ROLL NO. _____

Code: AE14 **Subject: ELECTROMAGNETICS AND RADI**

AMIETE – ET (OLD SCHEME)

Time: 3 Hours **OCTOBER 2012** **Max. Marks: 1**

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. For a line of characteristic impedance, z_o terminated in a load, z_R such that $z_R > z_o$ the Voltage Standing Wave Ratio (VSWR) is given in

(A) z_R / z_o **(B)** z_o

(C) z_R **(D)** z_o / z_R

b. Energy stored in magnetic field is

(A) $W = \frac{1}{2}\sqrt{\frac{\mu H}{4}}$ **(B)** $W = \mu\sqrt{\frac{H^2}{2}}$

(C) $W = \frac{\mu H^2}{2}$ **(D)** $W = \frac{\mu\sqrt{H}}{2}$

c. The equation $\nabla \times \overline{E} = \frac{-\partial \overline{B}}{\partial t}$ is the generalization of

(A) Amperes Law **(B)** Faradays Law
(C) Gauss's Law **(D)** Biot-Savarts Law

d. When an EM wave is incident on a dielectric it is

(A) fully transmitted
(B) fully reflected
(C) partially transmitted & partially reflected
(D) None of these

e. Poisson's equation is

(A) $\nabla^2 V = \frac{-\rho}{\in}$ **(B)** $\nabla^2 V = -4\pi\sigma$

(C) $\nabla^2 V = -4\pi\rho$ **(D)** $\nabla^2 V = 0$

f. Divergence theorem is applicable for

(A) static field only
(B) time varying fields only
(C) both static & time varying fields
(D) electric fields only

g. Maxwell's equation in free space is

(A) $\nabla.\overline{B} = 0$ **(B)** $\nabla.\overline{B} = \rho$
(C) $\nabla.\overline{B} = J$ **(D)** $\nabla.\overline{B} = \sigma J$

h. Intrinsic impedance of free space is given as

(A) 75Ω **(B)** 73Ω
(C) 377Ω **(D)** 300Ω

i. Poynting vector gives the

(A) Direction of polarization **(B)** The rate of energy flow
(C) Intensity of electric field **(D)** Intensity of magnetic field

j. Which of the mode does not exist in a resonant cavity?

(A) TE_{110} **(B)** TE_{011}
(C) TM_{110} **(D)** TM_{111}

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

Q.2 a. State and derive Gauss's law. Find electric field near an infinite sheet of charge of density σ using Gauss's law in integral form. **(8)**

b. Prove that energy density stored in an electric field of magnitude **E** is proportional to $\mathbf{E}^2$**.** **(8)**

Q.3 a. Develop an expression for the magnetic field at any point on the line through the centre, at a distance 'h' from the centre and perpendicular to the plane of a circular loop of radius 'a' and carrying current I. **(8)**

b. State and prove Biot-Savart's law for the magnetic flux density. **(8)**

Q.4 a. State Maxwell's equation and explain their physical significance. **(8)**

b. State Faraday's law in differential form for the general case of the electric field having all three components (x, y, z) each of them depending on all three co-ordinates (x, y & z) in addition to time. Also find B (magnetic field) using Faraday's law for the given $E = 10\cos\left(6\pi \times 10^8 t - 2\pi z\right)a_x V/m$ **(8)**

Q.5 a. Write and derive Stoke's and divergence theorem.

b. Explain the phenomena of reflection and refraction for a uniform wave in conductor with oblique incidence. **(8)**

Q.6 a. Derive the basic transmission line equation. Also, explain the lossless and distortion less transmission lines. **(8)**

b. Let us assume that measurements performed on a slotted line of characteristic impedance $Z_0 = 50\Omega$ provided the following data. First, with the short circuit as the termination, voltage minima were found to be 20 cm apart. Next, with one of the minima marked as the reference point and the short circuit replaced by the unknown load, the SWR was found to be 3.0 and a voltage minimum was found to be at 5.80 cm from the reference point on the side toward the load. Calculate the value of the unknown load impedance. **(8)**

Q.7 a. List different transmission line matching techniques explain one of them in detail. **(8)**

b. What is the dominant mode? Which one of the rectangular waveguide modes is the dominant mode? **(4)**

c. What is a cavity resonator? Give the expression for the frequencies of oscillation for the cavity resonator. **(4)**

Q.8 a. Define the radiation resistance and directivity of an antenna. What are the values of the radiation resistance and the directivity for a half wave dipole? **(8)**

b. What is an antenna arrays? Also give its advantage. **(8)**

Q.9 a. Describe the mechanism of sky wave propagation. Explain the terms critical frequency maximum usable frequency, virtual height and skip distance. **(8)**

b. Write short notes on
(i) Ground wave propagation.
(ii) Space wave propagation. **(8)**