. Briefly explain interference of electromagnetic waves. **(4)**

c. Define ionosphere and ionization. Explain characteristics of each layer. **(6)**

Q.9 a. Define the following terms for Antenna **(5)**
(i) Directive gain (ii) Power gain
(iii) Field Intensity (iv) Radiation resistance
(v) Beam width of antenna

b. Explain the difference between driven and parasitic elements in Yagi-Uda array. What is the difference between director and reflector? **(5)**

c. Explain the basic construction and operation of Helical Antenna with suitable diagram. **(6)**