WEST BENGAL UNIVERSITY OF TECHNOLOGY

EC-401

ELECTROMAGNETIC THEORY AND TRANSMISSION LINES

Time Allotted: 3 Hours | Full Marks: 70

The questions are of equal value.
The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable. All symbols are of usual significance.

GROUP A
(Multiple Choice Type Questions)

1. Answer any *ten* questions. $10 \times 1 = 10$

(i) A region of field for which $\nabla \times A \neq 0$ is called

(A) Solenoidal field (B) Irrotational field
(C) Conservative field (D) Vortex field

(ii) The unit of magnetic vector potential is

(A) Volt/meter (B) Weber/meter
(C) Coulomb/meter (D) Newton/meter

(iii) Which of the following is zero?

(A) Grad div A (B) Div curl A (C) Curl curl A

(iv) The unit of pointing vector is

(A) W/m (B) W/m^2
(C) W^2/m (D) $(W/m)^2$

(v) Ohms law is obeyed by

(A) Conduction current (B) Convection current
(C) Both (A) and (B) (D) None of these

(vi) A Transmission line is called distortion less line when

(A) R/L=G/C (B) R/G=C/L
(C) RG=L/C (D) R/L=GC

(vii) Intrinsic wave impedance of a medium with permittivity ϵ and permiabillity μ is

(A) $\sqrt{\frac{\mu}{\epsilon}}$ (B) $\sqrt{\frac{\epsilon}{\mu}}$ (C) $\sqrt{\frac{1}{\mu\epsilon}}$ (D) $\sqrt{\mu\epsilon}$

(viii) Hertizian dipole is a dipole with length

(A) $\frac{\lambda}{4}$ (B) $\frac{\lambda}{2}$ (C) $\frac{3\lambda}{4}$ (D) $\frac{\lambda}{7}$

(ix) In a transmission line the distance between adjacent maxima and minima of a standing wave is

(A) $\frac{\lambda}{8}$ (B) $\frac{\lambda}{4}$ (C) $\frac{\lambda}{2}$ (D) λ

(x) The divergence of $G = xa_x + ya_y + za_z$ at the point P(2,2,2) is

(A) 1 (B) 2 (C) 3 (D) 4

(xi) Which of the following antennas is best excited by a waveguide?

(A) Helical (B) Dipole (C) Horn (D) Yagi-Uda

(xii) In good conductors, the phases of E and H differ by

(A) 0° (B) 45° (C) 90° (D) 180°

GROUP B
(Short Answer Type Questions)

Answer any *three* questions. 3×5 = 15

2. Prove that if the divergence of a vector is zero, that vector can be expressed as curl of another vector. 5

3. State and prove the Gauss's law of electrostatics. 5

4. What is Smith Chart? What are the various applications of Smith Chart in the transmission line? Define the characteristic impedance of a loss less transmission line. 5

5. Derive the relation between reflection co. efficient and VSWR. 5

6. Write Integral or large scale form of Maxwell's equation. 5

GROUP C
(Long Answer Type Questions)

Answer any *three* questions. 3×15 = 45

7. (a) State Ampere's Circuital Law. Why was it necessary to modify Ampere's Circuital Law? 5

   (b) Define characteristic impedance. A lossless transmission line of length 100m has an inductance of 28 μH and a capacitance of 20 nF. Find the characteristic impedance of the line and the phase constant at an operating frequency of 100 kHz. 5

   (c) Derive the relation between antenna height and effective aperture of antenna. 5

8. (a) Obtain Pointing theorem for conservation of energy in an electromagnetic field and discuss the physical significance of each of them. 1(

   (b) Explain the boundary conditions for an interface separating dielectric rl ϵ_{r1} and dielectric ϵ_{r2}. 5

9. What is antenna array and why is it used? Derive the total E-field due to two element array. Find an expression for Array Factor of an N element array. Describe any two types of antenna array and draw their radiation patterns. 6+5+4

10. (a) What are standing waves and how are they formed in a transmission line? 5

    (b) Find the input impedance, reflection coefficient and VSWR for 1(

    (i) a lossless transmission whose load is open
    (ii) a lossless transmission whose load is short
    (iii) a lossless transmission which is perfectly matched.

11. Write short notes on any *three* of the following: 3×5

    (a) Yagi-Uda antenna
    (b) Skin effect
    (c) Microstrip line
    (d) Smith chart
    (e) Quarter wave length transmission line.