Code: AE14 **Time: 3 Hours**

Subject: ELECTROMAGNETICS AND RADIA

Max. Marks.

DECEMBER 2010

NOTE: There are 9 Questions in all.

- Student Bounty.com 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 half an hour 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 best alternative in the following:

(2x10)

- a. The surface charge density at the surface of a sphere of 2.5 m radius is 94.2 pc/m². The electric flux density at the surface of the sphere will be
 - **(A)** 0

(B) 94.2 pc/ m^2

(C) 4.8 pc/ m^2

- **(D)** 30 pc/ m^2
- b. Two identical coaxial circular coil carry the same current I but in opposite direction. The magnitude of the magnetic field \vec{B} at a point on the axis midway between the coil is
 - (A) zero
 - (B) the same as that produced by one coil
 - (C) twice that produced by one coil
 - (**D**) half that produced by one coil
- c. One of the following equations is not Maxwell's equation for a static electromagnetic field in a linear homogeneous medium
 - (A) $\nabla \cdot \vec{B} = 0$

(B) $\overline{\nabla}.\overrightarrow{D} = \rho_{v}$

(C) $\overline{\nabla}X\overline{E} = 0$

- **(D)** $\nabla^2 \vec{A} = \mu_{\circ} \vec{J}$
- d. What is/are the major factor/s for determining whether a medium is dielectric or good conductor?
 - (A) attenuation constant
- **(B)** constitutive parameters(σ, ε, μ)

(C) loss tangent

- (**D**) reflection coefficient
- e. A transmission line of characteristic impedance 50 ohm is terminated in a load of j100 ohm. The VSWR on the line is
 - **(A)** 1

(C) ∞

(D) none of the above

(A) TM_{01}

(B) TM_{11}

(C) TM_{10}

- **(D)** TM_{20}
- g. Which term is the radiation term?
 - (A) $\frac{1}{r}term$

(B) $\frac{1}{r^2} term$

(C) $\frac{1}{r^3} term$

- (D) all of the above
- h. The critical frequency of an ionospheric layer depends upon
 - (A) only height
 - **(B)** only electron density
 - (C) both height & electron density & nothing else
 - (D) height, electron density & angle of incidence
- i. What is the unit of magnetic charge?
 - (A) ampere-meter square
- **(B)** coulombs

(C) amperes

- (D) ampere-meter
- j. The property of a material which opposes the production of magnetic flux in it, is known as
 - (A) permittivity

(B) permeance

(C) reluctance

(D) mmf

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

- a. Find the force on a 100µC charge at (0, 0, 3) m if four like charges of $\mathbf{Q.2}$ $20\mu C$ are located on the x & y axes at $\pm 4m$.
 - b. Explain Gauss's law with appropriate equation. Also give its modified version.
 - c. Determine the capacitance of a parallel plate capacitor composed of tin-foil sheets of 20cm², separated by a 0.6 cm thick glass dielectric of relative permittivity 6. **(2)**
- a. Write Biot-Savart's law to find magnetic flux density due to a current Q.3element. Also explain Ampere's law for current element. **(6)**
 - b. Develop an expression for the magnetic field at any point on the line through the centre, at a distance 'h' from the centre & perpendicular to the plane of a circular loop of radius 'a' & carrying current I. (10)

- 0.4 a. Write Maxwell's equations in point form & integral form for static file with the related law. Also give the equation of continuity for steady current.
 - b. Write and derive Stoke's and Divergence theorem.

- Student Bounty.com Q.5 a. The magnetic field intensity of a uniform plane wave in air is 20A/m in y direction. The wave is propagating in z direction at a frequency of 2×10^9 rad/sec.
 - Find: (i) frequency in Hz.
 - (ii) period
 - (iii) wavelength
 - (iv) amplitude of electric field intensity
 - (v) direction of E
 - b. The material parameters of a certain food item are given by $\sigma = 2.17S / m$, $\varepsilon = 47\varepsilon_0$, and $\mu = \mu_0$ at the operating frequency f = 2.45microwave oven. Find the propagation parameters α , β , λ , $\nu_p \& \eta$. (8)
 - c. Define three types of Polarization of waves. **(3)**
- **Q.6** a. Discuss two applications of properties of the input impedance of a short circuited line. (12)
 - b. Explain the block diagram of a time-domain reflectometer to locate discontinuities in transmission line system. **(4)**
- **Q.7** a. What do you understand by rectangular cavity resonator? (9)Derive the expression for the frequencies of oscillation for it.
 - b. A hollow rectangular wave-guide has inner dimension of 8cm×4cm. Find the cut-off frequency in TE_{10} , TE_{01} & TE_{11} mode. Why TE_{10} modes is dominant mode. **(7)**
- 0.8 a. Discuss the principal of a broadband array using as an example of the log periodic dipole array. **(6)**
 - b. Derive the equation of effective area for Hertzian dipole. **(10)**
- **Q.9** Write notes on **(16)**
 - (i) Maximum usable frequency & optimum frequency of a layer.
 - (ii) Voltage Standing Wave Ratio (VSWR) and reflection coefficient