

Code: AE14

Subject: ELECTROMAGNETICS AND RADIATION

## AMIETE – ET (OLD SCHEME)

Time: 3 Hours

DECEMBER 2011

Max. Marks: 100

NOTE: There are 9 Questions in all.

- Please write your Roll No. at the space provided on each page immediately after receiving the Question Paper.
- 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. 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  $\nabla \cdot \mathbf{J} = 0$  is called

- (A) Laplacian equation                      (B) Kirchoff's law  
(C) Poisson's equation                      (D) Continuity equation for discrete currents

c. An electric field of 50 V/m have the charges of  $0.3 \mu\text{C}$ , what is the force on that charge

- (A)  $15 \mu\text{N}$     (B)  $12.5 \mu\text{N}$   
(C)  $18 \mu\text{N}$     (D)  $10.5 \mu\text{N}$

d. Ohm's law relates the current density  $\mathbf{J}$  with field intensity  $\mathbf{E}$  as

- (A)  $\mathbf{J} = \sigma \mathbf{E}$                                       (B)  $\mathbf{J} = \sigma^2 \mathbf{E}$   
(C)  $\mathbf{J} = \mathbf{E} / \sigma$                                       (D)  $\mathbf{J} = \mathbf{E}^2 / \sigma$

e. For normal incidence the angle of incidence is

- (A)  $90^\circ$     (B)  $180^\circ$   
(C)  $0^\circ$     (D)  $45^\circ$

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

- (A) vector  $\mathbf{E}$                                       (B) vector  $\mathbf{H}$   
(C) vector  $(\mathbf{E} \times \mathbf{H})$                                       (D)  $\mathbf{E} \cdot \mathbf{H}$

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- g. Point charges  $Q_1$  1nC and  $Q_2$  2nC are at a distant apart. Which of the following statement is incorrect?
- (A) The force on  $Q_1$  is repulsive.  
(B) The force on  $Q_2$  is the same in magnitude as that on  $Q_1$   
(C) As the distance between them decreases, the force on  $Q_1$  increases linearly.  
(D) The force on  $Q_2$  is along the line joining them.
- h. Which is not an example of convention current?
- (A) A moving charged belt  
(B) Electronic movement in a vacuum tube  
(C) An electron beam in a television tube.  
(D) Electric current flowing in a copper wire
- i. For a lossy transmission line, the characteristics impedance does not depend on
- (A) The operation frequency of line.  
(B) The load terminating the line.  
(C) The conductivity of conductors.  
(D) The conductivity of dielectric separating conductors.
- j. Indicate the antenna that is not wideband
- (A) Discone (B) Folded dipole  
(C) Helical (D) Marconi

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

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- Q.2** a. State and explain coulomb law and explain the electric field intensity at a point. (8)
- b. State and explain Gauss's law with appropriate equations. Derive the Maxwell's equation. (8)
- Q.3** a. What is capacitance? Derive the expression of capacitance in a parallel plate capacitor. (8)
- b. Explain the phenomena of reflection and refraction for a uniform wave in conductor with oblique incidence. (8)
- Q.4** a. State and prove Biot – Savart's law for the magnetic flux density. (8)
- b. Derive the continuity equation. (8)
- Q.5** a. Write the Maxwell's equations in differential and integral form for time varying fields. Also mention the related laws. (12)

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- b. Explain the concept of displacement current in magnetic field due to time varying field. (4)
- Q.6** a. Calculate the input impedance at anti-resonance of a full-wave cylindrical dipole antenna (dia 2 cm). Frequency is 150 MHz. Assume  $R_a = 210 \text{ ohm}$ . (12)
- b. Define the surface impedance w.r.t a good conductor. (4)
- Q.7** a. What do you mean by standing wave? Derive the expression for reflection co-efficient and SWR. (8)
- b. Derive the Transmission line equation for transmission line with distributive reactive & non linear resistive elements. (8)
- Q.8** a. A 6 GHz signal is to be propagated in the dominant mode in a rectangular wave guide. If its group velocity is to be 90% of the free space velocity of light, what must be the breath of the waveguide if it is correctly matched? (6)
- b. Derive the expression for critical frequency for any ionosphere layer and how it is dependent on the maximum ionization density for any given layer. (10)
- Q.9** a. Derive the equation of effective area for Hertzian dipole. (10)
- b. Explain the quarter wave transformer technique for Impedance matching. (6)