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B.TECH
(SEM VI) THEORY EXAMINATION 2022-23
ANTENNA AND WAVE PROPAGATION

Time: 3 Hours**Total Marks: 100****Note:** Attempt all Sections. If require any missing data; then choose suitably.**SECTION A****1. Attempt all questions in brief.****2 x 10 = 20**

- a. Evaluate points (0, -4, 3) into cylindrical and spherical coordinate system.
- b. Illustrate the gradient of a vector in cylindrical coordinate system.
- c. Illustrate Maxwell's equation for electric field.
- d. Discuss equation of continuity and its application.
- e. Describe the Beam Area of an Antenna and give the formula.
- f. Define gain and directivity of an antenna.
- g. Define radiation resistance of Antenna.
- h. Illustrate long wire antenna.
- i. Evaluate the maximum range of a tropospheric transmission for which the transmitting antenna height is 100ft and receiving antenna height is 50 ft.
- j. Evaluate the maximum electron concentration of the D layer and E layer has critical frequencies 2.5MHz and 8.4MHz respectively.

SECTION B**2. Attempt any three of the following:****10x3=30**

- a. Evaluate vector $\mathbf{A} = \rho z \sin\phi \mathbf{a}_\rho + 3\rho \cos\phi \mathbf{a}_\phi + \rho \sin\phi \cos\phi \mathbf{a}_z$ into Cartesian coordinate system.
- b. Demonstrate boundary conditions for electric field intensity and electric flux density for various types of medium.
- c. An antenna has a field pattern given by $E(\theta) = \cos^2\theta$ for $0^\circ \leq \theta \leq 90^\circ$. Evaluate the
 - i. HPBW
 - ii. FNBW
 - iii. Beam Area
 - iv. Draw the pattern showing HPBW and FNBW.
- d. Demonstrate vertical antenna and folded dipole antennas.
- e. Demonstrate critical frequency, multihop propagation and skip distance for sky wave propagation

SECTION C

- 3. Attempt any *one* part of the following: 10x1=10**
- a. Illustrate differential length, area and volume in Cartesian coordinates and cylindrical coordinates system with neat sketch.
 - b. Evaluate divergence for $P = yz\mathbf{a}_x + 4xy\mathbf{a}_y + yz\mathbf{a}_z$ at point (1, -2, 3). Also evaluate curl for the same and compare results.
- 4. Attempt any *one* part of the following: 10x1=10**
- a. Design a 3 elements yagi-uda Antenna. Demonstrate the length of elements and the distances between them.
 - b. Evaluate electric field intensity on a point P due to semi-infinite line.
- 5. Attempt any *one* part of the following: 10x1=10**
- a. Illustrate effective aperture and effective height of an antenna. Also discuss antenna temperature.
 - b. Design a radio communication link for directional antennas. Evaluate the power delivered to the receiver if a radio link has a 15W transmitter connected to an antenna of 1.5m^2 at 3 GHz. The receiving antenna has an effective aperture of 0.5m^2 and is located at a 15km line of sight distance from the transmitting antenna. Assuming lossless, matched antennas.
- 6. Attempt any *one* part of the following: 10x1=10**
- a. Evaluate electric field due to array of two $\lambda/2$ driven element when current of equal amplitude and same phase is flowing in antennas.
 - b. Derive expression of electric field due to short dipole.
- 7. Attempt any *one* part of the following: 10x1=10**
- a. Derive equation for maximum usable frequency for both flat and curved earth condition.
 - b. Demonstrate ground wave propagation and space wave propagation.