DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE

B.Tech (Electronics and Communication Engineering) SEMESTER - 5 Winter 2025 (Supply.)

Course :Bachelor of Technology (Electronics and Communication Engineering) Branch : Engineering and Technology

Semester : SEMESTER - 5

Subject Code & Name: BTETC501 - ELECTROMAGNETIC FIELD THEORY

Time : 3 Hours] **[Total Marks : 60**

Instructions to the Students:

1.Each question carries 12 marks.

2.Question No. 1 will be compulsory and include objective-type questions.

3.Candidates are required to attempt any four questions from Question No. 2 to Question No.6

4.Use of non-programmable scientific calculators is allowed.

5.Assume suitable data wherever necessary and mention it clearly.

Q1. Objective type questions. (Compulsory Question) 12

1 The gradient of a scalar field V represents _____ of V.

A. Curl B. Divergence C. Direction of maximum rate of change D. Laplacian

2 At the interface of two dielectric media, the tangential component of **E** must be:

A. Zero B. Continuous C. Equal to surface charge D. Discontinuous

3 The magnetic flux density **B** is related to the vector potential **A** by:

A. $\mathbf{B} = \nabla \mathbf{A}$ B. $\mathbf{B} = \nabla \cdot \mathbf{A}$ C. $\mathbf{B} = \nabla \times \mathbf{A}$ D. $\mathbf{B} = -\nabla \mathbf{A}$

4 Poynting vector **S** represents:

A. Stored electric energy B. Stored magnetic energy

C. Power flow density D. Mechanical force

5 For a lossless line (R = G = 0), the propagation constant becomes:

A. $\gamma = j\beta$ B. $\gamma = \alpha$ C. $\gamma = \alpha + j\beta$ D. $\gamma = 0$

6 On a Smith Chart, the center point corresponds to:

A. Open circuit B. Short circuit C. Normalized impedance = 1 D. Reflection = 1

7 Intrinsic impedance of free space approximately equals:

A. 73 Ω B. 100 Ω C. 377 Ω D. 500 Ω

8 Elliptical polarization occurs when:

A. Only one field component exists B. Components are equal but out of phase

C. Components have unequal magnitude and phase difference D. E-field rotates linearly

9 In phasor form, Faraday's law is written as:

A. $\nabla \times \mathbf{E} = j\omega \mathbf{B}$ B. $\nabla \times \mathbf{E} = -j\omega \mathbf{B}$ C. $\nabla \cdot \mathbf{E} = \rho$ D. $\nabla \times \mathbf{E} = -\mathbf{J}$

10 Which law gives the differential force between two current-carrying elements?

A. Ampere's Circuital Law B. Biot–Savart Law C. Gauss's Law D. Lorentz Force Law

11 A standing wave forms on a transmission line when:

A. The line is infinitely long B. The load is perfectly matched to the line

C. Part of the incident wave is reflected from the load D. Only low frequency waves propagate

12 A time-varying magnetic field produces:

A. Only displacement current B. Only conduction current

C. An induced electric field D. A static electric field

Q2. Solve the following.

A) Transform each of the following vectors to Spherical coordinates at the point specified 6

a) 3Ux at B ($r = 4, \theta = 25^0\ \emptyset = 120^0$)

b) 4Ux at A (x = 2, y = 3, z = −1)

B) Given two points C (-3,2,1) and D (5, 20^0,-70^0) 6
find: (i) Spherical co-ordinates of C, (ii) Cartesian co-ordinates of D and (iii) the distance from point C to D.

Q3. Solve the following.

A) Derive an Expression for the Electric Field Intensity at any point due to an infinite Line charge with charge density ρl C/m 6

B) State and explain Biot-Savart's law, and from Biot-Savart's law, prove that 6
$\bar{\nabla} . \bar{B} = 0$

Q4. Solve Any Two of the following.

A) The Electric field amplitude of a uniform plane wave propagating in az direction is 250 V/m. If E = Ex ax and ω = 1.00 Mrad/sec, the frequency, Wavelength, and Time period 6

B) State and explain the basic Maxwell's Equations in their point and integral form with their proper significance. 6

C) State Boundary condition for E and D at the boundary between two media of different permittivities 6

Q5. Solve Any Two of the following.

A) Derive the equation for the uniform EM plane waves for free space. 6

B) The Primary constants of a cable are R= 80 Ω/km, L= 2 mh/km, G= 0.3 x 10^{-6} Ω^{-1}/km, C= 0.07mF/km 6
Calculate the characteristic constants of the line.

C) Define: Propagation constant, characteristic impedance, reflection coefficient and VSWR 6

Q6. Solve Any Two of the following.

A) For a Poor conductor, prove that 6

$$\alpha = \frac{\sigma}{2}\sqrt{\frac{\mu}{\epsilon}} \qquad \beta = \omega\sqrt{\epsilon\mu}\left[1 + \frac{1}{8}\left(\frac{\sigma}{\omega\epsilon}\right)^2 + \cdots\right]$$

B) Describe the formation of the Smith chart. Explain clearly how the Smith chart is useful to calculate transmission line parameters 6

C) Explain Linear, circular & Elliptical polarization in details. 6

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